

Section 2.0 Previous Work within the Watershed and Current Issues

(Scope of Services 1.a)

Martins Pond, its watershed and its outlet, Martins Brook, have been a focus of attention concerning water quality issues for decades. Federal, State and Town agencies, private groups and concerned citizens have all been involved in assessing the status of these water resources, proposing remediation measures, and in some instances, implementing management practices. Much of the work related to the current project was initiated in the 1970's. A summary of previous work within, and concerning, the watershed is summarized in Table 1.

Martins Pond, a Great Pond of the Commonwealth, is highly eutrophic, exhibits very high levels of phosphorus, and is on DEP's Massachusetts Year 2004 Integrated List of Waters [303(d) list] as impaired by **turbidity**, **noxious aquatic plants**, **metals** {Hg-CN176.0}, and **exotic species**. Concerns over eutrophic conditions in the Pond date back more than 40 years. In addition, the area directly adjacent to Martins Pond in North Reading, including portions of Burroughs Road and Lakeside Boulevard, has been susceptible to periodic minor flooding as documented by flooding events in 1938, 1948, 1954, 1958, 1962, 1968, 1987, October 1996, June 1998, March 2001, April 2004, and most recently in May 2006. Based on the results of a 2004 FEMA flooding study in North Reading, minor flooding occurs at Pond elevations up to 78 feet and major flooding is defined when the Pond elevation exceeds 78 feet (FEMA 2004).

The initial quantitative concerns regarding water quality and eutrophication issues in Martins Pond date back to 1967 when the Town Beach on Martins Pond was constructed. The main water quality concerns focused on controlling nuisance aquatic plants, algal blooms and maintaining water quality levels suitable for swimming. The first diagnostic work on Martins Pond was initiated in the late 1970's through the *Martins Pond Eutrophication Study* (IEP 1977). That study investigated the sources of eutrophic conditions in the Pond and concluded that more phosphorus was exiting the pond into Martins Brook than entering from the Skug River inlet. The study attributed this to large reserves of phosphorus that existed in the bottom sediments of Martins Pond and deteriorating groundwater water quality. The study also concluded that the sewerage of residences around Martins Pond would also substantially reduce the annual phosphorus loading to the Pond.

In 1981, the *Martins Pond Reclamation Study Committee* was formed to develop a reclamation plan for the pond. In 1984, money was secured by the Town to contract out a Diagnostic/Feasibility Study (Anderson-Nichols and Lycott 1985). The 1984 D/F study concluded that Martins Pond was phosphorus limited and there were two major sources of phosphorus; (1) the Skug River and its drainage basin and (2) on-lot septic systems that serviced houses around the Pond. Sediment loadings from the watershed were reported as minimal. The high flushing rate of the Pond was noted as a key mechanism for limiting algal and nuisance aquatic plant growth. Following the 1984 D/F study, the pond was treated with alum in June 1985 and again in August 1987 in an attempt to reduce P levels. Despite the alum treatments, swimming was discontinued at the Town Beach in 1988 due to impaired water clarity.

Table 1. Chronology of Investigations, Reports and Key Activities
in and around Martins Pond and its Watershed

Year	Investigation / Activity	Investigator / Relevant Party
1912	Aquatic Survey	Unknown
1966	Biological Survey of Pond	Jason Cortell, Wellesley Hills, MA
1967	Town Beach Construction	Town of North Reading
1971	Drainage Facilities for North Reading	Maguire and Associates
1972	A Survey of Martins Pond	Eco-Control, Cambridge, MA
1976	DWPC Baseline Sampling Study	Division of Water Pollution Control
1976	Martins Pond Improvement Committee Formed	Town of North Reading
1977	Martins Pond Eutrophication Study	IEP (Interdisciplinary Environmental Planning, Wayland, MA)
1979	Martins Pond Eutrophication Study (Phase II)	IEP (Interdisciplinary Environmental Planning, Wayland, MA)
1981	Martins Pond Reclamation Study Formed	Members appointed by North Reading Selectman
1985	Martins Pond Diagnostic/Feasibility Study	Anderson-Nichols & Co, Inc., Clinton, MA and Lycott Environmental Research, Inc., Southbridge, MA
1987	Martins Pond Alum Treatment	Lycott Environmental Research, Inc., Southbridge, MA
1988	Swimming in Martins Pond Banned	Town of North Reading
1992	Martins Pond Association Formation	Martins Pond Association
1994	Lake and Ponds Grant	Town of North Reading and Martins Pond Association
1995	Fish Contaminant Monitoring	Massachusetts DWM
1996	The Sister Pond Project	Toohill Environmental Associates, Littleton, MA
1997	Turtle Trail Project	Town of North Reading
2000	Ipswich River Watershed 2000 Water Quality Assessment Report	Massachusetts Department of Environmental Protection
2001	FEMA Study for North Reading	Green International Affiliates
2003	Ipswich River Watershed Action Plan	Horsley and Witten
2003	SWAP Report	MASS DEP
2003	Lake and Ponds Study	Merrimack College and Malcolm Pirnie Inc.
2004	Martins Brook Flood Reduction Study	U.S. Army Corps of Engineers
2004	Geoarchaeological Traverse in Andover	Wall et al. 2004
2004	Base Flood Elevation Determinations	FEMA
2005-2006	Martins Pond Assessment and Remediation Project	Merrimack College, Malcolm Pirnie Inc., Town of North Reading, Martins Pond Association

In 2003, a Department of Environmental Management Lakes and Ponds Grant was obtained to further study water quality in Martins Pond. The study focused on (1) the components of turbidity in both the pond and in the watershed, (2) wetland assessments and biological control of purple loosestrife, and (3) hydraulics of Martins Pond. The water quality results from the first portions of the study indicated that the relatively high turbidity levels in the Pond were due to primarily organic total suspended solids (TSS with high organic content) and seasonal algal growth. Also noted was the importance of relatively high color levels in limiting light penetration in the water column. In addition, very high total P levels in both Martins Pond and at sites along the Skug River were observed but the study did not investigate phosphorus sources and/or phosphorus loadings. The hydraulic analyses of the Lakes and Ponds study indicated that flooding problems in the Martins Pond area were clearly related to the quantity of flow entering the Pond and the capacity and water surface elevation of Martins Brook leaving the pond. Thus, given that the quantity of flow entering the Pond cannot be controlled, the capacity and water surface elevation of Martins Brook dictates the elevation of Martins Pond during storm events and determines how fast the raised elevation of Martins Pond will fall after a storm event. As part of that study, permanent gauge stations were installed to monitor surface water elevations and for assistance in calibrating hydraulic models.

The water quality recommendations from the 2003 Lakes and Pond Study were as follows:

- *Support and continue monitoring water quality (including total P) in Martins Pond and upstream along the Skug River. A full year of water quality data is needed to assess seasonal changes in water quality in Martins Pond. Additional sampling sites upstream are also needed to identify the source(s) of high P levels in waters entering Martins Pond.*
- *Continue monitoring total and fecal coliform levels in Martins Pond and upstream along the Skug River until June 2003. A full year of coliform data is needed to assess seasonal changes in coliform in Martins Pond and the Skug River. Additional sampling sites upstream are also needed to identify the source(s) of high coliform levels in waters entering Martins Pond.*
- *Support combining water quality data with flow data to develop nutrient budgets for Martins Pond. This approach is needed to facilitate development of TMDL's for the pond. Financial support for this effort is needed to begin the process of addressing water quality concerns in Martins Pond and the Martins Pond watershed.*
- *Conduct a sediment study along Martins Brook from Martins Pond outlet past Route 62 to assess sediment composition and chemistry prior to any potential stream channel modifications.*
- *Develop a water quality monitoring network from members of the Martins Pond Association to track the newly installed water level gauges in and around Martins Pond, Skug River and Martins Brook.*

- *Link water quality monitoring with water quality efforts in the Ipswich River watershed. Understanding and addressing the linkages between the Martins Pond watershed, Martins Pond, Martins Brook and the Ipswich River is required, especially in the formation of TMDL's for Martins Pond.*
- *Swimming in Martins Pond is not advised – especially after rainfall events. Total and fecal coliform levels spike after rain events and residents around the Pond should be fully aware of the potential health risks of swimming under these poor water conditions.*

In late 2004, the General Court of the Commonwealth directed the Department of Environmental Protection (DEP) through Chapter 352 of the Acts and Resolves of 2004, Section 78, to expend \$300,000 toward the assessment and remediation of Martins Pond including a new Diagnostic/Feasibility Study for Martins Pond that included assessment of watershed sources of nutrients, hydrologic modeling, nutrient budgeting and a comprehensive water quality analysis. The Town of North Reading, in collaboration with the Massachusetts DEP, the Martins Pond Association, Merrimack College, and Malcolm Pirnie Inc., initiated the current project to conduct assessments of water quality, wetlands, and hydraulic conditions and to develop recommendations to address identified problems. One central theme in the current project is eutrophication and assessing current nutrient levels in Martins Pond and in its watershed. To understand nutrient levels requires identifying sources, sinks, loadings and nutrient impacts (especially N and P) as well as develop strategies to remediate their effects.

The current report presents the final results of that effort. The Scope of Work is presented in Appendix A. It should be noted that the hydraulic and hydrologic studies reported here are more relevant to ‘minor’ flooding scenarios, meaning at Pond elevations less than 78 feet. Large-scale flooding investigations were concluded in 2004 for Martins Pond and Martins Brook and published by FEMA (FEMA 2004).

Given the extensive diagnostic work conducted in and around Martins Pond, the data and information contained in this report have been collected for many sources, including the previous studies noted above and in Table 1, and from data collected specifically for this study from March 2005 to March 2006. Additional data collected from 2002-2005 by Merrimack College, where appropriate, and data published in other previous and relevant reports have also been included in this report.

It should also be noted that several studies on the broader Ipswich River watershed have also been conducted in recent year and provide a regional context for the results of the current study (Zarriello and Ries 2000, Armstrong et al. 2001, Felix 2002, Zarriello 2002, Filoso et al. 2004, Williams et al. 2004, Williams et al. 2005). Many of these studies are linked to work conducted as part of the Plum Island Ecosystem Long-Term Ecological Research Site (LTER).

Central Importance of Eutrophication

Eutrophication has been at the historical center of all the previous and most recent diagnostic work conducted in and around Martins Pond. Martins Pond can be considered highly eutrophic and it exhibits very high levels of phosphorus. Eutrophication and the eutrophication process can be defined as the loading of inorganic and organic dissolved and particulate matter to lakes and ponds at rates sufficient to increase the potential risk for high biological production, decrease basin volume and deplete dissolved oxygen (Cooke et al. 2005). Wetzel (2001) points out that eutrophication is the progression of the productivity of a pond or lake along a continuum in the direction of low to high values (from oligotrophy to eutrophy). Table 2 below summarizes some of the general characteristics between oligotrophic and eutrophic states. While not an exhaustive description, the information in Table 2 provides an overview of eutrophication and a general overview of the eutrophic characteristics of Martins Pond.

Table 2. A general comparison of lake and pond characteristics used to classify surface waters.

Parameter	Oligotrophic	Eutrophic
Aquatic Plant Production	Low	High
Aquatic Animal Production	Low	High
Aquatic Plant Nutrient Flux	Low	High
Dissolved Oxygen Levels	Higher	Lower
Water Depth	Deeper	Shallower
Water Conductivity	Usually Lower	Often Higher
Overall Water Quality	Good	Poor

The trophic state of any water body is a direct result of several factors, including their location in the landscape, land use, soils, the nutrients and sediments that enter them from their watershed and the influence of groundwater (Cooke et al. 2005). The Martins Pond watershed is a complex system with several overlapping factors that are contributing to its impairment. Given the eutrophic status of Martins Pond and surface waters within its watershed (Merrimack College and Malcolm Pirnie 2003), one of the overall objectives in this study was to analyze the Martins Pond watershed using a subwatershed/subcatchment focus in an intensive effort to try and identify and locate, potential sources of water impairment. The subwatershed focus helped facilitate our analysis of water quality data, flow monitoring data, hydrological modeling and land use assessments.

Given that Martins Pond is a designated Class B water under the Massachusetts Surface Water Quality Standards, standards regarding eutrophication are described in the Code of Massachusetts Regulations under sections: 314CMR 4.04 subsection 5:

(5) Control of Eutrophication. From and after the date 314 CMR 4.00 become effective there shall be no new or increased point source discharge of nutrients, primarily phosphorus and nitrogen, directly to lakes and ponds. There shall be no new or increased point source discharge to tributaries of lakes or ponds that would encourage cultural eutrophication or the growth of weeds or algae in these lakes or ponds. Any existing point source discharge containing nutrients in concentrations which encourage eutrophication or growth of weeds or algae shall be provided with the highest and best practical treatment to remove such nutrients. Activities which result in the nonpoint source discharge of nutrients to lakes and ponds shall be provided with all reasonable best management practices for nonpoint source control.

2.1 - Trophic Status of Martins Pond

In order to assess the root causes of eutrophication in Martins Pond and its watershed, the current trophic status of the pond along the continuum of eutrophication needed to be established. From a broad geographical perspective, Martins Pond is located in North Eastern Coastal Zone ecoregion in New England (Omernick 1987). In a more regional context, the larger ecoregion has been subdivided and Martins Pond is located within the Southern New England Coastal Plains and Hills sub-ecoregion (Barbour et al. 1999). Two ENSR studies (ENSR 2000; ENSR 2003) developed broad eco-regional based criteria for classifying water bodies in New England. Based on that study, a Trophic Status Classification Index (TSI) was established based on key water quality variables.

The TSI developed by ENSR used a system assuming thresholds or criteria for the transition from an oligotrophic to mesotrophic state (estimated as a TSI value of 35) and for transition from a mesotrophic state to a eutrophic state (estimated as a TSI value of 50). While the TSI represents a first approximation of the trophic status for purposes of comparison between ecoregions and historic data, it provides important context for evaluating the status of the Martins Pond study site. The TSI analysis is presented in Table 3.

Table 3. A Trophic Status Classification based on water quality variables (after Carlson 1977 and ENSR 2000). Martins Pond values are mean values for each year.

Variable	Oligotrophic	Mesotrophic	Eutrophic
Carlson TSI ¹	<40	41-50	51-60
ENSR TSI ²	<30	31-50	>50

<i>MARTINS POND CLASSIFICATION</i>				
Parameter	2002	2003	2004	2005-06
Secchi Depth (m)	1.09	1.06	1.13	1.07
Chlorophyll a (ug/L)	10.6	20.2	6.4	7.6
Total P (ug/L)	1310	40.2	69.1	52.0
A. ¹ TSI – Secchi	57	58	56	58
B. ¹ TSI – Chl-a	54	60	49	50
C. ¹ TSI – Total P	108	57	65	61
Average TSI (A+B+C) / 3	73	59	57	56

¹ Refers to values based on equations in Carlson (1977)

² Refers to values based on ENSR (2000)

It should be noted that the Carlson trophic state analysis (Carlson, 1977) may not be entirely appropriate for Martins Pond because the pond has a high quantity of aquatic macrophytes and the turbidity cannot be attributed primarily to algal biomass. The high turbidity and limited light penetration in the pond may also explain the somewhat low chlorophyll-a values for the pond shown in Table 3. In addition, the interpretation of the Secchi depth is complicated by the high dissolved color in the water that may be independent of eutrophication level. Based on this complexity, the components of the TSI are presented in Table 3 both independently and as an average of the three parameters. Regardless of the classification system used, the year or the Carlson or ENSR criteria, Martins Pond is clearly a eutrophic system even given its relatively high color level (see Section 5.3).

The mean yearly total P value presented in Table 3 also clearly put Martins Pond in the eutrophic category. Given that only 12.5% of all lakes and ponds in the North Eastern Coastal Zone ecoregion are classified as eutrophic based on total P (ENSR 2000) Martins Pond should be considered among the most eutrophic surface waters in the ecoregion. Additional predictions of total P values based on land use export coefficients and TDML modeling (See Appendix B) indicate expected total P values around 28 ppb (0.028 mg/L) assuming a forested watershed. Thus, based solely on total P levels, Martins Pond should be considered a highly eutrophic system.

The Secchi depth transparency in Martins Pond also would classify the pond as eutrophic. Some 15.3% of lakes and ponds in the ecoregion are in this grouping. Mean yearly chlorophyll-a levels in the pond also would classify the pond as eutrophic, except in 2004. Some 16.1% of lakes and ponds in the ecoregion are classified as eutrophic based on chlorophyll-a levels.

Overall, Martins Pond is clearly a eutrophic system based on the TSI criteria. Furthermore, within the ecoregion, the pond should be classified in the upper tier of eutrophic surface waters. However, the influence of the relatively high color and turbidity in this system must be considered when assessing the role of nutrient limitation on algal and macrophyte growth; light limitation may be as or more significant as nutrient limitation.

2.2 - Land Use

A thorough understanding of a watershed's current and historical land use characteristics is essential in evaluating ambient water quality and sources of nutrient loadings. Figure 2 shows the current land use in the Martins Pond watershed. Table 4 contains a more detailed breakdown of the specific area (acres) and percent cover for each land use category shown in Figure 2. The land use classifications are based on data layers from MassGIS and are based on statewide 1:25,000 aerial color infrared photography obtained in 1999. The fragmentation of contiguous forest cover by residential development (R0,R1,R3) is apparent in the northern and southern portions of the watershed.

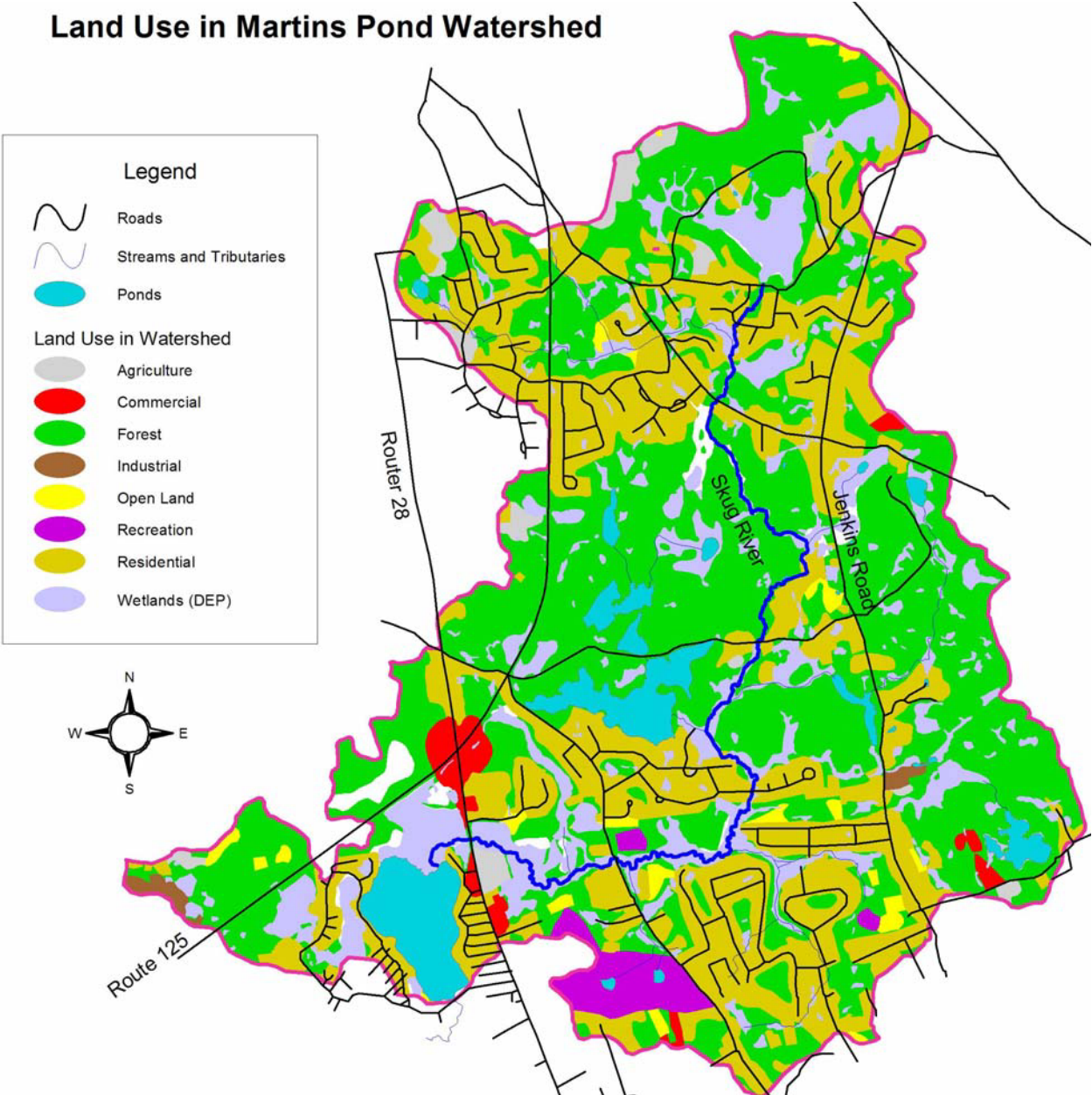


Figure 2. Land use in the Martins Pond Watershed based on the 21-category land use classification system (LU-21 codes) in MassGIS (based on 1999 aerial photography). More quantitative details on the land use cover depicted above are provided in Table 4.

Table 4 summarizes the current land use/land cover conditions across the entire watershed. Both overall acreage and percent of the watershed covered are noted. While forest covers the largest overall area land cover category (43.7% of the watershed), residential land uses cover a combined 29.2% of the watershed. Ponds (open water) comprise some 4.6 % of the watershed area and the total coverage of wetlands is some 15.9%.

Table 4. Current land use summary within the Martins Pond watershed.

Land Use Category ¹	Code ¹	Acres	% of Watershed
Cropland	1	19.8	0.4
Pasture	2	41.2	0.8
Forest	3	2182.9	44.3
Wetland	4	741.0	15.0
Mining	5	1.4	< 0.1
Open Land	6	60.6	1.2
Participation Recreation	7	48.7	1.0
RO Residential	10	18.2	0.4
R1 Residential	12	363.4	7.4
R3 Residential	13	1090.0	22.1
Commercial	15	21.8	0.4
Industrial	16	16.3	0.3
Urban Open	17	36.2	0.7
Transportation	18	43.91	0.9
Waste Disposal	19	3.7	0.1
Ponds	20	221.9	4.5
Woody Perennial	21	16.0	0.3
TOTAL		4927	100

¹ Land use categories and codes based on the 21-category land use classification system provided by MassGIS. Definitions are as follows for the categories: (1) *Cropland* – intensive agriculture; (2) *Pasture* – extensive agriculture; (3) *Forest*; (4) *Wetland* – nonforested freshwater wetland; (5) *Mining* – sand, gravel and rock; (6) *Open Land* – abandoned agriculture, power lines, areas of no vegetation; (7) *Participation Recreation* – golf, tennis, playgrounds, skiing; (10) *RO Residential* – multi-family housing; (12) *R2 Residential* – ¼ to ½ acre lots; (13) *R3 Residential* – larger than ½ acre lots; (15) *Commercial* – general urban, shopping center; (16) *Industrial* – light and heavy industry; (17) *Urban Open* – greenspace, vacant undeveloped land; (18) *Transportation* – airports, docks, divided highway, freight storage, railroads; (19) *Waster Disposal* – landfills, sewage lagoons; (20) *Water* – freshwater; (21) *Woody Perennial* – orchard nursery, cranberry bog.

Land use has obviously changed in the watershed since European colonization in the region, and more recently, there has been dramatic change in land use in the early 20th century, and even more recently over the past four decades. Table 5 summarizes the changes in land use as presented in various reports on Martins Pond and its watershed. More recent land use categories from MassGIS were back converted to the early land use designations (Map-Down categories by MacConell 1973), to facilitate comparisons. While there are likely some errors involved in summing up different type land uses, there are clear land use patterns changes that are evident in Table 5. The increase in urban/residential land use since 1971 has occurred with a corresponding decrease in overall contiguous forest cover. The increase in the area of wetland types noted from 1971 to 1999 is undoubtedly an artifact of the more detailed mapping and delineation of wetlands in recent years. For example, some 206 acres (4.2 % of the entire watershed) formerly classified as forest, were reclassified by the DEP in 2005 as wooded wetlands. In addition, the 1971 and 1979 classifications did not include detailed wetland type classifications. Thus, assuming that the difference in wetland extent from 1999 and 1979 (15.2% – 3.4% = 11.8%) might be considered forest in the 1979 and 1971 classifications, the forest type category in 1999 could be adjusted by adding the difference in wetland coverage (11.8%) yielding a forest type cover of 55.5%.

Table 5. A comparison of land use change in the Martins Pond Watershed from 1971 to 1999.

Land Use Category	1971 ¹	1979 ²	1999 ³
Outdoor Recreation	1.9	2.1	2.6
Urban /Residential Types	19.3	23.1	33.5
Mining and Waste Disposal	0.5	0.8	0.3
Forest Types	71.3	66.3	43.9
Wetland Types	2.3	3.4	15.2
Surface Water	4.7	4.3	4.5

¹ Based on Massachusetts Map-Down Land Use Category (MacConell 1973)

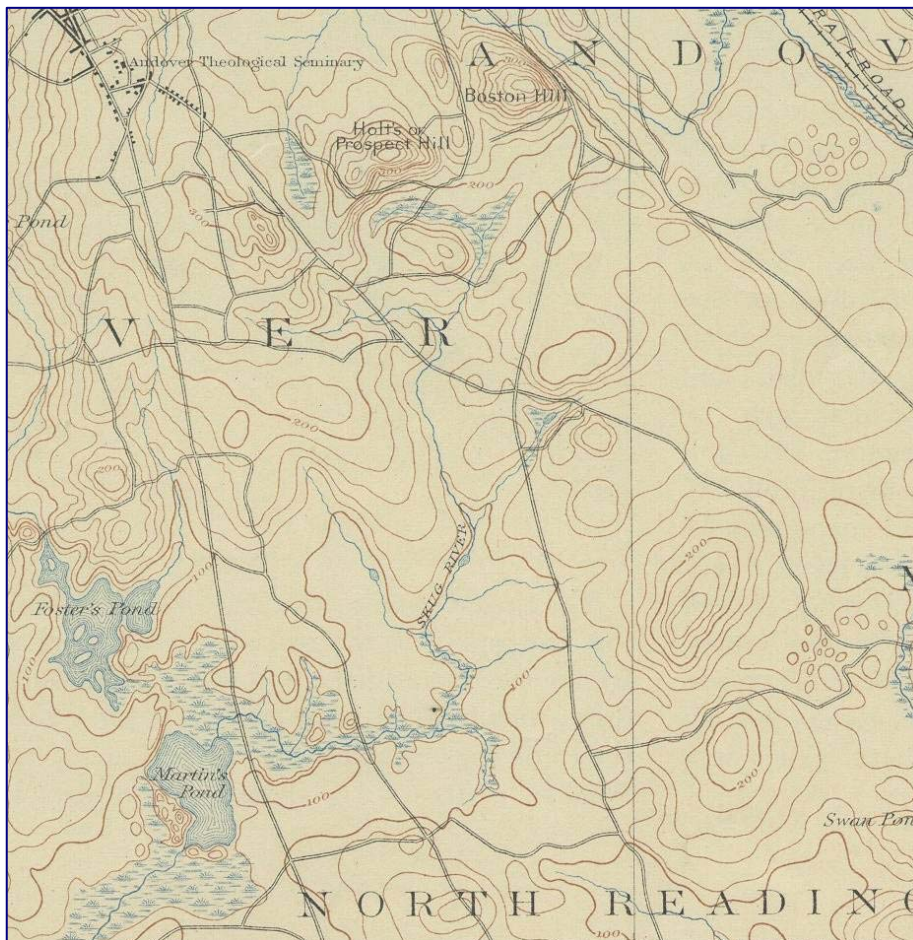
² Land Use Summary in Anderson-Nichols and Lycott (1985)

³ MassGIS land use information based on 1999 aerial photography and collapsed into Map-Down Land Use Categories

A more detailed and intensive analysis of current land use patterns based on the ten (10) subwatersheds with the Martins Pond watershed is presented later in this report (Section 5.0).

2.3 - Land Use and Hydrological Change in Harold Parker State Forest

In addition to the documented land use changes in the past three or four decades, more extensive historical analyses of land use in the watershed are helpful in elucidating potential long-term impacts from previous land use and land use alterations. One of the most interesting land use changes occurred in Harold Parker State Forest in the 1930's. This is of particular interest because the State Forest covers some 28.2 % of the entire watershed. The following information is modified from Berg (2001).



Harold Parker State Forest was established in 1916 and named in honor of the first chairman of the Massachusetts State Forest Commission. Minimal alterations of the land area were made until the 1930s when two Civilian Conservation Corps (CCC) camps were established. Camp S-S was open from 1933 to 1935 and was responsible for

damming the four ponds in the western section of the forest. Camp 5-76 was established in 1934, closed in 1941 and focused primarily on recreational development. The CCC transformed the area from second-growth woodland into a regional recreation area through the construction of a network of roads and extensive forestry, including fire hazard reduction, gypsy moth control, timber stand improvement and planting of red pines (*Pinus resinosa* Soland.).

The most significant surface water and hydrological change in Harold Parker State Forest was the damming of a number of small streams to create nine ponds. Bear, Aslebe and Berry Ponds are the only natural ponds in the Forest, as can be seen in the 1893 map to the left. The creation of the ponds found in the watershed today occurred from 1933 to 1938. The series of four interconnected man-made ponds in the western section of the Forest starting with Delano Pond (6 acres), Brackett Pond (18 acres), Collins Pond (7 acres) and ending at Field Pond (55 acres), were developed jointly for fishery and recreational purposes. Until 1983 these ponds were managed as a hatchery for warm water fish (bass, pickerel, perch, bullhead) by the Massachusetts Division of Fisheries and Wildlife. Since the hatchery has been closed, these ponds have been open to recreational use. All four artificial ponds have concrete dams with either concrete or stone spillways. Just below Collins Pond is an old fish sorting building that was used for hatchery purposes up until 1983.

The reference watershed (J) in this study is located primarily in the State Forest and ironically represents one of the most altered surface water sites in the entire watershed. Nonetheless, the relative low disturbance in past decades, the high percent forest cover and minimal residential development have provided a reference (control) site for comparison of other subwatersheds.

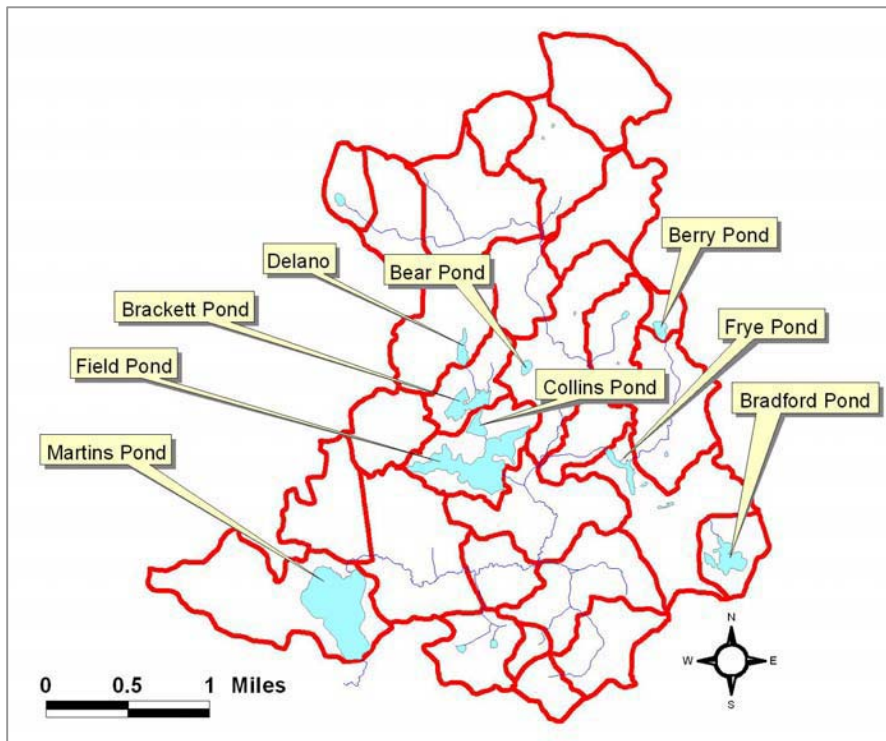
2.4 - Surface Waters

There are numerous ponds, both natural and human-made, in the watershed, and open surface water covers some 4.50% of the watershed (221.9 acres). Table 6 below provides a summary of some of the basic characteristics of the ponds within the watershed.

Table 6. A comparison of pond characteristics within the Martins Pond watershed.

Town	Pond	Area – acres	Origin	Elevation - ft
Andover	Delano	6	Artificial	131
	Field	59	Artificial	94
	Collins	7	Artificial	101
	Brackett	18	Artificial	107
	Frye	6	Artificial	91
	Bear	3	Natural	135
	Aslebe	3	Natural	112
	Pine Hole	1	Natural	128
	Others	10	-	-
North Andover	Berry	3	Natural	131
North Reading	Martins	94	Natural	74
	Bradford	17	Natural	119

Martins Pond is obviously the largest water body in the watershed and is at the lowest elevation. Except for Berry Pond, there is minimal information on water quality on the other ponds in the watershed. The public beach at Berry Pond in Harold Parker State Forest has been sampled over



the summer (weekly for some 16 times per year), since 2001 for *Enterococci* (see <http://www.mass.gov/dph> for annual beach testing reports). The figure to the left shows the locations and names of major ponds in the watershed.