

# LAMPREY RIVER RESOURCE ASSESSMENT

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### Abbreviations

LRAC	Lamprey River Advisory Committee
NHDES	New Hampshire Department of Environmental Services
NH F&GD	New Hampshire Fish & Game Department
NPS	National Park Service
SCS	Soil Conservation Service
UNH	University of New Hampshire
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey

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# Lamprey River Resource Assessment 1994

For the Lamprey River Advisory Committee (LRAC)  
and the towns of Durham, Epping, Lee, and Newmarket

## LRAC Members during the study period:

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Warren Daniel, Durham (1991-1993)  
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John Fitzgibbon, Newmarket (1994-present)  
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Prepared by Margaret Watkins, NH Department of Environmental Services,  
in cooperation with and funded by the National Park Service, as part of its  
Wild & Scenic Rivers Study of the Lamprey River.

Cover: Fall along the Lamprey, by John W. Hatch. Cover donated by John  
Hatch.

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- The Conservation Group. "De Novo Inventory and Baseline Monitoring for Alasmidonta varicosa, Lamprey River, Epping and Lee Townships, New Hampshire, 1994," 12/30/94.
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## INTRODUCTION

The Lamprey River originates in the Saddleback Mountains, Northwood, New Hampshire and flows 47.3 miles (45.4 freshwater, 1.9 tidal) to Great Bay. Major headwater streams include the North Branch River, which originates at Beaver Pond in Bear Brook State Park, Deerfield, and an unnamed tributary that originates in Candia and flows through Onway Lake. The river drains an area of 212 sq mi in the coastal lowlands, drops vertically a total of 600 ft<sup>1</sup>, and has an annual mean discharge into Great Bay of 278 cubic feet/second (cfs) (1934-1977)<sup>2</sup>.

Land in the headwaters is largely undeveloped and forested. Pawtuckaway State Park (5,535 acres) is a dominant feature in the upper watershed. Great Bay is the dominant feature at the river's mouth. One of twenty-one estuaries in the National Estuarine Research Reserve System, Great Bay's 4,500 acres of tidal waters and wetlands and approximately 800 acres of uplands support a rich and fragile complex of natural features and human activities. Fishermen, sportsmen, boaters of all types, and other recreationists frequent the estuary year round, attracted by Great Bay's relatively undisturbed beauty and its natural resources. Both in physical dynamics and biological productivity, the Great Bay Estuary "contribute[s] immeasurably to the economy of the northeast and to the values we maintain as important in New Hampshire and Maine." Its resources are "priceless."<sup>3</sup>

Of the eight tributaries to Great Bay, the Lamprey River contributes the greatest volume of water to the estuary. Tributaries are the primary source of pollution to Great Bay, with inputs from both wastewater treatment plants and "nonpoint sources," such as land disposal sites, urban and highway runoff, boats and commercial establishments.<sup>4</sup> The river's water quality is, therefore, of significant concern given its influence on Great Bay.

The river flows in a generally southeasterly direction, meeting its first large town in Raymond, population 8,791<sup>5</sup>. The 24.4 miles proposed for Wild & Scenic River study begin just downstream from Raymond, below the dam at Bunker Pond in West Epping,

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<sup>1</sup>NH Water Resources Board, River Basin Management Plan for the Lamprey River and Evaluation of Hydropower Potential at Existing Dams, 1982.

<sup>2</sup>Frederick T. Short, ed., The Ecology of the Great Bay Estuary, New Hampshire and Maine: An Estuarine Profile and Bibliography, UNH Jackson Laboratory, 1992.

<sup>3</sup>F. T. Short, ed., Ibid., p. 165.

<sup>4</sup>F.T. Short, Ibid., pp. 61-62.

<sup>5</sup>NH Office of State Planning 1991 estimated population.

and end in Newmarket at the McCallen Dam, below which fresh and salt water mix. The segment expands the original scope authorized by Congress in 1991 (two towns, Lee and Durham, to Woodman Brook)<sup>6</sup> to include Epping and Newmarket.

The decision to expand the study area reflects the desire of both Epping and Newmarket to participate in the study.<sup>7</sup> It also supports recommendations of the House Report of the US Congress on the Lamprey River Study Act to include in the study additional river mainstem and tributary segments, subject to local support for such addition. The Department of Interior's Nationwide Rivers Inventory, 1982, included 18 miles of the Lamprey (Newmarket to Epping), 13 miles of the North (confluence with the Lamprey to North River Pond), the Piscassic, and some of its tributaries.

Major tributaries considered in this report but in considerably less detail than the Lamprey River are the Pawtuckaway River, the North River, the Little River, and the Piscassic River, particularly segments that flow through the study towns. (See the map entitled "State Water Quality Sampling Sites.") River lengths, by town,<sup>8</sup> are:

- For the Lamprey (freshwater portions, total length 45.44 miles):

Newmarket	0.9 miles
Durham	3.9 miles
Lee	8.1 miles
Epping to Bunker Pond	<u>11.5 miles</u>
Total 4-town study area	24.4 miles

- For the North (total length - 18.9 miles)

Lee	1.9 miles
Epping	<u>1.4 miles</u>
Total 4-town study area	3.3 miles

- For the Little (total length - 7.9 miles)

Lee	2.5 miles
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- For the Pawtuckaway (total length - 3.6 miles)

Epping	1.4 miles
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<sup>6</sup>H.R. 1099, amending the Wild and Scenic Rivers Act "by designating segments of the Lamprey River in the State of New Hampshire for study for potential addition to the National Wild and Scenic Rivers System.."

<sup>7</sup>As reflected by votes of Selectmen (Epping) and Town Council (Newmarket) in the spring of 1992.

<sup>8</sup>Data from Strafford Regional Planning Commission, GIS data base.

•For the Piscassic (total length - 14.7 miles)	
Newmarket	4.4 miles
Epping	<u>4.3 miles</u>
Total 4-town study area	8.7 miles

### Purposes

This report has two compatible purposes: to provide background information necessary to an eligibility determination by the National Park Service for Wild & Scenic Rivers System purposes; and to provide the Lamprey River Advisory Committee (LRAC) information for its river management and planning efforts. The report focuses on the river and adjacent areas within 1/4 mile of each bank (the "river corridor").

### Background/Study Partners: LRAC, NHDES, and NPS

The New Hampshire Department of Environmental Services (NHDES) and the National Park Service (NPS) cooperated in the development of this assessment. The LRAC played a key advisory role and actively contributed expertise from a range of professions to the study's design and implementation. The LRAC was created under auspices of the NH Rivers Management and Protection Program.<sup>9</sup> It builds on a history of citizen involvement in Lamprey River corridor protection, including such organizations as the Lamprey River Watershed Association and the Ad Hoc Committee on Conservation Lands, as well as planning efforts under auspices of the Strafford Regional Planning Commission (early 1980s) and ongoing efforts of town conservation commissions. (See appendices F and G.)

The State's rivers program was legislatively established in 1988 to address the problems of conflicting demands on significant river resources. The designation process is locally initiated. It includes an inventory of natural resources, managed resources (impoundments, water withdrawals/discharges, and hydroelectric facilities), cultural resources, and recreational resources. The Commissioner of the Department of Environmental Services must approve the nomination before it is forwarded to the legislature for consideration. State designation is designed to protect significant instream resources and mandates that intermunicipal river corridor plans be developed at the local level.

The river reaches in Lee and Durham were designated into the State program in 1990; the LRAC originally consisted of representatives from Lee and Durham only. It was expanded to include representatives from Epping and Newmarket when those communities elected to participate in the Wild & Scenic River study. To maintain the program's original intent of balancing competing claims on the river, the Committee is designed to represent a variety of interests, including riparian owners, business, conservation, recreation, agriculture, and local government.

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<sup>9</sup>NH RSA 483:1-15. See also Chapter Laws of 1988, Chapter 273:2-4, which identified the mainstem of the Lamprey River as 1 of 13 named rivers to be considered for designation into the program.

## GEOLOGY

### Geomorphology

Glacial ice, wind, and water working over the bedrock have shaped the present landscape of the Lamprey corridor. As one might expect in this relatively low lying, coastal area, the divide between the Lamprey and Oyster river watersheds is unpronounced: water from the Lamprey crosses into the Oyster during times of even moderate flood, as in the spring of 1993. Lamprey River water also crosses into the Piscassic basin, through Tuttle Swamp.

### Bedrock Geology

The oldest rocks in the Lamprey valley were created at different times some 650 to 410 million years ago. Collectively, these rocks are grouped together as the Avalonian Composite terrane and constitute the oldest dated rocks in the state.<sup>10</sup> They consist of metamorphic rocks (the Massabesic migmatite and Merrimack Group) intruded by the Exeter epidiorite in the vicinity of Newmarket and Durham and by a two-mica granite elsewhere in the corridor. Though technically a feldspar, the Exeter epidialete is known locally as Durham's granite; it was used in constructing foundations of the stone buildings at the University of New Hampshire and in the mill buildings along the Lamprey in Newmarket.

Key rock formations in the Merrimack Group are the Kittery, Eliot, and Berwick formations.<sup>11</sup> The Eliot and Berwick formations occur in northeast-trending bands. Because the Kittery quartzite was deposited in relatively discontinuous lenses, outcroppings occur only rarely, as at Wadleigh Falls.

Major fault lines run through West Epping and, most likely, through Epping in a northeasterly direction. The longest of these extends almost to the Maine border. Although once active, they have been stationary for perhaps 90 million years and appear to have "healed."

### Surficial Deposits

The Ice Age (Pleistocene) began more than 2 million years ago and ended on a continental scale some 6,000 years ago. Although there were at least four major glacial advances, only the last influenced present day topographic features. Two kinds of

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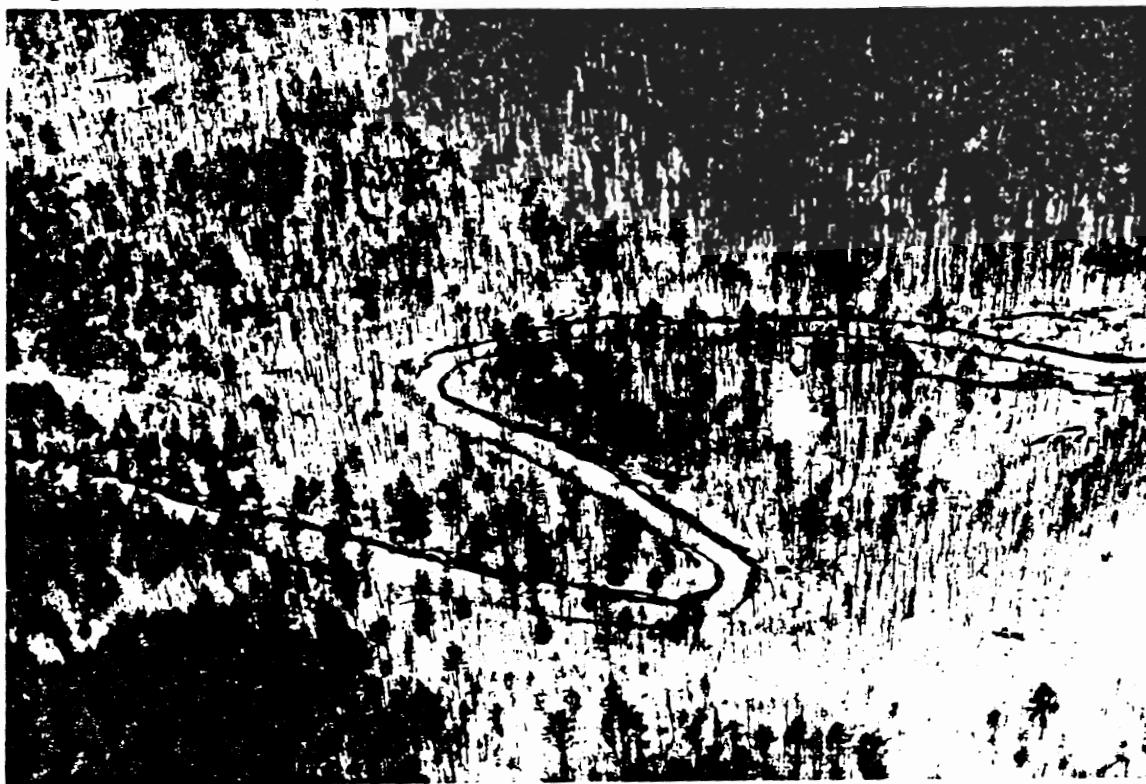
<sup>10</sup>Dr. Eugene Boudette, NH State Geologist, pers. comm., 1994.

<sup>11</sup>The Berwick formation consists of a purplish biotite-quartz-feldspar granofels or schist, with interbeds or boudins of calcarious-silicate granofels; some metapelites. Stratigraphic sequence with respect to Eliot formation is uncertain. Upper member contains more calcium-silicate. The Eliot formation is gray to green phyllite, quartzite, and quartz mica schist and well-bedded calcium silicate. The Kittery formation consists of well-bedded and graded bedded purple and green phyllite and tan calcarious siltstone, grading upward into the Eliot.

glacial drift characterize glacial deposits in the study area: stratified deposits, in which materials from glacial ice were sorted by running water; and till, unsorted clay, sand, gravel, and rocks deposited directly by the ice sheet with little or no modification by meltwater.

West of Epping one finds typical remnants of an active ice margin, advancing, stagnating, and melting over the surface of the earth. Through Deerfield and into Raymond the Lamprey flows through glacial till deposits variously identified as eskers, outwash, or end moraine, depending on the way they were deposited. Less prominent is the thin (5' to 10') mantle of ground moraine consisting of what was in the ice as it melted.

East of West Epping, where the ice came into contact with the ocean, melting glacial ice water deposited the coarser sands and gravels as deltas, either at the glacial ice/ocean interface or at the marine limit, often over previous marine deposits. Modified by beach processes, these deposits form the topographic highs in the four corridor communities.<sup>12</sup> Water carried the finer silts and clays out into the ocean, where they formed glacioestuarine deposits.<sup>13</sup> The raw material for the bricks made in Epping was



Geological and fluvial processes past and present continue to influence the river's course.

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<sup>12</sup>USGS Water-Resources Investigations Report 88-4128, 1990 revised, p. 6.

<sup>13</sup>Per conversation with Eugene Boudette, State Geologist, 5/12/93.

derived from marine clays deposited late in the Pleistocene. The region's sand and gravel pits are also Ice Age remnants, as are Spruce Hole Bog in Durham (a National Natural Landmark located just outside the corridor off Packers Falls Road) and the kettle hole west of the river and south of Moat Island in the corridor on the present Benevento property.

A large aquifer in West Epping through which the river has cut a channel reflects a deltaic deposit probably formed where sediment laden meltwater flowing through what is today the Pawtuckaway River met the ocean.<sup>14</sup> Another extensive deposit, consisting largely of marine sand but including some sand deposited by the Lamprey during offlap of the ocean from the glacial marine limit and some marine silt and clay, forms a rough horseshoe around what is today Camp Hedding.<sup>15</sup> Both deposits are probably finer grained and less permeable to water than the deposits formed at the ice/ocean interface known as grounding-line deposits. Grounding-line deposits are the most productive aquifers in the Lamprey River basin. One such grounding-line deposit, known today as the Newmarket Plains aquifer, serves as a public water supply source for Newmarket.

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<sup>14</sup>USGS, NHDES, Geohydrology and Water Quality of Stratified Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire, Water-Resources Investigations Report 88-4128, 1990 (revised).

<sup>15</sup>Surficial Geologic Map of the Epping Quadrangle, Open File Map NH -90-1, prepared by NHDES in cooperation with USGS.

## SOILS

Most of the soils in the corridor formed in glacial till and sediment-laden streams flowing from melting glaciers. A few soils are forming today in alluvial sediments deposited annually along the Lamprey River floodplain.

For general planning purposes, individual soils can be mapped together as "associations" of soils commonly found together in more or less the same proportions and in similar landscape patterns. Each association contains two or more dominant soils, for which it is named, and minor amounts of other soils. Characteristics within an association may vary, e.g., from shallow to deep, because the dominant soils in the association have different characteristics. Soil associations in the study area are as follows.

### Soil Associations in the Corridor

*Chatfield-Hollis-Canton* soils, derived from glacial till, are somewhat excessively drained and well drained soils on gently sloping to steep uplands. Shallow depth to bedrock limits their suitability for urban development. Very stony with bedrock outcroppings, these soils are poor for agriculture. They are suitable for firewood production and wildlife habitat. These soils dominate the corridor in Newmarket.

*Hollis-Charlton-Buxton-Scantic* soils characterize most of the corridor in Durham. These soils are shallow and deep, somewhat excessively drained to well-drained, dominated by a very rocky, fine sandy loam series but including fine sandy loam and silt loam. They are suitable for agriculture, well suited for forestry (hardwoods), and generally have very low development potential.

*Hinckley-Windsor-Saugatuck* soils formed in sand and gravel deposits on outwash plains and terraces. They may be low in natural fertility, wet, or droughty. These loamy sands are well suited to forestry (pulpwood, and high quality softwood sawtimber), to urban development, and to sand and gravel extraction. They occur in Durham and southern portions of the corridor in Lee.

*Charlton-Hollis-Scantic* soils are dominated by fine sandy, well-drained to excessively drained loamy soils but include poorly drained soils that formed in marine silt and clay deposits. They are generally suitable for agriculture, well suited to forestry (high quality hardwood veneer and sawtimber and softwood pulp and sawtimber), and of variable development potential. This association occurs in Lee.

*Paxton-Charlton-Squamscott* soils characterize northern portions of the corridor in Epping. They were formed either in glacial till or marine or glacial lake plains. They are well to poorly drained loamy soils on level to steep terrain. Slope, moisture, and stoniness are limiting factors for development. Charlton and Paxton soils, where free of stones, are "prime" for agriculture (see discussion of prime farmland soils). They are

also well suited to forestry.

*Eldridge-Scitico* soils, moderately well-drained and poorly drained fine sandy or silt loam soils derived from silty to sandy deposits on marine or glacial lake plains, occur in Epping center. They are level to gently sloping soils and may be too wet for development. The Eldridge soils are considered prime for agriculture and are well suited for white pine and red oak production.

*Canton-Chatfield-Hollis* soils occur west of downtown Epping. They are similar to the association in Newmarket, but have different concentrations of the individual soil types.

*Windsor-Hinckley-Canton* soils formed chiefly in sandy glacial outwash deposits. They are excessively drained and well drained, sandy and loamy soils that are nearly level to steep. Slope and seepage create the greatest obstacles to development.

#### Development Potential

Given the intense pressure for development of land in Rockingham and Strafford counties, the Strafford (1987) and Rockingham (1988) county conservation districts rated each soil type in their respective counties as to its potential for development.<sup>16</sup> In assigning the ratings, an ad hoc committee considered whether corrective measures were possible and, if so, what they would cost. The ratings are intended as a guide and focused on the following factors: depth to water table, flooding, slope, depth to bedrock, stone cover (surface), permeability (septic tank absorption field), and shrink-swell potential.<sup>17</sup>

The Map entitled "Soils Potential for Development" shows development capacities of corridor soils. Costs of overcoming inherent limitations in soils of low or very low potential are very high or prohibitive [1987-88 costs].

#### Special soils

Farmland and wetland soils and commercially viable sand and gravel deposits have distinctive properties and special significance.

**Farmland:** Important, designated farmland soils have the qualities needed to produce sustained high crop yields with minimum tillage and minimum energy. They

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<sup>16</sup> Strafford County Conservation District, Soil Potential Ratings for Development, July 1987 and Rockingham County Conservation District, Soil Potential Ratings for Development, May 1987. Contributors included the Town of Stratham, Walter Cheney Associates, Strafford RPC, Rockingham County Conservation District, Strafford County CD, NH Water Supply & Pollution Control Commission [Division], Lewis Builders Associates, Soil Conservation Service, Southern RPC, and Rockingham PC.

<sup>17</sup> Although the cost information on corrective measures is dated and some members of the Strafford District have questioned the ratings, SCS soil scientists recommend their use as a guide.

may be nationally significant (prime) or of statewide importance.<sup>18</sup> Arguably, "prime farmland is one of the most important resources of the State."<sup>19</sup> Prime farmland soils are mapped on the Map of "Important Farmland Soils" and listed in Appendix A.

Of the 551 acres of soils in the corridor with prime characteristics, just under 64% are located in Lee. Not all of this land remains available for agriculture; some has been developed (note that the map includes soils presently in campgrounds but excludes other developed land). These prime coastal farmland soils are well suited to silage corn, hay and pasture crops, vegetables, and small fruit production.

Soils of statewide significance produce good crop yields when properly managed. Within the corridor 642 acres once qualified as soils of importance to the state for agriculture. Somewhat fewer acres are actually available for farming due to development. These soils are more evenly distributed among the four study area towns.

**Wetlands:** There are 1,710 acres of poorly drained wetland soils in the study corridor, and 281 acres of very poorly drained soils. Wetland soils and the 100-year floodplain are depicted on the Map by that name. Wetland soils are generally more inclusive than wetlands mapped on the USGS topographic maps, which overlap but may extend beyond mapped soil boundaries.

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<sup>18</sup>Prime farmland (P.L. 97-98-December 22, 1981) is land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion, as determined by the Secretary [of Agriculture]. It can be farmed continuously or nearly continuously without causing environmental degradation. STOCK and timber Prime farmland includes land that possesses the above characteristics but is being used currently to produce live-stock and timber. It does not include land already in or committed to urban development or water storage.

Farmland of statewide importance is evaluated for New Hampshire (6/20/83) by the following criteria:

1. Soils that have slopes of less than 15 percent.
2. Soils with stony and very stony (or bouldery) phase designations are excluded.
3. Soils in poorly or very poorly drained classes are excluded.
4. Complexes consisting of less than 30 percent shallow soils (lithic) and rock outcrop and slopes do not exceed 8 percent.
5. Excessively drained soils developed in stratified glacial drift (generally low available water capacity) are excluded.

<sup>19</sup>S.A.L Pilgrim and N.K Peterson, Soils of New Hampshire, USDA and Agricultural Experiment Station, UNH, Research Report Number 79, 1979, p. 3.

Wetland soil acreage breakdowns within the corridor by town are as follows:

	Newmarket	Durham	Lee	Epping
Poorly Drained	141 13%	323 24%	657 30%	590 19%
Very Poorly Drained	39 4%	19 1%	27 1%	196 6%

Wetlands ordinances in all four towns govern activities in, and to varying extents adjacent to, wetland soils. (See town-by- town discussions under Existing Regulations.)

**Sand and Gravel:**<sup>20</sup> Commercial aggregate (usable surficial sand and gravel deposits) occurs sporadically through the study area and more uniformly along the river valley upstream of the Epping town line. Within the study area, a large deposit spans the river from just south of Bunker Pond easterly to upstream of the confluence with the Pawtuckaway River. The deposit extends southeasterly to south of Rte. 101. A second deposit in contact with the river extends northward from the confluence of the Lamprey River with the North River to Wadleigh Falls. A third deposit roughly parallels Rte. 155 into Lee Village beginning just north of the Little River. One smaller deposit occurs on the south side of the river in Durham just upstream from the confluence with Woodman Brook at Packers Falls.

Commercial sand deposits (stratified and sorted fine to very coarse sand) occur in three discontinuous deposits in or along the Lamprey valley east of Rte. 125 in Epping. In Lee they lie in or along the valley from Wadleigh Falls to the confluences with Beaver Brook and the Little River. There is presently one active sand and gravel operation (Dearborn Excavation) off Rte. 27 in West Epping. The zoning in Lee prohibits commercial excavation in residential zones, which encompass the entire Lamprey River corridor in Lee.

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<sup>20</sup>All information on commercial deposits is from a map compiled by Carl Koteff, USGS, to accompany a report, New Hampshire Sand and Gravel Resources, prepared for the New England Governors' Conference, Inc. by C. Koteff, 1993.

## HYDROLOGY

### Water Quality

**Surface Water:** The Lamprey River is legislatively classified Class B, and thus designated "swimmable and fishable." The other classification, Class A, applies to waters that are potentially acceptable for water supply use after adequate treatment and into which no discharges of sewage or wastes may occur.<sup>21</sup> Within the study area, only the Piscassic is a legislatively classified Class A river.

Apart from special studies<sup>22</sup> and monitoring activities by private organizations like the Lamprey River Watershed Association or the Great Bay Watch, the State relies on its Ambient Water Quality Monitoring Program for water quality data. State personnel are scheduled to visit selected sampling stations on the Lamprey River two or three times every third summer. Problem situations may dictate additional visits in off years. Monitoring focuses on selected chemical parameters and limited biological and toxicological data, including Escherichia coli (E. coli) bacteria, dissolved oxygen, pH, alkalinity, biochemical oxygen demand, nutrients (nitrogen and total phosphorus), chloride, hardness, specific conductivity, total solids, and selected metals.<sup>23</sup>

Streams are classified as supporting, partially supporting, or not supporting Class A or B uses depending on the type, frequency, or duration of the violation. While some states are fairly liberal in their interpretation of the term "swimmable" for Clean Water Act compliance purposes, New Hampshire now uses E. coli bacterial counts as a prime determinant of compliance and has set the upper limit at 406 E. coli/100 ml. (freshwater standard).<sup>24</sup> Due to the health risks involved, a stretch of river is deemed not supporting

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<sup>21</sup>Prior to 1991, surface waters in New Hampshire were classified as A, B, or C. A significant change occurred in 1991 when the state legislature reclassified all Class C waters to Class B in order to conform with the federal Clean Water Act goals of "fishable and swimmable." The act also expanded the scope of water quality goals from the maintenance of "fish life" to the maintenance of "aquatic life" and established a more stringent bacterial standard for heavily used swimming areas.

<sup>22</sup>NH Water Supply and Pollution Control Commission assessed potential wasteload capacity of the river below Raymond in 1976; the town of Epping has retained Dufresne-Henry for several years to advise on treatment facility expansion issues; NHDES sponsored a nonpoint source study of the watershed in 1993.

<sup>23</sup>Aluminum, arsenic, cadmium, chromium, copper, iron, lead, nickel, selenium, zinc, and manganese.

<sup>24</sup>Escherichia coli are a subset of fecal coliform. Often the two counts are identical. The column is entitled "fecal coliform" because fecal coliform were the bacterial standard until 8/91, when E. coli were adopted to more accurately reflect health risks. The E. coli standard for Class B freshwater is 126 E. coli/100 ml., based on a geometric mean of at least 3 samples obtained over a 60 day period, unless naturally occurring. For designated beach areas, the standard is 47 E. coli/100 ml. based on the geometric mean of 3 samples, or 88 E. coli/100 ml. in any one sample, unless naturally occurring. Although the law exempts "naturally occurring" bacteria from calculations, it is not clear what "naturally occurring" levels in New Hampshire might be, nor are humans necessarily immune to pathogens from animals.

water quality standards if it violates the bacterial standard.

There are 18 permanent stations in the State's current water monitoring program on the main stem of the Lamprey, 1 on the North, 5 on the Little, 3 on the Pawtuckaway, and 7 on the Piscassic rivers. The State sampled each of six stations on the main stem one to three times, June through August, 1988 and seven stations on the main stem in 1990, for a total of nine stations. Seven of those stations are within the study area. Stations above and below the Epping treatment plant were monitored again in 1987 and 1992, as part of the town's ongoing wasteload allocation study. Five of the permanent stations and an additional seven stations on the main stem were sampled in 1993 as part of a nonpoint source pollution assessment. Table 1 summarizes water quality monitoring results for all sampling during 1987-1993, including bacteriological data from a Great Bay Watch station upstream of Rte. 108 in Newmarket taken in 1992. Numbered sites preceded by letters were temporary stations set up for the nonpoint source project. Monitoring stations throughout the watershed are depicted on the Map, "State Water Quality Monitoring Sites on the Lamprey River and Major Tributaries."

Exceedences of Present Water Quality Standards, 1987 - 1992  
Table 1

<u>River</u>	<u>Station</u>	<u>Fecal Coliform</u>	<u>Dissolved Oxygen</u>	<u>Zinc<sup>25</sup></u>
Lamprey	C29*	1 out of 10	2 out of 10	0/0
	A24b*	1 out of 9	0 out of 9	0/0
	A24a*	2 out of 8	0 out of 8	0/0
	22*	0 out of 5	0 out of 5	0/0
	21*	1 out of 17	2 out of 17	$\geq 3/13$
	19*	1/12	1/12	$\geq 4/10$
	15	0/3	0/3	0/1
	15'	1/1	0/1	0/1
	14	2/7	2/7	3/7
	13	5/8	1/7	0/5
	12	1/7	0/6	1/6
	S11a	0/6	1/6	0/0
	11	0/12	0/12	1/2
	9	1/9	0/9	0/1
	A8c	1/8	0/8	0/0
	S9b	0/6	0/6	0/0
	S9a	0/6	1/6	0/0
	8	0/1	0/1	0/1
	7	0/1	0/1	0/1
	GB(6a)	1/9	0/0	0/0
	5	0/8	3/8	$\geq 4/8$
Pawtuckaway	3	0/1	0/1	0/1
	1	1/3	1/3	0/3
Little	3*	1/1	0/1	0/1
	2a	0/3	0/3	0/1
	A1a	0/8	1/8	0/0
	1	1/8	0/8	0/0
	R2	0/7	3/7	0/0
North	1	0/3	1/3	0/1
	2	5/6	1/6	0/0
Piscassic				

\*Station not located in study area. Note that higher standards apply to the Piscassic River because it is classified Class A.

These data indicate consistently good water quality on the main stem of the Lamprey River from roughly the Rte. 87 bridge in Epping to tidewater, with only

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<sup>25</sup>Zinc was selected because it appears to be the most problematic metal, i.e., zinc concentrations exceeded US Environmental Protection Agency standards for acute toxicity in the study area more frequently than any other metal.

occasional violations in this reach. Problems appear to be concentrated in and immediately downstream of downtown Epping, as measured at the Main Street and 125 bridges (stations 14, 13), and about 2.5 miles from the Epping treatment plant (as measured by consultants to the Town of Epping, who detected a DO sag over an estimated 3 miles).<sup>26</sup> Bacterial problems documented in 1993 resulted in posting of the swimming area behind the Town Hall, in Epping.

One or more violations of zinc standards have been detected in downtown areas (Raymond, Epping, Newmarket) and at more rural sampling stations (Rte. 87, Wadleigh Falls, Lee Hook Road, Langford Road [Raymond]). Occasionally copper standards also have been violated, particularly in Newmarket. High concentrations of metals in the Lamprey are generally correlated with extreme low flows. Whether the problem is correctable depends on its source, which is unclear. However, the NHDES 1993 measurements of metals in the Lamprey River watershed are distinctively higher than in other watersheds in the State, and this issue merits additional analysis.<sup>27</sup> The high concentrations of copper and zinc, in particular, represent a threat to certain types of aquatic life<sup>28</sup> but do not affect swimmability. Although both metals may bioaccumulate in fish, oysters, and bivalves, neither is known to be harmful at the levels likely to be ingested from fish and mollusks in the Lamprey.<sup>29</sup>

Because they live in the water, aquatic animals can reveal a great deal about

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<sup>26</sup> In 1990, violations of E. coli, dissolved oxygen (DO), or zinc standards were detected at three stations in the study area - the Rte. 125 bridge in Epping (excessive E. coli and low DO), the Rte. 87 bridge in Epping (zinc and DO), and the Rte. 152 bridge in Lee (zinc) - for a total of 1 mile deemed not supporting Class B standards due to high bacterial counts and 5.0 miles in partial support of standards. The Pawtuckaway was in partial support of DO standards for 0.5 miles and nonsupport of bacterial standards for 0.5 miles. The Little River violated bacterial standards for 1 mile and partially supported DO standards for 1 mile. The North River sustained only partially supporting DO readings for 0.5 mile. The Piscassic River was in partial support of DO standards and nonsupport of bacterial standards for 1 mile. "Partial support" indicates occasional DO or metals violation with no bacterial violation. Low DO and excess zinc documented by state studies do not affect the edibility of fish or swimming opportunities but may affect aquatic life. "Nonsupport" generally means E. coli standards were violated, but may also reflect DO limitations. Violations of bacterial standards create conditions where swimming is inadvisable. From: Appendix E and Figure III-4, New Hampshire Water Quality Report to Congress - 305(b), December 1992.

<sup>27</sup> The 1993 nonpoint source field data are analyzed in Lamprey River Water Quality Report, Nonpoint Source Program 1994, available from the NHDES, 6 Hazen Drive, Concord, NH 03301.

<sup>28</sup> Some water quality professionals have questioned the reasonableness of water quality standards. A 1983 report on urban runoff prepared by consultants to the NHDES suggests a second set of standards for relatively short exposure regimes associated with storm-generated pollutant loads that is substantially higher than those promulgated by the Environmental Protection Agency. See SR 136, Summary Report, Durham Urban Runoff Program, NHWSPCC, June 1983, p. 81.

<sup>29</sup> Memo from J.J. Dreisig, Toxicologist, NH Bureau of Health Risk Assessment, to B.S. Dupee, Administrator, NH Bureau of Health Risk Assessment, dated 8/9/94.

water quality. The State monitoring program does not presently sample aquatic macroinvertebrate populations on a routine basis, but the presence of a species of pollution intolerant mussel in the Lamprey in Lee indicates good recovery from any impacts of the Epping wastewater treatment plant and good water quality. According to Robert Fawcett, NH Fish & Game fisheries biologist, the Lamprey is the best trout river in southern New Hampshire because it has the best water quality.

On the other hand, the State considers the Lamprey a "water quality limited" river, one in which there is little assimilative capacity for contaminants and, hence, high vulnerability to pollution. In addition, the distribution of the pollution intolerant mussels in the river does not match what biologists would expect to find in an essentially natural river of this type, and populations were smaller in number and/or areal extent than anticipated given the physical habitat. Pollution is one of several non-natural causes that "have probably affected current mussel distribution and abundance in the river."<sup>30</sup> A permanent monitoring plot for the Lee Alasmidonta varicosa mussel population was established in 1994, and baseline data were recorded.<sup>31</sup>

Violations on the Little, North, and Pawtuckaway rivers were measured at bridges near their confluences with the Lamprey. Bacterial and dissolved oxygen problems on the North River are presumed to have dissipated by the time it flows into the Lamprey. Bacterial problems on the Little River where it crosses under Tuttle Road detected in 1993 may affect the Lamprey. DO and bacterial problems further upstream at the 125 bridge likely do not. Bacterial and DO problems on the Pawtuckaway may influence water quality in the Lamprey; high bacterial counts on the Lamprey at station 15' (sampled only once, in 1988) conceivably reflect problems on the Pawtuckaway River.

The only Piscassic station monitored in recent years is in Newmarket, where dissolved oxygen and bacterial violations of Class A standards occurred. Natural sources are suspected.<sup>32</sup>

**Sources of Contamination:** The state attributes all surface water quality violations on the Lamprey and its tributaries to nonpoint sources except the DO violation at the Rte. 87 bridge, to which the Epping wastewater treatment plant (WWTP) contributes. The source of nonpoint water quality problems in downtown Epping is unclear. High bacterial counts below the Lee Hook bridge in 1993 are attributed to livestock. E. coli violations in a tributary on the farm may have been caused by farm runoff, but equally possibly by clay-sealed septic systems off Wednesday Hill Road.

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<sup>30</sup>The Conservation Group, "De Novo Inventory and Baseline Monitoring for Alasmidonta varicosa, Lamprey River, Epping and Lee Townships, New Hampshire 1994," p. 8.

<sup>31</sup>Ibid.

<sup>32</sup>NHDES, 1990 Ambient Water Quality Monitoring Results, WSPCD-91-1, p. III-7.

Swimming in this area is inadvisable. The only possible sources for bacterial problems at station A1-Ltv are farm animals, unless the farmhouse itself has a faulty septic system.<sup>33</sup>

Road salt probably causes high specific conductivity and sodium and chloride concentrations in a well at Camp Hedding, Epping. USGS analyses of well water data from wells in southeastern NH further confirmed a trend of rising chloride concentrations documented statewide in 1975.<sup>34</sup>

Major highways and local roads that are treated with salt for winter safety are generally sources of potential water quality degradation, as are: unsewered residential and village areas; year-round residences converted from seasonal use; waste disposal sites; construction sites with exposed soils; pastures sited on streams and rivers; lawns, fields, and greens to which chemicals are applied; and toxics stored on site. Within the study area the NHDES Groundwater Protection Bureau has mapped likely potential sources of groundwater contamination from hazardous wastes, including several garages and autobody shops in Newmarket, the Essex and Fish & Game properties in Newmarket, one underground storage tank (UST) in Durham, one underground injection site (UIC) in Lee, and in Epping, the sewage lagoons, an unlined landfill, several UICs and USTs.

Generally, containment of potential threats from nonpoint source pollution (essentially polluted runoff) "will depend on the implementation and enforcement of land use controls in communities within the study area as well as in those surrounding communities connected by common watersheds,"<sup>35</sup> including septic setbacks from waterbodies and vegetative buffers along shorelines. Within the corridor the maintenance of septic systems and underground storage tanks and continued monitoring of landfill leachate and waste water injections into the ground will contribute to water quality protection.

**Groundwater:** The goal for all groundwater in New Hampshire is that it be drinkable. The information on water quality data in the Lamprey River study area is based on monitoring data for existing public wells and USGS-sited test wells in stratified drift aquifers not located down gradient from landfills. These latter were collected in

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<sup>33</sup>NHDES, Lamprey River Water Quality Report, Nonpoint Source Program, 1994.

<sup>34</sup>Trend was documented by Hall as reported in USGS Water-Resources Investigations Report 88-4128, p. 50; see also water quality summary, pp. 45-51, in Geohydrology and Water Quality of Stratified-Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire, USGS Water-Resources Investigations Report 88-4128, revised 1990, and supplemental report of raw geohydrologic data in USGS Open-File Report 92-95, Bow, NH.

<sup>35</sup>Roy F. Weston, Inc. et al., Water Supply Study for Southern New Hampshire, Volume 1 - Report, May 1990, pp. 4-2.

August and December 1984 and November and December 1985. Analyses included common inorganic, organic, and volatile compounds.

The data indicate generally good groundwater quality that meets US Environmental Protection Agency standards for drinking water, with site-specific exceptions. Of the seven test sites that are hydrologically connected with the river, three, all in Raymond, had iron concentrations significantly higher than EPA secondary drinking water standards, and all had excessive manganese concentrations. High sodium and chloride concentrations at the Camp Hedding well have been referenced above.

#### Flow

**Gradient:** From its headwaters in Northwood to West Epping the river drops roughly 450 feet in 22.5 miles, or 20 feet/mile. In this reach, the river is shallow. Where its flow is fast, the substrate is sandy or gravelly. Where the flow slows, the river bottom is muddy. There is a significant 12' drop at a gorge upstream of Dead Pond in Raymond and a 10' drop at Bunker Pond dam in West Epping, at this study's western terminus.

From West Epping to Epping the river drops roughly 7 feet/mile and is characterized by alternating flat water and rapids. This stretch contains about one-half mile of Class II ledges. From Epping to Wadleigh Falls the river falls roughly 1.2 feet/mile, creating a highly meandering channel, which is often jammed with brush and logs. The remaining 10 river miles in the study area fall only 60 feet. Most of the drop occurs at Wiswall Dam and Packers Falls, which is a Class III canoe run in early spring and often a Class II run well into the summer. There are short rapids below Wadleigh Falls, about 200 yards of rapids below the Lee Hook Road, and a short rapid about a mile beyond on either side of an island.<sup>36</sup>

Virtually all stretches of the river above Packers Falls are subject to low summer flows, except the ponded areas above Wiswall Dam and Wadleigh Falls. The Macallen Dam influences flow for roughly 2 miles upstream. The National Wetlands Inventory classifies the lower reaches of the river as lacustrine.

**Quantity:** Since 1934 the U.S. Geological Survey has maintained a stream gauging station (No. 01073500) on the Lamprey River at Packers Falls, recording flows from approximately 87% (183 sq. mi.) of the watershed. During this period of record, extreme discharges of 7,570 cubic feet/second (cfs) and 1 cfs have occurred on 4/7/87 and 10/21/35, respectively.<sup>37</sup>

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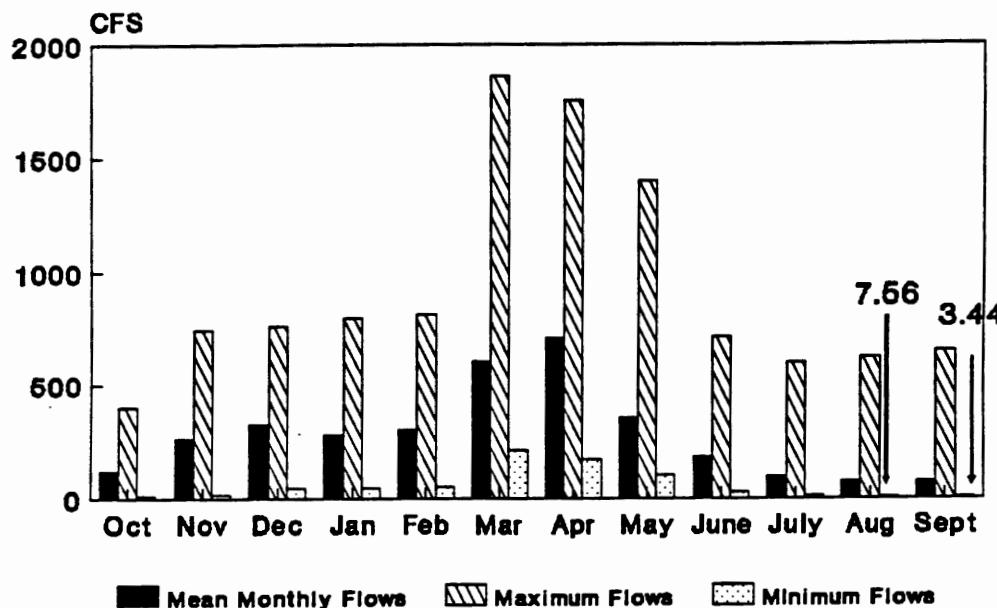
<sup>36</sup>Appalachian Mountain Club River Guide for NH and VT.

<sup>37</sup>Report No. USGS/WRD/HD-92/274, Water Resources Data for New Hampshire and Vermont, Water Year 1991, prepared by K.W. Toppin, K.E. McKenna, J.E. Cotton, and J.C. Demner.

Mean monthly flows for the period 1961 to 1975 as measured at the Packers Falls gauge and expressed as cubic feet per second per square mile (cfs/m) are: October - .56; November - 1.50; December - 1.99; January - 1.34; February - 1.61; March - 3.05; April - 4.13; May - 1.81; June - .85; July - .44; August .23; September .27.<sup>38</sup> Selected annual flow values are: .94 cfs/m (likely flow 50% of the time), .21 cfs/m (likely flow 85% of the time), and .14 cfs/m (likely flow 90% of the time).<sup>39</sup> As the data and Figure 1 (Mean Monthly Flows at Packers Falls, 1934-1993) indicate, low flows continue well into the fall. Highest flows generally are in April.

Notably, also, there may be considerable variation from one year to the next. In July, August, and September of 1993, for example, mean monthly flows at Packers Falls measured 12.2 cfs, 15.5 cfs, and 18.4 cfs, respectively, compared with 80.5 cfs, 42.1 cfs, and 49.4 cfs during 1961-75.

### Mean Monthly Flow at Packers Falls 1934-1993 Water Years, USGS Data



**Figure 1**

See Appendix J for actual values.

<sup>38</sup>NH Water Resources Division, River Basin Management Plan for the Lamprey River and Evaluation of Hydropower Potential at Existing Dam Sites, final report, December 1982, Table 1, p. 8. Measurements are often expressed in cfs/m so that one can compute the approximate flow for any given point in the watershed, by multiplying the number of square miles above the area by the measured flow in cfs/m. Thus, the mean monthly flow at Packers Falls (183 sq mi) for August during 1961-75 is 42.1 cfs.

<sup>39</sup>Unpublished "Preliminary Findings" prepared for the Rivers Management Advisory Committee by Kathy Fallon, Staff Scientist - Water Resources, Appalachian Mountain Club, 1/12/93.

The 7Q10 value (a statistic probability of a particular low flow occurring for seven consecutive days once every 10 years cited widely in wastewater treatment plant regulations) for the Lamprey is 4.9 cfs. Comparable values for the North, Little, and Piscassic rivers have not been computed. None of these rivers is gauged. Equations to determine approximate values, based on three variables -- mean basin elevation, percent stratified drift, and drainage basin area -- have been developed for annual Q95 and 7Q10 values, but none of these variables has been calculated for the three tributaries.

The local geology, gradient, and flow create a floodplain that varies in width between West Epping and tidewater from 125' to 2,625'. At flood stage, the Lamprey has been known to cross watershed boundaries and flow into the Oyster and Piscassic rivers. Town by town, the floodplain varies in width, as follows:<sup>40</sup>

	<u>Minimum width</u>	<u>Maximum width</u>
Newmarket	125' (at dam)	1,190'
Durham	125' (at Packers Falls brdg)	2,625'
Lee	190'	2,250'
Epping	125' (at 125 bridge)	2,190'

The floodway, a regulatory construct, is defined as the channel of a watercourse plus any adjacent floodplain that must be kept free of encroachments so that the 100-year flood can be discharged without increasing the elevation of the flood more than a specified amount. In Epping the floodway varies from about 65' (under the 125 bridge) to 565'. No floodway has been mapped in Lee. In Durham it has been mapped to Wiswall Dam and varies from 125' to 1,250'. In Newmarket base flood elevations have been mapped. (See the Map, "Wetland Soils and 100 Year Floodplain.")

**Source:** All the water that ultimately makes its way into the Lamprey comes from precipitation, whether it enters as surface water or groundwater. Of the 20+-inches/year of runoff available through overland and groundwater flow to the river (roughly 1.5 cfs/square mile of drainage area), half occurs in March, April, and May, with the remaining evenly distributed throughout the year.<sup>41</sup> Low summer and fall flow values in the river reflect the relative scarcity of stratified sand and gravel aquifers. Such water-bearing aquifers are a major source of groundwater reserves and, if upgradient, generally sustain river flow during periods of little rain.

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<sup>40</sup>Floodplain data are measured from GIS data, as mapped by John Hatch and digitized by Strafford Regional Planning Commission. Floodway data are measured from Federal Insurance Rate Maps prepared by the US Army Corps of Engineers.

<sup>41</sup>Mean annual precipitation is about 41 inches, which falls relatively evenly throughout the year. Annual runoff varies by less than 3 inches/year. See USGS, Water Resources Data New Hampshire and Vermont by Water Year, an annual publication containing flow information for gauged streams.

**Regulation of Flow:** In 1982 the NH Water Resources Board evaluated the potential for hydropower production at existing dams and former dam sites on the Lamprey River. As part of that effort, they assessed the potential of headwater reservoirs to influence flow. There are two such waterbodies, Pawtuckaway Lake (903 acres, 10% of the total drainage area) and Mendum's Pond (2.5% of the total drainage area, which feeds into the Little River) (total usable capacity of the two ponds c. 600 million cu ft).

Although originally created to insure water for powering mills, no dam on the Lamprey or its tributaries today is used to regulate flow. In a 1982 evaluation of hydropower potential, the State Water Resources Division determined that Pawtuckaway and Mendum's ponds store an amount of water "sufficient for only a minor modification of the normal unregulated flows." In addition, because both waterbodies are managed for summer recreational use, with full summer pools and gradual, seven-foot fall drawdowns, flow augmentation was considered impractical during the dry summer months. However, the WRD evaluation indicates it is possible that "a reservoir plan could be implemented which would benefit recreation and fishing interests."<sup>42</sup>

As presently managed, the fall drawdown occurs in October, after Columbus Day. At this time the river generally is low and benefits from the additional water. Releases from Pawtuckaway Lake into the Pawtuckaway and Bean rivers augment Lamprey River flows at a rate of up to 110 cfs over an extended period, into December. Winter operation of the Pawtuckaway Lake dam allows for fluctuating lake levels to moderate peak spring stream flows, with final summer recreational levels generally achieved in late April or early May and invariably by June 1.<sup>43</sup> Fall drawdowns releasing a lesser volume of water occur also at Bunker Pond, Mendum's Pond, and North River Pond.

Low relief and the high flood storage capacity of floodplain wetlands have helped minimize flood damages, although a 100-year flood in April 1987 caused millions of dollars in damages to roads, bridges, and curbing from Raymond to Newmarket.<sup>44</sup> The mean daily flow on April 7, 1987 as measured at the gauge at Packers Falls is the highest on record (1934-1994), at 7,360 cfs. The highest instantaneous peak flow on record, 7,570 cfs, occurred on the same day.

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<sup>42</sup>NH Water Resources Board, River Basin Management Plan for the Lamprey River and Evaluation of Hydropower Potential at Existing Dam Sites, 1982, p. 33.

<sup>43</sup>Letter from Kenneth Stern, Chief Engineer, NHWRD, to Mr. Jonathan F. White, Raymond, dated 4/20/92.

<sup>44</sup>Exeter News-Letter, 4/16/87.

High instantaneous flow probabilities used to characterize storm events on the Lamprey as measured at the Packers Falls gauge follow.

2-year storm event	2,079 cfs
10-year storm event	3,656 cfs
25-year storm event	4,418 cfs
50-year storm event	4,970 cfs
100-year storm event	5,506 cfs

Quantitative flow information prior to 1934 does not exist, but that floods have challenged man's relation to the river at least since early colonial times is evident in the following entry from an Epping settler dated April 1, 1671. "A great snow storm came out of the northwest, making drifts 6 feet deep. Rain set in for the next 14 days, with resulting floods causing considerable damage to mills along streams."<sup>45</sup>



Bunker Pond Dam area at flood stage during 1993 spring runoff, West Epping.

**Dams:** At one time or another there have been dams at a minimum of 15 sites on the main stem of the Lamprey, 3 sites on the Little River, 1 on the Pawtuckaway River, and 2 on the North River. Smaller tributaries to each of these rivers have supported at least 16 additional dams.<sup>46</sup> Except for the dams at pond outlets,<sup>47</sup> the

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<sup>45</sup>Richard B. Sanborn, A Bicentennial History of Epping New Hampshire, the Withey Press, Seabrook NH, 1976.

<sup>46</sup>Except as otherwise indicated, information on dams and dam status is from the NH Water Resources Division's basic data sheets on dam safety parameters prepared for each dam.

<sup>47</sup> In addition to the dams on Pawtuckaway Lake (3 State-owned dams [WRD], 900 ac) and Mendums Pond (State-owned [WRD] dam, 252 ac, Nottingham) referenced above, dams occur at pond outlets feeding the river or a tributary on Meadow Lake (dam is State owned [DRED], 17 ac, Northwood), Freeses Pond (dam owned by Town of Deerfield, 82 ac, Deerfield), Onway Lake, aka Jones Pond (private dam, 192 ac,

NHDES classifies most of these dams "inactive" or, if "active," too small to pose any safety hazard or to require annual registration.

There are three additional "active" dams located on the main stem of the Lamprey (and none in its tributaries). Two are within the study area and one, the Macallen Dam, is at its terminus in Newmarket. Although it is breached and creates virtually no downstream flooding hazard, the NH Water Resources Division considers the dam at Wadleigh Falls in Lee an active dam. The dam is owned by Peter Dodge, Rte. 152, Lee, NH, and has a drainage area of 154 square miles. In the early 1980s a Maine corporation applied to the Federal Energy Regulatory Commission for a license to build a hydroelectric energy facility at this site.<sup>48</sup> The application was never completed, and there are no applications pending at this time.

Wiswall Dam in Durham is intact as a run-of-the-river dam. Listed on the National Register of Historic Places (see discussion under Archaeologic Sites), the dam is owned by the Town of Durham, which relies on the pool behind it for a backup water supply and for recreation. A minor license to reconstruct a hydroelectric facility at this site (FERC #6632-000) has been issued, but its effective date has been stayed pending a final determination on whether the river segment is designated into the Federal Wild & Scenic Rivers System.<sup>49</sup>

The proposed run-of-the-river facility would utilize the existing 17.8 foot structure and divert all but 30 cfs of river water from the streambed for about 150 feet. It would include fish passage facilities. Although the licensee, John N. Webster, originally proposed two-foot flashboards, the final proposal relies on head from the existing dam alone. Language designating the Lamprey River into the state's Rivers Management and Protection Program prohibits flashboards to increase the height of either the Wiswall or the Wadleigh falls dams (RSA 483:14, I). The state program, while not controlling over Federal hydroelectric licensing activities, would factor into any FERC decision relative to an amendment to add flashboards.

In 1989 the State, the Town, and an abutter appealed the FERC's decision to issue a license at Wiswall Dam. In 1990 the FERC denied their appeals, whereupon the appellants requested a rehearing. The requests for rehearing are pending. Central to the state's objections are the effects of a hydropower facility on dissolved oxygen levels, which the applicant failed to examine. Also raised in appeals were the project's

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Raymond), Hoar Pond (dam owned by UNH, 26 ac, Epping), Bunker Pond (dam is State owned [WRD], 29 ac, Epping), Nottingham Lake (private dam, 35 ac, Nottingham), and North River Pond (State owned [WRD], 80 ac, Nottingham).

<sup>48</sup>New England Rivers Center, New Hampshire River Protection and Energy Development Project, final report, 2/22/83, Appendix A.

<sup>49</sup>Project No. 6632-006, Order Issuing Stay, issued February 18, 1992.

environmental impacts and financial viability.

The river at the dam has a drainage area of 181.9 square miles and would create a "significant" downstream hazard if it ever let go (i.e., the WRD classifies it a Class "B" dam). There is no fish ladder presently at the site.

The Essex Group, Inc. owns the Macallen Dam in Newmarket, which is located at the eastern terminus of the study area and separates tidal from fresh waters. The dam is equipped with a fish ladder that the NH Fish & Game Department operates. Dams have existed at or near the site since at least 1660,<sup>50</sup> and water was diverted from the river for power. Today the canals have been filled, and the dam no longer generates power.

Throughout the study segment the river is largely free flowing. The Macallen Dam, at 27', is the most significant impediment and affects flow for about 2 miles upstream.

#### Water Supply

**Present Sources:** Over the years thousands of dollars have been spent to assess existing and potential water supplies in the Piscataqua and New Hampshire Coastal river basins, where "[i]nsufficient public water supply is the most pervasive water resource problem."<sup>51</sup> Because water resources are limited, communities eye the river as a potential source of water supply (as well as a conduit for treated wastewater).<sup>52</sup>

At present, only the UNH-Durham water system taps directly into the river or its major tributaries for public drinking water. This back-up supply pumps water from the Lamprey into the Oyster River reservoir. In 1993 the UNH-Durham system transferred 3.733 million gallons from the Lamprey to the Oyster River September 1 through 3. Four million gallons were withdrawn over a 24-hour period earlier in the summer to check the system's capacity for a large, lengthy withdrawal. This 24-hour capacity use translates into roughly 6.2 cfs, about 1.3 cfs (840,154 gpd) more than the rate of flow in the river expected as a statistical probability to occur for 7 days once every 10 years,

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<sup>50</sup>Mill of Valentine Hill, built at the "high water mark below Lmaper Eel Riuver [sic] falls," in Sylvia Fitts Getchell, Lamprey River Village, The Early Years, 1976, p. 24.

<sup>51</sup>New England River Basins Commission, Piscataqua and New Hampshire Coastal River Basins Overview, 1980, p. 5.

<sup>52</sup>Discussion with Lee selectman Dwight Barney, 5/10/93; Strafford Regional Planning Commission, Water Resources Chapter, Regional Master Plan, 12/90, p. 48.

and 30% of the 30-day low flow at Wiswall Dam likely to occur every other summer.<sup>53</sup>

On average (there is considerable, inexplicable variation from day to day), the town consumes 324,000 gpd.<sup>54</sup> When UNH is in session, the average ranges around 1.4 million gpd. Voluntary conservation measures during the drought in 1993 reduced demand by 200,000 gpd (including 100,000 gpd for watering the lawns at UNH).<sup>55</sup>

Durham is presently assessing Spruce Hole Bog as a potential water source for expansion purposes. In the short term it might also buy water from Newmarket, which has the capacity to use water from the Lamprey and Piscassic rivers but doesn't presently. UNH plant operators are looking towards a .4 mgd expansion, which will increase capacity to 2 mgd. In the spring of 1993 the Durham Town Council established a Water Policy Task Force to examine supply and demand issues facing the town. The Task Force issued its report and recommendations in August 1994. Among its recommendations, the Task Force endorsed research and development of groundwater supply sources, conservation measures, planning for construction of a new treatment facility, and an alternative to the present management structure for the water system.

Of the towns in the study area or immediately upstream, Raymond relies on two gravel packed wells for its public water supply. At some point water supply experts recommend the town seek additional sources in order to diversify its system. Both wells are located in the same aquifer, which abuts the Lamprey River.

Epping also relies on groundwater for its public water supplies (its major well, bedrock, yields 150 gpm; an auxiliary gravel packed well yields 80 gpm). Both wells are located in the Piscassic watershed and are not hydrologically connected to the Lamprey. The town has had a moratorium on water hookups for more than a decade, and has been looking for additional water for some 10 to 15 years. Exploratory tests in the large aquifer in West Epping indicated high iron and manganese concentrations,

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<sup>53</sup>Data are from preliminary findings on Lamprey River instream flows prepared by Kathy Fallon, Staff Scientist, Water Resources for the Appalachian Mountain Club, 1/12/93. NHDES 7Q10 flow data indicate a 7Q10 flow rate at Wiswall Dam of 4.9 cfs. The watershed at Wiswall is 182 sq. mi., based on NHDES dam safety data. The conversion from cfs is as follows: gpm = rate at point in watershed x 7.48 (cfs to gallons) x 60 (seconds) x 60 (minutes) x 24 (hours).

<sup>54</sup>This figure includes billing data, 10/1/92-9/30/93 (97.5 million gallons) and the town's share of unaccounted for water consumption, an additional 19 million gallons, per conversation with Skip Grady, public works department. Consultants to the town and university have recently completed a water audit to determine why the system appears to be losing so much water - 30% as compared with the national average of maximum acceptable loss of 15%. Fire hydrants and public garden water tie-ins will soon be metered. Other sources of loss may include meters incapable of accurately measuring extreme high and low rates of flow, leaks in the system, and unmetered tie-ins.

<sup>55</sup>Per conversation with Joe Winkling, Chief Water Utilities Operator, UNH/Durham Water Works.

correctable but expensive problems. Townspeople have stymied the water and sewer commission's efforts to expand the system by refusing to allocate funds, and new subdivisions have installed their own wells.

Lee has no municipal water system. Durham uses a combination of Oyster River water and wellwater (gravel packed well yields 650 gpm)(with Lamprey River, as indicated, an emergency backup); and Newmarket draws from two gravel packed wells (total potential yield is 0.46 MGD). Newmarket has a treatment plant for treating raw water from Follett's Brook, the Piscassic River, and the Lamprey, although these sources are not presently tapped.

In addition to the public water systems, numerous private community well systems supply water to mobile home, subdivision, and condominium developments. There is relatively little industrial demand. In general, per capita water use is highest in the summer. The cost of water and wastewater treatment also influence consumption.<sup>56</sup>

**Aquifers as Public Water Supplies:** Recent US Environmental Protection Agency regulations promulgated to protect public water supplies make groundwater an increasingly attractive drinking water source. While the quality of groundwater in the Lamprey River basin is generally good (see above), stratified drift aquifers - the most promising source of public water supplies - are relatively small and isolated within the study area. Public water supplies are defined as any system servicing 25 people or 15 service connections for 60 days or more. State law (RSA 485c) requires a transmissivity of greater than 1,000 feet squared/day and a saturated thickness of more than 20 feet for any public water supply tapping groundwater. Few coastal aquifers have both characteristics.

Within the watershed there are about eight aquifers of varying sizes that meet State public water supply standards, of which the Newmarket Plains is probably the largest. Simulated withdrawals from an aquifer hydraulically connected with the river in West Epping and an aquifer not so connected in Newmarket (the Newmarket Plains aquifer) indicate that the greatest potential for large water withdrawals is from aquifers that are hydraulically connected with streams from which water can be pumped when water in the aquifer is low.<sup>57</sup>

Aquifers in both Raymond and West Epping are hydraulically connected with the river. In 1989 Raymond withdrew approximately 200,000 gpd from its floodplain wells. The water system serves about 30% of the town's population. Nearly 70% of the water goes to domestic use, with the remaining equally divided among commercial, industrial,

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<sup>56</sup>Roy F. Weston, Inc., et al., Water Supply Study for Southern New Hampshire, Vol. 1, 1990, p. 5-8.

<sup>57</sup>U.S. Geological Survey, Water-Resources Investigations Report 88-4128, Geohydrology and Water Quality of Stratified-Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire, p. 1 ff.

and unaccounted.<sup>58</sup> Present use represents about 12% of the estimated 1.7 mgd available yield projected by consultants and Southern NH Regional Planning Commission in Water Supply Study for Southern New Hampshire (May 1990). Projected demand for the year 2000 is 0.40 mgd (average) and 0.80 mgd (maximum).

Whether any of the current or projected yields draw water in Raymond from the Lamprey has not been determined. Water was drawn from the river in the simulation developed for the West Epping aquifer in a 1988 study by the USGS, in cooperation with NHDES. The study assumed that river flows must meet or exceed flows presently in the river 99% of the time, calculated to be 1.5 cfs (an assumption which allows for extremely low flows). It postulated four wells strategically placed within the aquifer and pumping at a rate of 2 Mgal/d. At this rate, stream flow was reduced by 2.3 cfs, or 1.5 Mgal/d, to the 99% duration flow. Groundwater was withdrawn at a rate of 0.5 Mgal/d. After 180 days of continuous pumping the area of measurable drawdown within the aquifer was about .6 sq mi. The ratio of groundwater to river water remained unchanged when various assumptions were modified. The assessment concluded that 2 Mgal/d would be available from the West Epping aquifer 95% of the time, provided extended periods of extreme low flow conditions in the Lamprey were acceptable.<sup>59</sup>

A major fault, known as the Flint Hill Fault, trends northeasterly through West Epping. It presently supplies Barrington water and has the potential to serve as public water supply source in Epping. A second study of potential public water supplies, initiated in 1993 as a cooperative undertaking of the State and USGS, will focus on water resources in fractured bedrock.<sup>60</sup>

**Regulatory Authority to Tap River Water:** In 1965 the legislature appropriated waters in the Lamprey River and its tributaries first and foremost to the towns of "Durham, Epping, Lee, Newmarket and Raymond ... for the purpose of public water supplies to the exclusion of all other municipalities."<sup>61</sup> The law directs the legislature to allocate water in the event the demands exceed supplies. It also restricts what communities can withdraw: none can "decrease the amount or type of water currently

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<sup>58</sup> Wellhead Protection Program, prepared for the Town of Raymond by the Southern New Hampshire RPC, May 1992, p. 2.

<sup>59</sup> USGS Water-Resources Investigations Report 88-4128, Geohydrology and Water Quality of Stratified-Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire, revised 1990.

<sup>60</sup> Pending State appropriations for continued support, the project will result in interpretive maps for the entire state identifying the most favorable faults. A second phase of the study will focus on one area for more indepth supply analyses and will explore different geophysical techniques for tapping bedrock supplies. Interim fracture trace maps are scheduled for completion in 1997.

<sup>61</sup> Laws of 1965, Chapter 332, An Act Relative to Future Use of Portions of the Waters of the Lamprey River and/or Its Tributaries for Public Water Supplies, and to Name the Dam at Ayers Lake in Barrington.

required or used or reasonably required for use by any municipality, person, firm or corporation having rights [to water use]." The law specifically prohibits Durham from "[lowering] the water level upstream from the so-called Hook Island Falls" or curtailing "present or future recreational uses, namely swimming, boating and fishing." The law further authorizes both Durham and Newmarket to maintain dams (at Wiswall and Macallen dams) and flowage rights for water supply purposes.

The State Rivers Management and Protection Program (NH RSA 483) also establishes jurisdiction over instream flow. Its mandate is broader than the earlier law's and includes the state's interest in, but not limited to "navigation; recreation; fishing; storage; conservation; maintenance and enhancement of aquatic and fish life; fish and wildlife habitat; wildlife; the protection of water quality and public health; pollution abatement; aesthetic beauty; and hydroelectric energy production." Instream flows under this law are set for rivers designated into the state program. The State's authority to control flow, as articulated in proposed rules, is limited to the designated river or river segment, groundwater or surface water withdrawals from within 200' of the river, and large withdrawals from within a set distance of the river on tributaries.

To the extent the 1965 law and regulations promulgated under RSA 483 conflict, additional legislative action will be necessary to clarify withdrawal policy.

#### Water Withdrawals/Discharges

Three facilities are registered with the NH Water Resources Division for water withdrawals or returns of more than 20,000 gpd from the Lamprey River. They are the University of New Hampshire, the Town of Newmarket, and the Town of Epping.<sup>62</sup>

During a brief time in 1988 when UNH took water from the Lamprey to supplement its water supply, the average daily withdrawal was 933,000 gallons, with a maximum of 1,375,000 gallons.<sup>63</sup> 1993 withdrawals are discussed under "water supply." Both Newmarket and Epping return treated water to the river.<sup>64</sup> Newmarket's outlet is in the saltwater portion. Average daily discharges in 1992 were 450,000 gpd and 120,000 gpd, respectively. Design capacities are 850,000 gpd and 275,000 gpd, respectively.

The Epping plant was built in 1971. No storm sewers discharge into the system.

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<sup>62</sup>Essex International had an industrial discharge permitting 0.5 mgd discharges at 90 degrees F. in Newmarket. That permit was closed out in 1993 since the facility no longer discharges into the river.

<sup>63</sup>NH Water Resources Division, registered water user reported data.

<sup>64</sup> Any discharger is responsible for obtaining a National Pollutant Discharge Elimination System (NPDES) permit, regardless of its size. Permittees are classified as major or minor. The Epping WWTP is considered a minor facility based on its size, but will be treated as a discretionary major facility because it is a tributary to Great Bay.

The plant presently provides secondary treatment to a mean daily flow of 140,000 gpd, up from 100,000 gpd in 1973 and 110,000 gpd in 1982.<sup>65</sup> Although its capacity is 275,000 gpd, the plant presently is limited to discharges of 200,000 gpd because of water quality violations, particularly DO. During summer low flow periods, no discharges are made. For several years developers have pressured the town to extend sewer tie-ins beyond the immediate downtown area.

Epping's treatment expansion plans call for a tripling of capacity, to 800,000 gpd. Consultants to the town concluded from water quality data, summarized 11/17/93, that there is a high background demand on dissolved oxygen in the river upstream of the treatment plant, and any additional discharge from the plant will require advanced treatment. These conclusions affirm an earlier assessment, that the river has "little to no measurable excess assimilative capacity available to handle discharges from Epping or any other community."<sup>66</sup> Low aeration potential below the outfall compounds the problem. A new permit, scheduled to be issued by the US Environmental Protection Agency in 1995, will hold the town to current State water quality standards and may restrict the town's expansion capacity.

Raymond, population 8,713,<sup>67</sup> has no municipal treatment facility. Because the river has so little assimilative capacity, Raymond will need to prepare a wasteload allocation study before any NPDES permit is issued. The wasteload allocation study would be similar to Epping's, with discharge parameters based on the 7Q10 worst case low flow scenario (the assumption being that discharges not harmful to the river under low flow conditions will not harm it under more favorable flows).

The river's natural characteristics - its low summer and fall flows, its low gradient, and possibly other natural attributes or inputs from natural sources (e.g., low DO from swamps) are such that water quality will be an important management issue for both point and nonpoint discharges.

There is one registered river water user on the North River in Nottingham. Fernald Lumber, Inc., uses water on its logs during the summer to prevent insect damage. 1992 withdrawals averaged 453,000 gal/mo May through September. A hydroelectric company (Gerald Chikalla) on the Little River in Nottingham is registered for water withdrawals but has not been operational since 1989.

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<sup>65</sup>Short, Great Bay Management Plan, Table 4, p. 25. Monthly average flows vary tremendously (70,000 gpd in 10/92 to 170,000 gpd in 12/92).

<sup>66</sup>Lamprey River Model Study: Epping, New Hampshire, prepared for the Town of Epping, 1988, section 2.2.

<sup>67</sup>1990 Census

## WILDLIFE, HABITAT, AND PLANT COMMUNITIES

The Lamprey River, from source to mouth, "furnishes every possible type of stream environment."<sup>68</sup> The main stem and its major tributaries represent some 115 miles of coastal waterways that flow through mostly forested land. The largest lake in the watershed is Pawtuckaway Pond (903 acres).

The river corridor from West Epping to Newmarket is also mostly forested, with pockets of residential development and open fields interspersed. The river channel, floodplain, and adjacent wetland communities are particularly intact compared with other rivers in the region. As a result, the Lamprey River system has "landscape-level significance" that extends beyond its individual components.<sup>69</sup> Wildlife studies during the 1993 and 1994 field seasons clearly documented the correlation between land use, forest type, and riverine and wetland conditions and the presence of species known to frequent such habitats. The presence and diversity of habitats in the corridor make possible the wide range of fish and wildlife species found here. Their persistence depends on the maintenance of water quality, flow patterns, adjacent land uses, and management decisions affecting the riparian zone.

### Wetlands

Wetland soils constitute 22% (1,992 acres) of the study corridor. Wetland habitats range "from river channel and riverbanks to marshy river margins, river rapids, floodplain forests and oxbow habitats, to streamlets and associated marshes and swamps."<sup>70</sup> Wetlands immediately adjacent to the river are predominantly broad-leaved deciduous floodplain forests, with occasional softwood stands. Forested wetlands are extensive in Epping from Camp Hedding north to the confluence with the North River. Emergent and scrub-shrub wetlands throughout the corridor are limited in number and size. Wetland complexes running from the river inland occur just below the sewage lagoons in Epping, along Rum Brook in Epping, along Beaver Brook in Lee, and at Tuttle Swamp in Newmarket/Lee. There is also a large wetland complex associated with the North River via a small stream just west of the corridor.

Throughout the corridor wet areas lie tucked behind natural leveelike deposits running parallel the river channel. Some are still linked to the river. Others have been blocked from it by natural deposits, often held in place by silver maples. Influenced to varying degrees by river levels, these riparian wetlands represent a relatively more

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<sup>68</sup> C.F. Jackson, Marine Fisheries Commission, A Biological Survey of Great Bay, New Hampshire, No. 1, Physical and Biological Features of Great Bay and the Present Status of its Marine Resources, 1944.

<sup>69</sup> D. Sperduto and G. Crow, "A Vegetation Assessment of the Lamprey River Corridor in Epping, Lee, Durham, and Newmarket, New Hampshire," 1994, p. 5.

<sup>70</sup> Ibid., p. 5.

stable environment than the river, providing refuge to fish, reptiles, and amphibians during floods and low flow periods and important to the seasonal cycles of fish and herptiles (reptiles and amphibians). In his studies of turtles and vernal pools in the Lamprey corridor (see below), D.M. Carroll observed a greater abundance of even relatively common species in an outlying pond off Wiswall Road (almost 2 miles from the river), suggesting to him the importance of outlying wetland niches as nurseries, refugia, foraging, and breeding areas for herptiles as well.



Oxbows are created when the river changes course. They vary in character, depending on their different hydrologic regimes, which in turn are influenced by distance from the river.

Wetlands are transitional between aquatic and terrestrial systems. They are low areas, where nutrients from decaying vegetation and runoff accumulate. The high concentration of nutrients usually produces lush vegetation, which attracts herbivores, which in turn attract predators. Wetlands adjacent to rivers can be even more productive as wildlife breeding and/or foraging habitat, as suggested above, because they receive additional nutrients from floodwater deposits. Some wildlife species occur in a variety of different wetland types, while others have specific wetland habitat preferences. Many species of wildlife that spend the bulk of their lives in upland areas prefer or require wetlands for part of their life cycle.

Vernal pools are permanent, short-lived, seasonal depressions. Because they cannot support a fish population, these wetlands provide critical breeding habitat to five species of amphibian in New Hampshire which can breed nowhere else and are used by other herptiles, in particular, as well. Black-leaf pack, water-stained trees, and in the spring, fairy shrimp and the egg masses of wood frogs and Ambystomid salamanders

are characteristic of vernal pools. In the Lamprey corridor they occur at varying distances from the river and no doubt in greater numbers than one field season can reveal. They vary in depth, size, position relative to the river channel and water table, and vegetation. These differences may well influence faunal use of these persistent though seasonally ephemeral habitats.

The upland edges of wetlands provide equally important habitat. Many wildlife species that feed in the wetland nest in the adjacent upland edge. Waterfowl commonly nest within 300' of the water's edge. Songbirds also nest near wetlands. Vegetation along the edges of wetlands provides an important food source, particularly for small mammals and birds.

**Wetland and Aquatic Plant Communities:** A summer 1994 assessment of wetland and aquatic plants of the Lamprey corridor revealed 286 species of vascular plants in the wetland and low floodplain communities inventories. Broadly speaking, they occur in either floodplain forests and forested wetlands or open wetland and riverbank communities. Several such communities are discussed below.<sup>71</sup>

Floodplain forests along the Lamprey are fewer in number than along some other coastal rivers, like the Exeter, and are most extensive above Wadleigh Falls in Epping, where several excellent floodplain forest systems occur in a "mosaic of other floodplain communities including wetter red maple swamps, and abandoned oxbow channels, forming oxbow marshes, oxbow ponds and floodplain vernal pools."<sup>72</sup> Emergent marshes may be present as well. Vegetational distinctions distinguish lower floodplain forests from higher floodplain forests. The lower forests are generally more diverse.

The *lower floodplain forests* are characterized by red maple (Acer rubrum) and, generally, black cherry (Prunus serotina). Shagbark hickory (Carya ovata), white pine (Pinus strobus), and red oak (Quercus rubra) occur in varying abundances. Although not common, silver maple (A. sacharrinum) sometimes occurs in the lower floodplain forests. This species has high regional significance due to its relative rarity and apparent decline but is generally more typical of larger rivers. In the shrub layer, musclewood (Carpinus caroliniana) is often diagnostic of this community, and arrowwood (Viburnum recognitum) and nannyberry (V. lentago) are often abundant or dominant. Abundant herbaceous species typically include New York fern (Thelypteris novaboracensis), sensitive fern (Onoclea sensibilis), and wild-lily-of-the-valley (Maianthemum canadense), and rough-stemmed goldenrod (Solidago rugosa). Although floodplain forests have been most thoroughly studied on the State's largest

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<sup>71</sup>The following discussion is from the vegetative assessment prepared by Sperduto and Crow for the Lamprey River study, op. cit.

<sup>72</sup>Sperduto and Crow, 1994, p. 11.

rivers and there are virtually no studies against which to compare the Lamprey River floodplain communities, several of these communities are presently considered exemplary at the State level and likely will remain so.<sup>73</sup>

The higher floodplain forests include some of the same species as the lower communities, but also species typical of drier conditions, such as eastern hemlock (Tsuga canadensis), bracken fern (Pteridium aquilinum), creeping juniper (Juniperus communis), and partridge berry (Mitchella repens). Occasionally these higher floodplain forest communities occur on natural levees along the river and are actually closer to the river than the lower floodplain forests.

An extensive swamp white oak/floodplain forest community exists at Tuttle Swamp, Lee. Other than the swamp white oak (Quercus bicolor), many of the species found here are the same as occur in the lower floodplain forests. Species typical of the swamp proper and absent from the lower floodplain forests include umbellated aster (Aster umbellatus), yellow-fox sedge (Carex annexans), common cinquefoil (Potentilla simplex), and dwarf enchanter's nightshade (Circaeae alpina).

Red maple swamps occur along smaller tributaries to the river and in wet oxbow swales. They are generally characterized by deeper muck soils than the floodplain communities and contain proportionally more wetland-restricted plant species.

Aquatic bed communities occur in the river channel proper, in quiet backwaters, and in oxbow ponds. The *main river channel* is characterized by relatively few submerged aquatic plants. There are two common pondweeds, Potamogeton epihydrus and P. spirillus.

*Rapids*, of which the most notable are at Packers Falls, Wadleigh Falls, and Lee Hook Road but including small sets of rapids from Wadleigh Falls to the Lee Hook bridge and downstream from the Main Street bridge in Epping, exhibited the greatest diversity. Here are found plants adapted to flood conditions and plants adapted to low flow conditions. Riverweed (Podostemum ceratophyllum), a plant that grows only at rapids, was found at all sites. Also common are white water-crowfoot (Ranunculus trichophyllum) and long leaf pondweed (Potamogeton nodosus). Including riverbank plants, into which rapids quickly grade and which constitute significant plant communities of their own, plant diversity at rapids ranged from a notable 40 to 60 species.

*Marsh communities* form along the edge of slow flowing sections of the river, in stagnant backwaters, oxbows, and along tributaries. Their composition is influenced by water depth and the temporal extent of standing water. Typical of deep emergent marshes are lesser bur reed (Sparganium americanum), pickerel weed (Pontederia cordata), common arrowhead (Sagittaria latifolia), and three-way sedge (Dulichium

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<sup>73</sup>Personal communication with Daniel Sperduto, NH Natural Heritage Inventory, 11/14/94.

arundinaceum); of shallow emergent marshes, cutgrass (Leersia oryzoides), tussock sedge (Carex stricta), blue-joint (Calamagrostis canadensis) spotted Joe-pye-weed (Eupatorium maculatum), blue flag (Iris versicolor), and tall meadow rue (Thalictrum pubescens). Shrubs fill in behind the marshy areas, including such species as buttonbush (Cephaelanthus occidentalis), sweet pepperbush (Clethra alnifolia), silky dogwood (Cornus amomum), highbush blueberry (Vaccinium corymbosum), arrowwood (Viburnum recognitum), and maleberry (Lyonia ligustrina).

#### Selected Instream Habitat Parameters

**Substrate:** The river has a variety of substrates. A relatively firm bottom with sand, gravel, and small rocks characterizes some stretches, while others, particularly those behind beaver dams and other impoundments but also where the river's flow slows, are silty or mucky. There are occasional sand bars and gravel bars, large flat rocks, and boulders throughout the study area.

**Insects:** Insects, though a significant food source, have not been widely studies on the Lamprey. Preliminary macroinvertebrate studies by the NHDES, summer 1993, at Wadleigh Falls and Packers Falls show good mayfly and caddisfly populations, with fewer stoneflies and midges. NH Fish and Game Department (NH F&GD) data from the 1980s for a site in downtown Epping show higher proportions of midges and caddisflies and more orders than the 1993 data for downstream sites. The high numbers of mayflies, caddisflies, and stoneflies suggest good trout and salmon feeding habitat.

**Water Quality, Flow, and Temperature:** Water quality, flow, and temperature influence habitat suitability. As indicated in previous discussions, water quality in the Lamprey appears to be good. Flow in the river varies seasonally and by stream segment (see discussion of Flow under Hydrology). It is slowed (and warms up) behind dams. Springs feeding the river and the riverside vegetation help compensate for the slow, low flow in maintaining cooler temperatures. Springs are particularly evident below Packers Falls, where they feed into the river throughout the dry summer months from the west bank.

Measured summer water temperatures within the study area averaged 65°F in July 1990 and 69°F in August 1990.<sup>74</sup> They averaged 51°F in April, 61°F in May, 62°F in June, and 71°F in July (a drought summer), 1993. Comparable data from fewer samplings sites for the North River are 47°F in April, 56°F in May, 59°F in June, and 71°F in July (1993); for the Little River 53°F in April, 56°F in May, 63°F in June, and 66°F in July (1993).<sup>75</sup> Lethal temperatures for trout and salmon are mid-to-high 70s.

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<sup>74</sup>Taken from two stations in Epping and one in Lee, in early July, 1990, and in early August, 1990, in 1990 Ambient Water Quality Monitoring Results, NHDES WSPCD-91-1.

<sup>75</sup>Raw data from NHDES Nonpoint Source Assessment of the Lamprey River Watershed, April-July, 1993.

### Fish Resources

By resolution dated 4/17/85 the NH Fish & Game Commission identified the Lamprey River as "the state's most significant river for all anadromous species."<sup>76</sup> The Nationwide Rivers Inventory (1/81) cites the Lamprey for anadromous fish, the NH Office of State Planning's evaluation of NH rivers credits the Lamprey with "prime fish habitat," and the Fish and Game Department's Atlantic salmon program has consistently galvanized 50-70 volunteers to help stock 110,000 fry in the Lamprey and North rivers. The main stem is considered both a cold water and a warm water stream, depending on the river stretch.

**Anadromous Fish:** River herring (largely alewives), American shad, and Altantic salmon are the principal anadromous species found in the Lamprey River. The State's management goals for these three species are: to provide a recreational fishery (salmon and shad) and to restore self-sustaining runs (shad and river herring), including restoration of river herring to their former abundance and distribution. Sea lamprey, a parasite on other fish, also come upriver to spawn.

Since installation of a fish ladder at the Macallen Dam in 1971, hundreds of thousands of river herring have passed up the ladder in the spring to spawn. These fish provide critical forage for other fish in the river, e.g., chain pickerel, largemouth bass, American eel, yellow perch, smallmouth bass, and trout. Between the Wiswall and Macallen dams is an important spawning and nursery area, although passage at Wiswall would open up some 43+ miles of additional spawning and nursery areas.<sup>77</sup> (See Anadromous Fish Habitat Map.)

The shad restoration program was initiated in 1972. Initially reliant on eggs taken from Connecticut River shad and broadcast in the Lamprey (1972-78), the program shifted to releases of adult shad taken from the Connecticut River at the Holyoke Dam in Massachusetts (1980-88). Currently, no shad are stocked in the Lamprey. At least 200 shad passed up the ladder in 1993, an excellent return; only 12 were documented at the ladder in 1994, when shad runs all along the Coast from Maine to Florida were down, for unknown reasons. The Lamprey and North rivers have good spawning and nursery habitat for shad. They, too, would benefit from fish passage at Wiswall.

The salmon program was initiated in the early 1970s. This effort, discussed in more detail under Recreation, has involved two strains of Pacific salmon and, since 1989, Atlantic salmon. A record eight Atlantic salmon (3 males and 5 females) passed through the ladder at Newmarket in 1993; 3 females passed up the ladder in 1994. Although there is good survival of fry in the upper Lamprey (Raymond and Deerfield)

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<sup>76</sup>Contained in letter to the FERC from Charles Barry, executive director, NH F&GD, dated 11/14/85.

<sup>77</sup>NH fishermen use alewives and bluebacks as bait for lobster and sport fishing, netting the herring during their spring spawning migration.

and the North River, anticipated returns for every 110,000 Atlantic salmon fry released in the watershed are a maximum of 30 to 50 adults.

Because salmon spawning and nursery habitat even with fish passage at the Wiswall and Bunker Pond dams would be limited, NH F&GD's aim for the Atlantic salmon program is to obtain all necessary eggs and sperm from returning adults at the fish ladder in Newmarket for hatchery rearing to the fry stage. Whether there was ever a strong population of Atlantic salmon in the river is unclear. Salmon were indigenous to virtually every tributary, large or small, to the Atlantic Ocean north of the Hudson river except those rivers with impassable falls or an absence of breeding habitat.<sup>78</sup> The Lamprey has had mills at Newmarket since at least 1660, but presumably there were salmon here before then.

**Freshwater Fish:** Members of the sunfish, catfish, and pike families are common to the Lamprey, as are a variety of minnows, common white suckers, and American eels. The State stocks brook, brown, and rainbow trout in the Lamprey River and its major tributaries. Only in the North River and upper reaches of the Lamprey do brook and brown trout reproduce naturally. Appendix B lists all fish species found or expected in the Lamprey.

#### Mollusks and Crustaceans

Crayfish, snails, clams, mussels, and other river dwellers play a key role in river ecosystems, as consumers and as prey. To date, only mussels have been researched as a part of this assessment. Observations of additional species include: crayfish, freshwater clams, hairy wheel snail (*Gyraulus hirsutus*), and "an abundance of large snails (possibly the winkle, *Viviparous intertextus*)."<sup>79</sup>

Areas searched thoroughly for mussels, particularly for rare species, during the 1993 field season include 2.25 miles in the vicinity of Camp Hedding and north, the stretch from Wadleigh Falls to .25 mile below the Lee Hook Road bridge, about .5 mile in the vicinity of Wiswall Dam, and from Moat Island to about .25 mile below the confluence with the Piscassic River. All other segments in Lee and Durham received a cursory search. Stretches of the river above the Camp Hedding area were surveyed in 1994.<sup>80</sup>

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<sup>78</sup>C.G. Atkins (1874) in The Fishes of New England. The Salmon Family. Pt. 2- the Salmons, by William Converse Kendall, Boston Society of Natural History, Boston, 1935.

<sup>79</sup>David Carroll, "Lamprey River Turtle Study," 30 November 1993.

<sup>80</sup>All information on mussels, unless otherwise noted, is from Andy Cutko, NH Natural Heritage Inventory, in notes and written summary, "Mussel Studies on the Lamprey River: First Year Interim Report - December 1993," prepared for the National Park Service or The Conservation Group, "De Novo Inventory and Baseline Monitoring for Alasmidonta varicosa, Lamprey River, New Hampshire 1994."

The Lamprey contains at least six of the nine riverine mussels known to occur in New Hampshire. Only the Piscataquog River is known to support more. One of the six, the brook floater (Alasmidonta varicosa, formerly swollen wedge mussel), is state listed as endangered and is a candidate for federal listing. It was found in appropriate habitat intermittently from West Epping to Packers Falls. The most abundant populations, downstream of West Epping and Wadleigh Falls, contained both juveniles and adults, although the Wadleigh Falls site showed a slightly more even distribution of size classes, suggesting greater viability. Notably, the West Epping population may well have been harmed by the apparently one-time presence of all-terrain vehicles in the river during 1994.

Relative to the six other rivers where this pollution-sensitive species has been found, "the Lamprey River population is average in terms of quality of habitat and population size and viability." The river's significance is statewide.<sup>81</sup> According to US Fish and Wildlife Endangered Species Specialist Susi vonOettingen, the presence of six species is "outstanding," indicative of good diversity, good water quality, few dams, and little sedimentation.

Other more common mussels found between Wadleigh and Packers falls include the common eliptio (Elliptio complanata, abundant), the triangle floater (Alasmidonta undulata, occasional), and the alewife floater (Anodonta implicata, infrequent). Mussels found in soft, silty, unconsolidated substrate in the Lamprey (in Durham) include the common eliptio (a mussel of wide habitat affinities), eastern lampmussel (Lampsilis radiata), and eastern floater (Anodonta cataracta). A small area of suitable habitat in the North River, Lee, contained common eliptios and triangle floaters. Much of the North River upstream of this area is beaver-impounded or too small to support mussels.

Cutko (1993) identified degradation of water quality and changes in flow as the key threats to brook floaters and other fresh water mussels. Mussels are known to concentrate potassium, copper, zinc, cadmium, chlorine, and pesticides and are sensitive to them.<sup>82</sup> Excessive nutrients, depleting oxygen, also may be harmful, as may recreational impacts. Brook floater mussels may be particularly sensitive to the impacts of water withdrawals, particularly if they occur quickly, but all mussel species are vulnerable to increased predation and disruption of their breeding cycles or death when exposed.

Other threats to mussels include changes in the substrate, as behind a dam or from sedimentation, which can affect habitat suitability, suffocate feeding mollusks, or abrade

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<sup>81</sup>Andy Cutko, NHNHI, Ibid.

<sup>82</sup>A US Fish & Wildlife Service study of a dwarf wedge mussel population located next to a golf course on the Ashuelot River in NH has documented a 10-fold decline in population size due to loss of streamside vegetation (loss of shade) and runoff carrying pesticides, fertilizers, and heavy metals. The dwarf wedge mussel is a federally listed endangered species and member of the same genus as the brook floater.

their shells. Invasions of nonnative species (like the Asian clam [*Corbicula fluminea*] and zebra mussel [*Dreissena polymorpha*]), annihilation of host fish species (necessary to a brook floater's larval development), and alteration of the light/shade regime by removal of shoreline vegetation also pose threats. The small size of most of the streams in which the rare brook floater continues to be found "makes remaining populations highly susceptible to annihilation by only slight degrees of pollution or habitat destruction."<sup>63</sup>

### Birds and Mammals

The varied habitats in the corridor support a wide diversity of migrant and resident wildlife.

Furbearers in the river corridor include:

<u>Water Based</u>	<u>Scientific Name</u>	<u>Occurrence</u>
Beaver	<u>Castor canadensis</u>	Abundant
Mink	<u>Mustela vison</u>	Common
Muskrat	<u>Ondatra zibethicus</u>	Abundant
River Otter	<u>Lutra canadensis</u>	Common

<u>Land Based</u>	<u>Scientific Name</u>	<u>Occurrence</u>
Black Bear	<u>Ursus americanus</u>	Occasional
Coyote	<u>Canis latras</u>	Common
Fisher	<u>Martes pennanti</u>	Common
Gray Fox	<u>Urocyon cinereoargentenus</u>	Common
Opossum	<u>Dedelphis virginiana</u>	Occasional
Raccoon	<u>Procyon lotor</u>	Abundant
Red Fox	<u>Vulpes vulpes</u>	Common
Bobcat	<u>Lynx rufus</u>	Occasional
Skunk	<u>Mephitis mephitis</u>	Abundant
Shorttail Weasel	<u>Mustela erminea</u>	Common
Longtail Weasel	<u>Mustela frenata</u>	Common

Source: NH Fish & Game Department

Other common mammals include whitetail deer, moose, porcupine, woodchuck, flying squirrels (northern and southern), eastern chipmunk, and red and eastern gray squirrels. The snowshoe hare and eastern cottontail probably occur in the corridor occasionally, and, rarely, New England cottontails. Riverfront landowners contributing to an informal survey of wildlife reported a variety of birds from every station in Epping, Lee, and Durham (no observers were from Newmarket), beaver from 6 of the 8 stations, otter from 3 of 8 stations, fox from 2 stations (including a red fox with four pups), mink

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<sup>63</sup>D.G. Smith, Selected Freshwater Invertebrates Proposed for Special Concern Status in Massachusetts (Mollusca, Annelida, Arthropoda), 1981 in National Park Service "Draft Eligibility and Classification Report for the Farmington River," August 1989, p. 35.

from 1 station, deer from 1 station, moose, and muskrat.<sup>84</sup>

In addition, numerous smaller mammals - shrews, moles, bats, and voles - occupy the river corridor.

Birds documented in the corridor, and particularly along the riparian zone and in wetlands during the spring - fall, 1993 and 1994 are listed in Appendix C. During this time, 159 species were observed, including four state-endangered species: the pied-billed grebe, bald eagle, sedge wren, and peregrine falcon; and three state-threatened species: the northern harrier, osprey, and common nighthawk. An additional two species of concern were documented, the red-shouldered hawk and the whip-poor-will. Other species of note include the black duck (declining), black-crowned night heron (no recent nesting records in the state, although historically [1890s] numerous),<sup>85</sup> bobolink and meadowlark (declining nationally), and least flycatcher, wood thrush, and American redstart, all of which showed significant declines in the state during the period 1966-91 and over a shorter subset of that period, 1982-91.<sup>86</sup>

Of the eighteen species in New Hampshire that prefer riparian habitat for breeding



Swamp Sparrow, courtesy of David M. Carroll.

<sup>84</sup>Contributors include: Tracy Kane (Lee), Jennifer, Scott, and Jorden LaPointe (Epping), Ronald, Ellen, and Rebecca Laub (Durham), Richard Lord (Durham), Kevin Martin (Epping), Jennifer and Robert McKown (Lee), Patricia and Bruce Samuels (Durham), and Nancy Winterbottom (Durham).

<sup>85</sup>Carol Smith, ed., Proceedings of the New Hampshire Endangered Species Conference, 12/1/79, p. 25.

<sup>86</sup>Carol F. Foss, Audubon Society of New Hampshire, notes.

or for feeding during the breeding season,<sup>87</sup> all but two, the red-bellied woodpecker (an occasional visitor to NH but generally a more southern species), and the yellow-breasted chat (generally a more southern species, though occurs occasionally in NH), were documented on the river.<sup>88</sup> One of these species, the spotted sandpiper, prefers streams and rivers during the breeding season; it nests throughout the Lamprey corridor. The presence of so many riparian species is indicative of a wide variety of plant species and habitats along the river and a diversity of upland habitats in close proximity to it.

#### Reptiles and Amphibians

Appendix D lists the reptiles (snakes and turtles) and amphibians (salamanders and frogs) known to occur in the river corridor. In general, little is known about the distribution of reptiles and amphibians in New Hampshire, even though they may be conspicuously present at certain times of year - the heralds of spring, Pseudacris crucifer, for example. Only turtles were a focus of the Lamprey River resource assessment field studies.

**Turtles:**<sup>89</sup> All six of the turtles known to occur in New Hampshire have been documented in the river corridor. For two of the species, the Blanding's turtle and the spotted turtle, southeastern New Hampshire appears to be their stronghold in the state. New Hampshire's Blanding's population is considered of global significance.<sup>90</sup> The spotted turtle is probably the "most scarce" of New Hampshire's turtle species.<sup>91</sup> Both species depend primarily on wetland habitats, but travel widely and may use the river extensively as a travel corridor.

Within the corridor larger beaver impoundments and beaver-influenced wetland mosaics, seasonal wetlands, dug ponds, and marshy and scrub shrub backwaters, inlets, and sloughs associated with the river are prime Blanding's turtle habitat. Sand and gravel pits and sandy roadsides are preferred nesting habitat, though these turtles have been known to nest in cornfields and no doubt benefit from the area's

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<sup>87</sup>R.M. DeGraaf and D.D. Rudis, New England Wildlife: Habitat, Natural History, and Distribution, General Technical Report NE-108, US Forest Service, 1986.

<sup>88</sup>Eastern screech-owl (uncommon throughout the state) has been documented by Jay McKinley, former superintendent of Camp Hedding property, at Camp Hedding and by M. Wittner in 1994 just downriver of Camp Hedding.

<sup>89</sup>All information on turtles, unless otherwise indicated, is from D.M. Carroll's 1993 and 1994 field assessments of the Lamprey River, as summarized in "Lamprey River Turtle Study," 30 November 1993 and "Lamprey River Turtle Study 1994." These reports contain extensive recommendations for management of the various species.

<sup>90</sup>Pers. comm. of M. Klemens in David M. Carroll's "Lamprey River Turtle Study," 11/30/93.

<sup>91</sup>Jim Taylor, UNH, in David M. Carroll, ibid.

characteristically sandy soils. Given the distribution of sites where it was located, this turtle probably travels throughout the study area and resides where suitable habitat exists and in varying local population sizes.

The spotted turtle's distribution may be more disjoint than the Blanding's turtle's, since no specimen was found in two years of field work. The most recent reported sighting for the Lamprey corridor is from 1991 or 1992. The spotted turtle is the least riverine of the New Hampshire turtles and generally prefers smaller, shallower, more transient wetlands than the Blanding's turtle - habitats both vulnerable to destruction and less abundant along the Lamprey corridor than in other parts of the region. If preserved unfragmented (and perhaps enhanced), the Lamprey, its tributaries, and adjacent wetlands "could ... become a significant focus for a turtle that is likely to need landscape-level sanctuaries for population viability in southeastern NH."<sup>92</sup>



Spotted turtle (*Clemmys guttata*), courtesy of David M. Carroll, 1993.

Another turtle experiencing decline throughout New England is the wood turtle.<sup>93</sup> It is present in the Lamprey and North rivers, and likely lower reaches of the Little River, possibly in some numbers.<sup>94</sup> The wide-ranging wood turtle requires extensive instream and upland habitats (powerline cuts, unmown fields and ecotones between hayfields and the forest, floodplain forest, shrub thickets) with abundant understory and foot-

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<sup>92</sup>Ibid., p. 11.

<sup>93</sup>R.M. DeGraaf and D.D. Rudis, Amphibians and Reptiles of New England: Habitats and Natural History, 1983, p. 46.

<sup>94</sup>The densities found were low, perhaps a function of the turtle's typical absence from coastal areas, perhaps a reflection of collecting by anglers and other recreationists, perhaps due to prolonged flooding conditions in 1993 during the time when captures are most likely to occur or to oversight. However, the abundance of high-quality, relatively inaccessible habitat and reports of local sightings argue for a good population of wood turtles.

trapping tangle, particularly silky dogwood.

Log jams, debris dams, tree roots, and underwater bank burrows of beaver and muskrat provide important instream habitat. Washouts, beaver dragways, and instream sand and gravel bars create basking and forage habitat for adults and, particularly, hatchlings and juveniles. Sandy fields, impoverished hayfield borders, sandbanks, abandoned sand/gravel pits, and sawdust piles offer nesting habitat. The Lamprey River has excellent habitat components and may well represent a stronghold for the wood turtle in southeastern NH, particularly in light of its general absence from coastal areas within its northeastern range. Preservation of nesting habitat linked via natural cover with the river is key to continued wood turtle population viability.

With all three species, experts attribute declining populations largely to habitat destruction and fragmentation. The presence of spotted turtles, in particular, indicates desirable habitat complexity, species diversity, and high water quality. Continued viability in the corridor of these increasingly rare species depends on the protection of significant stretches of undisturbed habitat "along both sides of extended reaches of the river ... [with] buffers considerably more generous than the commonly discussed ranges of 50' to 150' [and] significant no-access and limited access zones along the river."<sup>95</sup>

The eastern painted turtle, perhaps best known because most visible of the turtles, occurs commonly throughout the study area. Its annual activity circuit includes the river and a variety of ponds and marsh habitats. Deadfalls and debris dams create cover, basking, and foraging sites. Vernal and floodplain pools may provide critical overwintering niches, which changes in hydrology would affect.

The musk turtle, or stinkpot, is common in the river throughout the study area. It likely occurs also in lower reaches of the North and Little rivers, as well as lesser inlets. Where aquatic weed beds are limited, instream debris is especially important to this turtle for cover, basking, and foraging. Leaf litter, debris drifts, rotting stumps, and leaf pack and sand layers along the immediate edge of the river provide nesting habitat. This turtle would suffer from any decline in water quality affecting its aquatic food source.

Another species likely to be widespread along the corridor is the snapping turtle, in common to locally abundant numbers. Like the painted turtle, the snapping turtle moves back and forth between the river and outlying wetland systems. It favors shallow, well-vegetated, soft-bottomed situations open to the sun, but occupies a wide variety of aquatic and terrestrial habitats over its annual activity cycle. Contrary to popular belief, this species is not "a marauder of wild wetlands or menace to boaters

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<sup>95</sup>D.M. Carroll, "Lamprey River Turtle Study 1994," p. 2.

and swimmers.<sup>96</sup>

Management concerns for these species include: instream flow levels; recreational impacts; instream, riparian, wetland, and upland habitat protection and protection of travel routes; positive contribution of beavers in creating habitat; and exclusion of invasive nonnative plants, such as purple loosestrife (*Lythrum salicaria*) and common reed (*Phragmites communis*), from the river corridor.

#### General Habitat Considerations

As indicated, the Lamprey corridor contains a wide variety of riparian and upland habitats. Maintenance of habitat diversity, together with specific actions to protect or enhance particular habitats, is key to the long-term survival of existing wildlife populations.

Habitat requirements may range from general, e.g., a body of water and suitable den sites (otter), to specific, e.g., cavities for nesting and roosting in trees with a minimum d.b.h. of 12" (Eastern screech-owl), early coniferous second growth of trees 6' to 10' tall (Bay-breasted warbler), and temporary pools that last only long enough for breeding and reproduction (*Ambystoma* salamanders, wood frogs, and fairy shrimp).

Many species forage in the river or along the shore but require upland habitat for nesting or denning.<sup>97</sup> Certain waterfowl, wood ducks and hooded mergansers, for example, nest in tree cavities; black ducks and mallards are ground nesters, often some distance from the river. Mink, otter, and beaver den in river banks.

River corridors also offer a natural travel route for wildlife on the move, whether annually, seasonally, or in daily travel patterns. The ability to move is important not only for individuals in a population, but for the long-term survival of a population through genetic diversity. Long-distance migrating songbirds rely on river corridors for the earliest spring hatches of insects and for the rich array of berry-producing shrubs and vines in fall. Waterfowl depend on bottomland fields and flooded wetlands for feeding and resting during their northward migration in the spring.

Water-based mammals, such as beaver, mink, otter, and muskrat rely on the aquatic plants and animals found in the river and along its banks. Farmlands provide an important food source for mice and other small mammals, which in turn support larger mammals and birds. Raccoons and occasional bears, wild turkeys, killdeer, bobolinks, meadowlarks, and barn swallows also benefit from open farmlands. White-tailed deer occur in the corridor year round. They find protection during harsh winter months in

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<sup>96</sup>Carroll, *Ibid.*, p. 42.

<sup>97</sup>Information for much of the following discussion contributed by Diane Evans and Carol R. Foss, Audubon Society of NH.

"yards" of softwood stands.

The river's backwaters, wetlands, and vernal pools provide critical habitat to reptiles and amphibians, as discussed above. The system's numerous invertebrate species provide the prey base for fish and larger animals.

### Rare Plants

One federally listed species, the small whorled pogonia (Isotria medeoloides), one State-Endangered species, separated sedge (Carex seorsa), and three State-Threatened species, climbing hempweed (Mikania scandens), blunt cliff-fern (Woodsia obtusa), and small beggars tick (Bidens discoidea, currently listed but likely to be delisted due to recent finds) were documented in the Lamprey during the 1993-94 field seasons. Although New Hampshire has the best representation of small whorled pogonias in the country, only one plant was found, growing under atypical conditions, in Epping. This site is the southernmost known for the species in the state, and considerable search revealed no additional plants. Separated sedge, which reaches the northern limits of its coastal range in New Hampshire, is known from few NH localities. The Lamprey River population is small and may not persist. Climbing hempweed is characteristic of moist thickets and streambanks and was found in Tuttle Swamp. It is typical of more southern climates and here is at the northern limits of its range. Blunt cliff-fern is a fern that requires more calcium than one generally finds in New Hampshire. This species was found growing on rock outcrops in a forested setting near the river in Durham, on the Benevento property.

Seven additional species of note were also documented during 1994. Three are associated particularly with the backwaters around Moat Island: water-marigold (Megalodonta beckii), Robbins pondweed (Potamogeton robbinsii), and tape grass (Vallisneria americana). Water-marigold was found also in the Lamprey at the confluence with Woodman Brook and in the channel to the Oyster River. Three tree species are notable along the Lamprey: black gum (Nyssa sylvatica) and sycamore (Platanus occidentalis), which reach the northern limits of their ranges in New Hampshire, and butternut (Juglans cinerea), a candidate for listing under the federal Endangered Species Act due to pathologically induced decline in the southern portion of its range and uncommon in New Hampshire. Finally, found throughout the area at rapids and considered relatively rare in the State was knotty pondweed (Potamogeton nodosus).

### Notable Habitats and Plant Communities Identified in the Lamprey Corridor

The following list of notable habitats is based primarily on findings from the 1993-94 field seasons. It includes recommendations of the ad hoc committee on conservation lands (including representatives from the conservation commissions of Durham, Lee, Madbury, and Newmarket), the Lamprey River Watershed Association, and the UNH Natural Areas Committee.

It is important to keep in mind the limitations of two field seasons' investigations and

the focus of the investigations (birds, turtles, mussels, rare plants, and wetland and aquatic plant communities), as well as the fact that some areas along the river and most areas any distance from the river but still within the 1/4 mile corridor received only cursory, if any investigation due to time, weather (late spring flooding, summer drought), and other unavoidable constraints. Except as otherwise noted, all sites are on private property.

**Epping:** Just upriver of the study area are backwaters and a mosaic of associated wetlands created in part by the dam at Bunker Pond. This area represents possible turtle habitat and may contribute to downstream populations.

The entire stretch of river from West Epping to developed areas in Epping is a feeding ground for great blue herons, green-backed herons, black-crowned night herons, and kingfishers. Spotted sandpipers nest along this stretch of river. Because it is so remote, wooded, and inaccessible, the area supports a wide variety of interior forest birds. All the bird species one might expect to find were here, except flycatchers, which are declining generally and not common. This area also represents good wood turtle and brook floater mussel habitat. An area of floodplain in old pasture includes a large butternut tree (Juglans cinerea), probably planted.

River mile 22 - A small floodplain forest containing an unexpected mix of upper and lower floodplain forest and seepage swamp vegetation grows by a stream inlet.

River mile 21 - Cattails, sedges, grasses, snags, and fish provide an ideal nesting/feeding area for waterfowl.

River mile 19+ - The rapids through downtown Epping have characteristic river rapids vegetation.

Below Rte. 125 woodland bird species give way to open country, edge species attracted to the river by insects, on which they feed. Dense cover provides excellent aquatic, riparian, and upland turtle habitat from the treatment plant to the County line.

River mile 18 - The Town-owned parcel and adjacent wetlands provide significant potential turtle habitat, although ATV traffic threatens nesting areas. Notable vernal pools occur at the site. Loosestrife and phragmites are evidence of other adverse intrusions. This is an active feeding area for insectivorous birds, e.g., tree swallows, cedar waxwings, chimney swifts, and eastern kingbirds. Riverine areas provide roosting, feeding, and nesting areas. From the Rte. 125 bridge through this area is one of few places on the river black ducks were regularly found during 1993.

From below the outlet from the treatment plant to below the Rte. 87 bridge is a floodplain forest/oxbow/vernal pool plant community system of note.

River mile 17 - Along a tributary to the river is a red maple swamp. Although

common elsewhere, red maple swamps like this one are uncommon along the corridor. Silver maple floodplain forests occur on both sides of the river, amid generally continuous floodplain forest.

River mile 16.5 - Black ducks frequent the open marsh upstream of Camp Hedding, which represents generally good waterfowl habitat. The Camp Hedding river/wetland complex is highly favorable to a variety of other species as well, including herptiles, and represents potential habitat for night-herons and rails. This parcel and that across the river from it "together could well represent a critical block of enduring habitat of exceptional biodiversity along the river corridor."<sup>98</sup>

Many downed trees and beaver dams are found in the stretch from Rte. 87 to the confluence with the North River. This area is rich in woodland birds, including the State-threatened red-shouldered hawk. Osprey, wood ducks, and hooded mergansers also were observed. Two classic examples of floodplain forest/oxbow/ vernal pool systems occur along this stretch of river, which as a whole "is of great significance to the integrity of the Lamprey's natural features owing to its primary [sic] natural character, substantial buffers and limited development."<sup>99</sup>

River mile 16 - Single *Isotria medeoloides* plant found, 1993, on a hillside overlooking the river. This site is the furthest south known in New Hampshire. The plant was found in atypically dry habitat. The area was searched for additional plants without success. Though the viability of this population is improbable, the occurrence may indicate other *Isotria* populations, which served as the seed source, occur in nearby towns. The species is federally listed as endangered.

At the mouth of Rum Brook is a sedge marsh and open thicket of vines and shrubs under snags of dead elm and silver maple. Around this low terrace is a thin band of silver maple and red maple floodplain. Wood ducks, alder flycatchers, a screech owl, nesting northern flickers and hairy woodpeckers, and migrating warblers were documented here. It is an area of high wildlife activity, including possible rail habitat. Across the river and extending downstream 1.5 miles is a floodplain ecosystem with good representation of all the major floodplain plant communities.

River mile 14.5 - Forested on the west bank, intricate floodplain forest on the right, this area is always active for birds - osprey, red-shouldered hawks, great blue herons, green-backed herons. The abundance of snags provide ideal nesting habitat for downy and hairy woodpeckers, wood ducks, and all New Hampshire's small owl species.

River mile 12.5 - This floodplain forest/oxbow/vernal pool system is an extremely

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<sup>98</sup>D.M. Carroll, Lamprey River Turtle Study 1994, p. 2.

<sup>99</sup>Sperduto and Crow, 1994, op. cit., p. 35.

rich area for songbirds, raptors, waterfowl, and herptiles and botanically.

River mile .75 - This wetland complex in the North River corridor provides good potential turtle. (It was not assessed for other purposes.)

**Epping/Lee:** The North River corridor features extensive instream, riparian, and upland wood turtle habitat. Lower reaches of the river offer potential brook floater habitat. A significant stand of native sycamore trees grows in the floodplain at the High Road bridge, Lee. This species, characteristic of river margins and floodplains, is uncommon in the state.

Insectivorous birds feed throughout the Lamprey River stretch upriver from the North River confluence. Cedar waxwings invariably were found along the rapids gleaning bugs.

**Lee:** Records of rare plants exist for the Wadleigh Falls area, but none were found in either 1993 or 1994, possibly due in part to extensive recreational use of the area. Although it has been disturbed, the vegetation is a good example of floodplain forest, river rapids, and riverbank communities. On the island below the falls is a red oak-white pine forest that includes numerous relict beech and red oak trees. Its overall structure suggests a relatively mature forest, uncommon along the Lamprey and therefore significant.

Downriver from Wadleigh Falls the substrate and water quality create favorable conditions for brook floater mussels as far east as Packers Falls. Farmlands, open fields, and forests create a diversity of habitats which in turn support a diversity of birds - woodland species (including red-shouldered hawk, peewee, veery, great horned owl), wood ducks, and bluebirds.

River mile 10 - The Tuttle Swamp wetlands complex contains an exemplary swamp white oak stand and marsh. It is the largest such community in the watershed and represents an uncommon to rare community in New Hampshire. Historically it offered acres of prime Blanding's and spotted turtle habitat. The present hydrological conditions are generally not favorable for these species, but the extent, ecological complexity, and a 1989 sighting of a juvenile spotted turtle argue for additional study. The area may serve as a link between the Piscassic and Lamprey watersheds for both turtle species, as well as other species. A wide variety of birds nest, migrate through, and reside year-round in Tuttle Swamp, considered in one assessment "the most productive [wetland] site" in the corridor and in another, a site "of high ecological significance in the Lamprey corridor."<sup>100</sup> Least, alder, and willow flycatchers and a pair of blue-gray gnatcatchers nested here, and single golden-winged and cerulean warblers

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<sup>97</sup>M. Wittner, "Bird Survey of Wetlands within Lamprey River Corridor," 11/94, and D. Sperduto and G. Crow, 194, op. cit.

(both rare) were observed using the area during 1994. Although none have been documented, the area represents possible sedge wren habitat. Tuttle Swamp is Identified as a priority protection/conservation area in Newmarket's "Natural Resource Inventory and Conservation Plan" (12/91) and by reference in its Master Plan because of its value to wintering deer, general wildlife habitat/wildlife corridor values, proximity to protected lands, potential impact on Newmarket Plains aquifer, and prime farmland values.<sup>101</sup> The site contains at least one State-threatened plant species and some large, old musclewood.

River mile 9 - Marsh and open fields create good habitat for a variety of birds and other wildlife. Red-shouldered hawks used the area throughout the 1993 summer season. Marsh wrens, considered uncommon and local, were present throughout the 1994 nesting season. Up to a dozen wood ducks were observed here in late September.

River mile 8 - A noteworthy marsh/swamp/floodplain plant community is found downriver of Glenmere Village. Vernal pools and oxbow marshes occur here, and a variety of sedges. Trash has been dumped down the bank just north of Glenmere Village.

River mile 6.5 - The confluence of Beaver Brook and no-name brook creates what appears to be outstanding shallow marsh backing into scrub-shrub wetland. The shallow marsh has a high diversity of common wetland plant species and provides highly favorable wetland habitat.

For about 1.5 miles upriver on the Little River from its confluence with the Lamprey the instream, riparian, and upland habitat looks promising for wood turtles.

River mile 6 - Along this stretch of river below the Lee Hook bridge 76 plant species were observed along riverbanks and rapids in 1994, including one rare pondweed (found at most rapids sites along the river).

River mile 5 - This beaver marsh complex is an exemplary plant community and represents an ecotype uncommon in the river corridor. Some plant species were found only at this site during 1994 botanical studies of the river, and overall the marsh exhibits wide species diversity. It is well buffered and gains significance as a result. It supports a good representation of Neotropical nesters, migrants, and permanent residents, as well as nesting American kestrel and mallards. A sedge wren (State listed as threatened) was documented here during 1994, as was a possible least bittern vocalization and a whip-poor-will (also State threatened). This is the Town of Lee's largest wetland and likely is critical habitat for many plant and animal species. It is likely linked ecologically with nearby vernal pools, dug ponds, and the UNH agricultural lands.

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<sup>101</sup>Smart Associates, pp. 32-33.

In the vicinity of the campgrounds, just upstream, families of mallards, kingfishers, green-backed herons, and solitary and spotted sandpipers commonly feed. Woodland bird species also reside in the area.

**Durham:** Spruce Hole Bog lies just outside the 1/4-mile corridor. It is owned by the Town of Durham and has been designated a National Natural Landmark because it is an excellent example of a kettle hole bog and a complete ecological community.

River mile 4 - Black ducks and black-billed cuckoos, osprey, goshawks, and swamp sparrows, among other species, have been documented in this wetland. A sedge-marsh perimeter, tussock sedge and other dense emergent vegetation, scrub-shrub vegetation, a deep emergent marsh, and a red-maple swamp at the northern end provide a variety of wetland habitats.

Other backwaters and drainages in the stretch above Wiswall Dam may also support a variety of significant wildlife species. Agricultural fields and road edges near the river along Lee Hook, Little Hook, and Wiswall roads probably support nesting Blanding's turtles.

River mile 3.25 - A small floodplain forest of about 1 acre just north of the bridge contain many of the characteristic floodplain plant species, as well as vernal pools and oxbow channels.

River mile 3 - Nesting cardinals and broad-winged hawks were documented here during the 1993 season, despite heavy recreational use. The powerline and wetlands may serve to connect this area with the Folletts Brook watershed, which the ad hoc committee on conservation lands identified as a priority conservation corridor. The Folletts Brook/Newmarket Plains area is a conservation priority of Newmarket.<sup>102</sup>

River mile 2.5 - Packers Falls is an interesting assemblage of riverbank, rapids, and upland plant communities. Although historically the site of several rare plants, the most notable found in 1994 is the butternut.

Just south of Packer Falls in a small kettle hole basin is a classic fen -- a peatland distinguished from a bog by its dominance of grasses, sedges, and herbs and its different nutrient and pH status. This fen may harbor rare plants and insects; nearby development threatens its potential long-term viability.

River mile 2+ - At the confluence with Woodman Brook fish-feeding birds are regularly observed. In 1993 and 1994 swans displaced hooded mergansers, mallards, and wood ducks, which otherwise probably would have nested here as they have in past years. Swallow sparrows, warbling vireos, and Louisiana waterthrush were

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<sup>102</sup>Ibid., pp 32-33.

observed to nest here, in 1994, and the area is a regular haunt of osprey. It is a key, favored stopover for waterfowl in the early spring (common mergansers, hooded mergansers) and in the fall (including black ducks). Great blue heron occur here all season. A rare water-marigold grows in the area.

River mile 1.5 - Sluggish, shallow backwaters in Durham and Newmarket support an abundance of submersed and floating-leaving vegetation, including such species as water shield (Brasenia shreberi), spatterdock (Nuphar variegata), floating heart (Nymphoides cordata), hornwort (Ceratophyllum demersum), and water milfoil (Myriophyllum verticillatum, a native species not to be confused with the invasive European milfoil). Significantly dense populations of water marigold (Megalodonta beckii), Robbins pondweed (P. robbinsi), and tape grass (Vallisneria americana) grow around Moat Island. All three species are rarely found in coastal NH. Moat Island is characterized by a high diversity of habitats. It is excellent for many species of wildlife. Nesting brown creepers, and golden-crowned kinglets (both uncommon) were observed here; it is a regular haunt of osprey for feeding; waterfowl and great blue heron feed here. A family of black-crowned night herons (a State-extirpated species for which there is no current record of breeding in the state) was observed feeding in mid-summer (1993). A sora and willow flycatchers were observed in the northernmost marsh where LaRoche Brook flows into the backwaters. Adjacent farmlands support nesting meadowlarks, bobolinks, bluebirds, red-tailed hawks, kestrels, killdeer. Pintail ducks and common snipe frequent the marshy inlets. The buttonbush swamp along Rte. 108 historically has supported common snipe, Virginia rails, sora rails, and occasionally an American bittern. One sora was observed here in June, 1994. The area provides good turtle habitat.

The river south of Moat Island has many small inlets. The narrow spits of land have floodplain features -- silver maple, high levels of siltation, alders, winterberry, elm, red osier dogwood, and various ferns. "Very significant" populations of Robin's pondweed and water marigold occur in the backwaters. The dense beds of tape grass are also notable.

River mile 1 -This is the site of a rare fern, blunt cliff-fern, found in calcareous outcropping of Exeter diorite. The surrounding area contains young beech, musclewood, witch hazel, and gray birch. Exposure to full sunlight would eliminate the population.

**Newmarket:** Although developed, the river above the dam at its confluence with the Piscassic River and at Folletts Brook could harbor a significant Blandings turtle population. On the spit of land at the Newmarket town line impressive silver maples, too few to be considered exemplary, may be locally significant. This area appears to be good habitat for ducks and waders, though few were documented, wood ducks and mallards being the exception. The mouth of Follett's Brook supported up to 50 mallards.

**Corridor:** In its report of January 1988 the ad hoc committee on conservation

lands, whose aim was "to develop a regional approach to identifying and conserving lands which provide important connections between existing protected tracts,"<sup>103</sup> identified the Lamprey river and its tributaries, the Little and North rivers, as a potential conservation corridor. It also recommended informing the University of regional conservation concerns and seeking UNH cooperation in protecting key parcels. (See also the discussion under Master Plans for indications of public interest in corridor protection.)

Additional areas of conservation concern, either because they are limited in number or extent or because they are critical to one or more life stages of corridor species, or both, include: farmlands, vernal pools and seasonal wetlands, the riparian zone and floodplain forests, sandbank habitat, abandoned sand and gravel pits, and wetlands, including beaver ponds.

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<sup>103</sup>Ad hoc committee, "A Regional Perspective on Conservation Lands in Durham, Lee, Madbury and Newmarket," 1/88, p. 1.

## AGRICULTURE

Although much of the Lamprey valley is characterized by relatively infertile, sandy soils, farming has persisted into the present century, and much of the best land has remained in cultivation for more than two hundred years. Today there are only 6 dairy farms in Strafford County (1 in the Lamprey corridor) compared with more than 20 less than 15 years ago. Instead, one finds many smaller, generally part-time "niche" farm enterprises, including pick-your-own fruit and vegetable farms, sheep, beef cattle, goats, and other livestock, nurseries, and greenhouses, evidence of a trend observed statewide towards more value-added, specialty agriculture.

Generally speaking, the land that was in dairy has remained in agriculture, either as pasture for other livestock or in hayfields. A marked, areawide increase in the number of horses has spurred a demand for hay and improves the likelihood that hayfields will persist as open space. Incentives to maintain land in production, particularly, programs to purchase the development rights of prime agricultural land and thereby eliminate its marketability for development<sup>104</sup> and the present current use program, which taxes land as agricultural land, woodland, or wetland and not as house lots, successfully promote the retention of productive open space.



The Sanborn farm at Lee Hook Road, Lee.

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<sup>104</sup>The NH legislature in 1985 authorized the NH Department of Agriculture to acquire development rights on agricultural lands, including agriculture, farming, dairying, pasturage, horticulture, floriculture, and animal or poultry husbandry, and appropriated funds. Although on the books, RSA 432:17 et seq., Acquisition of Agricultural Land Development Rights, is unfunded.

Other measures designed to enhance the visibility or viability of agriculture include the promotion of local markets and nuisance ordinances protecting farmers against complaints from nearby residents. To connect farmers, particularly dairy farmers who are looking for additional land for growing corn or hay fields, with nonfarmers who have fields they would like to maintain, the SCS initiated a clearinghouse for the two groups. Tillman Marshall, District Conservationist for Strafford County, believes such a clearinghouse, if properly publicized and maintained, would provide a needed service and a benefit to both farmers and nonfarming landowners. Promoting both a greater awareness of farms as part of the landscape and economy of Lamprey communities and an understanding of the true costs of development as compared with the true costs of open space may also serve the long-term interests of agriculture in the Lamprey corridor.

## RECREATION

### Access/public lands

Although situated in a heavily populated part of the state (the State-estimated 1993 population of Strafford and Rockingham counties alone exceeded 353,000) and offering a variety of recreational opportunities, the Lamprey River is remarkably undeveloped in terms of access and recreational facilities. Public access points and recreation areas are summarized in Table 2. There are no state facilities nor any state-owned land.

The public traditionally has relied in part on informal access across private land, generally adjacent to public roads. In Lee, river access is limited to highway rights-of-way at bridges and to private land. Private access occurs directly from riverfront landowners' homes or land abutting the river and owned by homeowners' associations, and from one of three commercial campgrounds in Lee (Wellington Camping Area, Lamprey River Campgrounds, and Ferndale Acres) or the commercial boat operation in Durham.

Commercial establishments dependent in part on the river are limited to the three seasonal campgrounds in Lee, and the Durham Boat Company in Durham.



Beavers contribute to some recreational opportunities - Hook Island, Lee.

Existing Public Recreation Areas Along the River - Table 2

Location	Town	River Access	Activities
Water treatment plant Owned by Newmarket Water Dept.	Newmarket	Yes, informal - canoes, small boats, vehicular access	Fishing, boating, feeding of ducks, limited parking
Sliding Rock, Twin Rivers Owned by Town	Newmarket	Yes - all water craft, vehicular access	Boating, fishing, picnicking, swimming, picnic tables, limited parking. Town is considering installation of beach, jungle gym, and handicap access. 5 cars.
Doe Farm/Moat Island Owned by Town 80 acres	Durham	Yes - 0.5 mi. portage, canoes, small boats	2 miles hiking trails, 1 mile Class VI road, no picnic facilities Swimming - muddy substrate; ice skating, x-c skiing, bird watching, snowmobiling, historic significance
Packers Falls Owned by Town 3 acres	Durham	Yes - by foot - boat launching difficult	Swimming, tubing, fishing, kayaking (Cl. III rapids), picnicking, bird watching, historic significance. Trash can, limited parking (4-5 cars), 1/4 mile trails
Wiswall Falls Owned by Town 2.5 acres	Durham	Yes - by foot	Fishing (stocked in spring), swimming, ice skating, bird watching, ice fishing, snowmobiling, x-c skiing, canoe put-in; posted against parking - room for 9 cars along road. Site is mostly on private land
George Falls Woods Owned by Town 11 acres	Epping	Yes - canoe launch with portage from parking lot on road	Natural area, passive recreation
Route 87 bridge (private ownership, town in process of acquiring access/con-servation easement)	Epping	Yes, informal - canoes	Canoeing, fishing, swimming Parking for about 10 vehicles
Route 125 bridge 75' R-O-W at riverbank, 190' along Rte. 27.	Epping	Yes, informal - canoe w/ difficulty	Fishing, canoeing
Miriam Jackson Park Owned by Town 0.3 acres	Epping	No	Fishing, canoeing
Town Hall (The Rock) Owned by Town 1.77 acres (total lot)	Epping	Yes - canoe launch possible	Fishing, swimming, natural area Good parking 300' from river
Boy Scout field Owned by town 12 acres	Epping	No	Natural area, hiking trails, passive recreation
Mary Folsom Blair Park Owned by Town 10.5 acres	Epping	Yes - canoes (50' walk from vehicular access)	Baseball fields, canoe launch, parking for 50+ vehicles Swimming, fishing, canoeing, ball games, campouts, picnicking

This table excludes land held in common ownership by subdivision residents where the access is exclusively for residents, as at Riverfields (dock), Riverside Farm (trails), and Lamprey Lane (beach). It excludes private land, except as noted.

### Activities

Activities people pursue along the Lamprey include swimming, fishing, nature watching, canoeing, kayaking, sculling, tubing, hiking, picnicking, horseback riding, duck hunting, skating, cross-country skiing, snowmobiling, ice fishing, and in the deeper reaches, motor boating. Looking for live bait, frogs, and turtles and "thinking"<sup>105</sup> also rank (probably high) among summertime activities.

Highest use areas include the stretch of river from Newmarket to Moat Island, Packers Falls, and the areas immediately upstream of Wiswall Dam and downstream to Packers Falls. Downtown Epping, areas around the private campgrounds, and Wadleigh Falls also receive relatively more traffic than other reaches.

Nearly all (88%) of the 129 riverfront landowners responding to a question on their uses of the river<sup>106</sup> indicated that they and their families enjoy the scenery. Watching nature/wildlife is the next most popular pursuit, followed by walking (72%), canoeing (62%), swimming (58%), fishing (45%), and photography (42%).

**Fishing:** New Hampshire Fishing Maps characterizes the Lamprey as "a truly exceptional river offering a vast variety of fishing. It contains every type of stream and river fish you could expect to find in New England. Undeveloped along its entire length, except at Newmarket, it is a pretty river to be on and to fish."<sup>107</sup> It is open to fishing year round, with the exception of salmon, which have the same season as elsewhere in the state. In addition to the naturally reproducing warmwater fish -- smallmouth and largemouth bass, chain pickerel, brown bullhead [catfish, horned pout], yellow perch, American eel, and pumpkin seed -- caught in the Lamprey River, the NH Fish & Game Department (NH F&GD) stocks roughly 2,300 8" brook trout, 870 13" rainbow trout, and 2,200 12" brown trout each spring in Lee and Durham. An additional 880 yearling brook trout are released in the North River, 960 in the Little River, and 200 in the Pawtuckaway River in Nottingham.<sup>108</sup> The releases create trout fishing opportunities, and some trout survive into subsequent years.

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<sup>105</sup>From Lamprey recreational users survey, comment by young boy in downtown Epping. The Committee developed a recreational users survey, from which this comment was taken, and used it only sporadically. Results did suggest river use patterns that basically corroborated what Committee members had assumed. Specific recommendations from the survey for improving recreation are listed in Appendix H.

<sup>106</sup>All quantitative information on riverfront landowners is from the results of a 5-page questionnaire sent to all riverfront landowners in the four study towns. See Appendix E for a summary of results to all questions and summary of issues.

<sup>107</sup>New Hampshire Fishing Maps, Delorme Publishing Co., Freeport, Maine, Map 89.

<sup>108</sup>Stocking levels may vary year to year based on hatchery production. The Department determined optimal levels for a recreational fishery on the Lamprey based on the river's size, accessibility, fishing pressure (based on local demographics), instream biology, and water temperature.

NH F&GD anticipates continued stocking of similarly sized or possibly larger trout in the future.<sup>109</sup> Access for fishing is generally informal. In key areas, Salmon Unlimited has negotiated agreements with landowners.<sup>110</sup>

Anadromous fish of recreational importance are the American shad and salmon. While shad restoration efforts are designed primarily to restore a self-sustaining run of American shad to the Lamprey River, they will create spring fishing opportunities. As indicated, the 1993 spring shad run at Newmarket was at least 200 fish.

NH F&GD's salmon program is focused on establishing a recreational fishery in the Lamprey River system.<sup>111</sup> More specifically, these stocking efforts are aimed at creating "a recreational angling opportunity [spring and fall] within predictable limits." Key elements include spring scatter-stock releases of Atlantic salmon fry in the upper reaches of the Lamprey and in appropriate habitat in the North River and fall point-stock releases of Atlantic salmon parr and/or smolts, when available. A Chinook salmon smolt stocking program has been discontinued (as of 1993) due to low returns. The fry and parr remain in freshwater rivers for one to three years before heading out to sea. The smolts are seabound at the time of release.

Objectives of the Atlantic salmon stocking program are to stock at least 110,000 fry per year and to provide for a recreational fishery for salmon.

In 1984 4,251 angler hours were spent during October and November fishing for Coho salmon,<sup>112</sup> essentially in the stretch between Packers Falls and Wiswall Dam, where the dam prohibits further upstream passage. In 1985, NH F&GD recorded 3,839 angler hours.<sup>113</sup> These figures are based on catches of 229 fish and November 389 fish, respectively. Fish passage at Wiswall would open up approximately 43 miles of additional habitat and relieve fishing pressure in Wiswall/Packer's Falls area (see the Map entitled "Anadromous Fish Habitat"). Ultimately some natural salmon reproduction in the Lamprey headwaters (requiring fish passage at both Wiswall and Bunker Pond)

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<sup>109</sup>Bob Fawcett, fisheries biologist, cited in "New Hampshire's Lamprey River Trout," by Alex Cote in New England Game & Fish, April 1993, pp. 24-27/52-53.

<sup>110</sup>Lamprey River nomination to the State Rivers Management and Protection Program, p. 12.

<sup>111</sup>Information on the salmon stocking program is from performance reports for the NH Anadromous and Inland Fisheries Operational Management Investigation, Anadromous Fish Investigations and Marine Recreational Fishery Evaluation, various years.

<sup>112</sup>Coho were stocked for a number of years until the availability and cost of disease-free eggs became prohibitive.

<sup>113</sup>1984 and 1985 Annual Reports of the Division of Inland and Marine Fisheries, NH Fish & Game Department.

and in the North River could result from these efforts, although conditions for spawning are not ideal. It's unlikely, however, that the state's Atlantic salmon stocking program will ever produce returns comparable to the early Coho stocking program without smolt stocking. The latter, like the Chinook program, was based on releases of smolt, not fry, substantially increasing the likelihood of survival.<sup>114</sup>

**Boating (Including Tubing):** Spring canoe runs on the Lamprey include class II or III rapids in West Epping, below the Lee Hook bridge and the Wiswall Dam, and at Packer's Falls, which the AMC River Guide characterizes as "one of the most challenging rapids in the Piscataqua Watershed," a "roaring Class II run in early spring, and .. often run well into the summer as a Class II drop."<sup>115</sup> The Town of Epping holds a canoe race, beginning in West Epping, each spring; tubing is a popular pursuit at Packers Falls and elsewhere (e.g., formerly annual Lamprey River Watershed Association's tube race).



The river meanders through old pastures and mixed forests.

Elsewhere the river meanders through mixed forests that generally come right to its banks with occasional openings. The AMC River Guide describes the stretch from Rte.

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<sup>114</sup>Robert Fawcett, NH Fish & Game Department, personal communication.

<sup>115</sup>AMC River Guide for New Hampshire and Vermont, p. 217. See also, AMC River Guide for Central/Southern New England, Vol. 2, 1978, p. 322 and "Canoeing the Lamprey River," a 5-page descriptive booklet with map insert prepared by the Lamprey River Watershed Association.

87 to the mouth of the North River as "a long, smooth stretch" that "twists through old pastures and woods..For a quiet retreat into the woods, the first 4 miles [from Wadleigh Falls east] are superb...quiet paddling past densely forested banks of hemlocks and hardwoods."

Motor boats are limited largely to the flat, deeper waters below Packers Falls to Newmarket. Beaver dams, occasional blowdowns, and, in mid-to-late summer, low water limit the river's potential for heavy boat/canoe use in upper reaches of the study area.

According to the AMC River Guide, the North River offers a brief canoeing season, late March to late April, but also "definitely" the "best whitewater run in the Piscataqua Watershed, with a 2.5 mile, continuous class II run above NH-152."<sup>116</sup> In high water the river is canoeable from near the outlet on Pawtuckaway Pond. Class IV rapids occur below the 152 bridge at the shingle mill.

**Swimming:** There are five municipally owned sites on the river where swimming is a recognized use, though none has lifeguards. One is in Newmarket, two are in Durham, and two are in Epping (see Table 2). In 1993 the Department of Environmental Services posted the area behind Epping's town hall against swimming due to (temporarily) high bacterial counts. The posting resulted from a new policy developed pursuant to RSA 485-A:4xIV, which requires "proper warning to the public by posting a sign where water quality standards are not being attained as they relate to specified designated uses." The policy specifies that "only Town or State designated swimming areas and obvious swimming areas" will be posted after at least two violations of bacterial standards have been verified.<sup>117</sup>

**Trails:** Informal hiking, horseback riding, ski, and snowmobile trails have been created by common use or negotiated, generally by snowmobile clubs, with landowners along the river. A large snowmobile club, Great Bay Snow Rollers, has some 14 miles of trails on and along the river and utility line corridors, and across fields in the towns of Newmarket, Durham, and Lee into Epping. No formal, designated public trails exist except at the Doe Farm in Durham, where 2 miles of trails are available for hiking. Other paths along the river result from traffic of fishermen.

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<sup>116</sup>AMC River Guide for Central/Southern New England, Vol. 2, p. 325.

<sup>117</sup>Water Supply & Pollution Control Division Memo from Raymond Carter to Richard Flanders dated 9/22/93 re. Posting River Signs Policy.

### Users, Issues, and Opportunities

The river attracts all ages. Areas with easy access attract the highest numbers of people, including, as indicated, the stretch from Newmarket to Packers Falls, Packers Falls, and Wiswall Dam. Virtually any day from mid-April (or when water temperatures reach 45° F for stocking trout) through fall and into winter fishermen fish the river. Students and faculty from the University of New Hampshire frequent nearby areas, and one regularly encounters children playing along the river within walking or bicycling distance of their homes. Except for fishermen (seasonally) and people staying at campgrounds on the river, most recreationists probably live in the seacoast area.

Although the number of recreationists interviewed was too small to be statistically meaningful, the river's beauty, proximity to home, and its relative solitude were the most frequently identified reasons for recreating on the Lamprey in midsummer; in spring, fish stocking is a major draw.

The river has a highly natural appearance, which is broken only occasionally by conspicuous homes and road crossings. The river has riprap only at bridges,<sup>118</sup> and no apparent manmade diversions or channelization projects impede its flow. Its size, substrate, and depth vary from West Epping to Newmarket, providing for recreational diversity. Throughout most of its length the river is forested. Silver maple, red maple, occasional sycamores, birch, beech, oak, hickory, ironwood, hemlock, and white pine line its banks, creating a range of colors, textures, patterns, and forms. In places the branches extend across the river and block out the sun. Occasionally fields come right to the river, or beyond the fringe of trees one can see or sense open spaces. Low-growing riverine vegetation (like silky dogwood, sensitive fern, royal fern, and grapevine) and splashes of colorful sheep laurel, cardinal flower, meadow rue, false milkweed, buttonbush, and other conspicuous plants add to the river's scenic appeal. Against this backdrop is the likelihood of seeing fish and wildlife in and along the river.

While steep valley walls or the otherwise low, flat terrain limit panoramic views, perhaps it is the absence of far-reaching views – as well as the relative absence of people – that create the sense of isolation one feels along most of the river. Particularly in the upper reaches before the river slows and widens, this is a river on which one can find real intimacy with the natural riverine world.

Additional development and heavier recreational use may well change how people relate to the river. The river's wide floodplain and steep banks (particularly in Epping) no doubt have discouraged development, as limited access has discouraged recreational use. Elsewhere, the river's undeveloped shoreline may be due more to decisions by individual landowners about development of their land than to natural

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<sup>118</sup>There are river crossings at: Main Street, Rte. 125, and Rte. 87 in Epping, Rte. 152 and Lee Hook Road in Lee, Wiswall, Packers Falls, and Bennett roads and the former B&M railroad in Durham, and the railroad and Rte. 108 in Newmarket.

constraints or any overall public policy of river corridor protection.

Riverfront landowners and recreationists alike complain of litter on and in the river. Young boys playing under the Main Street bridge in Epping said they cannot wade barefoot because there is too much broken glass. Boaters, in particular, also complain about blowdowns, log jams and other natural trash, and beaver dams in the river. (Note that instream debris provides important habitat for fish and other aquatic and semiaquatic species. Most such obstructions along the Lamprey are from natural causes, although changes to the river bank or channel that affect flow create unstable conditions.)

Landowners responding to the landowners' survey (Appendix E) also cited problems with trespassing, partying, vandalism, and open fires. Nearly 40% have had bad experiences with people on their land, and roughly 40% post it (not necessarily the same 40% as have had problems with recreationists).<sup>119</sup> About 43% feel that the towns should help landowners who are keeping their land open to the public deal with problems of litter and noise.

Riverfront landowners generally support existing levels of recreational use of the river, although additional canoeing/kayaking and walking/picnicking/bird watching/skiing received nearly as much support as maintaining the status quo. More than one-third expressed concern over the potential for crowding (too many recreationists on the river). Only 10% support the idea of large-scale recreation facilities and 25% campgrounds, boat rentals, and other smaller scale commercial development for recreation.

The State's 1991 Public Access Plan for New Hampshire's Lakes, Ponds, and Rivers recommends one state-owned or controlled access site for every 10 river miles.<sup>120</sup> Based on an inventory and assessment of existing town-owned access points, a UNH student team concluded that "the public's demand for access to the Lamprey is met." The possible exception may be in Lee, which has no publicly owned access. The group recommended limited improvements to existing sites, including locational signs, handicap access where feasible (Newmarket and Epping), and picnic tables, where appropriate.<sup>121</sup> The LRAC recommends promoting a "carry-in, carry-out" policy towards trash consistently in all four towns as generally preferable to trash cans. The Committee also has identified several additional sites where access may be feasible.

A 1982 report on recreational use of the Lamprey River prepared by the Strafford

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<sup>119</sup>The question asking whether landowners allowed access across their land may have been misinterpreted, so whether the 59% saying yes actually meant that they allow general public access is unclear.

<sup>120</sup>NH Office of State Planning, 1991, p. 3 and p. 30.

<sup>121</sup>Nikki Assarian, et al., 1993, "An Inventory of Public Access Along the Lamprey River," prepared in conjunction with the NH Office of State Planning.

Regional Planning Commission<sup>122</sup> identifies the following potential improvements: improved and additional access at Mary Blair Park, Epping; trail from Wadleigh to Wiswall falls, Lee and Durham; public access for swimming off Wednesday Hill Road (at intake plant), Durham; canoe access at Wiswall Dam, Durham; trail from Doe Farm to Newmarket along the B&M R-O-W.<sup>123</sup>

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<sup>122</sup>SRPC, 1982, "Final Report: Summary of Issues Related to Recreational Use of the Cocheco and Lamprey Rivers and Evaluation of the Proposed River Management Plans Prepared by the NH Water Resources Board."

<sup>123</sup>The B&M line is now owned by Guilford Transportation, North Belknap, Massachusetts, and carries six freight trains a day with about 50 cars each. Future plans anticipate this line serving the Boston to Portland passenger trains.

## HISTORIC RESOURCES

### General Significance

The Lamprey River is one of New Hampshire's most historic streams.<sup>124</sup> We know from archaeological remains that the Lamprey's history of human habitation extends back in time some 8,000 years. Some of New Hampshire's earliest colonial settlements and roads followed the Lamprey valley. Provincial authorities established the river as a boundary between Dover and Exeter, two of New Hampshire's four original towns. At one time the river divided Strafford and Rockingham counties. Its modest drop in elevation from source to mouth notwithstanding, the Lamprey's capacity to produce power was valued from the 1600s into the present century. Reservoirs built in the upstream reaches and on tributaries to enhance production significantly increased control over year-round power generation capacity.

The Map, "Historic Sites," depicts the location of known historic and archaeological sites within the corridor. Figure 2 identifies the sites. Because little evidence of the Native Americans who preceded European settlement has been found,<sup>125</sup> this discussion focuses on interactions with the river during the last 300 years and on one ancient archaeological site in Lee.

### Mill Sites and Other Historical Reminders

One of the state's early geographical landmarks was "the Picked rock, so-called," situated "a little above the first Dam in s<sup>d</sup> [Lamprey] river."<sup>126</sup> This rock, which served as the southern abutment of a bridge across the river where the Rte. 108 bridge presently stands, was a boundary between Strafford and Rockingham counties until 1870, the year Durham ceded land north of the Lamprey River to Newmarket.

Bridges were another early landmark, and a continuous challenge to settlers on both sides of the river. As early as 1644 the towns of Dover and Exeter were ordered by the provincial court to "build a sufficient Bridg for horse & men over Lamprey River," and in 1647 and at various times thereafter were fined for failing to do so.<sup>127</sup> Several early locations are in use today -- at Rte. 108 in Newmarket, at Packer's Falls in Durham, at Lee Hook in Lee, and at both Blake Road and Rte. 27 in Epping. Structural

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<sup>124</sup>James Garvin, NH Division of Historical Resources, who contributed much of the information in the section on mills and other historic reminders in this Assessment as contained in his draft document "Lamprey River Historical Background: Supplied to Aid Assessment of the Stream for Potential Wild and Scenic Designation," undated.

<sup>125</sup>Sylvia Fitts Getchell, The Tide Turns on the Lamprey: Vignettes in the Life of a River, 1984, p. 132.

<sup>126</sup>From a report of the NH General Assembly dated July 12, 1723 in M.P. Thompson, Landmarks of Ancient Dover, 1892, reprinted by Durham Historic Association 1973, p. 201.

<sup>127</sup>As quoted in historical background paper of James Garvin, op. cit.

remains at river crossing are visible at low flow just below Hook Island in Lee, at the large U-bend in the river below Wadleigh Falls (the Oxway Road, possibly Brackett's Bridge<sup>128</sup>), also in Lee, at the Boston bridge, just downstream of the present Rte. 125 bridge in Epping, and just upstream and north of the intersection of rtes. 125 and 27 in Epping, where a covered railroad bridge and later a long iron trestle bridge<sup>129</sup> crossed the river and Rte. 27.

Mills, too, were an early and enduring part of the Lamprey valley's settlement, commerce, and industrial development. Within the first few river miles from Great Bay were four important falls: the "lower falls," or "Lamprey River falls" in Newmarket where the Macallen Dam now stands; Packer's Falls (the "second falls") in Durham; Wiswall's Falls in Durham just above Packer's; and Wadleigh's Falls (variously known as the "upper falls," "Island falls," and "Wadley's Falls") in Lee.<sup>130</sup> Two or three lesser falls between Wiswall and Wadleigh falls, and falls in downtown Epping, at Blake Road about 3-1/4 miles upriver, and at the present Bunker Pond Dam in West Epping were also tapped for power.

Earliest of the falls to be harnessed was the nearest to Great Bay. In 1647 Edward Starbuck and Hatevil Nutter of Dover were granted the right to build a sawmill at either the "uper or louer falls." They chose the lower falls in Newmarket. Nutter received the mill privilege on the north side of the river and Starbuck on the south side. The two men agreed "that If one Bulds a mill before the other, that when the Other Bulds hee shall paye to him that Bult firs one halfe the valew of what Indeferent men shall Judge the mill Dam to be worth at said time of the latter Buldinge of a mill."<sup>131</sup>

It is not known whether any mills were actually built at the lower falls before 1652, when Valentine Hill was granted mill rights to the site, where his "works ... stood at high water mark below Lamper Eel Rieu falls."<sup>132</sup> Grist mills succeeded the sawmills erected at this site, followed by a fulling mill (for thickening and degreasing woven cloth), and, in 1823, the first of the Newmarket Manufacturing Company textile mills. The Newmarket Manufacturing Company mills operated continuously until 1929 and dominated community life for many years. They have since been adapted for shoe and other light manufacturing.

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<sup>128</sup>From notes of Seth Walker, surveyor, c. 1837, Sylvia Fitts Getchell collection.

<sup>129</sup>This bridge is pictured on p. 87 of Richard B. Sanborn, A Bicentennial History of Epping New Hampshire, Withey Press, Seabrook, NH, 1976. This booklet contains several other interesting photographs, including the Folsom Saw Mill and Box Factory, the Benjamin Franklin Prescott House, several buildings at Camp Hedding, and Watson Academy.

<sup>130</sup>Various names for Wadleigh Falls are from M.P. Thompson, op. cit., p. 119.

<sup>131</sup>As quoted in James Garvin, op. cit.

<sup>132</sup>Sylvia Fitts Getchell, Lamprey River Village: The Early Years, Newmarket Press, 1976, p. 24.

Upstream of the Lamprey River falls at the Moat, Valentine Hill in 1655 was given "free liberty" to construct what was probably the first canal project in New England from the Moat on the "lamperele River" to the Oyster River "for the supply of his mill" on the Oyster River, provided he would cease Lamprey River withdrawals should he relinquish his mill privilege on the Lamprey. Although the canal may never have been completed, Longmarsh Brook is suggestively canal-like, and the river continues to flood through it and Denbow's Brook into the Oyster River watershed to this day.

In 1694 the town of Dover granted Col. Thomas Packer of Portsmouth and four other individuals rights "for the erecting of a sawmill or mills" and land grants to encourage them. This was the site of various enterprises, including a box and nut and bolt factory. A bridge spanned the river at Packer's Falls as early as 1763.<sup>133</sup>

It has been speculated that Packers Falls also was the site of the Lamprey River Iron Works, established in 1719 in what was then Dover by Archibald McPhedris of Portsmouth, though it is equally possible that the iron works were located at the lower falls in present day Newmarket. Although not the first iron works in America, as claimed by their owner, the Lamprey River Iron Works were among the first in the country and the first in New Hampshire. Here bog ore dredged from the river and surrounding wetlands was transformed into iron. Charcoal for drying and smelting processes at the Iron Works was produced in Barrington in an area 2 miles wide and 6 miles long still known today as the Two-Mile Streak.<sup>134</sup>

Mill privileges on the lower part of Packer's Falls were granted to General John Sullivan of Durham Landing in 1770. General Sullivan built a grist mill, sawmill, fulling mill, scythe mill, and other mills. Though originally part of Packer's Falls, this stretch of rapids became known as Sullivan's Falls.

Mill activity at Wiswall's Falls less than a mile upstream of Packer's didn't get underway until 1835, nearly two centuries after the first mills were established downstream, but Wiswall Falls became an industrial center for the Town of Durham. This site, presently listed on the National Register of Historic Places, is discussed in detail, below, under "archaeological sites".

Falls in Lee at Hook Island (the Hook Mill site<sup>135</sup>) were also tapped for power production (see discussion under "archaeological sites," below). It has been suggested that additional falls between Hook Island and Wiswall were considered or exploited for

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<sup>133</sup>M.P. Thompson, op.cit., p. 191.

<sup>134</sup>N.P. George, Old Newmarket, 1932, pp. 28-29.

<sup>135</sup>See map of Lee, New Hampshire, pp. 16-17 in U. Baier, ed., Lee in Four Centuries. Some Historical Notes Published to Commemorate the Bicentennial of the Incorporation of the Town 1766-1966, 1966.

power, but no archaeological evidence has been discovered to verify the claim.<sup>136</sup>

Above Hook Island the river makes a dramatic meander, which long ago received the name of "Lee Hook" and includes several small falls. A 1724 inventory mentions a mill "at the hook of the Lamprell river." Later records also reference a mill here. The 1803 map of Lee shows a sawmill and grist mill at the great turn of the Hook, near Lee Hook Road, owned by Capt. Reuben Hill. In 1856, under John Mathes' ownership, the mills were used for manufacturing shingles and grinding grain and in 1892, under Israel Dame's operation, as a sawmill and gristmill. The mills ceased operations in 1916-17.

The next prominent waterpower site on the river is Wadleigh Falls in Lee. The "upper falls," this site was recognized almost as early as the lower falls for its power generating potential, with first mill privileges granted to Samuel Symonds of Ipswich, Massachusetts in 1657. Symonds' grant was transferred to Robert Wadleigh, who was operating a sawmill there by 1668. From this time into the twentieth century sawmills operated continuously at this site. In 1850 Guy Glidden produced 800 sides of leather at a tannery here, which also persisted into the twentieth century. By the late 1800s a shoe shop (one of many in Strafford and Rockingham counties) stood near the tannery.



"Winter scene" or "View near Lee, N.H. - Wadleigh Falls," painted by W.H. Titcomb, c. 1856-57.

<sup>136</sup>M.P. Thompson, *op.cit.*, pp. 119-120 and Jeffrey H. Maymon, "A Preliminary Cultural Resource Survey of the Lamprey River Drainage," Independent Reading and Research UNH 1983, pp. 27-28 (citing M.P. Thompson, *op.cit.*, and Lucien Thompson collections). According to Thompson, the falls in question were called Long Falls and Unnamed or Leony falls. Another view is that Long Falls refers to the Lee Hook Falls, and Leony Falls are at Hook Island.

Dr. Isaiah Edgerly operated a grist mill, where he is said to have manufactured 25 tons of ground botanic medicines in a single year, supplementing this production with that of a second mill at Edgerly's Falls in Strafford.

Upstream of Wadleigh Falls the river flattens into meanders for some distance, to what is now the center of Epping. The first mill on the Lamprey in Epping was built sometime before 1720, at the foot of Blake Road, on the west side of the bridge, in the "Lower Tuckaway Grant."<sup>137</sup> The mill and dam remained in use for more than 100 years, until about 1870. The mill was used first as a sawmill, producing boards, shingles, and clapboards, and at various times thereafter as a grist mill, a carriage factory, and a woolen mill.

Joshua Folsom established the first grist mill in Epping at the "Upper Tuckaway Mill Grant" in 1746. This site, at what is now Bunker Pond Dam, housed mills and factories for some 200 years. Included among these enterprises at various times were a grist mill, sawmill, plaster mill, woolen goods factory, shoe factory, and box factory. Buildings were located on both sides of the river. The Town acquired rights to the dam in the late 1950s, which it sold to the State in 1966. The State now operates the former Folsom's Mill Dam. Mary Blair, for whom the adjacent park is named, was the sister of the last mill owner, Edwin S. Folsom.

The dam in Epping village just above present day Mill Street was built about 1750. Operations at this site over time included a sawmill, a shingle and clapboard mill, a woolen mill, an ax handle factory, and a gristmill. A canal situated on the east side of the river channeled water through the mill works and discharged it back into the river downstream across from the Mariam Jackson Park. The dam went out c. 1912.

The mills in downtown Epping served other functions as well, as this report from the Exeter News-Letter dated 9/27/1875 indicates:

For a week or two past large quantities of eels have been caught at Miles mills. The manner of catching them is to raise the gate a few inches at night and fix an eel-pot in the aperture. During the night the eels rush into the box, and in the morning are bailed out and disposed to those who have a relish for this kind of fish. As many as three bushels have been taken in one night, many of them of a large size; one recently caught weighed six and a half pounds.<sup>138</sup>

The 1871 Gazetteer of New Hampshire indicates that four grain mills, six sawmills, and one clothing mill were located on the Pawtuckaway and North rivers. One of these,

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<sup>137</sup>Most of the information about Epping mills was contributed by Donald R. Sanborn of Epping in his document, "Some Data on the Lamprey River" dated April 1994.

<sup>138</sup>In D.R. Sanborn, "Some Data on the Lamprey River," p. 3.

the North River Mill or Harvey's Mill, at the "North River Great Falls" or "long falls" is still standing. By at least 1733 a sawmill stood on the Little River at its intersection with Cartland Road, not far from the first tavern in Lee, where much of the Town's business purportedly took place.<sup>139</sup> A grist mill and fulling mill known as Bark's Mills were located downstream of the bridge at Thompson's Falls and, later, Bartlett's Falls.<sup>140</sup> No evidence of the latter remains, but the mill foundations above the bridge are still visible.

The mills were always weather-dependent, and extreme low flows would cause many of them to shut down. To better control flow and enhance power production at its Newmarket mills, the Newmarket Manufacturing Company (incorporated in 1822) early on built dams at Pawtuckaway and Mendums ponds. Other mill owners benefited as well. Without the supplementary water from the Nottingham reservoirs, mill owners along the Lamprey below its confluence with the Pawtuckaway "would be obliged to suspend business altogether" during periods of extreme low flow.<sup>141</sup> Today these dams are now regulated for recreational use of the impoundments behind them. At Bunker Pond Dam, however, the State still augments flows, when necessary, to accommodate the annual Lamprey River Canoe Race in Epping.

With mills grew up settlements, most notable today the towns of Newmarket and Epping. Today, Newmarket's commercial and industrial mill district, consisting of 140 sites, is listed on the National Register of Historic Places. "[A] unique example of a New England mill town developed as a Waltham-type cotton textile manufacturing community," this complex of historically and architecturally significant buildings includes the granite mill buildings on the Lamprey, considered "the most beautiful of all textile factories of that period," [J. Coolidge, Mill and Mansion, 1942] and the best preserved examples in the state. Dominant in parts of the area are buildings of the former Newmarket Manufacturing Company, including seven textile mills, a machine shop, office, storage buildings, agent's house, and multi-family residences built for the mill workers. Epping's town-designated Historic District (NH RSA 674:45 et seq.) encompasses the mill site off Mill Street as well as many historic homes and buildings.

Other notable historical features occur along the river. In addition to the Newmarket Commercial and Industrial District there are four sites in or near the 1/4 mile corridor of the Lamprey River listed on the National Register of Historic Places. These

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<sup>139</sup>U. Baier, ed., Lee in Four Centuries. Some Historical Notes Published to Commemorate the Bicentennial of the Town 1766-1966, p. 6.

<sup>140</sup>M.P. Thompson, op. cit., p. 127.

<sup>141</sup>Exeter News-Letter, 7/2/1875, in D.R. Sanborn, "Some Data on the Lamprey River," p. 2. Sales material promoting the mill privilege at Wiswall Falls in 1857 claimed the "advantage of abundant water throughout the year. In seasons of drought, people resort here from 15-20 miles away to have grain ground." Note, however, that an 1883 sales notice claimed both "water power! and stream supplied by two large reservoirs." (From collections of Durham Historic Society.)

are: the Stone School, a beautiful stone building reflective of other stone architecture in Newmarket and in 1966, when the Newmarket Historical Society acquired it for use as a museum, "quite possibly the oldest school in New Hampshire used continuously since its construction" in 1841; the Wiswall Falls Mill Site in Durham (see below); the Benjamin Franklin Prescott House in Epping, home of the 39th governor of New Hampshire and the finest example of the Second Empire style built by Gilman C. Stone of Concord, NH in 1875; and Watson Academy (1883) in Epping, the finest surviving example of the Queen Anne style as applied to a large, educational building and a landmark in the development of the public education system in Epping.<sup>142</sup>

A significant site of religious origins is the 280-acre Camp Hedding property on the river in Epping, deeded to the newly incorporated Hedding Camp Meeting Association in 1864 (after purchase in 1862 by Rev. Holman). The Association consisted of Methodist pastors, ten townspeople, and the owners of cottages on the grounds. Its chartered purpose was to serve as a "body politic and corporate for such religious, moral, and charitable, and benevolent purposes as said corporation may from time to time designate."<sup>143</sup> The first meeting was held August 14-19, 1863. By 1881 attendance at the annual Hedding Camp Meeting was high enough (18,000 for a single day) to warrant construction of a branch railroad, which operated to the site for nearly 15 years. Today Camp Hedding is largely a summer community of more than 100 buildings, including a post office, library, and community house.

Of recreational significance, Highland House at Packer's Falls in Durham was a 19th century farm turned early 20th century destination resort hotel described in an advertisement as,

Directly on Lamprey River. Comfortable, modern, airy rooms with scenic view. Swimming, boating, fishing, ... tennis, ping pong, shuffleboard, recreation hall on grounds; golf near by. All meals cooked in tasty New England style. Rates \$30 up weekly.<sup>144</sup>

Families from Boston, New York, New Jersey, and California came here, as well as singers, writers, actors, and musicians from all over the world. Activity at Highland House peaked in the 1930s. The house and land are presently owned by the University of New Hampshire.

#### Archaeological Sites

There are two well-studied sites along the Lamprey River in the study area, at Wadleigh Falls and Wiswall Falls. Because the rest of the corridor is relatively

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<sup>142</sup>Information on significance is from the National Register forms prepared for each building, available from the NH Division of Historic Resources, Concord, NH.

<sup>143</sup>From charter in John J. Tilton, Epping, New Hampshire Bicentennial History 1741-1941, 1941.

<sup>144</sup>From Durham Historic Association collections.

undeveloped, it is likely that evidence of earlier times has been well preserved and remains intact, except the millsites at Wadleigh, Wiswall, Packer's, and Dame's (a.k.a. Hill's Falls, Mathe's Falls, below the Lee Hook Road) falls. Each of these rapids powered a number of different mills over time.<sup>145</sup>

The river's length and inland penetration add to its archaeological significance. Additional archaeological work might reveal patterns of distribution of native American people and the role of watersheds as meeting places or boundaries. Although native American activity in the watershed is poorly known, what evidence is available indicates that the Lamprey and Exeter rivers may have been, at different times, important areas in terms of settlement patterns and resource procurement.<sup>146</sup>

**Wadleigh Falls:** The Wadleigh Falls site is among the ten most significant sites in New Hampshire,<sup>147</sup> "rich in prehistoric cultural remains found in an undisturbed context."<sup>148</sup> The site was discovered in 1969/70 and revisited in 1980 and 1982. It was first occupied some 8630+/-150 years ago, during the Early Archaic period,<sup>149</sup> placing it among the earliest dated sites in the state.<sup>150</sup> The tools from the earliest occupation are largely "expedient," fashioned from local materials, used, and discarded. Most of the artifacts from the Wadleigh Falls site were found above the Early Archaic remnants, and most date from the Middle Archaic period, between 7000 and 8000 years ago. Some of the material used to fabricate tools apparently was brought to the site. A roasting pit or pit hearth at the site was radiocarbon dated to 7920+/-100 years B.P. The assemblage is similar to that excavated at a site in Manchester.

Preliminary findings suggest more than one occupation, including upland areas in the vicinity. Unusually numerous faunal remains from the upper component include deer, beaver, muskrat, rabbit or hare, mustelid, osprey, shad, snapping turtle, and

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<sup>145</sup>Jeffrey Maymon, "A Preliminary Cultural Resource Assessment of the Lamprey River Drainage," Independent Reading and Research, Fall, 1983, UNH, p. 4.

<sup>146</sup>Robert Goodby and Ritchie Duncan, An Intensive Archaeological Survey and Site Examination at Little Rattlesnake Hill, Raymond, New Hampshire, submitted to NH Division of Historic Resources, Concord, NH, 1989, p. 1.

<sup>147</sup>Victoria Bunker, Archaeologist, pers. comm., 11/2/93.

<sup>148</sup>David Skinas, "The Wadleigh Falls Site (NH 39-2[sic]): A Preliminary Report of the 1980 Excavations" in The New Hampshire Archeologist, 22(1), p. 16.

<sup>149</sup>Jeffrey Maymon and Charles Bolian, "The Wadleigh Falls Site: An Early and Middle Archaic Period Site in Southeastern New Hampshire" in "Early Holocene Occupation in Northern New England," Occasional Publications in Maine Archaeology 9 (1992). Except as otherwise noted, information is from Maymon and Bolian, 1992.

<sup>150</sup>Victoria Kenyon, "Cultural Resources Review, Wiswall Falls, Durham, NH," Report prepared for the Town of Durham, 6/13/86, p. 2.

timber rattlesnake. There is a relatively high proportion of reptile bones, possibly a function of sampling, of seasonal eating patterns, or of a nonsubsistence cultural activity. The absence of pottery may indicate that the site was a seasonal camp established on the river to exploit seasonally abundant flora and fauna.<sup>151</sup>

**Wiswall Falls:** The Wiswall Falls mill site, as indicated, is listed on the National Register of Historic Places. Although listed for its ties to the industrial age, the site holds information about precolonial people as well. Three unfinished stone tools retrieved at it suggest trade between early Lamprey River peoples and Saugus, Massachusetts. Although excavations have produced no evidence of prehistoric occupation, "the falls must have been attractive for thousands of years prior to colonial settlement" as is revealed by materials found above and below the falls.<sup>152</sup>

As a National Register property, this 3-acre historic archaeological site, owned by the Town of Durham, contains the remains of nine separate structures and is "the best remaining example in Durham of the town's nineteenth century manufacturing base."<sup>153</sup> The area has been relatively undisturbed and "holds considerable potential to inform us about the organization of a small paper mill and the hydraulic relationship of three [grist, saw, and paper] competing mills."<sup>154</sup>

As far as has been documented, the site was first utilized for industrial purposes in 1835, when Moses and Issachar Wiggin built a dam and sawmill, followed by a grist and flour mill and various other manufacturing pursuits -- cloth, shoe knives, hoes and pitch forks, wooden measures, nuts and bolts, bobbins, axe handles, carriages and sleighs, chairs, and matches. In 1853 the site was leased to Thomas H. Wiswall and Isaac Flagg, Jr. for manufacturing paper. The existing canal was built in 1854. During the mid-1800s the Wiswall Mills reportedly were "the busiest spot in town."<sup>155</sup> In 1878 T.H. Wiswall & Co. was one of 34 paper manufacturers in New Hampshire, producing 2500 pounds/24 hours and a major feature of Durham's economy. Fire destroyed the mills in 1883. In 1896 a freshet destroyed part of the dam. Extant remnants of structures from this manufacturing and residential center include the power canal, sawmill, paper mill/hydroelectric plant, boiler room, shingle shed? [sic], shed, stockhouse, two

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<sup>151</sup>Laura Pope, "Wadleigh Falls Island NH 39-1: A Preliminary Site Report" in The New Hampshire Archeologist, 1981, Vol.22, No. 1, p. 11.

<sup>152</sup>V. Kenyon, op. cit., p. 11.

<sup>153</sup>National Register of Historic Places Registration Form, section 8, p. 1.

<sup>154</sup>Ibid.

<sup>155</sup>Stackpole et al 1913:309 in Victoria Kenyon, "Cultural Resources Review, Wiswall Falls, Durham, NH," 6/13/86, p. 5.

unidentified structures,<sup>156</sup> and the remains of a crib dam at the base of the present dam.



Wiswall Mill c. 1885 (after J. Adams, Drowned Valley: The Piscataqua River Basin, University Press of New England, Hanover, 1976).

**Other sites:** Because early development frequently centered on the mills, old sites hold good research potential. Sites with single occupancies, like the 18th century mill at Hook Island, offer interesting research potential.<sup>157</sup> In addition, "the historic mill activity of Packer's Falls, where General Sullivan had his mill complex might make for a study that would appeal to a large audience. However, the mill activity of that period are [sic] probably heavily disturbed by later mill activity."<sup>158</sup>

Additional sites on file at UNH from which fragmentary data have been derived are the Hedding Campground, NH39-30 (chips of blade and pestle found); the Willard site, W. Epping, NH 39-23; Quaker Cemetery prehistoric site, W. Epping, NH 39-24; Reblin site, W. Epping, NH 39-25; Dick site, W. Epping, NH 39-26; and the Quaker Cemetery historic site, W. Epping, NH 39-34. Also known are remnants of an early colonial brick kiln off Lee Hook Road in Lee.

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<sup>156</sup>The present dam was built in 1912 by Newmarket Electric Light, Heat and Power Company (later acquired by the NH Electric Company), which retained the land until 1955.

<sup>157</sup>Jeffrey Maymon, "A Preliminary Cultural Resource Survey of the Lamprey River Drainage," Fall 1983.

<sup>158</sup>J. Maymon, "A Preliminary Cultural Resource Survey," p. 16 .

Sites on the Historical Resources Map  
Figure 2

- #1 Newmarket Industrial and Commercial District, NRHP
- #2 Stone School, NRHP
- #3 Old Stone Church
- #4 Macallen Dam
- #5 State Highway Marker #154, commemorating Packers Falls
- #6 Valentine Hill Canal
- #7 Doe Homestead
- #8 Sullivan Mills
- #9 Highland House
- #10 Mill site, 1694
- #11 Packers Falls District
- #12 Pendergast Garrison
- #13 Wiswall Falls Mill site, NRHP
- #14 Wiswall archaeological district
- #15 Hook Island Mill site
- #16 Mathes (Dame, Hill) Mill site
- #17 Hill's bridge
- #18 Bartlett Barks Mill site
- #19 Thompson Mill site
- #20 Oxway Road crossing
- #21 Wadleigh Falls archaeological district
- #22 Wadleigh Falls mill complex, including leatherboard factory
- #23 Wadleigh Wilson Mill site
- #24 Harvey's Mill
- #25 Allen's Mill site
- #26 Camping Hedding
- #27 Boston bridge
- #28 Railroad bridge
- #29 Mill Street Dam and Canal complex
- #30 Epping Historic District
- #31 Watson Academy, NRHP
- #32 Benjamin Franklin Prescott House, NRHP
- #33 Norris Mill site
- #34 Bunker Pond Dam

NRHP = National Register of Historic Places listed site.

## CORRIDOR COMMUNITIES

### Growth

Two of the towns in the study area are in Rockingham County, and two are in Strafford County. All four are in southeastern New Hampshire, an area that experienced phenomenal growth relative to the rest of New England throughout the 1980s.<sup>159</sup> Table 3 shows changes in population in each of the four study area towns over the last 30 years.<sup>160</sup>

Population Growth, 1970-1990  
Table 3

	1970	1980	1990	% Change 70-90	Area in Acres
Durham	8,869	10,652	11,818	33%	16,430
Epping	2,356	3,460	5,162	119%	16,620
Lee	1,481	2,111	3,729	152%	12,535
Newmarket	3,361	4,290	7,157	113%	8,640

With this growth the landscape has changed. Figures based on aerial photo interpretations of uses mapped at 5-acre minimums in 1953 and 1982<sup>161</sup> indicate the shifts in land use in the four towns displayed in Table 4.

Land Use Change, 1953-1982-Table 4

Acres of Agricultural Land:	1953	1982	% Chge
Durham	2645	2055	-22%
Epping	1795	1180	-34%
Lee	2315	1765	-24%
Newmarket	<u>1980</u>	<u>905</u>	<u>-54%</u>
Total:	8735	5905	-32%

Acres of Forest Land:	1953	1982	% Chge
Durham	8870	7100	-20%
Epping	12990	9555	-26%
Lee	8490	6205	-27%
Newmarket	<u>4630</u>	<u>2990</u>	<u>-35%</u>
Total:	34980	25850	-26%

<sup>159</sup>Between 1970 and 1980 Rockingham County accounted for more than 10% of the total growth of population in New England, most of it in the southernmost communities bordering Massachusetts. (Befort et al., Land Use Change: Rockingham County New Hampshire 1953-1982.)

<sup>160</sup>Population figures are from U.S. Bureau of the Census.

<sup>161</sup>Befort et al., Land Use Change: Strafford County New Hampshire 1953-1982 and Land Use Change: Rockingham County New Hampshire 1953-1982.

Acres of Developed Land:	<u>1953</u>	<u>1982</u>	<u>% Chge</u>
Durham	2390	5400	+130%
Epping	1325	5495	+315%
Lee	1165	4240	+264%
Newmarket	<u>595</u>	<u>1860</u>	<u>+213%</u>
Total:	5475	16959	+210%

Development continues to occur in the corridor, particularly subdivision incursions. The riparian edge, however, remains remarkably intact and free from many adverse impacts of development (e.g., nonnative plantings, lawns, imported beach areas, the absence of understory vegetation). Occasional homes, lawns, beach areas, clusters of homes, bridges, and dams break an otherwise naturally scenic, uninterrupted landscape.

The corridor as a whole remains remarkably undeveloped, as land use data from the Strafford and Rockingham regional planning commissions indicate:

	<u>Total acres of developed land</u>	<u>% of corridor by town</u>
Newmarket:	216 acres	48%
Durham:	218 acres	15%
Lee:	287 acres	13%
Epping:	567 acres	20%

**Future Land Use Plans:** Epping's future land use plan as articulated in the 1988 Master Plan anticipates development in narrow strips along Rtes. 27 and 25 and expansion of the downtown. Most of the land along the river is delineated "rural residential" (1 acre).

Newmarket's 1988 Master Plan calls for 2 and 3 acre lots in rural zones (present zoning is 2 acres/dwelling structure)(see the "Generalized Zoning Map"). It encourages commercial development in the town's commercial zones and recommends a special review process for proposals for redevelopment of the mill district (not implemented).

Durham's future land use plan (1989) calls for a "wildlife area/recreational corridor" along the length of the Lamprey<sup>162</sup> and designates land adjacent to the river upstream of the Wiswall Dam for water supply protection. Remaining land in the corridor is designated low density (3 acre) residential.

Lee's 1988 master plan apparently has no future land use plan.

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<sup>162</sup>The map also identifies a wetland just south of the corridor and west of Packers Falls Road as a wildlife area.

### Town Government

Newmarket and Durham have town administrator/town council forms of government (with informational town meetings), while Lee has a three-member board of selectmen and Epping a five-member board of selectmen. All four towns have conservation commissions and recreation commissions, as well as planning boards and zoning boards of adjustment. Epping has an historic district commission (RSA 673 and 674:44, heritage commissions) and an historic district covering part of the downtown area (RSA 674:45 et seq.).<sup>163</sup> All four towns are members of either the Strafford Regional or Rockingham planning commissions. Only Durham has a professional, fulltime planning staff. The planning boards in Newmarket and Epping have fulltime administrative assistants who assist both the planning boards and the code enforcement officer. Lee has a parttime planning assistant.

### Town Infrastructure

Lee and Durham provide no public water or sewer hookups in the corridor and have no plans to do so. Public sewers in Epping extend throughout the downtown area, generally east of Rte. 125 and south to MacDonald's. The water system includes generally the same area. In Newmarket virtually all of the properties on Rte. 108 and Packer's Falls Road are on public water. All but four are on public sewers.

### Land Ownership Patterns Along the River

Table 5 on the following page highlights the extent to which land abutting the river in each of the study towns has been subdivided.

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<sup>163</sup>Durham also has an historic district commission to govern activities in the downtown Durham district.

Selected Information on Privately Owned Lamprey Riverfront Lots  
Winter/Spring 1993 - Table 5

	Newmrket	Durham	Lee	Epping <sup>1</sup>	Total
No. of Lots	53 <sup>2</sup>	57 <sup>3</sup>	103 <sup>4</sup>	110	323
No. of Owners	37 <sup>2</sup>	45 <sup>3</sup>	88	98	268
<b>Lots by frontage</b>					
<75'	7	1	3 <sup>5</sup>	4	15
75'-200'	22	21	35	32	110
201'-500'	19	16	28	21	84
501'-1,000'	4	5	19	24	52
>1,000'	1	14	20	30	65
Maximum frontage	1,700'	10,050'	5,000'	5,475'	
Lots w/ >1,000' as rough % of total town frontage	18%	37%	55%	66%	
<b>Lots by acreage</b>					
<1/2 acre	12	1	17	4	34
1/2 - 3 acres	35	28	38	37	138
3+ - 15 acres	6	17	30	40	93
15+ - 50	0	7	8	15	30
50+ - 150	0	2	10	11	23
>150	0	2	0	1	3

<sup>1</sup>All data except frontage missing for two lots, 11-7 and 8-104.

<sup>2</sup>Excludes all condominium owners (except developer) but includes condominium lots.

Summary also includes all lots on river east of Packers Falls Road.

<sup>3</sup>Excludes Cold Springs Road common area.

<sup>4</sup>Excludes two lots owned by the University of New Hampshire totalling 9,200' of frontage and 310.6 acres.

<sup>5</sup>Excludes undeveloped island.

Most of the development that has occurred along the river has been residential, with an occasional commercial building in Newmarket and Epping and occasional commercial uses, particularly campgrounds.<sup>164</sup> Municipal lands used for recreation are summarized in Table 2. Other town holdings include land associated with the water treatment plant (Newmarket), with the wastewater treatment plant (Epping), and with a utility building on Mill Street (Epping). There is only one state-owned parcel, in Epping, totalling 75' of frontage and 8,000 ft<sup>2</sup>, map/lot 12-418.

Following is ownership information on the North, Little, and Pawtuckaway rivers.

**Private Holdings on the North River  
Winter/Spring 1993 - Table 6**

	<u>Lee</u>	<u>Epping</u>	<u>Total</u>
No. of Lots	14	9	24
No. of Owners	11	8	19 <sup>1</sup>
Lots by frontage			
<75'			
75'-200'	1	1	2
201'-500'	3	1	4
501'-1,000'	5	5	10
>1,000'	6	3	9
Lots by acreage			
<1/2 acre	0	0	
1/2-3 acres	2	3	5
3+-15 acres	8	3	11
15+-50 acres	4	1	5
50+-150 acres	2	2	4
>150 acres	0	0	0
No. of lots w/ one or more buildings	7	4	11

<sup>1</sup>Information on ownership and development status is unavailable for one lot in Epping.

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<sup>164</sup> About two-thirds of the riverfront lots are developed with at least one residence or commercial building. Riverfront lots representing wholly undeveloped land total more than 2,328 acres, a figure which actually underrepresents the amount of undeveloped land along the river since buildings occupy only a small portion of the larger lots. On the other hand, many of the vacant lots are small, most likely lots in subdivisions.

Private Holdings on the Little and Pawtuckaway Rivers  
Winter/Spring 1993 - Table 7

	<u>Little/Lee</u>	<u>Pawtuckaway/Epping</u>
No. of Lots	22	11
No. of Owners	18	8 <sup>1</sup>
Lots by frontage		
<75'		
75'-200'	1	0
201'-500'	9	2
501'-1,000'	3	5
>1,000'	9	4
Lots by acreage		
<1/2 acre		
1/2-3 acres	8	0
3+-15 acres	11	6
15+-50 acres	1	3
50+-150 acres	2	1
No. of lots w/ one or more buildings	13	6

<sup>1</sup>Acreage, ownership, and development information not available for one lot in Epping.

There is one town-owned lot on the Little River, totalling 6.6 acres with 1,125' of frontage off West Mill Pond (Lee Hill) Road.

Future land use patterns will be determined by local zoning and the independent decisions of hundreds of current landowners, or their successors. To remove any possibility that their land will be developed after they cease to control it, a landowner may decide to sell or gift land to a conservation organization or town, with restrictions as to its future use. A landowner may also retain ownership of the land as private property but permanently restrict the uses to which the land may be put by putting a conservation easement or other deed restriction on it.

The two maps entitled "Protected Lands and Institutionally Owned Lands" show where public and private conservation lands presently exist throughout the four towns. The maps include nearly 2,000 acres of land controlled by the University of New Hampshire that are not necessarily permanently protected. Table 8 on the following pages summarizes ownership and protection status of the mapped properties.

Data on Individual Parcels Mapped as Protected Lands  
Table 8

Note that this information has not been verified with landowners or local officials. It should be checked before applied to other uses.

<u>Parcel Number</u>	<u>Parcel Name</u>	<u>Type of Protection</u>	<u>Size(acre) Deed/Map</u>
1	Brown	CE - Lee	19.6/21.1
2, 4	Woodman Farm	UNH ownership	NA/470.7
3	Foster Properties, Ltd	CE - Lee	60.1/61.3
6			NA/29.4
7	UNH Property	UNH ownership	NA/169.8
8	Johnson Creek	Set aside - Durham	22.7/24.3
9	Steppingstone Rd #1	Restricted - Lee	17.8/18.6
10	College Woods	UNH ownership	NA/378.6
11	Spruce Hole Conserv Area	Restricted - Durham	20/36
12	Steppingstone Rd #2	Restricted - Lee	9.7/11.2
13	Stolworthy Wildlife Sanc	Restricted - Durham	3.5/5.9
14	Wagon Hill Farm	Restricted - Durham	130/134.6
15	A.C. Durgin Preserve	Restricted - Lee	21/19.7
16	Lee Town Forest	Restricted - Lee	78/79.9
17	James Farm	Restricted - Lee	14.8/13.9
18	Deer Point	Set aside - Durham	13.5/13.3
19	Foss Farm West	UNH ownership	NA/449
20, 26	Foss Farm East	UNH ownership	NA/164.8
22	Macdonald Lot	UNH ownership	82.8/95.3
23	Linn Ponds	CE - Durham	3/3.5
24	Durham Pt Rd Forest	Restricted - Durham	41/50.6
25	Claridge	CE - Lee	75.8/80.5
28			NA/3.4
29	Horsehide Creek	Restricted - Durham	11/15.7
30	Little River Parcel	Restricted - Lee	6.7/7.1
31	Carriage Trail Estates	Set aside - Durham	60.8/63.1
32	Langmaid Farm	Restricted - Durham	44/52.5
33,35,36	Earle	CE - SPNHF	143.4/144.7
34	Colby Marsh	Restricted - Durham	15/12.8
37, 40	Keniston	Ag Rstrctn - Dept Ag	73.1/73.5
39,45,47,51	Doe Farm	Restricted - Durham	80/92.4
41			NA/1.7
42	Brown & Beckwith	CE - NH Fish & Game	118.4/123.2
43	Packer's Falls	Restricted - Durham	3.5/4.8
46	Wiswall Dam	Restricted - Durham	2.5/5.3
38	Davis Park	UNH ownership	11/11.1

<u>Parcel Number</u>	<u>Parcel Name</u>	<u>Type of Protection Acres</u>	<u>Deed/Map</u>
49	Ellingwood Property	Restricted - Durham	7/8.5
50	Burley-DeMeritt Farm	UNH ownership	197.7/209
52,53,54	Stagecoach Farm	Set aside - Durham	66.9/64
55	Riverside Farm	CE - Lee	NA/35.4
56	J.R. Collier Corp	Set aside - Durham	14.5/15
57, 58	Riverside Farm	Set aside - Lee	NA/62.4
59,62,63	Cheney-England Ltd Ptnsp	Restricted - NH F&G	21.2/20.9
60	Cheney East Corp.	Restricted - NH F&G	6.3/7.1
61, 66	Folletts Brook	Restricted - Nwmrkt	28/27.5
63, 65	Cheney-England Ltd Ptnsp	CE - NH F&G	5.9/5.8
64	Cheney	CE - NH F&G	3.4/4.1
67	Trotter Park	Restricted - Nwmrkt	8.5/9.3
68	Schultz Place	Set aside - Newmarkt	24.9/21.3
69	Rte. 152 Parcel	Restricted - Nwmrkt	42/44.3
70,71,72	Heron Point	Set aside - Newmarkt	17.3/12.7
73	SMAS	CE - NHF&G	29.4/30.1
74, 75	Moody Point	Set aside - Newmarkt	114.8/118.7
76, 78	Durrell Woods	Set aside - Newmarkt	74.3/75.4
77	Norton Woods	CE - Newmarket	NA/34.9
79,80,81	Doe Farm	CE - Newmarket	NA/11.4
82	Sewall Farm	Set aside - Newmarkt	49/49.4
83	Lita Lane Parcel	Restricted - Nwmrkt	19.5/20
84	Schanda Farm	Set aside - Newmarkt	71.8/72.7
85	Sanborn Memorial Forest	Restricted - SPNHF	27/32.6
86	George Falls Woods	Restricted - Epping	14.4/14.9
87	Hoar Property	UNH ownership	69.6/70.2
88	Scout Field	Restricted - Epping	12/12.9
89	Unnamed Parcel	Restricted - Epping	5.5/6.2
90, 92	Goodrich Marsh	Restricted - NHWtfwl	34.6/35.6
91	Wheelabrator Epping	CE - Epping	8.5/8.3
93	Seymour & Fry	CE - Rockingham LT	4/4.7

## EXISTING REGULATIONS

This section summarizes major laws and regulations that presently govern land use within the corridor, water quality, flow, dams and diversions, riprap, wetlands, and related riverine and corridor features.

### Federal

Major federal laws applicable to the protection of New Hampshire rivers include the Clean Water Act, the National Flood Insurance Program, and the National Environmental Policy Act.

The Clean Water Act (33 USC 1334 et seq., 1977), which is implemented by both federal and state agencies, established the "swimmable, fishable" standards by which water quality is judged. It also prompted the state's antidegradation policy for water quality and created a number of grant and regulatory programs. Among them is the 404 permit program, designed to protect wetland and aquatic resources against any adverse impacts from dredge and fill activities. Although the US Army Corps of Engineers generally issues 404 permits, in New Hampshire the state wetlands board is authorized to issue "programmatic general permits" that serve both the federal and state programs. The Corps reviews all wetlands board decisions and contacts the owners of projects that the Corps determines merit additional review (roughly 10% of the permits issued).

The National Flood Insurance Program (44 CFR Ch. 1, 1968) provides federally subsidized flood insurance to property owners in flood-prone areas, as mapped on official Federal Flood Insurance Rate Maps (FIRMs), whose structures conform to municipally adopted minimum flood damage reduction standards. The program was designed to reduce flood damage to property, not to protect floodplain resources.

The National Environmental Policy Act (42 USCA Sec. 4321 et seq., 1970) requires federal agencies to evaluate the environmental impact of "major" federal actions and to consider alternative actions. Its aim is to foster more environmentally informed decisions.

### State

The NH Department of Environmental Services is responsible for monitoring and enforcing state water quality standards, monitoring instream flow, operating state-owned dams and permitting the construction of private dams, and permitting any activity occurring in rivers and wetlands. The Department also regulates terrain alteration activities involving 100,000 ft<sup>2</sup> or more. If the activity is within 250 feet of a great pond, coastal or estuarine waters, or 4th order or greater river, it falls under state jurisdiction at 50,000 ft<sup>2</sup>.<sup>165</sup> The NHDES's Subsurface Systems Bureau reviews all new or

replacement septic systems unless in subdivisions of lots of 5 acres or more. Where a lot falls within 250 feet of a great pond or 4th order or greater stream, any new or replacement system must be reviewed, regardless of lot size.<sup>166</sup>

The Department also administers the State Rivers Management and Protection Program. This program was created in 1988 to ensure additional protection for the state's outstanding rivers. As has been indicated, the segment of the Lamprey from the Lee/Epping town line to the Durham/Newmarket town line is in the state rivers system as a "rural" river. The additional protection afforded rural rivers focuses on instream values, particularly water quality and flow.

By definition, rural rivers "shall be maintained and protected from significant discharges, unless the petitioner can prove to the Division [of Water Supply and Pollution Control], in accord with the state's antidegradation implementation policy, that allowing limited water quality degradation is necessary to accommodate important economic and social development in the area in which the receiving water is located. In allowing limited degradation or lower water quality, the applicant shall provide adequate scientifically valid documentation to the Division that existing uses and water quality standards shall be fully protected."<sup>167</sup>

The law prohibits new dams on the Lamprey and precludes the use of flashboards to raise the height of any existing dam. By law, water may not be transferred from the Lamprey out of the Coastal River Basin, nor shall permits be issued for any new channel alteration activities "which interfere with or alter the natural flow characteristics of the river or segment or which adversely affect the resources for which the river or segment is designated."<sup>168</sup> The law establishes, by rulemaking, a protected instream flow level, unique to each river in the system. The proposed rules, released in July 1994, identify a rate of flow at which users must initiate conservation measures to reduce their withdrawals and one where all water withdrawals except withdrawals for human consumption and fire emergencies must ceased until such time as the flow is sufficiently restored. The proposed rules recognize seasonal differences and establish seasonal triggers.

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<sup>165</sup>In the Lamprey watershed, this provision applies to all reaches of the Lamprey below its junction with the North Branch River except the portion in Lee and Durham. It applies to the North River from its junction with the Bean River, and to the Bean River from its junction with the north outlet of Pawtuckaway Pond.

<sup>166</sup>The standards affecting activity within 250' of public waters were passed in 1993 and apply to all public waters except those rivers in the State Rivers Management and Protection Program as of the time the legislation was passed. These rivers, including the Lamprey, are exempt from protection measures as of the present time.

<sup>167</sup>Part Env-Ws 437 ANTIDEGRADATION. This policy is the same for surface waters that exceed the minimum criteria for their legislated classification.

<sup>168</sup>NH RSA 483:9-a IV.

Two provisions of the state program directly regulate land-based activities. No new solid waste landfills will be permitted within the 500 year floodplain, and any new landfill within the 1/4 mile corridor must be set back at least 100' from the 500 year floodplain and screened vegetatively; existing facilities are unaffected, provided no degradation occurs to areas lying beyond those identified in permits in place at the time of designation. Land applications of solid waste, except manure used as fertilizer, must be incorporated immediately into the soil and set back at least 250' from the normal highwater mark.

The law also creates permanent local river management advisory committees for each of the designated rivers. Although appointed by the Commissioner, members are recommended by the local governing body to represent a broad constituency. The committees are charged with considering and commenting on "any federal, state, or local government plans to approve, license, fund, or construct facilities that would alter the resource values and characteristics for which the river or segment is designated." They are also responsible for developing or assisting in the development and adoption of local river corridor management plans and reporting annually to the state advisory committee and the commissioner.<sup>169</sup> (This document provides background information for the local corridor plan required under RSA 483.)

By law the river corridor plan must address recreational issues, nonrecreational uses, existing land use, protection of riparian areas, fish habitat, wetlands, "and other significant open space and natural areas," dams, bridges and other water structures, access, setbacks, dredge and fill activities, earth moving, and prohibited uses.<sup>170</sup> While advisory only, the plan is designed to prompt changes to local zoning and other regulatory measures that fail to conform with recommendations, as well as highlight opportunities for communities to capitalize on riverine resources.

Larger rivers in the state that were not in the State Rivers Management and Protection Program as of 1/1/93 and all lakes and ponds of 10 acres or more are governed by the NH Shoreland Protection Act, RSA 483-B, which became effective in July 1994. The law applies to the Lamprey River from its junction with the North Branch River in Raymond, in Epping, and in Newmarket. It also applies to the North River, from its junction with the Bean River in Nottingham. It establishes minimum standards for timber harvesting, clearing, and development of land within 250' of the water's edge aimed at preventing water pollution, protecting buildings and lands from flooding and accelerated erosion, and other public purposes.

Other state laws directly relevant to river protection include:

- water protection planning assistance (RSA 4-C:19-23);

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<sup>169</sup>NH RSA 483:8-a, III.

<sup>170</sup>NH RSA 483:10, II.

- excavation requirements, specifically the prohibition against excavation within 75' of any navigable river or great pond and 25' of any perennial stream (RSA 155-E:4 II-a);
  - timber harvesting law, specifically limiting basal area cut within 150' of a river to ≤50% unless for development and prohibiting slash (RSA 224:44);
  - pesticide application requirements, specifically the regulation of pesticides near any stream or other surface waters per rules adopted under RSA 541-A (RSA 430:46)
  - enforcement of legislated water quality classifications (RSA 485-A:12);
  - terrain alteration requirements for 50,000 and 100,000 ft<sup>2</sup>, see above (RSA 485-A:17);
  - septic setbacks (RSA 485-A:29, A:32, Env.-Ws 1008.03, and RSA 483-B:9 V(b));
  - dredge and fill laws, specifically no activity in a river or riverbank without a permit (RSA 482-A:3);
  - motor boat operating restrictions, particularly, speeds no greater than headway speed within 150' of the shoreline (RSA 489 and RSA 270:12); and
  - endangered wildlife and plant protection (RSA 212-A and RSA 217-A, respectively).

### Municipalities

While the State exerts regulatory jurisdiction over water and wildlife resources, most land use decisions occur at the local level. Table 9 summarizes existing local land use regulations affecting the river corridor in the four study area towns.

**Summary of Local Land Use Regulations, as of 6/93**  
**Table 9**

	Newmarket	Durham	Lee	Epping
Zoning (all basic restrictions affected by overlay districts)	Contains several zones; vpd soils and water-bodies may not be used to fulfill lot size; <25% pd soils	Rural: 2.75 ac.; ≤20% lot cover by bldgs; ≤ 25% pd soils; no vpd soils; minimum shore frontage - 200'	Residential: 2 ac., 64,000 ft <sup>2</sup> must be "developable," ≤25% impervious lot coverage	Lgely Residential: 40,000 ft <sup>2</sup> ; ≤30% lot coverage by bldgs, vpd soils excluded from lot size determination where > 1 dwelling unit/lot; Rural
Shoreland	YES - 125' setback for permanent structures; 75' septic setback; no cutting of trees >10" in diameter. Marinas in mill & village district exempt	YES - 125' setback for structures; 150' septic setback; restricts chemical use, tilling w/in 75'; limits vegetation cuts w/in 150' of river, 75' of perennial streams. No clear cuts	YES - 100' setback for roads, structures, septic; limits vegetation cuts. No clear cuts	YES - 100' setback for permanent structures unless water-related
River Access	1 per lot, up to 20% lot frontage	1 per lot, up to 10% lot frontage	Not addressed	1 per lot up to 20% for commercial enterprises. Silent as to residential.

	Newmarket	Durham	Lee	Epping
Floodplain	Code enforcement officer reviews projects proposed for flood hazard areas; no increase in flood levels from activity in regulatory floodway. Base flood elev. determined-100-year floodplain mapped	Bldg inspector reviews applications; no activity in regulatory floodway may cause any increase in flood levels; reg. floodway mapped to Wiswall Dam. 100-year floodplain mapped	Development in regulatory floodway may not increase base flood discharge - but flood hazard zone and floodplain are defined as undevelopable for lot size determination. 100-year floodplain mapped	Bldg inspector must issue permit for building in flood hazard area; no increase in flood levels from activity in regulatory floodway; 100, 500 year floodplain, reg. floodway mapped.
Wetlands	YES - p, vpd soils, bogs, marshes, ponds, major streams. No structures, no change of configuration; No dredge or fill in vpd soils	YES - p, vpd soils, surface waters (incl. rivers); 50'-75' setback for structures; 75' septic setback. PB may grant conditional uses, but limited by buffer zone provisions	YES - p, vpd soils, marshes, bogs, swamps. No structures, no change of natural surface configuration. SE for activities w/in 75'; 125' leachfield setback; no structures w/in 75'. Taxed as open space, undevelopable	All wetlands as defined in RSA 483-A. No alteration w/out Site Plan Review or variance; hydric A soils may not be used to fulfill lot size requirements in subdivisions.
Aquifer	YES - .64 sq mi; for water supply protection $\leq$ 20% impervious surface, same use as overlying district w/ prohibitions	YES - $\leq$ 25% impervious surface. PB and Council review runoff plans; all uses conditional; minimize road salt. Hydrology study required for projects w/ $\geq$ 10 lots; sewer hookups required	YES - $\leq$ 10% impervious. Low density residential. Certain prohibitions re. salt, underground tanks	YES - 3 ac. lots, $\leq$ 10% impervious coverage; no road salt. Excavation by SE
Agriculture	Permitted in RR zone only	Permitted in R, RC zones. Prohibited in RA, limited in RB. No till w/in 75' rivers	Permitted in all zones, per standards or by SE	Permitted in R, RR; limited to nurseries, garden supplies in HC; limited as above and by SE in R-C
Cluster	YES - 20 to 100 acres, in residential zones only. Formula for determining density incl. reduction for limited soils & no net increase in # of lots; performance std.; open space $>$ 25%	YES - $\geq$ 20 ac, 20% in open space, residential and nonresidential. Provides for greater density w/ formula for calculating net acreage; Council approves	YES - $\geq$ 20 ac, $\geq$ 25% open space, residential only, community water. No increase in overall density allowed.	YES - $\geq$ 10 ac, residential only, no community septic. $\geq$ 50% of tract in open space, excluding slopes $>$ 15% and 75% of vpd soils. No increase in overall density allowed.
Excavation	Town excavation ordinance, per RSA 155-E; annual site plan review	Requires conditional use permit in resid. and office/research zones; not permitted in rural zone	Requires site plan review; allowed only in commercial zone	Permitted in R and RR zones per RSA 155E and Epping Earth Excavation Regulations
Slopes	Zoning and subdivision silent. SPR authorizes PB to determine "steep slopes" unsuitable for development	Steep slope identified as criterion for conditional use decisions; slopes $\geq$ 25% considered in PUD open space and lot calc.	Slopes $\geq$ 15% defined as undevelopable for lot size determinations	Slopes $\geq$ 15% defined as nonbuildable for lot size and open space calcs in cluster development. Subdiv. regs. ( $>$ 4 lots?) exclude slopes $>$ 35% from lot size calcs; leaching area must be on $<$ 25% slope. Lot size also subject to soil types.

Vpd = very poorly drained (soils); pd = poorly drained (soils); SE = special exception

As of 7/94, the State Shoreland Protection Act applies to Newmarket and Epping except where local requirements are more stringent.

### Town by Town Summary<sup>171</sup>

**Newmarket:** Zoning Ordinance - 3/13/90; Subdivision Regulations - 3/26/91; Site Plan Review - 12/88.

Most of the Lamprey River frontage in Newmarket is developed. The area falls into six zoning districts - the village and mill redevelopment districts around the Macallen Dam, a business district along Rte. 108, and residential districts (R-1, R-2, and rural) elsewhere in the study area. It is characterized by impressive stone mill buildings immediately adjacent to the dam, commercial development in the downtown and along Rte. 108, and single family houses, duplexes, and condominium complexes. Although the condominium structures are built right on the river, the river stretches dominated by older homes are reasonably well vegetated.

Forty-one buildings along the river in the study area are listed on the National Register of Historic Places as part of the Newmarket Industrial and Commercial Historic District. The zoning for this NRHP site is mixed. Some of this District lies within the Mill Redevelopment District. This district specifically recognizes the mitigation value of "visual and pedestrian access to the waters at controlled locations on both sides of the Lamprey."

Newmarket has shoreland conservation, floodplain development, aquifer protection, and wetlands conservation overlay districts, although no significant aquifers occur along the Lamprey. The shoreland conservation zone applies to all land within 125' of the Lamprey and Piscassic rivers, Follett's Brook, and tidal marshes. Its purpose is "to mitigate the costs occurring to the community as a result of vegetation removal from shoreland banks and/or water inundation through the destruction of flood storage areas. Concurrently, the zone will conserve the natural environment as a natural wildlife habitat and buffer zone." To this end, and to avoid the "destruction of aesthetic qualities" the ordinance prohibits any structures with toilet facilities, any seasonal or year-round homes, any permanent structures except water-related facilities, and cutting of trees >10 inches in diameter within 125' of the river. Roads, access ways, and/or utilities are subject to site plan approval, and up to 20% of the total river frontage under one ownership may be developed as a single access point.

Newmarket's Floodplain Development Ordinance applies to all properties in the special flood hazard areas ( $\geq 1\%$  possibility of flooding in any given year as mapped by the Federal Emergency Management Agency for flood insurance purposes). It is designed to insure that new construction and improvements are resistant to flood damage and establishes certain information that the code enforcement officer must have before s/he issues a building permit. The code enforcement officer is charged with determining 100 year flood elevations in the special hazard areas.

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<sup>171</sup>Throughout this section unless otherwise noted all quoted materials are from the relevant local ordinance, regulations, or master plan.

The Wetlands Conservation District includes all poorly and very poorly drained soils as delineated by the US Soil Conservation Service, unless amended by site specific determinations by a qualified soil scientist. The ordinance prohibits both structures and dredge and fill in wetlands, except as commonly accessory to permitted agricultural, forestry, recreation, well water supply, and conservation activities. In very poorly drained soils, such footbridges, catwalks, and wharves are permitted only by special exception. The planning board may issue conditional use permits for roads and other access ways and utilities. Nonconforming lots within the district may be developed by special exception, and additions to preexisting homes in the district are permissible.

Newmarket's subdivision regulations apply to any subdivision of land into more than three lots. They authorize the planning board to provide against scattered and premature development or development of unsuitable land. Cluster subdivision is subject to performance standards contained in the zoning ordinance and to subdivision review. At least 25% of the gross land area must be dedicated as permanent open space, of which at least 50% must be developable land; the actual amount and location of setaside land are at the planning board's discretion. The board must require posting of a performance guarantee for roads and utilities, including drainage systems. Leachfields must be 4,000 ft<sup>2</sup> or twice the required size, whichever is larger.

The site plan review regulations require stormwater plans, which must address projected downstream impacts from runoff. The board may mandate the preservation and dedication of wetlands to reduce the impacts of off-site flooding or find certain land (whether steep, wet, ledgy, or otherwise restricted) to be unsuitable for development. Projects located in special flood hazard areas as defined in the Flood Insurance Rate Maps and flood boundary and floodway maps are subject to additional restrictions to minimize flood damage and health risks to wells and septic systems. Site plans must show the 100-year flood elevation.

Newmarket's 1988 Master Plan defines several attributes of the Lamprey River that the Town values, including the shorelines, which "should be protected against potential detriment of quality or quantity [of surface and ground waters] that may be proposed by new development or a conversion of use" (Goal 5) and preserved where undeveloped (Goal 7). Preservation of existing wildlife habitat (Goal 6) and historic resources (Goal 14) are also expressed community goals. The Plan identifies areas of steep slopes  $\geq 25\%$ , like the south shoreline of the Lamprey River in the downtown area, as "best suited for wildlife habitat and passive recreational uses." Newmarket looks to the Lamprey for future water supplies and respects the river's role in the town's history.

In 1993 the town began an update of the 1988 Plan. As part of this update the town surveyed residents. In a fill-in-the-blank question about favorite places to visit or spend time in town "waterfront" ranked first. Seventy-six percent of those responding (believed to be a representative cross section of the population) said the town should purchase or protect land for public use or open space preservation. Regarding tax

dollar expenditures, 87% ranked environmental protection as a "most important" reason (51%) for municipal expenditures or "of some importance" (36%), and 72% ranked expenditures for water access as a "most important" reason (28%) or "of some importance" (44%). Ninety-five percent believe the environment will be a "most important" concern (63%) over the next ten years or "of some concern" (32%) in terms of tax dollar expenditures. About half of the townspeople make use of the river or the Bay.<sup>172</sup>

The 1994 update calls protecting the Lamprey (among other waterbodies) "against detriment of water quality or quantity," addressing threats to water quality in Town regulations and policies, and supporting a strong Conservation Commission "for ongoing preservation and protection of Town resources." It also recommends the development and implementation of zoning and site plan review regulations to preserve and protect the town's historic character and consideration for both the creation of an Historic District Commission and an historic landmark plaques program. It recommends all development in Newmarket be done with "due regard to the protection of the terrestrial resources and aesthetic beauty of the town, including limits to development in important areas" such as Tuttle Swamp, the Lamprey River Estuary, and Follots Brook/Newmarket Plains.<sup>173</sup>

**Durham:** Zoning Ordinance - 10/8/90; Subdivision - 12/12/90; Site Plan Review - 12/12/90.

Unlike the other towns in the study area, Durham gives the Town Council final authority over zoning ordinance amendments. The Council regularly makes refinements.

All of the land within the corridor is zoned Rural, where "customary rural land uses will be preserved." Low density (120,000 ft<sup>2</sup>) development and agricultural uses are allowed by right, including single detached dwellings, bed-and-breakfasts, commercial greenhouses, public recreational uses, professional offices, and seasonal campgrounds (per RSA 676:4). Conditional use permits, authorized by the Town Council, allow for planned unit developments, private airstrips, year-round campgrounds, and educational and religious uses. The area presently reflects dispersed development with only small subdivisions (e.g., Cold Springs Road, Sullivan Falls Road) well screened from the river.

The shoreland protection zone, aquifer protection district, flood hazard overlay district, and wetland conservation overlay district provide additional protection to the river corridor. The shoreland protection zone applies to all land within 150' of Great

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<sup>172</sup>Preliminary results, Strafford Regional Planning Commission.

<sup>173</sup>Newmarket Final Draft Master Plan, 12 July 1994, prepared for the Newmarket Planning Board by the Strafford Regional Planning Commission, pp. I-11, II-9, IX-4, and IX-5.

and Little Bays, the Oyster River, Lamprey River, and Follett's Brook, and land within 75' of all other perennial brooks, excluding College and Pettee brooks. The ordinance requires a 150' setback for all septic systems and a 125' setback for all other structures in the 150' zone (75' building setback in the 75' zone). The ordinance specifically recognizes the importance of rivers as wildlife travel corridors. It allows one access point to the water, developed on no more than 10% of the river frontage, and requires that any cutting or pruning of the "overstory, understory and ground cover" result in "well-distributed stands with varying levels of maturity and vegetative cover." At least 50% of the vegetation must be maintained in its "existing undisturbed natural" condition. The ordinance prohibits or restricts certain activities (e.g., feedlots, excavation and fill, chemical applications, storage of hazardous wastes) in the protected shoreland zone. It resulted from petitions in the late 1980s favoring new shoreland ordinances supported by 89% of Durham's Lamprey riverfront landowners.

Durham's Aquifer Protection District protects all aquifers in Durham, of which the two largest lie partly or wholly within the Lamprey River corridor, one at the proposed golf course near the Newmarket town line (Benevento property) and one around Spruce Hole Bog. The protected zone includes all delineated portions of the aquifers (including influence areas where flows are less than 500 ft<sup>2</sup> per day).<sup>174</sup> The ordinance restricts impervious surfaces to <25% per lot (size of lots is governed by the underlying district), requires additional measures for runoff control, restricts the use of deicing chemicals, prohibits certain activities, allows other activities by conditional use permit, and requires town water and sewer hookups.

The Flood Hazard Overlay District applies to lands designated on the Flood Insurance Rate Maps (FIRMs) as special flood hazard areas (subject to the standard ≥1% possibility of flooding in any given year). The ordinance requires a building permit for any proposed development in special flood hazard areas and for any on-site water and sewer systems. All new or improved structures must be floodproofed to the 100-year flood elevation, as determined by the building inspector. Development in the regulatory floodway or in FIRM Zone A may not cause any increase in flood levels during the base flood discharge. Where no regulatory floodway has been mapped, the cumulative impact of proposed, existing, and anticipated development may not increase the water surface elevation more than 1' anywhere in the community. Within the town of Durham, the regulatory floodway conforms closely with the riverbanks.

The Wetland Conservation Overlay District governs activities on or within 75' of poorly and very poorly drained soils as defined in the Key to Soil Drainage Classes,<sup>175</sup> surface waters, and saltwater wetlands. Activities permitted by right or conditional use

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<sup>174</sup>Conversation with Durham Planning Director Rob Houseman 10/12/93.

<sup>175</sup>Found in the Society of Soil Scientists of Northern New England document High Intensity Soil Maps For New Hampshire, May 23, 1986.

in a wetland are nearly identical to those in Newmarket. Up to 25% of the poorly drained soils in an area may be used to meet lot size requirements in unsewered areas; no surface water nor very poorly drained soils may factor into minimum lot size determinations. The ordinance creates a 75' setback for septic systems, a 50' buffer along poorly drained soils for structures, roads, and utilities, and a 75' buffer along very poorly drained soils. Failed septic systems within 75' of a wetland may not be relocated within the buffer unless the health officer determines that no alternative placement is possible.

The subdivision regulations apply to any subdivision of land into more than two lots. Drainage plans are subject to Public Works Department review and approval. The zoning ordinance calls for retention of wooded and nonwooded natural areas, including specimen and historically significant trees.

The Town has standard site plan review regulations.

Durham's Master Plan Update, May 1989 identifies the area through which the Lamprey River flows as limited by soils for extensive development. The future land use plan designates land immediately adjacent to the river as "wildlife areas/recreational corridors." Although the Lamprey River lands were not identified as the town's highest acquisition priorities, it is a policy of the Parks and Recreation Committee to "[m]aintain and acquire green belts along both the Oyster and Lamprey Rivers for use as a trail system where appropriate." This Committee also believes that the Lamprey River does not have "sufficient development and access for recreational uses."

The town's land use goal speaks to the river corridor and protection for environmentally sensitive areas, "including water sheds [sic], aquifers, ... floodplains and stream banks." The Plan recommends establishing a watershed overlay protection zone along rivers that may now or potentially serve as water supplies, and identifies the Lamprey River as one such source. It also cites the report of the Ad Hoc Committee on Conservation Lands (see Appendix G).

People in Durham clearly support the Master Plan's recommendations. An opinion survey conducted for the Plan indicated strong support for the preservation of wilderness areas for wildlife, hiking and skiing (172), land along rivers and Great Bay (170), water source areas (159), and active farm land (137). Cost-sharing by the town for the protection of open space received 167 yes responses, 11 no's, and 16 no opinion. One hundred forty-eight people indicated current use penalty money should go into a conservation fund, as opposed to 40 favoring allocation to the general fund. Additional parks or recreational facilities, however, were favored by only 32%.

**Lee:** Zoning Ordinance - 3/93; Subdivision - 3/93; Site Plan Review - 1991.

Except for a strip along rtes. 125 and 4, all of the land in Lee is zoned residential with wetland and aquifer conservation districts as overlays. Residential and agricultural

uses, municipal structures, and churches are allowed by right in the residential district. No commercial excavations are allowed. The zone requires 2 acre minimum lots, of which at least 64,000 ft<sup>2</sup> must be "developable," i.e., may not be floodplain, wetland, or sloped  $\geq 15\%$ . By special exception the zoning board may approve barbershops/beauty salons, educational facilities, professional and medical buildings, real estate offices, funeral homes, bed-and-breakfasts, recreation areas, health care and retirement facilities, kennels, and mobile home parks and recreational campgrounds. The corridor is predominantly rural in character, with several farms. Located on the river in Lee are three campgrounds and six subdivisions.

In addition to shoreland, aquifer, and wetland conservation overlay districts, Lee's ordinance provides for the transfer of development rights (TDR) from one parcel of land to another, causing a reduction in development density on the one parcel and an increase in permissible density on the other. Cluster developments are subject to subdivision, site plan review, and zoning ordinance standards.

Lee's Shoreland Conservation District includes all land within 100' of the Lamprey, North, and Little rivers. Within this district no roads, parking areas, driveways, permanent or temporary dwellings, wastewater disposal systems, and dredge or fill activity (except by permission of the planning board with conservation commission review) are permitted. Cutting of trees is limited to 50% of the basal area, "leaving a well distributed cover of healthy, growing trees or other vegetation" within the district. The conservation commission may grant exceptions to the cutting limitations. Otherwise, except as noted above, no exceptions are authorized.

The Aquifer Conservation District protects limited areas of potential high groundwater yields along the Lamprey as delineated in 1977 and 1973 USGS and SCS publications, respectively.<sup>176</sup> The ordinance permits low density residential development, farming, gardening, forestry, and recreational uses with no more than 10% impervious coverage per lot or tract of land. Performance standards govern temporary storage and use of farm chemicals. The ordinance prohibits subsurface storage of petroleum products, outdoor storage or dumping of road salts or deicing chemicals, certain waste disposal facilities, automotive servicing shops, and certain earth removal activities.

Poorly and very poorly drained soils, swamps, marshes, and bogs define the Wetlands Conservation Zone. Permitted are low intensity uses that require no structures, dredge, or fill. A special exception is required for any other type of activity in the zone or within 75' of the zone, subject to comment from the planning board, conservation commission, and health officer. In addition, septic systems must be set

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<sup>176</sup>US Geological Survey Map entitled "Availability of Groundwater in the Piscataqua and other Coastal River Basins of Southern New Hampshire" and US Soil Conservation Service map entitled "Soil Survey of Strafford County."

back 125' from the zone, no structures, excluding wells, are permitted within 75' of the zone, and all land in the zone is "appraised for tax purposes at its full and true value in money, based on its market value as undevelopable and required to remain in open space."

Lee's subdivision regulations define wetland, land in the FIRM-based flood hazard zone, land in slopes of more than 15%, and rights-of-way as undevelopable. If more than 25% of a tract is undevelopable, the planning board will reduce the allowable density on it. The regulations encourage preservation of existing natural features - trees, streams, rock outcroppings, and water. Cluster developments must retain at least 25% of the land as legally restricted (permanent) open space. The regulations authorize special studies and require bonding for public improvements. Recreational campgrounds are subject to subdivision review, must contain at least 20 acres, and are restricted to seasonal use.

The site plan review regulations also limit the amount of undevelopable land to up to 25% of the lot or tract. For each proposed leaching area, there must be at least two acceptable test pits, guaranteeing at least 5,000 ft<sup>2</sup>.

Lee's 1988 Master Plan (update begun in late summer, 1993) characterizes Lee as a largely rural community. A member of the Lamprey River Watershed Association, the town values its large tracts of undeveloped land as evidenced by the TDR provisions in its zoning ordinance, a capital reserve fund for land acquisition, the Plan's stated encouragement of cluster development, and support for two land conservation investment program projects (including one with Durham and totalling 209 acres protected by conservation easement). The Plan observes that "[l]and as well as water, forests, farmland, sand and gravel deposits, unique animal and plant habitat and the like are fixed and finite. Once altered, they are difficult or impossible to regain. An inventory of Lee's existing land and natural resources and uses, when matched with resident's present and projected needs can serve as a guide to developing future plans."

A 1994 Master Plan survey of residents included a question about acquiring and developing an historic preserve at Wadleigh Falls. Of the 764 respondents, 135 (18%) felt that preserving the Wadleigh Falls district was "very important"; 230 (30%) thought it was "somewhat important"; 205 (27%) thought it "slightly important"; and 194 (25%) thought it "not at all important."

**Epping:** Zoning Ordinance - 1990; subdivision regulations - 12/5/91; site plan review regulations - 1992.

Except for a small area in West Epping south of the river and the downtown area, most of the land in Epping is zoned rural residential (northeast of Rte. 87 bridge) or residential. The residential zone has minimum lots of 40,000 ft<sup>2</sup> and allows for single family and duplex homes, churches, municipal buildings, essential services, outdoor

recreation, kennels, health care facilities, farms, and excavation of sand, gravel, and stone. Private schools, multi-family housing, and expansion of nonconforming uses are allowed by special exception. The rural residential zone has one-acre minimum lots and allows for single family dwellings, farms, churches, essential services, kennels, excavation, and sawmills. Outdoor recreation and expansion of nonconforming uses are allowed by special exception. The West Epping Business Zone allows for a multiplicity of uses, including light industrial and commercial, on 40,000 ft<sup>2</sup> lots.

The ordinance requires at least 15 acres for a campground and a 300' setback for campsites from waterbodies. Residential cluster developments require 350' frontage on a town or state maintained road and 10 acres of land, excluding ponds, lakes, marshes, very poorly drained soils, and slopes of 25%. Lot size determinations exclude slopes of  $\geq 15\%$  and very poorly drained soils. At least 50% of the development must be retained as permanent open space, with restrictions as to the type of land that may qualify.

Epping also has riverbank, floodplain, wetland, and aquifer protection overlay districts. Epping's Riverbank Protection District protects land within 100' of the Lamprey, North, Pawtuckaway, and Piscassic rivers from permanent structures except those "necessary for the legitimate use of the rivers by special exception." In no case may a structure within 100' of the river be built on the water, have running water, a septic system, or year-round habitation. Commercial enterprises are limited to one access point occupying up to 20% of the river frontage.

Epping's Floodplain Development Ordinance is based on the town's 1982 Flood Insurance Rate Maps and Flood Boundary and Floodway maps. The ordinance requires a permit for any new construction or substantial improvements to structures in any portion of the flood hazard area subject to a 1% or greater chance of flooding in any given year. The building inspector has primary responsibility for review and enforcement. Structures, including septic systems, must be designed to minimize or resist flood damage and downstream impacts. Construction or fill activities in the regulatory floodway that would cause any increase in flood levels are prohibited. In West Epping the regulatory floodway conforms closely with the riverbanks. Elsewhere the floodway generally exceeds the stream channel, by as much as 2,500'in one area between rtes. 125 and 87.

The Aquifer Protection District, based on a USGS report, "Geohydrology and Water Quality of Stratified-Drift Aquifers in the Exeter, Lamprey, and Oyster River Basins, Southeastern New Hampshire," applies to two relatively large aquifers in West Epping and Camp Hedding and to two smaller areas, one west of the central downtown area and one east of the river near the Lee town line. Within the districts, lots must be at least three acres, with no more than 10% impervious to groundwater infiltration. The ordinance cites prohibited uses (including use of road salt or other deicing chemicals), permitted uses, allows for special exceptions, requires special certification procedures for any new on-site septic system, and sets design standards for toxic and hazardous

chemicals and runoff. Mining is prohibited on aquifers of any size "capable of yielding quantities of groundwater usable for a municipal or private water system" under the town's Earth Excavation, Removal or Movement Regulations.

Epping's Wetlands Ordinance allows for construction of structures subject to site plan review and for other activities by variance. Wetlands are defined by reference to RSA 483-A (the State's wetlands law).

In addition to the requirements specified by the underlying district, lots created by subdivision must conform to minimum sizes based primarily on soil types, provided, however, that hydric A soils (very poorly drained soils, marshes, or surface waters) and slopes >35% are excluded from lot size computations. Septic systems must be setback 75' from very poorly drained soils and 50' from poorly drained soils. Drainage, water supply and waste water systems located in the floodplain must be designed for 100 year flood conditions. The regulations encourage protection of significant features, e.g., large or unusual trees, watercourses, and natural stone outcroppings. The review process includes a consistency review and recommendations by the regional planning commission, highway superintendent, code enforcement officer, and town administrator.

The site plan review regulations prohibit the removal of significant natural or historic features without planning board approval. Site plans also are subject to a review for consistency with town ordinances.

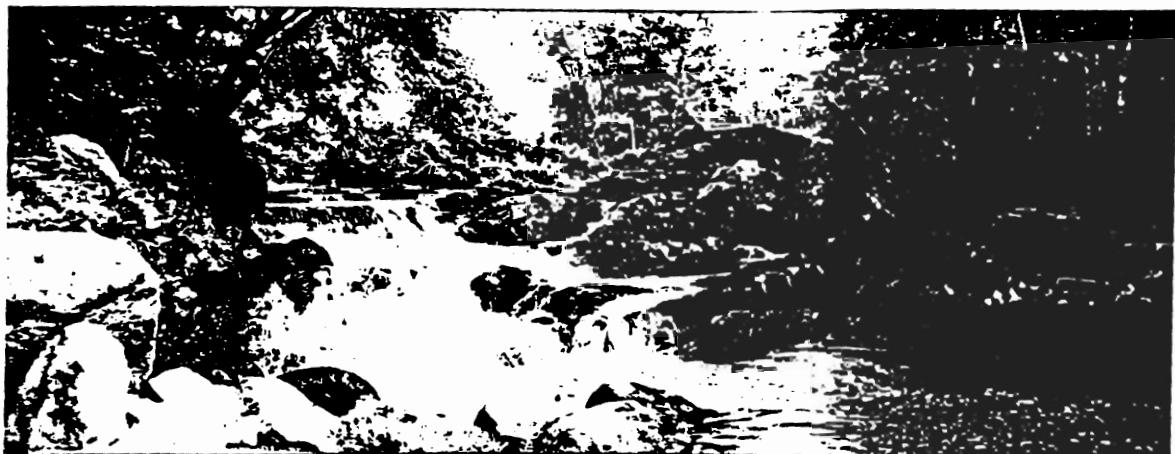
Epping's Master Plan, 1988,<sup>177</sup> while strong on diversified and expanded development, contains two goals directly relevant to Lamprey River resource protection, to "identify productive farmland, forestland, water sources, open space, scenic areas, wildlife habitats, recreation land, river corridors and frontage and tracts of land adjacent to protected land" and to "protect valuable natural resources from encroachment." River banks and water quality are identified as "two critical areas to be protected." The text speaks to the rich habitat along river, stream, and wetland corridors. It cautions that hydro development can destroy productive habitat, degrade water quality, and harm aquatic organisms. Prompted by the Master Plan's recommendation for a 150' setback along major rivers, the town voted to amend the then-existing 75' riverbank setback to 100'. The Plan also calls for preserving and enhancing the town's cultural and historic resources, of which Camp Hedding is the largest single such example.

Respondents to a master plan survey of residents (168 total respondents) indicated a strong desire to protect and preserve water supplies (96%), historic buildings (89%), forests (88%), wetlands (84%), open space (80%), and farmlands (79%). Only 8% espoused unlimited growth. Among capital expenditures, however, only 20% ranked acquisition of additional open space as very important, and 17%, more

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<sup>177</sup>Master Plan, Epping, NH 1998, prepared for the Planning Board by the Rockingham Planning Commission, December 1988.

recreational facilities compared with 27% and 36%, respectively, who ranked these expenditures least important.



## Appendix A

### Agricultural Soils of Importance in the Lamprey Corridor

#### Prime Soils

##### **Rockingham County**

26B Windsor loamy sand  
38A Eldridge fine sandy loam  
44B Montauk fine sandy loam  
62B Charlton fine sandy loam  
446A Scituate-Newfields complex  
446B " " "

##### **Strafford County**

BzA Buxton silt loam  
CfB Charlton fine sandy loam  
EaA Elmwood fine sandy loam  
On Ondawa fine sandy loam  
Po Podunk fine sandy loam  
SnB Sutton fine sandy loam  
WfB Windsor fine sandy loam

#### Statewide Importance

##### **Rockingham County**

32B Boxford silt loam  
42B Canton gravelly fine sandy loam  
42C " " " " "  
44C Montauk fine sandy loam  
62C Charlton fine sandy loam  
66C Paxton fine sandy loam  
460C Pennichuck channery very fine sandy loam

##### **Strafford County**

AcB Acton fine sandy loam  
BzB Buxton silt loam  
CfC Charlton fine sandy loam  
G1B Gloucester fine sandy loam  
PbC Paxton fine sandy loam

### Wetland Soils in the Lamprey Corridor

#### Very Poorly Drained

##### **Rockingham County**

97 Greenwood and Ossipee soils, ponded  
134 Maybid silt loam  
295 Greenwood mucky peat  
395 Chocorua mucky peat  
495 Ossipee mucky peat  
597 Westbrook mucky peat

**Strafford County**

Be Biddeford silty clay loam  
Fa Freshwater Marsh  
Mp Muck and peat

**Poorly Drained**

**Rockingham County**

33A Scitico silt loam  
305 Lim-Pootatuck complex  
314A Pipestone sand  
538A Squamscott fine sandy loam  
547A Walpole very fine sandy loam  
547B " " " "

**Strafford County**

LeA Leicester very stony fine sandy loam  
LeB " " " " " "  
LrA Leicester very stony fine sandy loam  
Ml Mixed alluvial  
RgA Ridgebury fine sandy loam  
Ru Rumney fine sandy loam  
Sb Saugatuck loamy sand  
ScA Scantic silt loam  
SwA Swanton fine sandy loam  
SwB " " " "

A = 0 to 3 percent slope

B = 3 to 8 percent slope

C = 8 to 15 percent slope

## Appendix B

### Fish Species Found in the Lamprey River (boldface indicates fish of sport or recreational importance)

#### Anadromous Fish

Trout Family:      **Atlantic Salmon**

Herring Family:      **American Shad**  
                        **Alewife**  
                        **Blueback Herring**

Lamprey Family:      **Sea Lamprey**

#### Freshwater Fish

Trout Family:      **Brook Trout**  
                        **Rainbow Trout**  
                        **Brown Trout**

Sunfish Family:      **Smallmouth Bass**  
                        **Largemouth Bass**  
                        **Pumpkinseed**  
                        **Redbreast Sunfish**  
                        **Bluegill**  
                        **Rock Bass**  
                        **Banded Sunfish**

Pike Family:      **Chain Pickerel**

Freshwater Catfish Family:      **Brown Bullhead**

Perch Family:      **Yellow Perch**

Minnow Family:      **Golden Shiner**  
                        **Bridled Shiner**  
                        **Common Shiner**  
                        **Blacknose Dace**  
                        **Longnose Dace**  
                        **Creek Chub**  
                        **Fallfish**  
                        **Swamp darter**

Temperate Bass Family:      **White Perch**

Sucker Family:      **White Sucker**

Freshwater Eel Family:      **American Eel**  
Source:    NH Fish & Game Department, fishermen

Appendix C  
 Bird Species Documented on the Lamprey River  
 April - November 1993, 1994  
 Compiled by Maggie Wittner

<u>Species Name</u>	<u>Status</u>	<u>Season Present</u>	<u>Occur. on River</u>
Blackbird, Red-winged	N	March-October	Common
Blackbird, Rusty	M	April	Uncommon
Bluebird, Eastern	N	March-October	Unc-Rare
Bobolink	N	May-August	Uncommon
Bobwhite, Northern	P		Release
Bunting, Indigo	N	May-September	Common
Cardinal, Northern	P	All	Common
*Catbird, Gray	N	April-October	Common
Chickadee, Black-capped	P	All	Common
Cormorant,			
Double-crested	M <sup>1</sup>	Mar/Apr-Sept/Oct	Common
Cowbird, Brown-headed	N	April-October	Common
Creepers, Brown	P	All	Uncommon
Crow, American	P	All	Common
Crow, Fish	P	All	Uncommon
Cuckoo, Black-billed	N	May-September	Uncommon
Cuckoo, Yellow-billed	N	May-September	Unc-Rare
Dove, Mourning	P	All	Common
Dove, Rock	P	All	Common
Duck, American Black	P	All	Uncommon
Duck, Pintail	M <sup>1</sup>	L Mar-Oct/Nov	Uncommon
*Duck, Wood	N	March-November	Uncommon
Eagle, Bald	V	Fall/Winter	Uncommon
Egret, Cattle	M <sup>1</sup>	L Apr-Nov	Rare/Unc
Falcon, Peregrine	M	April-Sept/Oct	Rare
Finch, House	P	All	Common
Finch, Purple	P	All	Uncommon
Flicker, Northern	N	March-November	Common
Flicker, Yellow-shafted	N	Spring-Fall	Common
Flycatcher, Alder	N	L May-L Aug	Uncommon
Flycatcher,			
Great Crested	N	May-September	Common
Flycatcher, Least	N	April-September	Uncommon
Flycatcher, Olive-sided	N	May-September	Uncommon
Flycatcher, Willow	N	May-	Rare
Gnatcatcher, Blue-grey	N	April-August	Uncommon
Goldeneye, Common	M	March-April	Uncommon
*Goldfinch, American	P	All	Common
Goose, Canada	M	Spring-Fall	Common
Goshawk, Northern	P	All	Uncommon
Grackle, Common	N	March-November	Common
Grebe, Pied-billed	M	March-September	Uncommon
Grosbeak, Evening	W	October-April	Common
Grosbeak, Rose-breasted	N	May-September	Common

P=Permanent    N=Nester    M=Migrant    V=Visitor    W=Winter Range

\*=Riparian species

Grouse, Ruffed	P	All	Common
Gull, Great Black-backed	P	All	Common
Gull, Herring	P	All	Uncommon
Gull, Ring-billed	P	All	Uncommon
Harrier, Northern	M	March	Uncommon
Hawk, Broad-winged	N	April-September	Common
*Hawk, Red-shouldered	N	March-September	Uncommon
Hawk, Red-tailed	N/P	All	Common
Hawk, Sharp-shinned	N	April-September	Common
Heron, Great Blue	N <sup>1</sup>	March-October	Common
Heron, Green-backed	N	April-?	Uncommon
Heron, Black-crowned Night	V?N	March-October	Uncommon
Hummingbird, Ruby-throated	N	May-September	Common
Ibis, Glossy	M	April-Sept	Uncommon
Jay, Blue	P	All	Common
Junco, Dark-eyed	W	October-April	Common
Kestrel, American	N	April	Common
Killdeer	N	March-September	Uncommon
Kingbird, Eastern	N	May-September	Common
*Kingfisher, Belted	N	March-December	Common
Kinglet, Golden-crowned	W	October-March	Uncommon
Kinglet, Ruby-crowned	N	March-December	Common
Loon, Common	M	April	Uncommon
Mallard	P	All	Common
Meadowlark, Eastern	N	March-September	Uncommon
Merganser, Common	M <sup>1</sup>	March-April/Winter	Uncommon
Merganser, Hooded	N	March-September	Uncommon
Mockingbird, Northern	P	All	Uncommon
Nighthawk, Common	M	May-August	Uncommon
Nuthatch, Red-breasted	P	All	Common
Nuthatch, White-breasted	P	All	Common
Oriole, Northern	N	May-September	Common
Oriole, Orchard	N	May-	Uncommon
Osprey	N	March-November	Uncommon
Ovenbird	N	May-September	Common
*Owl, Barred	P	All	Common
Owl, Eastern Screech		All	Unc-Rare
Owl, Great Horned	P	All	Uncommon
Owl, Northern Saw-whet <sup>2</sup>	P	All	Uncommon
Parula, Northern	M	May-September	Common
Phoebe, Eastern	N	March-November	Common
Raven, Common	P	All	Uncommon
Redstart, American	N	April-October	Common
Robin, American	N	March-Sept/Oct	Common
Sandpiper, Solitary	M	April	Uncommon
*Sandpiper, Spotted	N	April-October	Common

P=Permanent    N=Nester    M=Migrant    V=Visitor    W=Winter Range

\* = Riparian species

<sup>1</sup>Some individuals overwinter around rapids, open water. Several nesting Great Blue Heron colonies near corridor.

<sup>2</sup>Seen by Jay McKinley, former superintendent, Camp Hedding

Sapsucker,				
Yellow-bellied	M?N	April-October	Uncommon	
Snipe, Common	N	April-September	Uncommon	
Sora	N	April-	Uncommon	
Sparrow, American Tree	V	Winter	Uncommon	
Sparrow, Chipping	N	April-Oct	Common	
Sparrow, Field	N	April-October	Scarce	
Sparrow, Fox	M	March-November	Uncommon	
Sparrow, House	P	All	Common	
Sparrow, Lincoln's	M	September-October	Uncommon	
Sparrow, Savannah	N	May-September	Loc Comm	
*Sparrow, Song	N	March-November <sup>1</sup>	Common	
Sparrow, Swamp	N	April-Oct	Common	
Sparrow, White-throated	P	All	Common	
Starling, European	P	All	Common	
Swallow, Bank	N	April		
Swallow, Barn	N	April-September	Common	
*Swallow				
Northern Rough-winged	N	April-September	Uncommon	
Swallow, Tree	N	April-September	Common	
Swan, Mute	P	All	Introduced	
Swift, Chimney	N	April-September	Common	
Tanager, Scarlet	N	May-September	Common	
Teal, Green-winged	N	March-August	Rare	
Thrasher, Brown	N	April-September	Uncommon	
Thrush, Hermit	M	April-October	Uncommon	
Thrush, Swainson's	N	May-September	Uncommon	
Thrush, Wood	N	May-September	Common	
*Titmouse, Tufted	P	All	Common	
Towhee, Rufous-sided	N	April-September	Common	
Turkey, Wild	P	All	Uncommon	
*Veery	N	May-September	Common	
Vireo, Philadelphia	M	May-Oct	Uncommon	
Vireo, Red-eyed	N	May-September		
Vireo, Solitary	N	May-October	Uncommon	
Vireo, Warbling	N	May-September	Common	
Vulture, Turkey	N	March-L Oct	Common	
Warbler, Bay-breasted	N	May-September	Uncommon	
Warbler, Black-and-White	N	April-September	Common	
Warbler,				
Black-throated Blue	M	May-September	Uncommon	
Warbler,				
Black-throated Green	N	May-September	Common	
Warbler, Blackburnian	M	May-September	Common	
Warbler, Blackpoll	M	May-September	Common	
Warbler, Blue-winged	N	May-September	Loc Comm	
Warbler, Canada	N	May-September	Uncommon	
Warbler, Cape May	M	May-September	Uncommon	
Warbler, Cerulean	N in NH	May-September	Rare	
Warbler, Chestnut-sided	N	May-October	Common	
Warbler, Golden-winged	N	May-September	Rare	
Warbler, Magnolia	N	May-September	Uncommon	

<sup>1</sup>Some winter over.

Warbler, Nashville	M	May-Fall	Uncommon
Warbler, Palm	M	April-October	Uncommon
Warbler, Pine	N	May-Fall	Common
Warbler, Prairie	M	May-September	Uncommon
Warbler, Tennessee	M	May	Uncommon
Warbler, Wilson's	M	May-August	Common
*Warbler, Yellow	N	May-September	Common
Warbler, Yellow-rumped	M?N	April-October	Common
*Waterthrush, Louisiana	N	April-October	Uncommon
*Waterthrush, Northern	M	April-October	Uncommon
Waxwing, Cedar	P	All	Loc Comm
Whip-poor-will	N	May-August	Uncommon
*Wood-Pewee, Eastern	N	L May-L August	Common
Woodcock, American	N	March-November	Uncommon
Woodpecker, Downy	P	All	Common
Woodpecker, Hairy	P	All	Uncommon
Woodpecker, Pileated	P	All	Uncommon
Wren, Carolina	P	All	Unc-Rare
Wren, House	N	April	Common
Wren, Marsh	N	E May-L Sept	Unc/Local
Wren, Sedge	N	Mid-May-Mid-Sept	Rare/Local
Wren, Winter	N	April-October	Uncommon
*Yellowthroat, Common	N	May-October	Common

Dates of arrival and departure are based primarily on observations of Eleanor E. Barry for New Hampshire and Massachusetts, printed by Natural History Services.

## **Appendix D**

### **List of Reptiles in the Lamprey River Corridor Except as Otherwise Noted, Compiled by David Allan, 1970-1990 For the area off Lee Hook Road**

Smooth Green Snake  
Common Garter Snake  
Eastern Hog-nosed Snake  
Northern Water Snake  
Ribbon Snake  
Eastern Ringneck  
Racer (Black Snake)  
Milk Snake  
Redbelly Snake<sup>1</sup>  
Spotted Turtle  
Blanding's Turtle  
Snapping Turtle  
Wood Turtle  
Painted Turtle  
Musk Turtle<sup>2</sup>

<sup>1</sup>Sighting reported to NHRAARP from town of Lee.

<sup>2</sup>David Carroll, 1993, found throughout the river within study area

### **List of Amphibians in the Lamprey River Corridor Except as Otherwise Noted, Compiled by David Allan, 1970-1990 For the area off Lee Hook Road**

Jefferson Salamander  
Spotted Salamander  
Eastern Newt  
Redback Salamander  
Northern Two-lined Salamander<sup>1</sup>  
pring Peeper  
Gray Treefrog  
bullfrog  
Green Frog  
Wood Frog  
Northern Leopard Frog  
Pickerel Frog<sup>2</sup>  
Common American Toad

<sup>1</sup>Riverine salamander, likely to occur in Lamprey, per Jim Taylor,  
UNH.

<sup>2</sup>Sighting reported to NH RAARP from town of Lee.

*The Lamprey River Local Management Advisory Committee consists of member put forward by Selectmen, Conservation Commissions and Town Councils of Lee, Durham, Newmarket and Epping to guide a study of the Lamprey River. We encourage you to attend meetings, held once a month at the Lee Town Hall. For more information, call 659-5441, evenings.*

## LAMPREY RIVER STUDY QUESTIONNAIRE

**Dear Landowner:**

The Lamprey River Management Advisory Committee asks that you take a few minutes to fill out the enclosed questionnaire and mail it back to us **within a week**. It is a vital part of a study now underway to plan for the river.

**The Committee has been established to represent you**, the citizens of the Lamprey communities, in making a plan for the management of the Lamprey River. The results of the study will be a plan which serves the requirements of both the state's River Management and Protection Act and the federal Wild and Scenic Rivers Study Act. Recommendations will be based, in large part, on your opinions about what is important about the river, what are problems, and what approaches landowners would like to take in addressing these issues. We have done our best to allow for a wide range of opinions about river planning, and we want to hear them all. We also need your help in identifying resources that exist on the river, from wildlife to swimming holes.

Findings of the questionnaire will be made available to local residents at a meeting to which all will be invited.

We strongly urge you to help us truly represent your views by filling out this questionnaire and returning it to us **as soon as possible. For it is YOUR study, planning for YOUR river.**

**THANK YOU FOR YOUR PARTICIPATION!**

**FILL OUT THE QUESTIONNAIRE TODAY, AND MAIL IT TO US  
IN THE ENCLOSED STAMPED, SELF-ADDRESSED ENVELOPE.**

## LAMPREY RIVER LANDOWNERS QUESTIONNAIRE

This questionnaire is anonymous. We have included a postcard which can be mailed in separately if you want to contact us personally. If the questionnaire does not allow you to express all your ideas, please add more comments on the back of the pages!

### THIS SECTION ASKS ABOUT YOUR RELATIONSHIP TO THE RIVER

1. How long has your family owned your Lamprey property? \_\_\_\_\_ years

Ave. #413:  
Newmkt 24.7 Durham 24.4 Lee 19.7 Epping 22.9

2. Do you: live there 16 summer 3 winter 102 all year  
7 rent it to someone else ( how many months/year ? \_\_\_\_\_)  
16 no residence on land

3. How would you describe most of your land on the Lamprey? (check one)

367 nonagricultural: woods and/or unfarmed fields  
59 agricultural: farmed or hayed fields, orchards (with or without some woods)  
50 residential lot with 5 acres or less  
97 other (describe: \_\_\_\_\_)

4. What are the three most important reasons you own your property on or near the Lamprey River ?

(rank them "1" through "3" with "1" the most important)

<u>36</u> riverfront land is a good investment	<u>25</u> inherited land
<u>69</u> wanted to live on a river	<u>24</u> good neighborhood
<u>94</u> privacy and solitude of area	<u>27</u> liked the house itself, river not as important
<u>74</u> scenic/wildlife qualities	<u>11</u> relates to my business
<u>29</u> good place to raise children	
<u>17</u> other (specify) _____	

5. How has your family used the river in the past five years?

(check all that apply)

<u>113</u> enjoying scenery	<u>75</u> swimming	<u>35</u> skiing
<u>102</u> nature/wildlife watching	<u>80</u> canoeing	<u>10</u> biking
<u>54</u> photography	<u>16</u> other boating	<u>6</u> snowmobiling
<u>93</u> walking	<u>58</u> fishing	<u>0</u> ATV riding
<u>41</u> picnicking	<u>48</u> skating	<u>2</u> commercial business
<u>10</u> hunting	<u>14</u> irrigation/water supply	
<u>14</u> other (specify) _____		

6. What importance do you attach to protecting the following attributes of the Lamprey?

	<u>Very Important</u>	<u>Somewhat Important</u>	<u>Somewhat Unimportant</u>	<u>Very Unimportant</u>	<u>No Opinion</u>
a. good water quality	<u>718</u>	<u>12</u>	<u>0</u>	<u>1</u>	<u>0</u>
b. wildlife/wildlife habitat	<u>101</u>	<u>22</u>	<u>1</u>	<u>1</u>	<u>0</u>
c. scenic beauty	<u>102</u>	<u>23</u>	<u>1</u>	<u>2</u>	<u>1</u>
d. stocked fish(salmon, trout)	<u>33</u>	<u>61</u>	<u>33</u>	<u>6</u>	<u>4</u>
e. natural fish	<u>73</u>	<u>44</u>	<u>13</u>	<u>6</u>	<u>1</u>
f. archeological/historical sites	<u>36</u>	<u>51</u>	<u>22</u>	<u>9</u>	<u>5</u>
g. high property values	<u>41</u>	<u>42</u>	<u>23</u>	<u>15</u>	<u>1</u>
h. river flow/level	<u>81</u>	<u>35</u>	<u>8</u>	<u>4</u>	<u>1</u>
i. undeveloped land	<u>70</u>	<u>30</u>	<u>8</u>	<u>5</u>	<u>10</u>
j. adjacent wetlands	<u>44</u>	<u>15</u>	<u>5</u>	<u>0</u>	<u>4</u>
k. other ( <i>specify below</i> )	—	—	—	—	—

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7. Are you concerned that any of the above could be threatened in the future?

Which? (Use letters in question above) \_\_\_\_\_

(If you wish to add comments, use back of page)

**THIS SECTION ASKS ABOUT THE LAMPREY'S WATER QUALITY**

8. Do you think the water quality of the Lamprey is good enough for:

(check for each)

a. drinking	<u>6</u> yes	<u>85</u> no	<u>31</u> don't know
b. swimming	<u>99</u> yes	<u>11</u> no	<u>24</u> don't know
c. fishing	<u>102</u> yes	<u>6</u> no	<u>27</u> don't know

9. Do you think the water quality is changing? Is it (check one):

87% improving 24% getting worse 19% no change 49% don't know

Describe any changes you have noticed: \_\_\_\_\_

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10. Which of the following practices do you believe would help protect water quality: (check any that apply)

94 not fertilizing close to the river

53 not exceeding headway speed in boats

81 leaving riverbanks in a natural state (soil, vegetation)

89 checking or pumping septic tanks near the river every 2 years

4 none of the above

36 other (describe:) \_\_\_\_\_

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**THIS SECTION DISCUSSES RECREATION ON THE LAMPREY**

11. Do you allow people to cross your land to get to the river? 59% Yes 41% No

12. Have you had any of problems with people using your riverfront land?

39%-Yes 61%-No

**IF YES, WHAT ARE THEY?** \_\_\_\_\_

13. Have you found any successful ways to deal with these problems? (describe)

\_\_\_\_\_

\_\_\_\_\_

14. What level of public use of the river and shorelands do you support  
for the following:

	Support <u>increase</u>	Support <u>decrease</u>	Stay the <u>same</u>	No <u>opinion</u>
swimming	<u>31%</u>	<u>27%</u>	<u>59%</u>	<u>8%</u>
canoeing/kayaking	<u>44%</u>	<u>27%</u>	<u>49%</u>	<u>4%</u>
motor boating	<u>21%</u>	<u>63%</u>	<u>25%</u>	<u>10%</u>
fishing	<u>33%</u>	<u>27%</u>	<u>58%</u>	<u>8%</u>
walking/picnicking/bird watching and skiing	<u>42%</u>	<u>27%</u>	<u>45%</u>	<u>10%</u>
horse riding	<u>14%</u>	<u>75%</u>	<u>48%</u>	<u>22%</u>
hunting	<u>37%</u>	<u>55%</u>	<u>32%</u>	<u>10%</u>
snowmobiling	<u>5%</u>	<u>62%</u>	<u>24%</u>	<u>10%</u>
off-road vehicles	<u>27%</u>	<u>81%</u>	<u>9%</u>	<u>8%</u>
camping	<u>15%</u>	<u>31%</u>	<u>43%</u>	<u>11%</u>
other (specify _____)	—	—	—	—

Comments? \_\_\_\_\_

15. Over time, several privately-owned areas used by the public along the Lamprey have been closed. What is your opinion about this?

(check as many as apply)

15 Landowners should continue to allow the public on their land

60 The towns should support landowners keeping private land open by helping with problems such as noise and litter

117 Each landowner should decide if and how to allow public use

77 The towns should buy land to create publicly-owned areas.

17 Public use of the Lamprey should be more limited.

14 other (describe) \_\_\_\_\_

\_\_\_\_\_

16. At locations where the public now uses the river, are any of the following a problem? (check, and indicate WHERE on the river it occurs)

LOCATION(S)

- Inadequate parking \_\_\_\_\_
- Too crowded/noisy \_\_\_\_\_
- Landowners discourage use \_\_\_\_\_
- Town discourages use \_\_\_\_\_
- Terrain makes access difficult \_\_\_\_\_
- Different types of uses conflict (explain) \_\_\_\_\_
- Need boat ramp \_\_\_\_\_
- Need hiking trails \_\_\_\_\_
- Need picnic areas \_\_\_\_\_
- Need swimming area \_\_\_\_\_
- Trees fallen in river \_\_\_\_\_
- Other (specify) \_\_\_\_\_

**NOW WE WOULD LIKE TO KNOW YOUR OPINION ABOUT FUTURE  
DEVELOPMENT ALONG THE RIVER....**

17. Most of the uses below are possible under current zoning. Which of them do you feel are appropriate for the Lamprey, in the future?

(check all that you approve of)

- 17 commercial businesses
- 108 agriculture
- 103 low density residential
- 6 high density residential
- 35 public drinking water withdrawals
- 21 hydropower development
- 30 commercial recreation (campgrounds, boat rentals, etc.)
- 6 public wastewater disposal (town sewage)
- 12 large-scale recreational facilities (golf courses, marinas)

Comments ? \_\_\_\_\_

18. How do you feel about the following methods of protecting a river and its shorelands?

	<u>Support</u>	<u>Don't Support</u>	<u>No Opinion</u>
a. Town's buying or receiving donations of conservation easements on land	<u>92</u>	<u>17</u>	—
b. Town regulations on shore development	<u>90</u>	<u>24</u>	—
c. Regulations on the size and number of docks	<u>88</u>	<u>15</u>	—
d. More information to landowners on how to protect the river	<u>119</u>	<u>2</u>	—

Comments? \_\_\_\_\_

19. Do you feel existing zoning is: (*check one*)  
13 too restrictive      44 just right      47 not restrictive enough

20. Do you feel that regulations protecting the river cause property values to: 49 rise    13 fall    20 no change    50 don't know

21. In your view, what are the greatest potential threats to the Lamprey River and its shores?

(*check as many as apply*) (*double check most important*)

- a. 48 too many people using the river
- b. 74 structures built too close to the river
- c. 77 removal of vegetation that buffers river from land development
- d. 106 faulty septic systems polluting the river
- e. 83 municipal wastewater treatment plants polluting the river
- f. 105 potential large-scale developments of riverfront property
- g. 80 power boats on the river
- h. 13 other (specify) \_\_\_\_\_

22. Are there any other important topics that you think the Committee needs to consider in planning for the Lamprey? (Feel free to continue on the back of the page.)

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23 We are studying both the State Rivers Protection and the federal Wild and Scenic programs. Do you have questions?

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24. What would be the best way to get information to you about the study?

- 45 newspapers
- 119 direct mailings to your home
- 17 neighborhood meetings
- 31 public meetings
- 5 Other \_\_\_\_\_

### *Optional Questions*

25. About how many acres do you own of land abutting the river?

(adding acreage of all your river properties)

4 less than 1/2 acre

15 15+ acres to 50 acres

54 1/2 to 3 acres

7 50+ acres to 150 acres

48 3+ acres to 15 acres

3 more than 150 acres

26. What plans do you have for your property along the Lamprey?

(check as many as apply)

114 continue as is

33 pass along to family members

21 hold as an investment

9 arrange for a conservation easements or deed restrictions to protect its  
open spaces or to avoid inheritance taxes.

10 will let the family decide later

14 don't know

14 other (specify): \_\_\_\_\_

27. About how many feet of river frontage would you estimate that you own?

       less than 75 feet             501 to 1,000 feet

       75-200 feet             1,001 to 2,000 feet

       201- 500 feet             more than 2,000 feet

28. How did you feel about this questionnaire?

(circle the letter in front of any that apply)

a. fun 14 b. nuisance 5 c. too long 10 d. boring 1 e. important 96

f. did not help me express my opinions 3

g. some questions were confusing. These were #: 7

h. questionnaire was biased in favor of 15

i. questionnaire was biased against 7

j. I don't understand what purpose it is supposed to serve 11

k. other comments: 31

If you would like to participate in the planning for the Lamprey, please come to the monthly meetings of the committee, at the Lee Town Hall. Call 659-5441 for meeting dates.

If you have information about the Lamprey, or would like to serve on the committee, please fill in the attached card and mail separately. We have a vacancy for Durham, and need back-ups as vacancies occur for all towns.

## **CONCLUSIONS FROM THE RIVERFRONT LANDOWNERS' SURVEY**

### **I. Riverfront Landowners value the river mainly for its natural qualities.**

If the survey indicated one thing most strongly, it was that Lamprey landowners want the river to remain unspoiled. The most commonly given reasons for living on the Lamprey were because the landowners want privacy; value the scenic and the wildlife qualities of the river; or want above all to live on a river. The qualities most widely seen as threatened are the natural aspects of the river – water quality, wildlife habitat and river flow. And when asked what things are in need of protection, a large majority indicated that it is "very important" to take steps to protect water quality, wildlife habitat and the scenic beauty of the river.

People value the riverfront more for these natural features than for its investment value. Only one quarter of the 141 respondents own their land because of its investment value. When asked what importance they attached to protecting different attributes of the river, two and one half times as many people chose natural qualities as "Very Important" as those choosing property values.

### **2. In the future, riverfront landowners want the Lamprey to stay rural.**

Most people support low-density residential and agricultural use for land along the river. In the eyes of Lamprey landowners, the least appropriate riverfront land uses were high-density housing, public sewage treatment plants, large scale recreational facilities and commercial businesses.

### **3. Most riverfront landowners support existing protection of the Lamprey (both town zoning and shoreland protection by landowners)**

The desire to protect the river seems to be much more prevalent than complaints about current regulations: while 12% feel existing zoning is too restrictive, 87% say it is either just right or not restrictive enough. Many people added comments to their surveys, and there were three times as many comments favoring controls protecting the river than comments against regulation. Fewer than 10% feel that regulations cause property values to fall.

Landowners see a role for their town governments in managing the river. About three-quarters of the respondents support towns' buying or accepting donated conservation easements on land; town shoreland regulations; and regulations on size and number of docks.

More than two-thirds of the landowners also recognize the importance of their own role, saying that not fertilizing too close to the water, checking and pumping shoreland septic systems, and leaving natural vegetation along the banks are important to protecting water quality. According to landowners, these problems also rank high among the greatest potential threats to the Lamprey and its shores.

(Because many of the landowners asked for information on how to protect the river and its shorelands, we are preparing literature for you over the next few months. See the septic system information enclosed.)

**4. Increased public use is supported only for a few types of recreation.**

Almost all of the people living on the river say they take advantage of it by enjoying its scenery and watching nature or wildlife, and most also walk, swim and canoe.

The majority of landowners do not want any change in recreational use of the Lamprey, and only quieter types of activities have support for heavier use: about 40% favor more canoeing and walking, about 33% favor more fishing and 31% more swimming. There is a very clear message about activities that are not welcome: many people are very much against even the existing level of motor boating, hunting, snowmobiling, and off-road vehicles. Motor boats were especially unpopular, being seen as dangerous to people, wildlife, river banks, water quality and the peace and quiet of the river.

In considering the future, just over one-third of the landowners see a threat in too many people using the river. However, few people feel that public use of the Lamprey should actually be decreased below today's level.

**5. Managing public access remains a problem.**

About 80% of the landowners feel that the best approach to public access is for landowners to decide themselves whether and how to allow people on their land. Few feel private property owners owe it to the public to allow access. Just over half think towns should buy land for public use.

The Committee will be exploring the issue of access for the types of public use favored by landowners, including walking, canoeing, fishing, and swimming, keeping in mind several points raised in the questionnaires: about half of the landowners allow people to cross their land to get to the river, and many have also encountered problems. Litter is the most common complaint and partying, noise and vandalism have also been major aggravations. These will have to be addressed at public access areas, as well. More assistance from towns in controlling noise and litter is seen as a possible solution to public use problems, with some landowners mentioning that a sympathetic police force is a great help.

*Prepared by the Lamprey River Management Advisory Committee, 1993*

Appendix F  
THE LAMPREY RIVER MANAGEMENT PLAN

1983

**INTRODUCTION**

The management plan examines environmental, cultural and recreational resources in a half mile corridor surrounding the Lamprey River and its major tributaries. The project covers the Lamprey River from its confluence with the Pawtuckaway River in Epping to the tidal waters of the Great Bay in Newmarket. The Little, North, Pawtuckaway and Stingy Rivers are detailed from their headwater dams on Mednum's Pond, North River Pond and the North and South outlets of Pawtuckaway Lake, respectively. The study area provides a diversity of interests between the communities of Nottingham, Raymond, Epping, Lee, Durham and Newmarket.

Data collection for the project was completed by SRPC staff. The planning phases to be detailed in the following, relied on local input. The final product is a resource management plan for the Lamprey River and its tributaries.

TABLE I  
LAMPREY RIVER AREA PLANNING COMMITTEE

<u>NAME</u>	<u>AFFILIATION</u>
<u>NOTTINGHAM</u>	
Charles Evans	Conservation Commission
Paul Auger	Planning Board
John Gardner	Planning Board
<u>RAYMOND</u>	
Willis Audette	Conservation Commission
Robert Fawcett	NH Fish & Game Dept.
<u>EPPING</u>	
Dorothy Hall	Conservation Commission
Nancy Haberstroh	Planning Board
<u>LEE</u>	
David Meeker	Conservation Commission
David Allan	Conservation Commission
Erick Sawtelle	NH Wildlife Federation
Renata Dodge	River Landowner
<u>DURHAM</u>	
John Hatch	Conservation Commission
Richard Hardy	Planning Board
David Walker	Town Planner
Malcolm Sandberg	Trustees of Trust Funds
Richard Lord	River Landowner
<u>NEWMARKET</u>	
Clifford Abbott	Planning Board
Sarah James	Newmarket Community Development Corporation
<u>MISCELLANEOUS</u>	
James Hayden	SCS District Conservationist
<u>SRPC STAFF</u>	
Mathew Eddy	Phases I & II
Francesca Latawiec	Phases III & IV

TABLE II

## LAMPREY RIVER MANAGEMENT GOALS

- I. Explore the possibility of setting up a water quality monitoring program and determine what parameters should be monitored.
- II. Protect, maintain and improve water quality in the river study area.
  - a. Pinpoint major detriments to water quality.
  - b. Develop strategies for alleviating threats to water quality.
- III. Participate in state and regional efforts to promote groundwater protection.
- IV. Establish a coalition of town boards to petition the NH State Legislature for stricter regulations to improve environmental quality.
- V. Promote safe and adequate access areas for hunting, fishing and boating, while protecting landowners' rights.
  - a. Problems with public access should be monitored.
- VI. Monitor NH Fish and Game's anadromous fish restoration programs and assist where possible.
- VII. Promote appreciation, awareness and environmental education pertaining to the river as a recreational resource and wildlife habitat.
- VIII. Promote public education about the impact of hydropower development to avoid future conflicts.
- IX. Conduct a comparative analysis of river protection oriented provisions of zoning, subdivision and board of health regulations of river area towns.
- X. Monitor forestry practices along the rivers and encourage sound sylvicultural practices in areas where wood is harvested.

Adopted by the Lamprey River Area Planning Committee at their fourth meeting on May 9, 1983

## MANAGEMENT PLAN RECOMMENDATIONS

Specific recommendations for action based on the findings of the LRAPC sub-committees are presented on the following pages. There is a separate section for each subject matter: local regulations, water quality, fisheries, public access, regulation of waterways, environmental education, a watershed association review and revision of the management plan. The issue that prompted the need for action and the party(ies) responsible for implementation are paired with each recommendation.

<u>ISSUE</u>	<u>ACTION</u>	<u>RESPONSIBILITY</u>
I. <u>Local Regulations</u>		
A. There are many gaps in river protection in the study area. Where protective measures exist, they are often inconsistent or inadequate.	Present findings of gaps or inequities in local regulations to decision makers in each community.	Conservation Commission representative to LRWA Board of Directors in each community and Planning Board.
B. Many river protection oriented regulatory techniques are misunderstood or under-utilized.	Recommend consideration of sample techniques in Appendix F.	SRPC staff and LRWA Board of Directors, local officials
II. <u>Water Quality</u>		
A. There are many potential non-point pollutant sources in the Lamprey River Watershed.	Develop a water quality monitoring program to document problem areas.	LRWA Board of Directors, UNH Freshwater Biology Groups, NH Fish and Game's Anadromous Fisheries Program.
B. Baseline data for the Lamprey River Monitoring Program shows four major problem areas:	Coordinate with local officials and landowners to work on solutions e.g., septic system inspection and maintenance programs, local protection ordinances, erosion and sedimentation plans, health inspector regulations, improved road salt storage and application practices, groundwater monitoring wells at landfills, improved waste/wastewater management practices.	Conservation Commission Representative to LRWA Board of Directors, Health Officers, Planning Board, Public Works Department.
1) Vicinity of Wellington and Ferndale Acres	Work with landowners to understand problem and improve septic systems and graywater discharge.	Conservation Commission Rep. LRWA Board of Directors

<u>ISSUES</u>	<u>ACTIONS</u>	<u>RESPONSIBILITY</u>
2) Town of Raymond	Conduct further tests to identify problem cause(s)	UNH Freshwater Biology Group
3) Piscassic River	Conduct further tests to identify problem cause(s)	UNH Freshwater Biology Group
4) Vicinity of Epping Wastewater Treatment Lagoons	Work with local officials in Epping to correct problems	Conservation Commission Rep. LRWA Board of Directors
C. Water quality parameters currently tested by the Lamprey River Monitoring Program are limited.	Research potential funding sources and prepare justifiable grant proposals for program expansion.	LRWA Board of Directors and UNH Freshwater Biology Group.

### III. Fisheries

A. The NH Fish and Game Dept. operates a fish ladder at the Macallen Dam in Newmarket.	Volunteer assistance to NH Fish and Game personnel when anadromous fish are running.	LRWA members
B. The NH Fish and Game is sampling invertebrates in the Lamprey Watershed and keying them down to species as an indicator or water quality for fisheries management purposes.	Coordinate with NH Fish and Game for data exchange.	The LRWA Board of Directors NH Fish and Game and the UNH FBC.
C. There are a number of existing hydropower dams in the watershed that could be reactivated.	Support NH Fish and Game's recommendations for construction of fish passage ways.	LRWA Board of Directors.
D. It is possible to develop new hydropower dams on the Lamprey. The most logical sites are fast moving water crucial to fish habitat.	Oppose any new hydropower dams proposed in the watershed.	LRWA Board of Directors.

<u>ISSUE</u>	<u>ACTION</u>	<u>RESPONSIBILITY</u>
IV. <u>Public Access</u>		
A. Access to the Lamprey River and associated tributaries is limited, and often not by formal agreement.	Work with landowners to negotiate public access agreements, e.g., land acquisition conservation/access easements, landowner permit system, current use for recreational purposes, deed restrictions, etc.	LRWA Board of Directors, Conservation Commission, Park and Recreation Depts.
B. Many river landowners do not allow public access because they fear potential liability.	Make river landowners aware of protection from liability offered by NH RSA's 508:14 and 212:34.	LRWA Board of Directors, Conservation Commission representatives to Board, Bi-County Environmental Education Committee,
C. Conservation Commissions are wary of accepting access easements because of the potential for municipal liability according to RSA 507-B.	Coordinate with the Great Bay Estuarine System Conservator Trust to accept easements negotiated by the LRWA.	LRWA Board, landowners and GBEST Trustees.
D. Litter and vandalism problems discourage private landowners from allowing public access on their property.	Negotiate with sporting enthusiasts to help clean up the resource they enjoy.	LRWA Board, Conservator Commission, Strafford County League of Sportsmen, Salmon Unlimited, etc.
E. Most litter and vandalism problems at publicly owned sites result from undesirable night-time use, rather than appropriate day-time recreational uses.	Close areas to public use from dusk to dawn and post them no trespassing during those hours, e.g., Packer's Falls in Durham.	LRWA Board, Local Conservation Commission, Selectmen, Park and Recreation Depts.

<u>ISSUE</u>	<u>ACTION</u>	<u>RESPONSIBILITY</u>
V. <u>Regulation of Waterways</u>		
A. Most recreational users of the Lamprey River are unaware of the Safe Passage Law, which limits boats to headway speed within 100 feet of a shoreline (most of the Lamprey River)	Make river users aware of the law. e.g., post signs media coverage, education of educators, hand-outs, posters, etc.	LRWA Board of Directors, Bi-County Education Committee, Schools, Bait shops.
B. Many violators of the safe passage law are weekend, non-resident users of the resource. They are not required by law to register their boats in NH to use them on tidal waters. Therefore, they are less likely to be aware of the law.	Make educational information available through sources that tourists/visitors generally seek e.g., information booths, chamber of commerce, bait shops etc.	LRWA Board of Directors, Local Merchants, Chamber of Commerce, etc.
C. Waves caused by violators of safe passage law erode undercut banks, creating a potential liability to land-owners.	Work with land-owners to recognize the problem and take legal precautions (posting a warning). This is also incentive for landowners to report violations.	LRWA Board of Directors Landowners, Conservation Commission representatives.

<u>ISSUE</u>	<u>ACTION</u>	<u>RESPONSIBILITY</u>
<u>VI. Watershed Association</u>		
A. A permanent entity to keep a watchful eye on the Lamprey Watershed is necessary to assure implementation of the management plan.	- Form a non-profit corporation. The Board of Directors should show representation from each town and special interest in the watershed.	LRWA Board of Directors, Conservation Commission, Sporting Clubs, Landowners.
B. Maintaining the activities initiated by the CEIP project requires people, time and money.	Apply for non-profit tax exempt status from the IRS so that membership fees and contributions are tax deductible.	LRWA Board of Directors.
	Initiate a strong membership campaign via strong media coverage: attending meetings of local groups (garden club, Kawanas, etc.) holding attractive events (canoe races, river fests, etc). Talking with river landowners. Involving more people in the lay River Monitoring Program.	LRWA Board of Directors Conservation Commission local media, etc., UNH Field Experience office.
	Form an internship program with the UNH.	
C. A large, diverse program of activities is being planned by LRWA.	- Form standing committees for each issue with an LRWA director on each to report back to the Board. Solicit active participation on each committee from the membership. Solicit interns from the UNH.	LRWA Board of Directors, UNH Field Experience Office
D. Many local issues are meaningful to the entire watershed. Some regional issues are inappropriate for local board members to address as a representative of their board.	Use the Watershed Association as a forum for discussion and action on these issues. Set up an inter-community hotline to alert the entire watershed of critical activities.	LRWA Directors, Conservation Commission Rep to Board members.

<u>ISSUE</u>	<u>ACTION</u>	<u>RESPONSIBILITY</u>
<b>VII. <u>Environmental Education</u></b>		
A. All river protection techniques depend on support from a well informed public.	Develop an on-going multi-faceted environmental education program to reach all ages, e.g., workshops, speakers, slide shows, field days, etc.	Strafford and Rockingham RPC, SCCD, SCS, Cooperative Extension.
B. Awareness and appreciation of the Lamprey River's resources are lacking.	Improve media coverage of river-related problems, e.g., articles in local and NH weeklies, NH Wildlife Federation News, Channel 11, etc.	LRWA Board of Directors, Local Media People.
<b>VIII. <u>Review and Revision of Management Plan</u></b>		
Conditions in the watershed will change as growth occurs, recommendations are implemented or political climates change.	Annual update of management plan recommendations according to current status.	LRWA Directors.

## CONCLUSION

The Lamprey is a relatively unspoiled river with anadromous fish runs. Increased developmental pressure within its watershed could pose threats to water quality beyond the river's capacity to assimilate pollutants. Associated population growth is likely to cause additional stress by increasing recreational demand on the river.

Strong resource protection efforts and increased effectiveness of local regulatory measures are necessary to combat river degradation. An area-wide environmental education program is the key to develop support from a well informed public to manage the Lamprey's resources. The Lamprey River Watershed Association was established for the purpose of taking action to implement the recommendations of this plan.

TABLE V

POTENTIAL AREAS FOR NEGOTIATING PUBLIC  
ACCESS AGREEMENTS

Newmarket

- 1) Roadway above the Macallen Dam on the west side of the river. (Previously a public right-of-way. May have reverted to landowners.) LRM 2.2-2.8.
- 2) The public landing behind the Town Hall. LRM 1.8.
- 3) Atherton's property across the river from the Town Hall landing. LRM 1.8.
- 4) Jr. Sawyer's land on the tidal Lamprey. LRM .8.
- 5) Cemetery at LRM 2.7.
- 6) Ernie Cutter's land on Route 108. Two spots. LRM 2.9.

Durham

- 1) Land off Wednesday Hill Road to northeast of river. LRM 6.3 (low priority).
- 2) At the Wiswall Dam, town of Durham and Spang's property to the south, LRM 5.5. (Spangs have an agreement to allow members of Salmon Unlimited on their property with permission, for fishing purposes.)
- 3) Packers Falls, LRM 4.8. Conservation Commission property. Sinclair's property.
- 4) Road to railroad trestle. LRM 3.9.

Lee

- 1) State owned land off Lee Hook Road (UNH) LRM 11.0. (Low priority, isolated.)
- 2) Lloyd Stevens property off Tuttle Road. LRM 9.0.
- 3) Wadleigh Falls - Peter Dodge LRM 13.5.
- 4) Lee Hook Road Bridge - Phil Sanborn. LRM 8.5.

Epping

- 1) Route 87 Bridge. LRM 18.7 (low priority).
- 2) Behind Epping Town Hall LRM 22.1.
- 3) Mary Blair Park, LRM 25.7

Nottingham

- 1) Route 152 Bridge near the elementary school.

Many LRAPC members were concerned about increasing litter and vandalism problems. A number of solutions to this dilemma were discussed. Conservation Commissions could take responsibility for clean-up. An agreement could be formed with local sportsmen to maintain the resources they use. Popular access sites could limit use to daylight hours and post the land "No Trespassing, Dusk to Dawn" to eliminate undesirable night-time use.

A number of landowners are willing to allow people to cross their property to get to the river, but were afraid that a formal agreement would increase their potential liability. The sub-committee researched New Hampshire statutes dealing with liability. RSA's 508:14 and 212:34 protect private landowners and easement holders when access is allowed without a fee. However, municipalities are open to litigation in accordance with RSA 507:B and corporations may be liable, depending on the situation.

In light of this information, sub-committee members determined that encouraging informal agreements with landowners would be preferable to having an easement granted to the town Conservation Commission or LRWA. This type of agreement could take the form of a renewable permit which states that the landowner agrees to allow access for no charge, understanding that he or she is protected by RSA's 508:14 and 212:34.

The problem with an informal agreement is its potential for dissolution. Where access is desired in perpetuity, it would be more effective to request an easement from the landowner. The LRWA could negotiate the agreement and encourage the Great Bay Estuarine System Conservation Trust to accept the easement.

The major access concern was created in the earlier part of the century when the Macallen Dam and Lamprey River were lowered below historical levels. Miles of undercut banks were exposed and subjected to erosion. The sub-committee determined that landowners who permit access should be made aware of the potential for liability that these conditions pose.

Regulation of Waterways. Sub-committee members met with NH Department of Safety Services personnel to discuss problems with application of the Safe Passage Law to the Lamprey River. The law requires boats to maintain headway speed within 100 feet of shore. Waves associated with violation pose a safety hazard to bathers and canoeists while disturbing wildlife habitat and increasing erosion of already undercut banks.

Enforcement is a problem for many reasons. Ignorance of the law is most prevalent. This condition is magnified by lack of patrol due to under-staffing of the Department of Safety Services. Thus, if a violation occurs the guilty party has usually departed long before Safety Services has the opportunity to respond to a complaint. Many violations are also perpetrated by non-resident weekend users, creating difficulty for education or apprehension.

The Department of Safety Services agreed to cooperate with the LRWA to post no-wake signs at problem areas on the Lamprey. Signs explaining the law would be placed at the major access points. Safety Services also agreed to send an occasional officer out to patrol the river and cite violations.

#### Establishing a Permanent Organization

The Sub-Committee on Establishing a Permanent Organization chose to prepare the paperwork necessary to form a private non-profit corporation - the Lamprey River Watershed Association. Articles of Agreement were prepared for submission to the NH Secretary of State and bylaws were drawn up to outline the

operational structure of the Association. The Association will be governed by a Board of Directors, with a municipal representative from each town appointed by the Conservation Commission. Five standing committees chaired by members of the Board of Directors will provide labor for tasks outlined in the Management Plan: Finance, Information/Education, Membership, Policy/Action and Activities/Functions.

#### Environmental Education

The Sub-Committee on Environmental Education requested that SRPC staff initiate a cooperative bi-county environmental education program between the Planning Commissions, SCS District Conservationists, County Conservation Districts and Cooperative Extension Agents in Strafford and Rockingham Counties. Existing agencies were contacted with the understanding that they will adopt an educational element as part of their annual work program. An annual spring lecture series is planned.

The first series, scheduled for Spring of 1984, will take the form of a five part mini-course on site plan review. The introductory session will cover map preparation and interpretation. In subsequent weeks, participants will study different components of a site plan, including soils, site hydrology, erosion and sedimentation control, wetlands and floodplains. In the final session, the group will participate in a mock site plan review. Every imaginable environmental problem will be encountered in the review process. Speakers from the workshop will be available to answer questions.

A REGIONAL PERSPECTIVE ON CONSERVATION LANDS IN  
DURHAM, LEE, MADBURY AND NEWMARKET

*REPORT OF AN AD HOC COMMITTEE  
JANUARY, 1988*

**INTRODUCTION**

**Background**

In 1986, the Natural Areas Committee of the University of New Hampshire became concerned about the future of the UNH Natural Areas in Durham. The committee observed that these areas may become "habitat islands," cut off from each other by increasing land development.

It was apparent that this was a problem which ought to be discussed among all those owning or managing conservation lands in the area. Thus, an informal ad hoc committee on conservation lands was formed. It includes representatives from the Conservation Commissions of Durham, Lee, Madbury and Newmarket, the Lamprey River Watershed Association and the UNH Natural Areas Committee.

The objective of the committee is to develop a regional approach to identifying and conserving lands which provide important connections between existing protected tracts.

This report summarizes the committee's findings.

**The Problem**

Southeastern New Hampshire has experienced dramatic increases in land development and population growth in the past few years. The combined population of Durham, Lee, Madbury and Newmarket increased 28% (from 12,816 to 16,343) in the five years between 1981 and 1986. The amount of developed land in Strafford County (which includes three of the towns) increased by 40% between 1974 and 1982. The total acreage in the four-town area is 45,410 acres.

**Intensifying land development has had two effects:**

- First, the number and size of undeveloped areas are declining.
- Second, lands which have been protected as conservation areas are being surrounded by development. This decreases their effective size: wildlife can no longer move easily from one natural area to another, and some must move away from the area's boundaries into the more protected center.

It is well known that some species of wildlife require fairly large areas of habitat to survive. (Home ranges for pine marten and white tail deer are roughly 640 acres ). Plant species also require contiguous areas to proliferate. Plants are valuable in their own right and also because they are the most crucial element in wildlife habitat.

**Small, isolated habitats have less diversity of plant and animal species than those that are large and contiguous.** Each species has its own mix of habitat needs for water, food, nesting or resting, breeding and cover. A species may require low wetland areas for one use and upland areas for another. If both types of areas are not accessible because land is developed between them, the species can no longer flourish. And other species dependent upon it will also disappear.

**Losing our open land has a profound negative effect on us all.** The U.S. Departments of Interior and Commerce have found that 17% of all Americans take special trips to observe, photograph or feed wildlife. About 47% of all Americans are actively interested in the wildlife around their homes. For those who have committed their lives and livelihoods to living in a rural environment, the ability to fish, hunt, photograph or just catch a glimpse of wildlife and to ski, walk and drive by scenic natural areas is an integral part of their reason for living here.

From a more utilitarian point of view, our open lands -- particularly wetlands -- protect the water supply, reduce flooding and clean up pollution caused by development. (Plants clean both water and air.) They provide natural buffers against noise and reduce human crowding. They create visual relief from developed lands, especially in areas of strip and "cookie cutter" development.

The economic and medicinal value of many plants and animals are just being discovered. Yet, at the same time, the earth's flora and fauna species are being destroyed. Scientists estimate that by the year 2000, as much as 15% of the earth's present plant and animal species may be lost, mainly because of development.

**The University has long recognized the importance of maintaining open land for education and research.** On a smaller scale, local schools and youth groups also use such areas for educating and exposing young people to the natural world.

In summary, protection of quality undeveloped areas from ever-increasing development should concern us all. Large, contiguous tracts of conservation land are necessary to protect our current diversity of plant and animal species from the impact of habitat isolation and fragmentation. It is thus exceedingly important to consider conservation lands not only as individual parcels, but also in relation to other protected lands.

## CONSERVATION LANDS IN THE FOUR-TOWN AREA

Independently, the towns of Durham, Lee, Madbury and Newmarket have all made efforts to secure conservation lands. (See map.)

**Durham** owns and manages over 200 acres of conservation lands including the Doe Farm, Langmaid Farm, Horsehide Creek, Colby Marsh and several smaller areas. Also in Durham are the Adams Point Wildlife Area on Great Bay and part of the Great Bay Estuarine Research Reserve.

**Lee** owns about 150 acres of conservation land, with 163 more in conservation easement to either the Town or the Forest Society. The largest parcels are the 80-acre Town Forest, 21 acres on Wheelwright Pond and two parcels on Steppingstone Road which total 27 acres. The Town is seeking conservation easements on land along the Lamprey River, the Oyster River, and areas lying between the extensive wetlands west of Route 125 and the Lee Bog near the Town Hall.

**Madbury** has recently purchased its first conservation area, a 38-acre portion of Hicks Hill adjacent to the U.N.H. Kingman Farm. The Town also has an interest in protecting its major natural features, the Bellamy River and associated Portsmouth Reservoir.

**Newmarket** has acquired no conservation land to date, but has been active in obtaining funds to do so. (However, developers have provided some significant open land -- at Moody Point, for example.) The Conservation Commission considers the Folletts Brook area to be an important candidate for protection, since it is part of the town's water supply and a valuable wildlife area. The Lamprey River is also important. Newmarket abuts Great Bay and includes parts of the Estuarine Research Reserve that have a high priority for protection, such as Lubberland Creek.

**The University of New Hampshire** owns about 3,000 acres of open land in the four-town area. Most of this is located in Durham (Foss Farm, Thompson Farm, College Woods, the Horticultural Farm). There are also major holdings in Lee (Burley-Demeritt and Dudley farms) and Madbury (Kingman Farm).

**When each of the four towns' conservation lands and the University's open land are viewed together from a regional perspective, it becomes evident that there are potential connections between them that often cross town**

boundaries. The effective size of existing undeveloped areas can be extended and maximized if towns plan together to acquire conservation land or easements which form natural corridors.

These potential natural corridors are described below.

(1) **Durham-Madbury corridor.** A nearly continuous band of open land extends from the Doe Farm in Durham, through the University-owned Highland House and Foss Farms and north through College Woods and the Horticultural Farm, almost to the Madbury line. Nearby in Madbury are Hicks Hill and the adjacent U.N.H. Kingman Farm with its extensive woodlands. University lands are essential to the continuity of these areas; however the degree to which these lands are protected is not certain.

(2) **Lamprey River.** Lee, Newmarket and Durham have identified the Lamprey River and its tributaries, the Little and North Rivers, as a potential conservation corridor. The shoreline of this river is largely undeveloped and several key parcels are already publicly owned (Doe Farm, Packers Falls) while one large section of shoreline is owned by UNH (Burley-Demeritt farm). Newmarket, Lee and Durham have Shoreline Protection Zones.

(3) **Folletts Brook area.** Including portions of Lee, Newmarket and Durham, the Folletts Brook area is comprised of extensive forest and wetland and has value as a wildlife habitat. While only a portion of the area is publicly owned (Newmarket water supply), there appears to be real potential for protection through easements or cluster development.

(4) **Durham Point.** The Durham Conservation Commission has identified a potential corridor of conservation lands between the town dump and Adams Point. This corridor includes town lands, state land, and areas protected by conservation easement.

(5) **Central Lee.** The Lee Conservation Commission has identified a potential conservation corridor from the extensive wetlands west of Route 125 through the Town Forest to the Lee Bog. Portions of this area are already protected.

(6) **Wheelwright/Oyster River.** The Town of Lee owns a parcel on Wheelwright Pond, and easements are being sought to augment the existing Shoreline Protection Zone along the Pond and the Oyster River.

## RECOMMENDATIONS

The Conservation Commissions of Durham, Lee, Madbury and Newmarket, with representation from the University of New Hampshire, the Great Bay Trust and the Lamprey River Watershed Association, should establish a committee to assist the Towns in:

- a. identifying key parcels for protection and developing a regional open space map;
- b. securing funding from governmental and private sources;
- c. developing and implementing a method of approaching landowners to seek their cooperation in protecting land (perhaps with the assistance of the Forest Society);
- d. supplying information to town boards on the potential corridors and means for protecting them;
- e. preparing voter education materials to support requests for money to acquire lands and for zoning regulations to provide buffers around conservation lands;
- f. informing UNH of regional conservation concerns and seeking its cooperation in protecting key lands; and
- g. cooperating with other conservation organizations such as the Trust for N.H. Lands, Audubon Society, Nature Conservancy, Society for the Protection of N.H. Forests, Fish and Game, Soil Conservation Service of Rockingham and Strafford Counties, etc.

Appendix H

Informal Recreational Users Survey Comments

Big motorboats should be banned from the river.

Keep the water clean.

There should be little or no development of the lands surrounding the river.

Clean up beer cans along the river. Reduce the fishing limit--there are no hold-over trout. Make the area below Wiswall fly fishing only, from the dam to the end of the first big pool.

Fish and Game should stock fish, but require a waiting period. Install a trash can on the bridge in Epping (behind the town hall).

Post access points to carry out trash. More stocking.

Fly fishing only, in spots, with restricted limits. I'd like to see an effort to clean up the river (bottles, tires, cans, etc.) and a better effort to protect the fishery.

Wish you could park without tickets at Wiswall.

Appendix I  
Summary of the Public Meetings, Fall 1993

Approx. number of people attending:

Lee - 16; Epping - 12; Newmarket - 12; Durham - 7

Volunteers to help with management plan - Traci Adams, Sharon Doucet (Newmarket), Phil LePage (Lee), Bill Channell (Epping)

**ISSUES**

Protection of water quality -

- \* Vegetation seen as filter for pollutants (no direct statement of need for good water, but by implication clean water is valued) (Durham)
- \* Issue in part revolves around water supply - need for clean water; concern re pesticides (Newmarket)
- \* Concern about pollution from agriculture, though people support farms (Epping)
- \* Suggestion that beaver flowage, wetlands can filter out pollution (Epping)
- \* Concern about substandard septic systems (Epping)
- \* Plan should cover what one needs to do to preserve water quality/monitor water quality (Epping)
- \* Maintaining high water quality is important (Lee)
- \* Concern that towns not be allowed to control pesticides because it creates inconsistencies for farmers (Lee)
- \* Question re. additional wastewater discharge systems emptying into the Lamprey in the future (Lee)
- \* Concern that Epping be required to separate storm sewers from wastewater system (Lee)
- \* Question whether pollutants exude from asphalt (Lee)

Shoreland vegetation management -

- \* Newmarket citizen suggested leaving more vegetation, concerned about the potential for unsightly development along the river - will town regulations adequately control what happens there? What role can riverfront landowners play in assuring that land they don't own is appropriately developed?
- \* Policing of shoreland covenants is difficult (Newmarket)
- \* In Durham ?s were raised about enforceability of shoreland regulations, both logistics (enforcing regs on people one knows, catching them before the damage is done) and legality (including interpretation of regs)(ref. to importance of having an code enforcement officer who knows the law, local laws, and exercises good judgement); Council seems swayed by lawyers, who should not be calling land use shots
- \* It seems there's plenty of vegetation along the river now - where does committee see any threat? (Durham)
- \* Education of landowners is seen as a key tool for achieving good vegetation management, since regulations often seem ineffective (Durham, Lee, Newmarket)
- \* In Epping concern was to protect wildlife habitat

### Growth Management

- \* People don't want to see condominiums along the river - control development by zoning (Epping)
- \* Desire by one Newmarket resident to stop further development on river
- \* Planning board is concerned about managing growth (Newmarket)
- \* Desire is not to ban growth but to control it (Newmarket)

### Economic Development

- \* Town economic assessment identifies mills as one of the few unique structures on the river. Mill owner concerned about possible restrictions on uses of mill buildings imposed by W&S designation, limiting options to point where buildings would be rendered undevelopable (Newmarket)
- \* Desire to keep the river as a working river. Concern that W&S designation might result in higher water quality standards relative to wastewater discharges (Epping)

### Recreation

- \* No motorboats, three-wheelers (Epping)
- \* Liability is identified by golf course developer as key issue for river access via golf course (Durham)
- \* It's important to survey nonriverfront landowners to measure demand for more access
- \* Must consider impacts of public use in dealing with access - litter, supervision, parking - all the ramifications of irresponsible as well as responsible use (Durham)
- \* Riverfront owners are philosophically sympathetic to public access to the river, but that must be done in a way that provides stewardship: the river has limitations on the amount of use it can sustain without ruining the features that draw people in the first place (Durham)
- \* The public use problem will have to be solved: as long as the river is protected, it will continue to attract the public and require efforts to deal meaningfully with the public use issue (Durham)
- \* Resentment about parking for fishermen at Wiswall but not for canoeists -- Because "no parking" signs at Wiswall give town authority to deal with irresponsible activities there, speaker's comment may suggest need for more public education about the purpose of access regulations (Durham)
- \* People come from Massachusetts to canoe here - need to wrestle with access issue (Durham)

### Water Levels

- \* Is there anyone controlling the amount of water that Durham can withdraw from the river during droughts? (Lee)
- \* If we are going to have the town altering water levels, we might as well have it done by a hydro plant, which at least produces taxes - arguing for control over drawdowns (Lee)

\* Is there any way to maintain minimum flows in the river?  
(Epping)

\* Question asked about the ability to supplement flows from ponds upstream (Epping)

General

- \* Education is needed for conservation to work (Lee)
- \* Beaver - are there too many now? (Lee)

Management Plan

\* Who will enact it? What parts will be enforced, by whom?  
(Lee)

Questions relevant to Wild and Scenic/State programs

How would W&S designation affect agriculture? (Epping)

Aren't there too many laws already? Will W&S process really do anything without adding regulation? Concern over added restriction on property owners (Lee)

Would W&S impact other uses of the river water, say for industrial use? (Lee)

General Questions/Discussions

Funding sources for conservation easements (Epping)

Discussion of golf course (Newmarket, Durham) In Durham, Planning Bd. member indicated trees will be left between holes to absorb pesticides, as will 150' buffer along river.

Question about heavy metals (Lee)

Prepared by Margaret Watkins and Judith Spang  
12/6/93

Appendix J  
PISCATAQUA RIVER BASIN

01073500 LAMPREY RIVER NEAR NEWMARKET, N.H.

LOCATION.--Lat 43°06'09", long 70°57'11", Rockingham County, Hydrologic Unit 01060003, on right bank 200 ft upstream from Packers Falls, 2 mi northwest of Newmarket, and 4.6 mi upstream from mouth.

DRAINAGE AREA.--183 mi<sup>2</sup>.

PERIOD OF RECORD.--Discharge: July 1934 to current year. Water-quality records: Water year 1954.

REVISED RECORDS.--WSP 1231: 1936-37.

GAGE.--Water-stage recorder. Elevation of gage is 40 ft above sea level, from topographic map.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Some regulation by Pawtuckaway and Mendums Ponds. These reservoirs have a usable capacity of about 600 million ft<sup>3</sup>.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1992 TO SEPTEMBER 1993  
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	45	125	461	418	e170	e100	3230	466	87	22	14	e9.0
2	40	119	401	374	e160	e110	2560	406	108	21	16	e8.7
3	39	152	399	312	e150	e115	1900	357	102	20	16	e8.4
4	36	219	389	e250	e140	e120	1500	322	88	19	19	e8.2
5	33	232	357	e350	e130	e120	1260	292	72	18	18	e8.1
6	33	251	327	531	e120	e120	1160	261	81	17	17	e8.0
7	32	236	303	557	e110	e120	1160	234	96	16	16	e7.8
8	31	214	e270	506	e100	128	1180	236	87	15	14	e7.8
9	33	191	e240	412	e100	139	1220	220	91	17	13	e7.8
10	93	156	e200	292	e100	166	1280	195	98	16	12	e7.8
11	141	171	e200	e250	e100	185	1760	175	90	14	16	e7.7
12	178	177	e220	e230	e100	190	2690	167	76	12	20	e7.6
13	182	203	e240	e230	e105	176	3140	162	70	11	16	e7.6
14	218	236	e250	e230	e105	150	2720	154	71	10	14	e7.6
15	251	246	e250	e230	e110	152	2020	141	77	11	12	e7.7
16	225	234	e230	e230	e120	171	1500	134	67	9.1	11	e7.8
17	214	220	e250	e220	191	178	1260	126	55	8.4	9.8	e8.0
18	161	244	439	e210	225	229	1160	116	48	7.9	17	e8.5
19	145	257	467	187	232	252	1040	124	44	7.5	18	e7.5
20	134	229	469	193	211	261	840	137	41	8.3	22	e7.3
21	131	211	409	190	e170	259	663	141	46	8.5	22	e7.5
22	146	212	378	218	e150	246	578	132	48	8.2	21	e7.8
23	136	359	347	311	e120	239	628	121	45	7.7	20	e8.2
24	132	471	296	371	e100	240	627	112	40	7.7	18	e9.0
25	144	529	290	454	e84	252	582	103	36	7.5	16	e11
26	138	564	259	443	e86	312	516	97	34	7.6	15	20
27	152	747	221	389	e90	430	693	88	31	8.8	14	37
28	169	711	203	334	e95	585	716	79	28	9.4	12	97
29	149	629	222	283	--	906	659	75	28	8.7	11	99
30	143	530	284	229	--	2120	548	68	25	11	9.7	97
31	139	--	362	182	--	3070	--	63	--	14	9.5	--
TOTAL	3843	9075	9633	9616	3674	11841	40790	5504	1910	379.3	479.0	552.4
MEAN	124	302	311	310	131	382	1360	178	63.7	12.2	15.5	18.4
MAX	251	747	469	557	232	3070	3230	466	108	22	22	99
MIN	31	119	200	182	84	100	516	63	25	7.5	9.5	7.3
CFSM	.68	1.65	1.70	1.70	.72	2.09	7.43	.97	.35	.07	.08	.10
IN.	.78	1.84	1.96	1.95	.75	2.41	8.29	1.12	.39	.08	.10	.11

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1934 - 1993, BY WATER YEAR (WY)

MEAN	120	263	326	279	303	604	706	356	186	97.0	76.9	74.9
MAX	404	742	761	796	811	1866	1756	1400	717	599	621	650
(WY)	1978	1952	1984	1956	1970	1936	1987	1954	1982	1938	1938	1954
MIN	11.1	15.9	45.9	46.4	49.7	210	170	105	29.8	12.2	7.56	3.44
(WY)	1948	1942	1942	1944	1980	1989	1985	1985	1964	1993	1965	1957

SUMMARY STATISTICS	FOR 1992 CALENDAR YEAR						FOR 1993 WATER YEAR			WATER YEARS 1934 - 1993		
ANNUAL TOTAL	79477						97296.7			282		
ANNUAL MEAN	217						267			441		
HIGHEST ANNUAL MEAN										100		
LOWEST ANNUAL MEAN										1934		
HIGHEST DAILY MEAN	831						3230			7360		
LOWEST DAILY MEAN	31						7.3			1.0		
ANNUAL SEVEN-DAY MINIMUM	34						Sep 9			2.5		
INSTANTANEOUS PEAK FLOW							3400			Aug 28 1964		
INSTANTANEOUS PEAK STAGE							9.84			7570		
ANNUAL RUNOFF (CFSM)	1.19						Apr 1			15.14		
ANNUAL RUNOFF (INCHES)	16.16						1.46			Apr 7 1987		
10 PERCENT EXCEEDS	441						19.78			1.54		
50 PERCENT EXCEEDS	189						560			20.91		
90 PERCENT EXCEEDS	52						140			650		
							9.1			170		
										24		

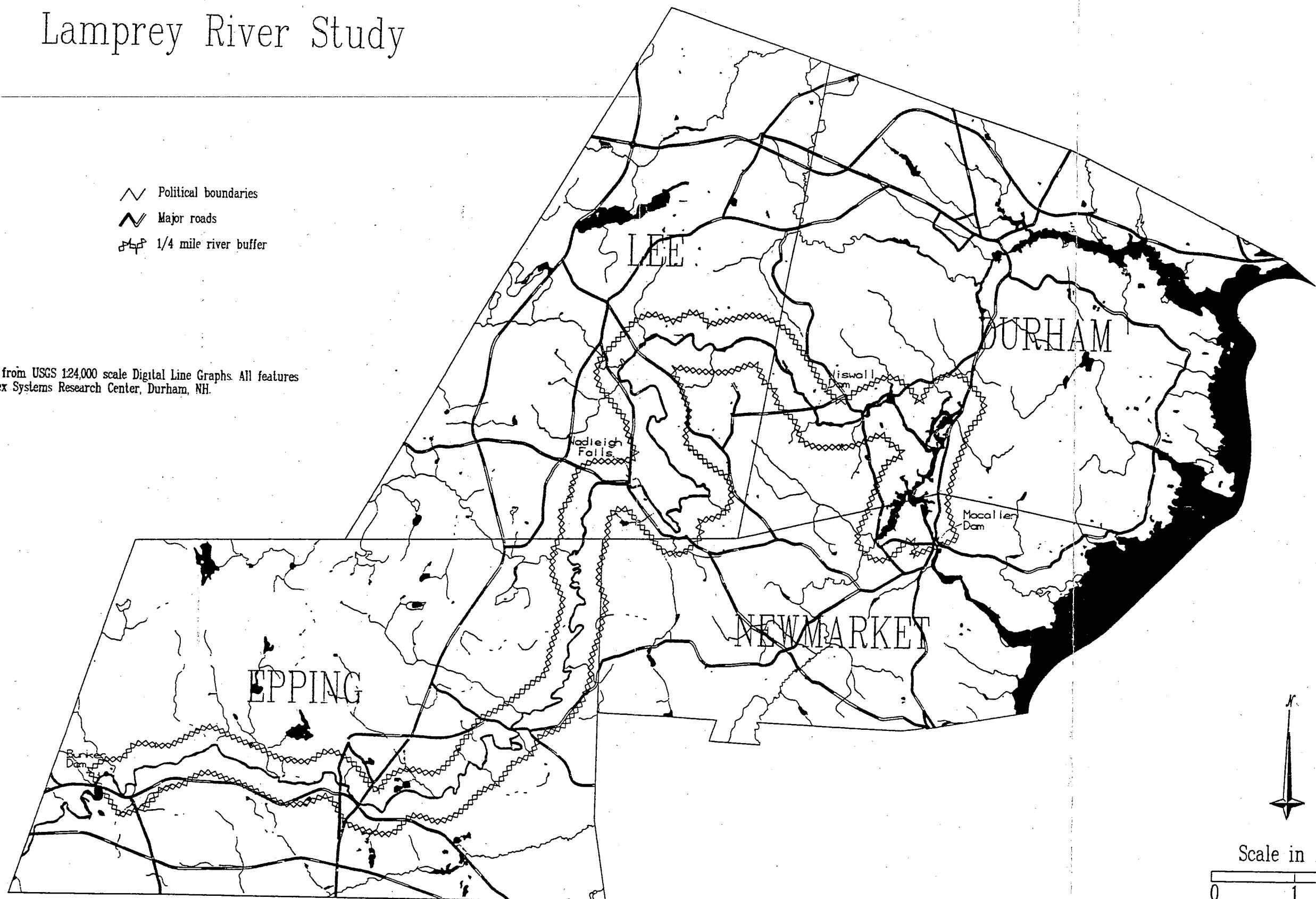
e = estimated

Source: Water Resources Data New Hampshire and Vermont Water Year 1993,  
US Geological Survey Water-Data Report NH-VT-93-1.

# Lamprey River Study

- ~ Political boundaries
- ~ Major roads
- 1/4 mile river buffer

All base features are from USGS 1:24,000 scale Digital Line Graphs. All features distributed by Complex Systems Research Center, Durham, NH.



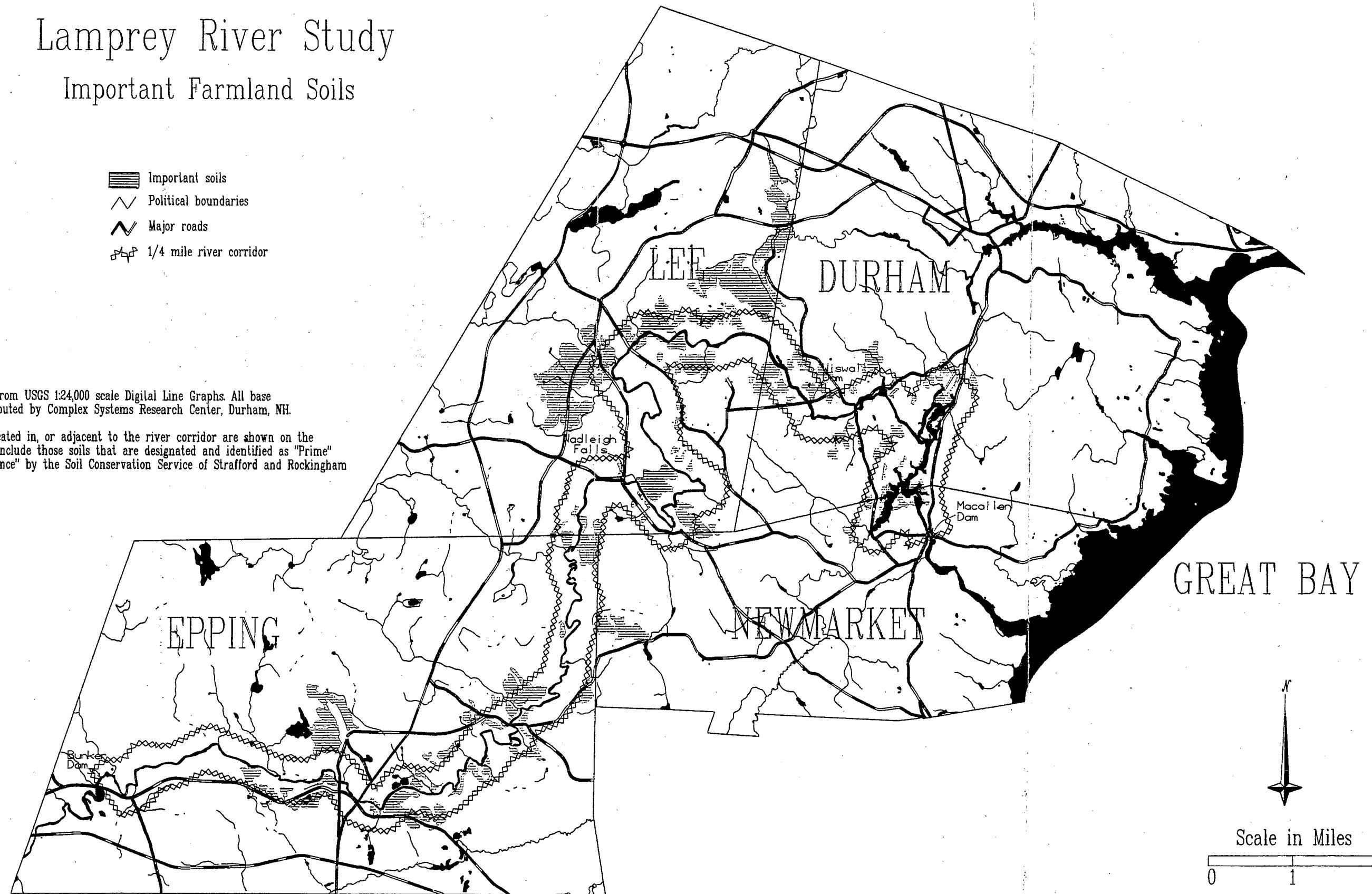
# Lamprey River Study

## Important Farmland Soils

- Important soils
- △ Political boundaries
- ~ Major roads
- 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

Only farmland soils located in, or adjacent to the river corridor are shown on the map. Farmland soils include those soils that are designated and identified as "Prime" or "State Wide Importance" by the Soil Conservation Service of Strafford and Rockingham counties.



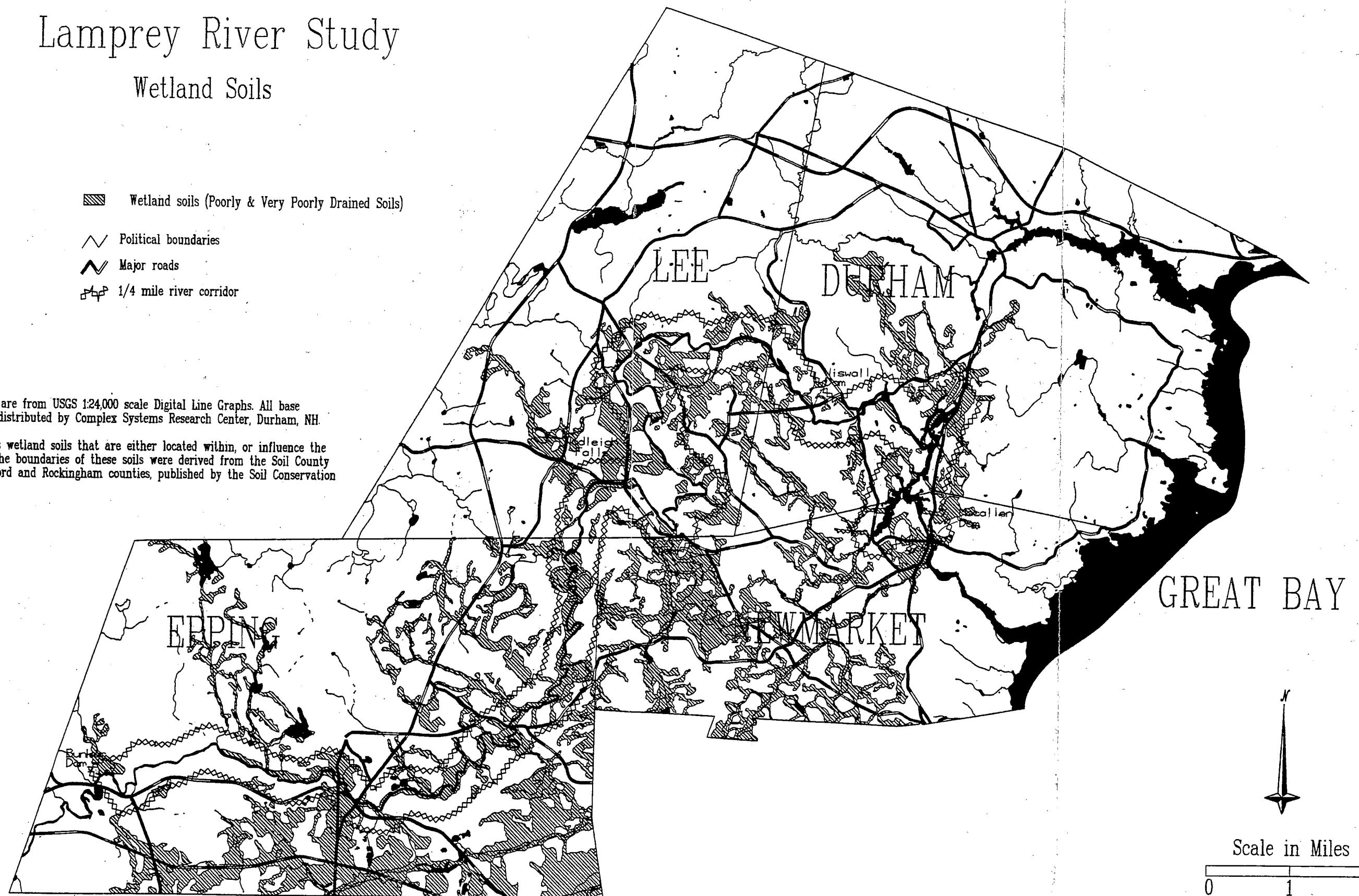
# Lamprey River Study

## Wetland Soils

- Wetland soils (Poorly & Very Poorly Drained Soils)
- ~ Political boundaries
- ~ Major roads
- △ 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

This map displays wetland soils that are either located within, or influence the river corridor. The boundaries of these soils were derived from the Soil County Surveys of Strafford and Rockingham counties, published by the Soil Conservation Service.



# Lamprey River Study

## 100 Year Floodplain

Floodplain

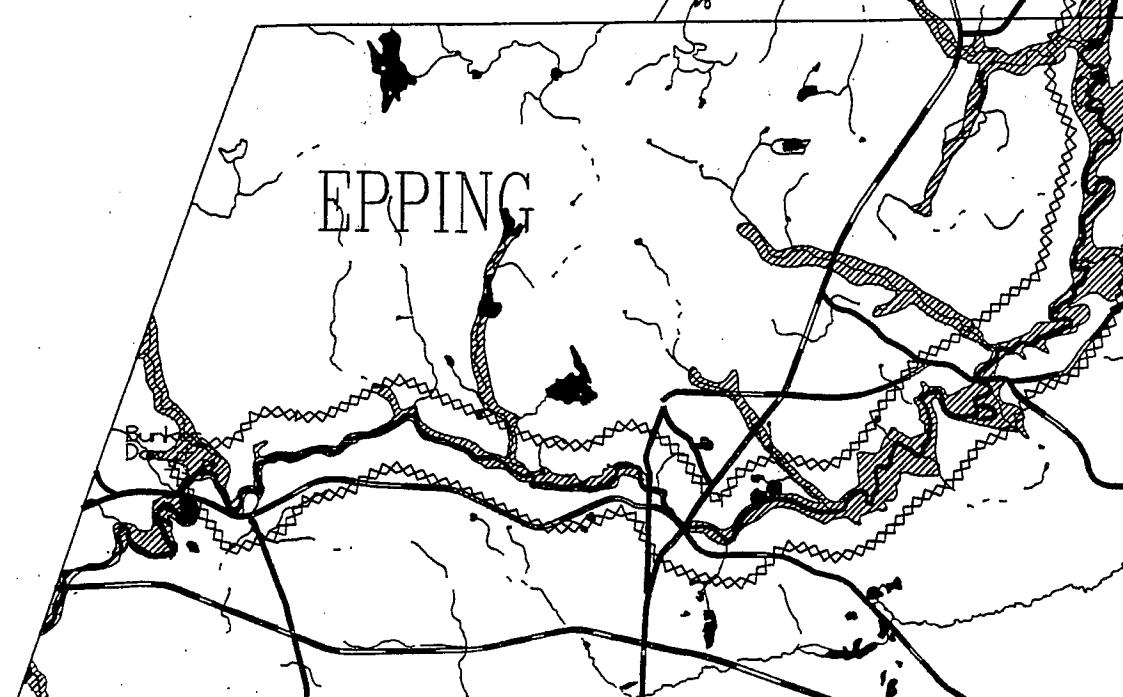
Political boundaries

Major roads

1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

This map displays the 100 year flood boundaries of the Lamprey River and selected tributaries. This information was compiled with the assistance of John Hatch, of Durham, NH, from maps prepared by the Federal Emergency Management Agency. The information was digitized by SRPC.



NEWMARKET

GREAT BAY

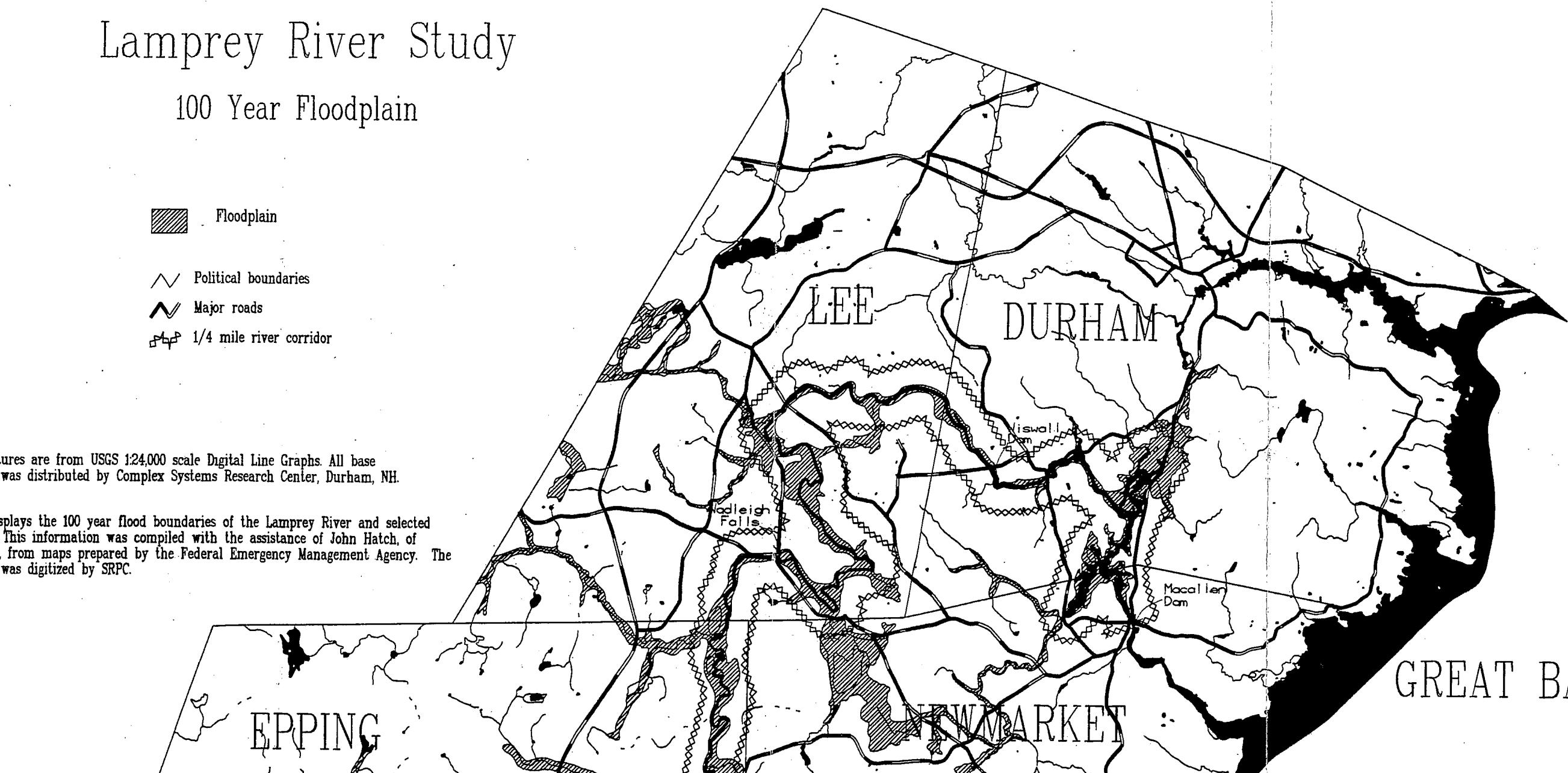
LEE

DURHAM

Odleigh  
Falls

Niswold  
Farm

Macallan  
Dam



Scale in Miles



# Lamprey River Study

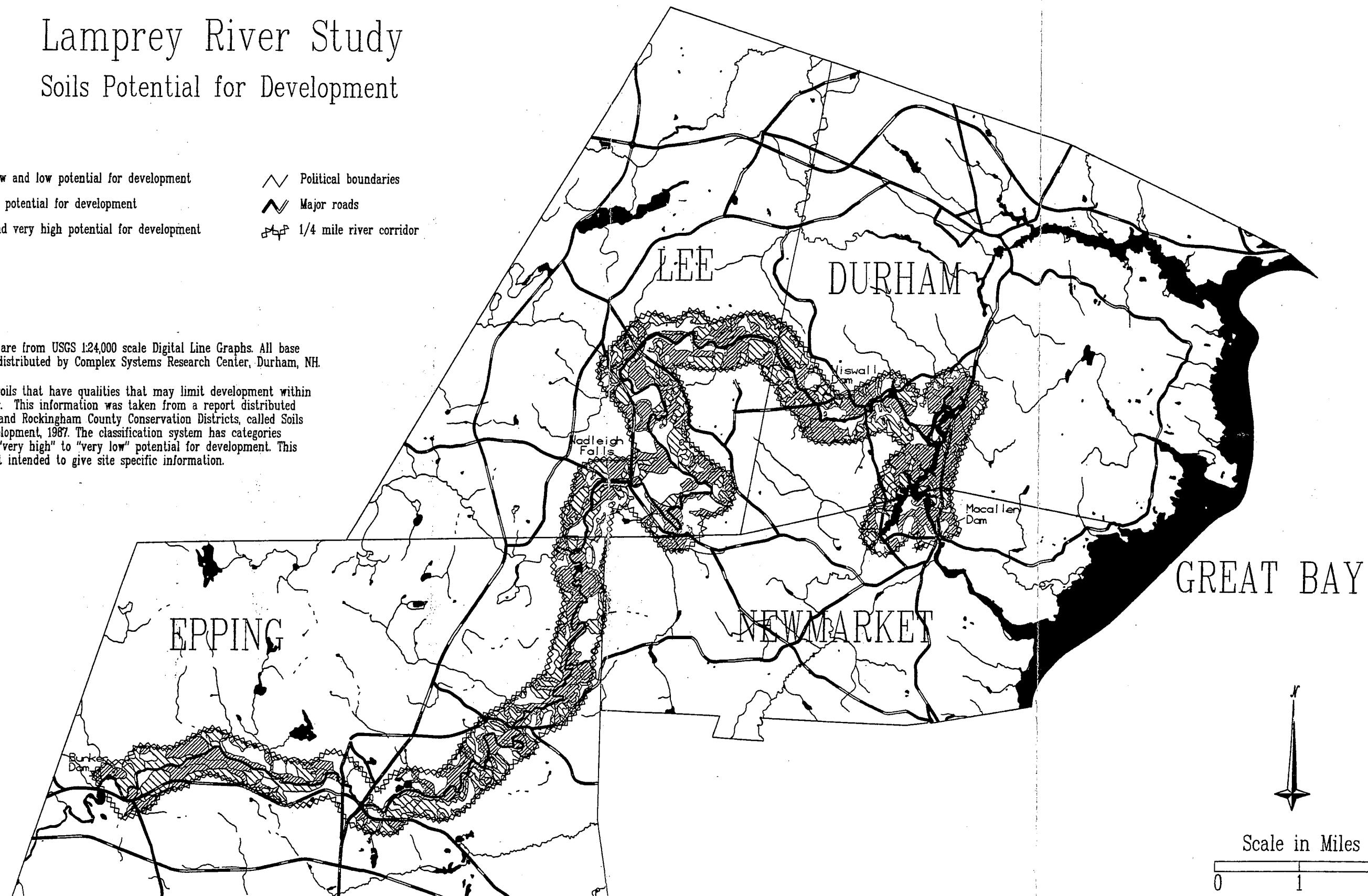
## Soils Potential for Development

Very low and low potential for development  
Medium potential for development  
High and very high potential for development

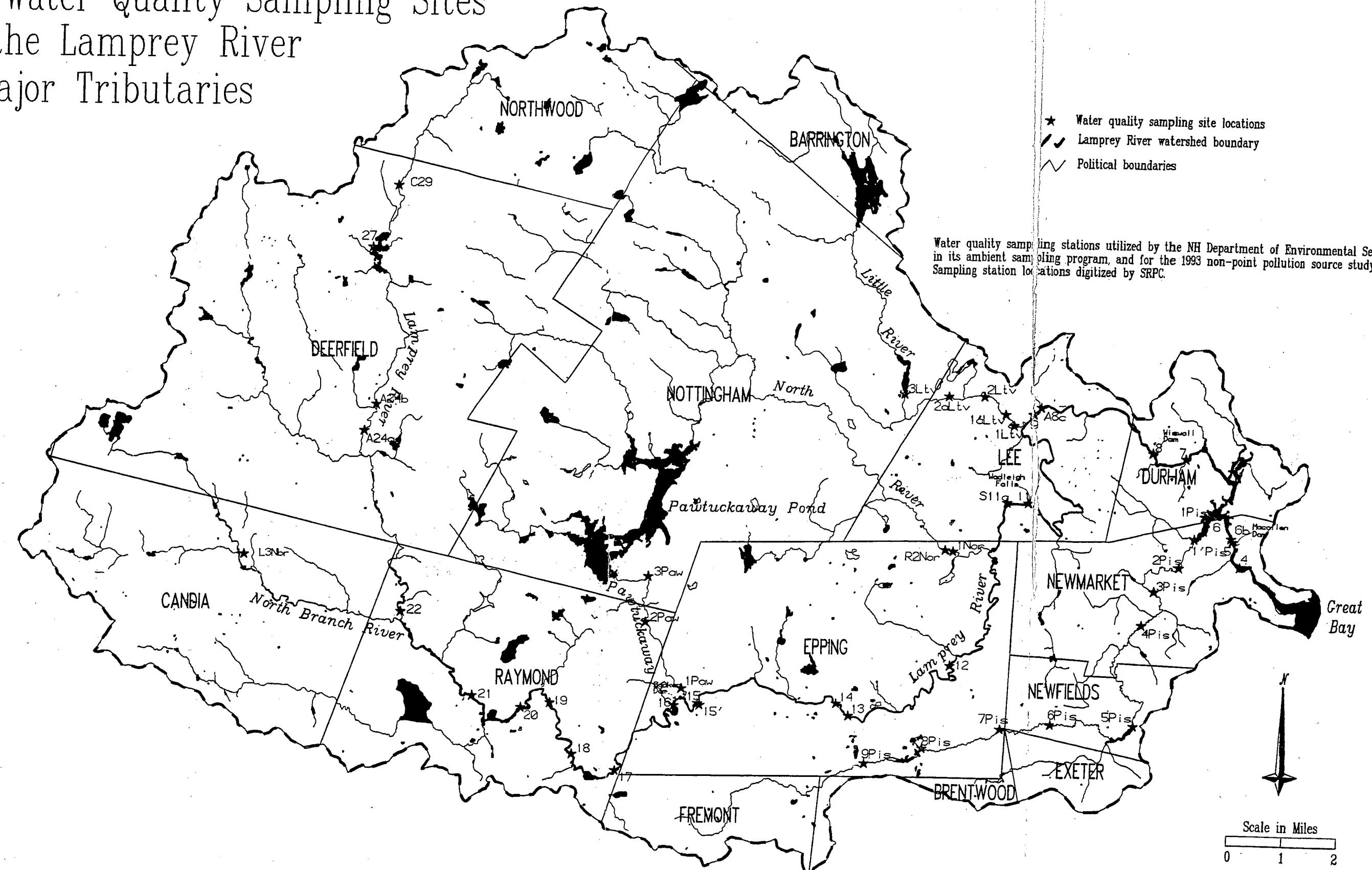
Political boundaries  
Major roads  
1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

This map shows soils that have qualities that may limit development within the river corridor. This information was taken from a report distributed by the Strafford and Rockingham County Conservation Districts, called Soils Potential for Development, 1987. The classification system has categories that range from "very high" to "very low" potential for development. This information is not intended to give site specific information.



# State Water Quality Sampling Sites on the Lamprey River & Major Tributaries



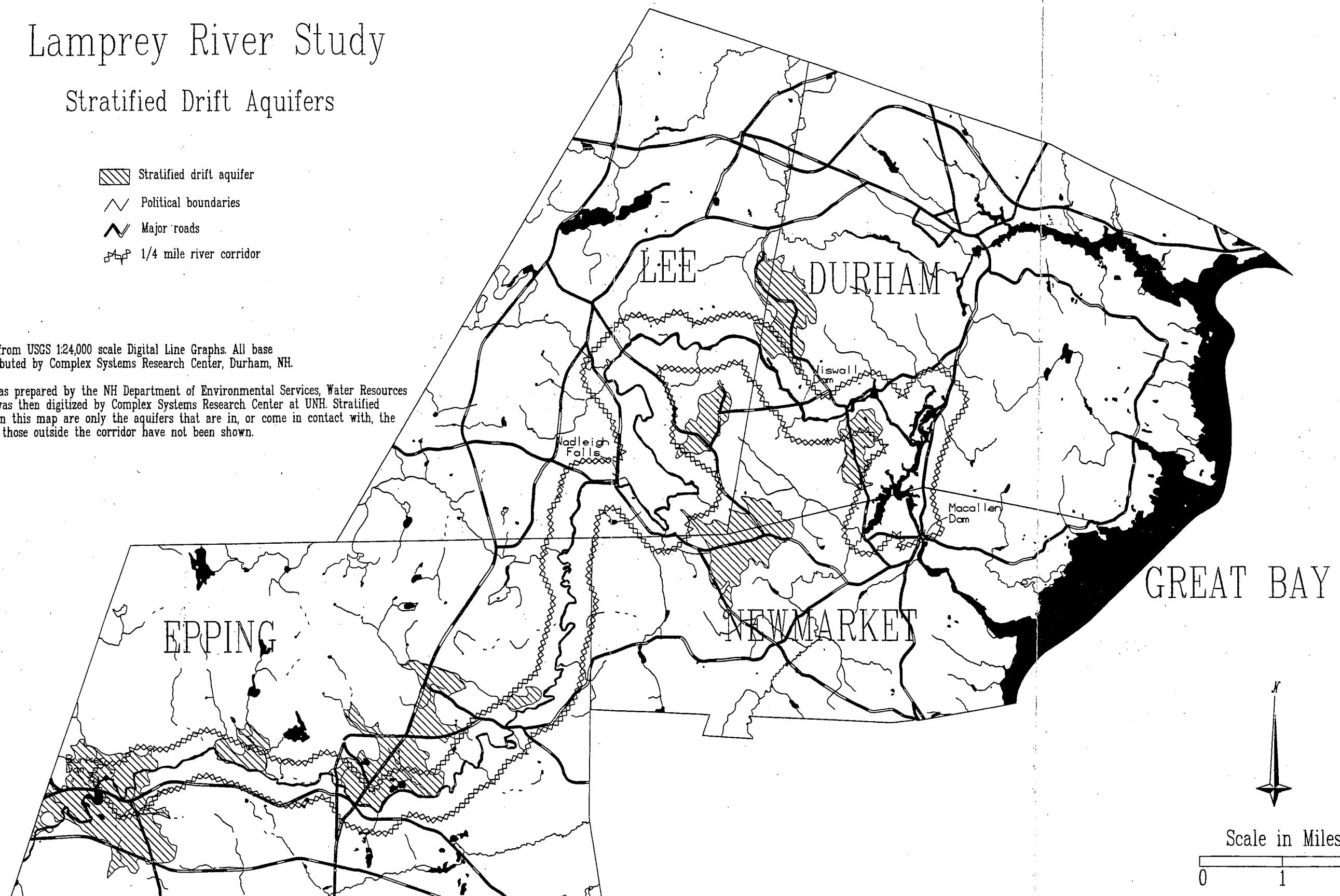
# Lamprey River Study

## Stratified Drift Aquifers

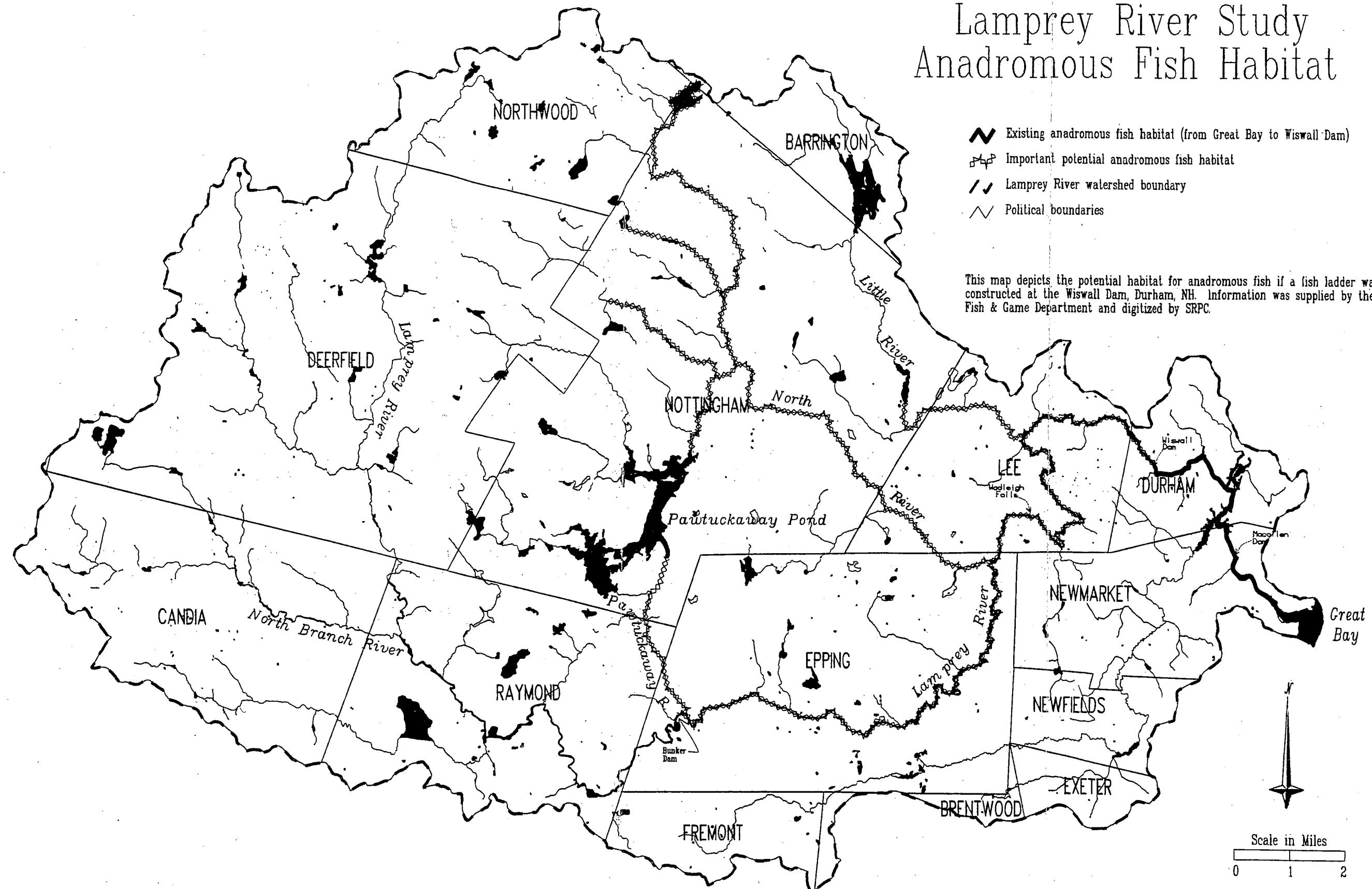
- [Hatched pattern] Stratified drift aquifer
- [Wavy line] Political boundaries
- [Major roads] Major roads
- [Dashed line with cross-hatch] 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

Aquifer information was prepared by the NH Department of Environmental Services, Water Resources Division. Information was then digitized by Complex Systems Research Center at UNH. Stratified drift aquifers shown on this map are only the aquifers that are in, or come in contact with, the quarter mile corridor, those outside the corridor have not been shown.



# Lamprey River Study Anadromous Fish Habitat



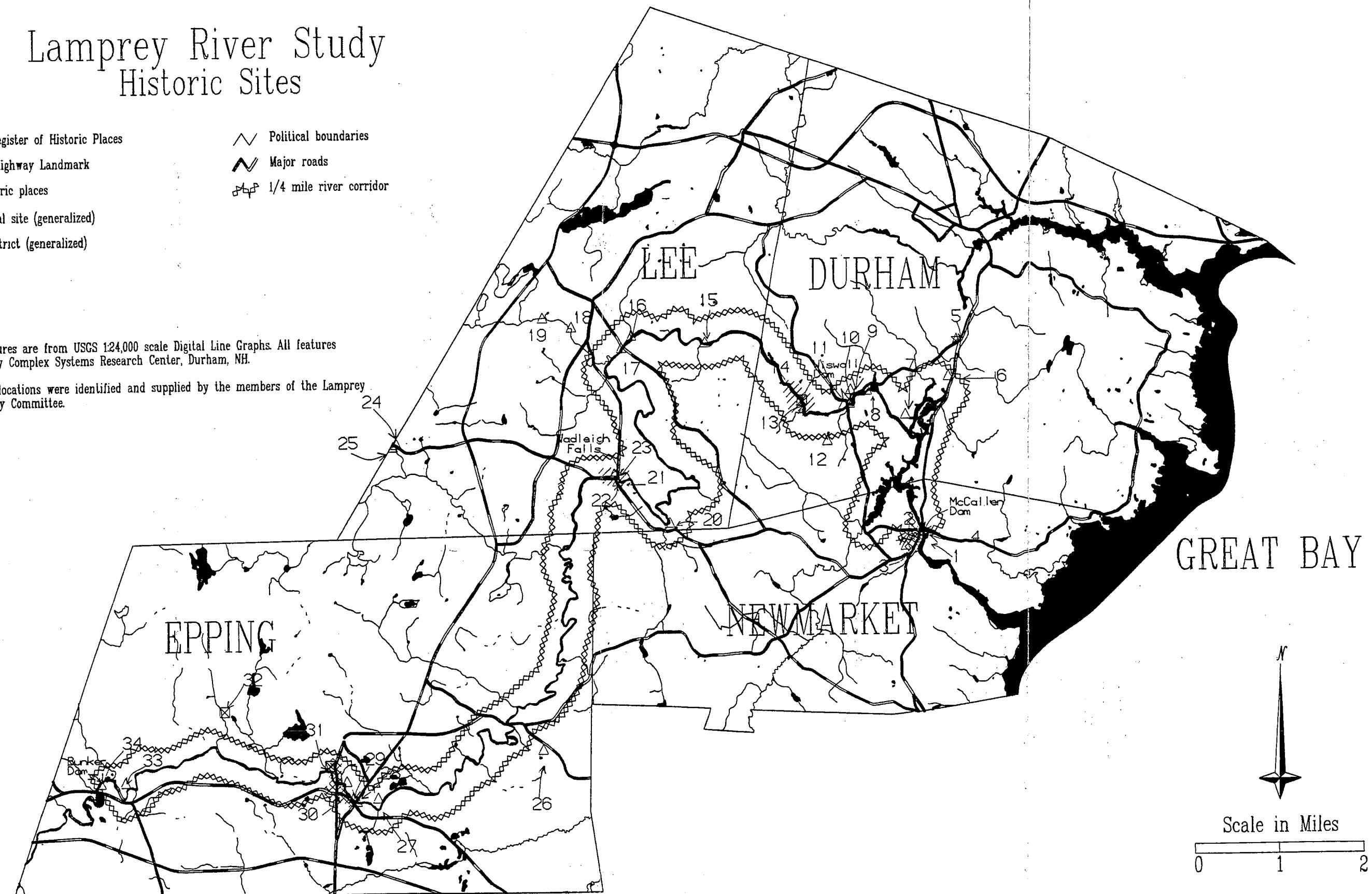
# Lamprey River Study Historic Sites

- National Register of Historic Places
- ★ NH State Highway Landmark
- △ Other historic places
- // Archeological site (generalized)
- xxxx Historic district (generalized)

- ~ Political boundaries
- ↗ Major roads
- ↗ 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All features distributed by Complex Systems Research Center, Durham, NH.

Historic site locations were identified and supplied by the members of the Lamprey River Advisory Committee.



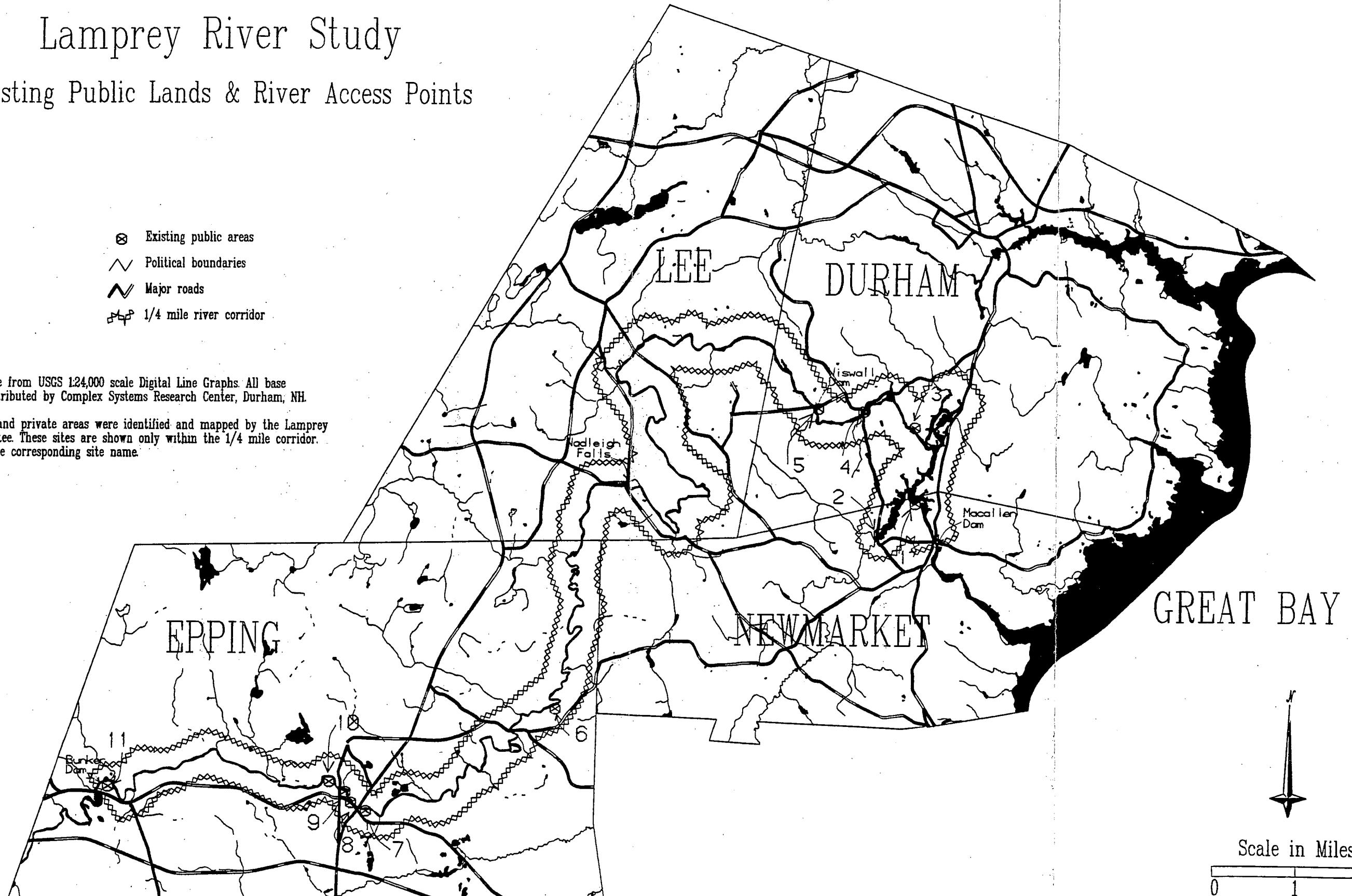
# Lamprey River Study

## Existing Public Lands & River Access Points

- ☒ Existing public areas
- ~~ Political boundaries
- ~ Major roads
- ~~~~ 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

The existing public and private areas were identified and mapped by the Lamprey River Study Committee. These sites are shown only within the 1/4 mile corridor. See document for the corresponding site name.



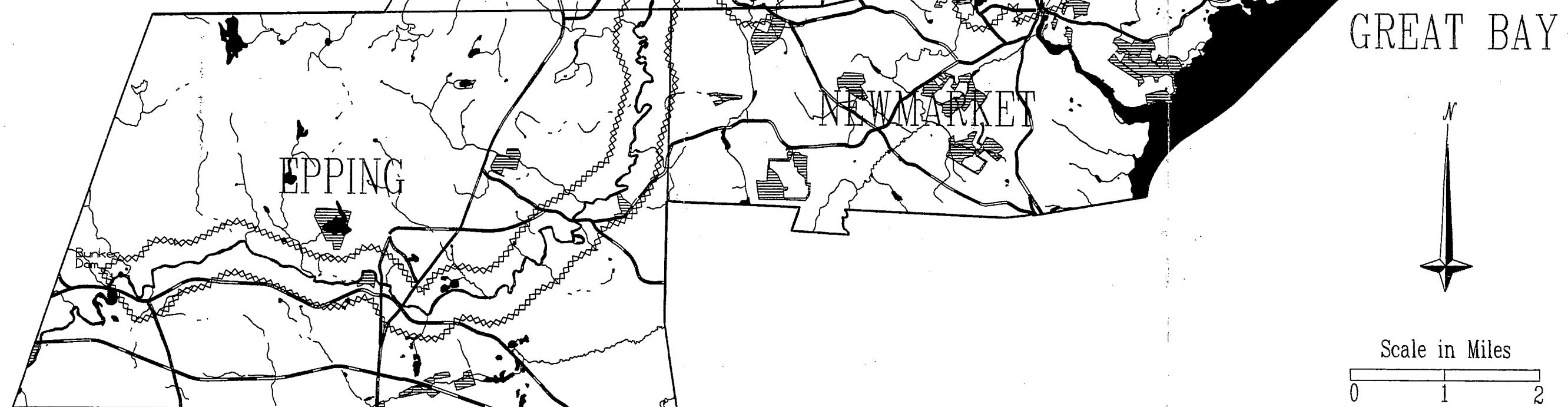
# Lamprey River Study

## Protected Lands and Institutionally Owned Lands

-  Protected or Institutionally Owned Land
-  Political boundaries
-  Major roads
-  1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All features distributed by Complex Systems Research Center, Durham, NH.

All protected lands are either owned privately, owned by the town/state, or part of an institutional holding. Protected Lands data was supplied by Complex Systems Research Center, Durham, NH.



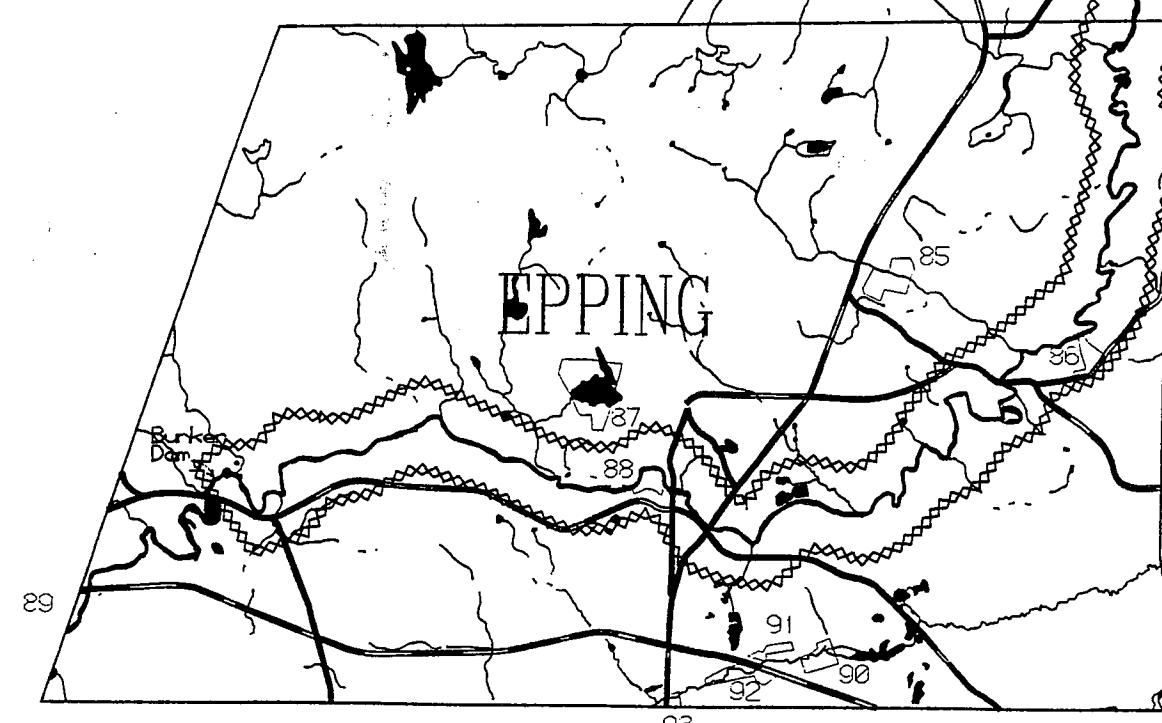
# Lamprey River Study

## Protected Lands

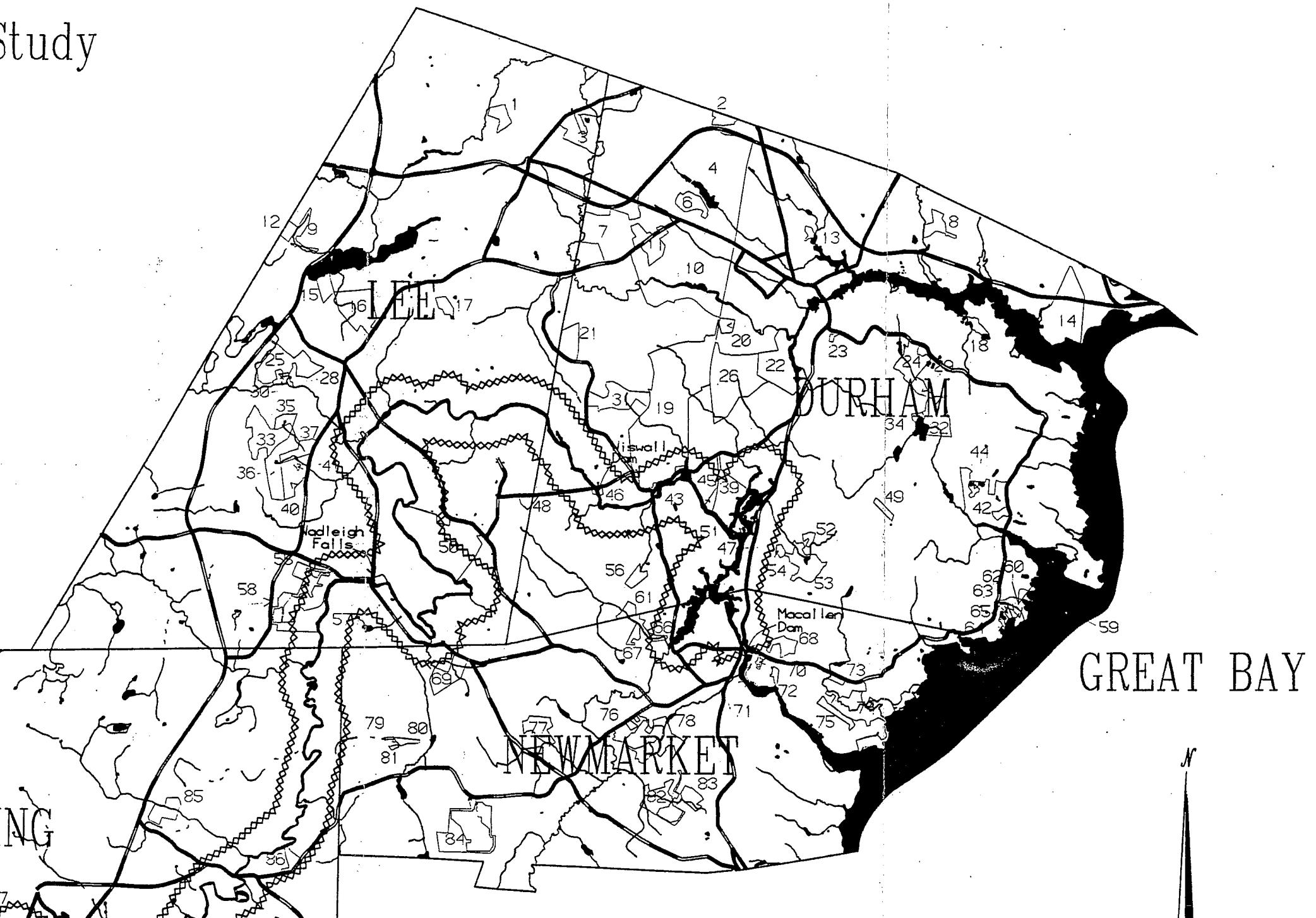
- ~ Protected Lands
- ~ Political boundaries
- ~ Major roads
- ~ 1/4 mile river buffer

All base features are from USGS 1:24,000 scale Digital Line Graphs. All features distributed by Complex Systems Research Center, Durham, NH.

All protected lands are either owned privately, owned by the town/state, or part of an institutional holding. Protected Lands data was supplied by Complex Systems Research Center, Durham, NH.



Strafford  
Regional  
Planning  
Commission



Scale in Miles



July 1994

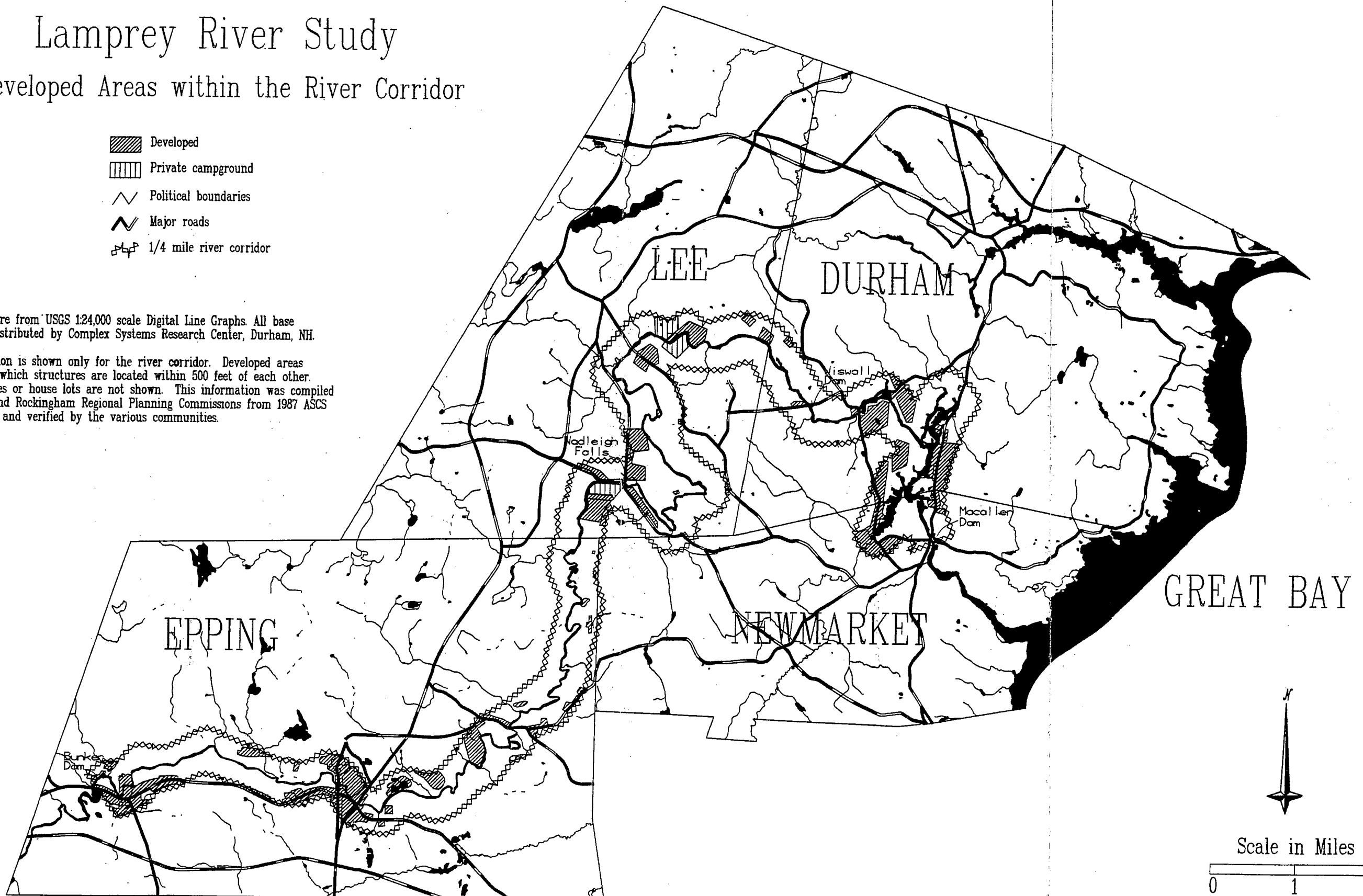
# Lamprey River Study

## Developed Areas within the River Corridor

- [Hatched pattern] Developed
- [Vertical lines pattern] Private campground
- [Wavy line pattern] Political boundaries
- [Major roads symbol] Major roads
- [Dashed line pattern] 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

Land use information is shown only for the river corridor. Developed areas represent land on which structures are located within 500 feet of each other. Individual properties or house lots are not shown. This information was compiled by the Strafford and Rockingham Regional Planning Commissions from 1987 ACS aerial photography and verified by the various communities.



# Lamprey River Study

## Generalized Zoning Map \*

- [diagonal hatching] Residential/Rural (R,RR,R1,R2)
- [vertical hatching] Commercial/Light Industry (C,B,BD)
- [cross-hatching] Mixed urban (V,M)
- / Political boundaries
- ~ Major roads
- > 1/4 mile river corridor

All base features are from USGS 1:24,000 scale Digital Line Graphs. All base information was distributed by Complex Systems Research Center, Durham, NH.

This map only displays zoning classifications within the river corridor. Zoning information was compiled from individual zoning maps which were adopted by each of the four municipalities. A generalized zoning classification system was then adopted that represents a best fit to the non-uniform zoning categories used by each municipality. The zoning symbols used are taken from the zoning ordinances of each of the four towns. A more detailed description of these symbols can be found in the town zoning ordinance.

\* In addition to these zones each community has overlay districts to protect important community resources, including the Lamprey River shoreline.

