

MONITORING THE ECOLOGICAL INTEGRITY OF PINELANDS WETLANDS

VARIATIONS IN SHALLOW, COASTAL PLAIN LAKE COMMUNITIES ASSOCIATED WITH LAND-USE-DEGRADATION GRADIENTS AND THRESHOLDS



**FINAL REPORT SUBMITTED TO THE
U.S. ENVIRONMENTAL PROTECTION AGENCY**

DECEMBER 2007

Chatsworth Lake
Chatsworth, NJ

Bullfrog
Rana catesbeiana

Pumpkinseed
Lepomis gibbosus

Inflated
bladderwort
*Utricularia
inflata*

Golden club
*Orontium
aquaticum*

Blackbanded sunfish
*Enneacanthus
chaetodon*

Carpenter frog
Rana virgatipes

Indian Mills Lake
Indian Mills, NJ

MONITORING THE ECOLOGICAL INTEGRITY OF PINELANDS WETLANDS

VARIATIONS IN SHALLOW, COASTAL PLAIN LAKE COMMUNITIES ASSOCIATED WITH LAND-USE-DEGRADATION GRADIENTS AND THRESHOLDS

Prepared By

**ROBERT A. ZAMPELLA, JOHN F. BUNNELL,
KIM J. LAIDIG, AND NICHOLAS A. PROCOPIO**

THE NEW JERSEY PINELANDS COMMISSION

Betty Wilson, Chairperson

Norman F. Tomasello, Vice Chair

Candace McKee Ashmun

William J. Brown

Dr. Guy Campbell, Jr.

Leslie M. Ficcaglia

Paul Galletta

John A. Haas

Hon. Robert Hagaman

Daniel Kennedy

Stephen V. Lee III

Edward Lloyd

Robert W. McIntosh, Jr.

Francis A. Witt

John C. Stokes, Executive Director

**FINAL REPORT SUBMITTED TO THE
U. S. ENVIRONMENTAL PROTECTION AGENCY**

December 2007

VARIATIONS IN SHALLOW, COASTAL PLAIN LAKE COMMUNITIES ASSOCIATED WITH LAND-USE-DEGRADATION GRADIENTS AND THRESHOLDS

INTRODUCTION

The concept of degradation thresholds has been used to describe the level of urbanization and associated impervious surface that results in stream impairment (Klein 1979, Steedman 1988, Arnold and Gibbons 1996, May et al. 1997). Although the concept is valid in areas dominated by urban-land use, it fails to account for the effect of agriculture on the ecological integrity of surface waters in areas with mixed land uses since both urban land and agriculture can result in water-quality degradation (Osborne and Wiley 1988, Johnson et al. 1997, Carpenter et al. 1998, Herlihy et al. 1998, Rhodes et al. 2001, Sliva and Williams 2001, Tufford et al. 2003) and associated changes in the composition of aquatic communities (Lenat and Crawford 1994, Wang et al. 1997, Carpenter and Waite 2000, Leland and Porter 2000, Waite and Carpenter 2000, Stepenuck et al. 2002).

New Jersey Pinelands streams are representative of blackwater coastal plain streams found along the east coast and Gulf Coast of the United States (Patrick 1996). Urban land and upland agriculture are generally good predictors of Pinelands stream-water quality when considered separately, but both land uses must be considered together to more fully describe the relationship between watershed disturbance and water quality (Zampella et al. 2007a). Pinelands water-quality and diatom-, macrophyte-, anuran-, and fish-community gradients are associated with variations in the extent of altered land (combined percentage of urban land and upland agriculture) in a watershed (Zampella 1994, Zampella and Laidig 1997, Zampella and Bunnell 1998, Dow and Zampella 2000, Zampella et al. 2001, 2003, 2005, 2006a, 2006b, 2007b). The purpose of this paper is to describe land-use gradients and thresholds associated with changes in water quality and the composition of diatom-, plant-, fish-, and anuran-assemblages found in Pinelands lakes.

METHODS

Land use and study-site selection

Most Pinelands lakes are artificial stream impoundments that were created for sawmills, ironworks, papermaking, and cranberry production (Patrick et al. 1979, Wacker 1979). Other lakes and ponds were created by sand mining and beaver activity. Although a prominent feature of the Pinelands landscape, these water bodies have received relatively little study compared to streams. There are nearly four hundred impoundments in the region. These impoundments are typically less than four hectares and are generally shallow with a mean depth of about one meter (New Jersey Division of Fish and Game 1950, 1951, 1957).

From a pool of 43 stream impoundments initially considered for the study, we selected 30 impoundments that represented a range of watershed conditions characterized by the percentage of developed land and upland-agricultural land (Figure 1, Appendix 1). Land-use/land-cover profiles for the entire watershed associated with each impoundment and for eight variable-width buffers surrounding each impoundment (0-25 m, 0-50 m,...0-200 m) were prepared using ArcView software (Environmental Systems Research Institute Inc., Redlands, CA, 1999-2006) and digital land-use/land-cover data obtained from the New Jersey Department of Environmental Protection (NJDEP, 1995/97 Land Use/Land Cover Update 2001). The NJDEP data set classifies land uses using a modified Anderson et al. (1976) system.

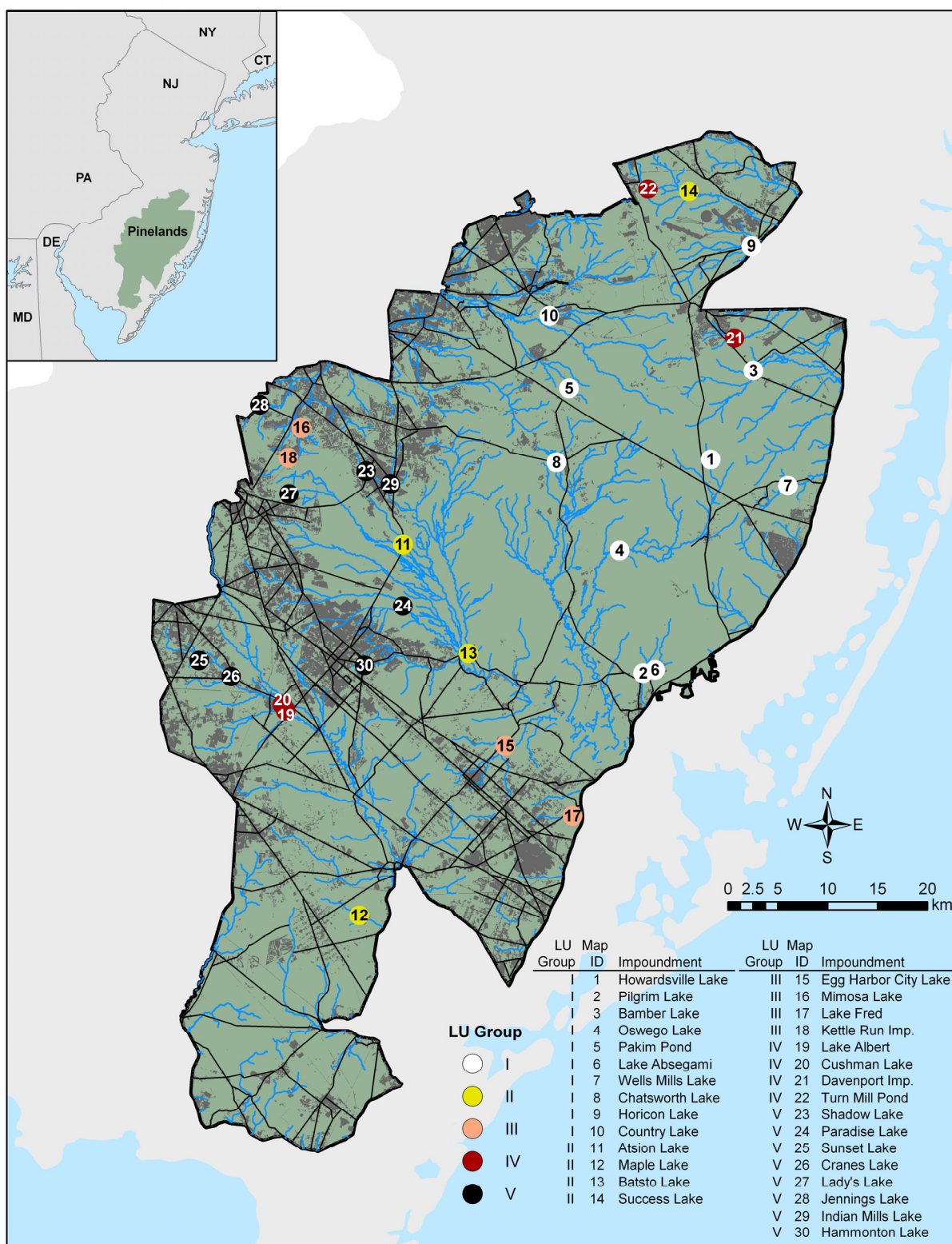


Figure 1. Location of 30 Pinelands impoundments representing five land-use groups. Altered land (upland agriculture and developed land) is shown in gray. Refer to Table 1 for the range of altered-land percentages assigned to each group.

In this paper, we refer to the Anderson-type land-use classes of urban land and agriculture as developed land and upland agriculture, respectively. Collectively, we refer to developed land and upland agriculture as altered land. Each impoundment was placed in one of five groups based on the percentage of altered land in the associated drainage basin (Table 1, Appendix 2). The five land-use groups were < 10%, 10-19.9%, 20-29.9%, 30-39.9%, and $\geq 40\%$ altered land, with each group represented by a Roman numeral (I-V). The percentage of altered land in the 30 study basins ranged from an average of 3.4% for Group I impoundments to 49.1% for Group V impoundments (Table 1). Altered land was absent in one watershed. On average, developed land and upland agriculture represented 69% and 31% of altered land in the other 29 drainage basins.

Table 1. Land-use, water-quality, impoundment-area, and nearshore-habitat characteristics of 30 Pinelands stream impoundments. The five land-use groups are defined by the percentage of altered land (developed land and upland agriculture) in the associated watersheds. Water-quality and vegetation-cover-rank values are group medians. All other values are group means (± 1 SD). Both pH and specific conductance values are based on samples collected over a three-year period (2003-2005).

Land-use/habitat factors	Land-use groups and the percentage of altered land (developed land and upland agriculture) associated with each land-use group.				
	I	II	III	IV	V
	<10% n = 10	10-19.9% n = 4	20-29.9% n = 4	30-39.9% n = 4	$\geq 40\%$ n = 8
Developed land (%)	2.8 $\pm$ 2.5	8.2 $\pm$ 2.6	18.8 $\pm$ 7.9	18.7 $\pm$ 11.9	33.3 $\pm$ 13.2
Upland agriculture (%)	0.6 $\pm$ 0.8	5.8 $\pm$ 3.7	6.7 $\pm$ 7.0	16.1 $\pm$ 11.1	15.9 $\pm$ 11.0
Altered land (%)	3.4 $\pm$ 3.0	14.0 $\pm$ 1.3	25.5 $\pm$ 4.6	34.8 $\pm$ 2.1	49.1 $\pm$ 6.5
Impoundment area (ha)	19.0 $\pm$ 13.3	26.2 $\pm$ 11.9	7.4 $\pm$ 5.5	18.0 $\pm$ 10.6	11.4 $\pm$ 8.3
pH	4.4	5.1	5.8	6.2	6.6
Specific conductance ($\mu\text{S cm}^{-1}$)	51.8	50.3	68.5	63.2	104.4
Nearshore-water depth (cm)	40.3 $\pm$ 9.0	41.0 $\pm$ 9.1	38.9 $\pm$ 17.3	40.2 $\pm$ 5.7	45.1 $\pm$ 5.9
Sand (%)	73.0 $\pm$ 17.4	82.5 $\pm$ 12.9	86.7 $\pm$ 13.6	84.2 $\pm$ 13.6	48.1 $\pm$ 38.0
Emergent-cover rank	1.0	0.8	0.0	0.3	0.7
Floating-cover rank	0.0	0.0	0.3	0.3	0.5
Submerged-cover rank	2.3	1.8	4.0	1.3	3.3

Environmental factors

Water quality. We sampled pH, specific conductance, and temperature monthly at all 30 impoundments from April through October 2003, March through October 2004, and March through September 2005 (Appendix 3). The period March through October represents the growing season. From April through December 2006, we measured the same variables at 24 of the 30 impoundments (Appendix 2). Nitrite as nitrogen ($\text{NO}_2\text{-N}$), nitrate as nitrogen ($\text{NO}_3\text{-N}$), orthophosphate as phosphorus ($\text{PO}_4\text{-P}$), sulfate as sulfur ($\text{SO}_4\text{-S}$), and chloride (Cl) also were measured at the 24 impoundments during the June, August, October, and December 2006 water-quality-sampling rounds. All water-quality measurements were completed under baseflow conditions.

Specific conductance was measured with an Orion model-122 meter and pH was measured using an Orion model-250A meter. Anion analyses were completed using a Dionex ICS90 ion chromatograph following Standard Methods (1998).

Shoreline habitats. At each impoundment, we established ten 4 x 10-m plots along representative shoreline habitats. Each plot extended 1-m above (terrestrial portion) and 3-m below (aquatic portion) the water line. To characterize the dominant-nearshore sediment, we subjectively classified substrate as gravel, sand, detritus, or mud (muck and silt) at 1-m intervals along transects located perpendicular to the water line at the middle and ends of each plot for a total of 9 measurements per plot. Based on the number of points where each type of substrate was found, we calculated the frequency of occurrence of each sediment type within each plot. We also measured water depth at the same 9 sampling points and used these data to calculate a mean water depth for each plot.

Biological surveys

Plants. At the 30 impoundments, we surveyed vegetation on a single occasion during the latter part of the growing season (July through early October). All surveys were conducted from 2003 through 2005. Separate presence/absence tallies were completed for each 4 x 10-m plot, resulting in ten sampling areas for each impoundment. These tallies were used to calculate a frequency of occurrence value for each species for each impoundment.

We used the Braun-Blanquet cover scale (Mueller-Dombois and Ellenberg 1974), where + = < 1%, 1 = 1-5%, 2 = 5-25%, 3 = 25-50%, 4 = 50-75%, and 5 = > 75% cover, to estimate the total abundance of emergent, floating-leaved, and submerged/free-floating vegetation within the aquatic portion of each plot. The plot values were used to calculate median cover values for each impoundment. Frequency of occurrence data for all plant species encountered in each impoundment are presented in Appendix 4. Taxonomic nomenclature follows Gleason and Cronquist (1991).

Diatoms. We used periphyton samplers that held 16 glass microscope slides to collect diatom samples at the outlet of 20 of the 30 impoundments. The samplers were placed in the stream below each impoundment for a 14-day period in July 2006 and again in September 2006. A spherical densimeter was used to measure canopy cover directly above the points where diatoms were sampled. Mean canopy cover for each site was based on four spherical-densimeter readings.

Slides from the two dates were pooled as a single sample and the samples were prepared following the methods described in Zampella et al. (2007b). Using a light microscope, diatoms were identified to species and enumerated until a total of at least 500 diatoms were counted. Species richness and relative abundance measures were based on all taxa collected, including those taxa identified only to genus. The complete diatom-data set is presented in Appendix 5.

Fish. We surveyed fish at the 30 impoundments on the same day that plant surveys were conducted. Using a 4-mm mesh nylon seine extending 3-m from the shore, we made two passes within each plot.

The number of individuals collected from each plot was used to determine presence/absence and relative abundance for each species in each plot. Relative abundance was calculated as: (number of individuals of a species/total number of individuals) × 100. Some juvenile *Esox* species (*E. niger* or *E. americanus*), *Enneacanthus* species (*E. obesus* or *E. gloriosus*), and *Lepomis* species (*L. gibbosus* or *L. macrochirus*) could not be identified to species and were not included in subsequent data analyses. Plot values were used to calculate frequency of occurrence and mean relative abundance for each species in each impoundment. The fish-survey data, which include the number of individuals of each species collected at each plot and the frequency of occurrence and mean relative abundance of each species for each

impoundment, are presented in Appendices 6 - 8. Taxonomic nomenclature follows that used in Page and Burr (1991).

Anurans. We conducted nighttime vocalization surveys at the 30 impoundments in June 2005. June is the calling season for both bullfrogs and carpenter frogs (Zampella et al. 2001), the two species that were the focus of our surveys. Each site was visited on one occasion. The number of calling individuals of all anuran species heard during a five-minute period was recorded. No attempt was made to count beyond 10 individuals of a given species so the maximum number for these species may be conservative. The time, temperature, and relative humidity were also recorded during each visit.

Tadpoles collected during the fish surveys were identified to species. No bullfrog or carpenter frog tadpoles were found at several sites where vocalizing bullfrogs or carpenter frogs were previously heard. These sites were revisited in September 2005 and a dip net was used to intensely sample nearshore habitats for tadpoles.

The anuran-survey data, which includes the number of individuals of each anuran species heard and the time, air temperature, relative humidity, and weather conditions recorded during site visits, are presented in Appendix 9. The presence of carpenter frog and bullfrog tadpoles at each site is also indicated. Taxonomic nomenclature follows Conant and Collins (1998).

Voucher collection

The Pinelands Commission maintains voucher collections for diatoms, plants, and fish. The diatoms found at each site are mounted in Naphrax on microscope slides. The herbarium collection includes voucher specimens for many of the plant species encountered during the surveys. The fish collection includes voucher specimens for all species collected at each impoundment.

Biogeography and wetland plant status

Following Zampella et al. (2006a), we refer to plant, fish, and anuran species whose distribution is limited to the Pinelands as restricted-native species, species that are native to both the Pinelands and other areas of New Jersey as widespread-native species, and species that are native to regions outside the Pinelands, including exotics, as nonnative species (Table 2). In the Pinelands, nonnative plant, fish, and anuran species are associated with watershed disturbance and water-quality degradation (Zampella and Laidig 1997, Zampella and Bunnell 1998, 2000, Zampella et al. 2006a).

Diatom pH categories

Pinelands streams draining developed lands and upland agriculture are dominated by diatom assemblages that are characteristic of circumneutral conditions, whereas acid-water diatoms dominate assemblages found in streams with little altered land in the watershed (Zampella et al. 2007b). Using Meriläinen (1967), Lowe (1974), van Dam et al. (1994), Charles (1985), and Dixit et al. (1999) and the methods described in Zampella et al. (2007b), we assigned diatom taxa to pH classes that describe the occurrence of diatoms in relation to pH. Indifferent or circumneutral species (pH around 7) were classified as indifferent. Acidobiontic (pH < 7), acidophilous (pH ≤ 7), and acidophilous-indifferent taxa were classified as acidobiontic-acidophilous. Alkaliphilous (pH ≥ 7), alkalibiontic (pH > 7), and indifferent-alkaliphilous diatoms were classified as alkalibiontic-alkaliphilous.

Table 2. Biogeographic classification of plant, fish, and anuran species based on Stone (1911), Hastings (1984), and Conant (1979), respectively. Nonnative-plant species also include species described as exotic by Gleason and Cronquist (1991).

Classification	Plants	Fish	Anurans
Restricted-native species	Pine Barrens District species	Restricted-characteristic species	Pine Barrens species
Widespread-native species	Species common to the Pine Barrens and Middle Districts	Widespread-characteristic species	Wide-ranging species
Nonnative species	Species restricted to the Middle District	Peripheral and introduced species	Border-entrant species

Data analysis

Analysis of variance. We used Kruskal-Wallis ANOVA tests to assess differences in mean water depth, mean sediment frequency, median pH, median specific conductance, mean canopy cover at diatom-sampling sites, median $\text{NO}_3\text{-N}$ concentrations, diatom-, plant-, fish-, and anuran-species richness, and the percentage of plant, fish, and anuran species classified as restricted native, widespread native, and nonnative between the five land-use groups. Kruskal-Wallis ANOVAs were also used to compare fish- and anuran-relative abundance and the percentage of dominant diatoms classified as acidobiontic-acidophilous, alkalibiontic-alkaliphilous, and indifferent between groups. Dominant diatoms were those species that comprised more than 75% of a sample. Plant-species-richness attributes included herbaceous- and woody-species richness. The percentage of acidobiontic-acidophilous, alkalibiontic-alkaliphilous, and indifferent species was based on the number of species assigned a classification rather than the total number of dominant species. Similarly for plants, the percentage of restricted-native, widespread-native, and nonnative species was based on the number of species assigned a classification. Unclassified diatoms represented 7.0% of all dominant-diatom species. Plants not assigned a biogeographic classification represented 11.7% and 6.3% of the total number of all herbaceous and woody species, respectively. Separate Kruskal-Wallis ANOVAs were performed using median growing season (March through October) pH and specific conductance values for the 2003-2005 and 2006 periods. Post-hoc comparisons were conducted using multiple comparisons of mean ranks (Siegel and Castellan 1988).

Correlations. Spearman rank correlation was used to relate altered land in entire watersheds to median pH and median specific conductance based on 2003–2005 growing season data, and median pH, specific conductance, $\text{NO}_3\text{-N}$, $\text{SO}_4\text{-S}$, and chloride based on data collected in June, August, October, and December in 2006 at the subset of 24 impoundments. Specific conductance and pH were also related to altered land in the variable-width buffers surrounding all 30 impoundments. We also used rank correlation to evaluate the relationship of diatom-species richness and pH classification and plant, fish, and anuran richness and biogeography to land-use and water-quality factors. Water-quality data collected during the 2003-2005 period were used in the analysis of plants, fish, and anurans. For diatoms, we used pH and specific conductance data collected in 2006.

MRPP. Nonparametric multi-response permutation procedures (MRPP, McCune and Mefford 1999) were used to compare selected biological attributes between the five land-use groups. Biological attributes included relative abundance for diatoms and anurans, frequency of occurrence for plants and fish, and mean relative abundance for fish. The MRPP analyses were

based on Euclidean distance. We report the p and A values for each significant result. The p value describes the likelihood that an observed difference is due to chance. The A statistic (chance-corrected within-group agreement) describes agreement within land-use groups. $A = 1$ when all attributes within a group are identical, $A = 0$ when within group heterogeneity equals that expected by chance, and $A < 0$ when within-group heterogeneity is greater than expected by chance.

Indicator-species analysis. We used indicator-species analysis, a method that complements MRPP by describing how well each species separates among groups (Dufrêne and Legendre 1997, McCune and Grace 2002, McCune and Mefford 1999), to contrast diatom, plant, fish, and anuran species present in the five land-use-based impoundment groups. Indicator values, which are usually based on relative-abundance and relative-frequency values, can range from zero to 100. We used relative-abundance data for diatoms, fish, and anurans and frequency of occurrence data for plants in the indicator-species analyses. A maximum indicator value is obtained when a species is unique to a group and is found in all samples of that group.

Logistic regression. Using logistic regression, we determined the probability of finding various percentages of nonnative-plant species, nonnative-fish species, and alkalibiontic-alkaliphilous or indifferent diatom species in relation to the percentage of altered land in a drainage basin. The nonnative-species percentage cutoffs were $\geq 10\%$, $\geq 20\%$, $\geq 30\%$, and $\geq 40\%$ of total classified-species richness. The same cutoff values were applied to the percentage of diatom species characterized as either alkalibiontic-alkaliphilous or indifferent. For anurans, we determined the probability of encountering restricted-native carpenter frogs and nonnative bullfrogs.

Statistical significance. An alpha level of 0.05 was used to assess significance for the Kruskal-Wallis ANOVAs and the MRPP and correlation analyses. Significance levels for related correlation tests and Kruskal-Wallis ANOVAs and the multiple MRPP post-hoc tests were adjusted using the sequential Bonferroni method (Rice 1989, 1990). In these cases, we used a single asterisk to denote tests significant at the initial p value and a double asterisk for those tests that were significant following the Bonferroni adjustment. Statistical significance of the indicator-species values was determined by a Monte Carlo method using 1,000 randomizations. We used $p = 0.10$ as the criteria for identifying species indicative of a particular land-use group. MRPP and indicator species analyses were performed using PC-ORD for Windows Version 5.0 (MjM Software, Gleneden Beach, OR). The ANOVA and correlation analyses were completed using Statistica 7.1 (StatSoft, Inc., Tulsa, OK).

RESULTS

Environmental factors

Water quality. For pH and specific conductance, group medians for the three-year sampling period at all 30 impoundments ranged from 4.4 to 6.6 and 50.3 to 104.4 $\mu\text{S cm}^{-1}$, respectively (Table 1). Both pH ($r = 0.85$, $p < 0.001^{**}$) and specific conductance ($r = 0.75$, $p < 0.001^{**}$) were positively correlated with the percentage of altered land in a drainage basin. The relationship between altered land and both water-quality variables did not improve when the proximity of altered land was considered (Figure 2). The Kruskal-Wallis ANOVAs revealed a difference in pH ($p = 0.006^{**}$) and specific conductance ($p = 0.004^{**}$) between groups. Based on the post-hoc tests, the median pH of Group I impoundments differed from Group V impoundments ($p < 0.001$), and the median specific conductance of Group V impoundments differed from Group I ($p = 0.039$) and Group II ($p = 0.006$) impoundments.

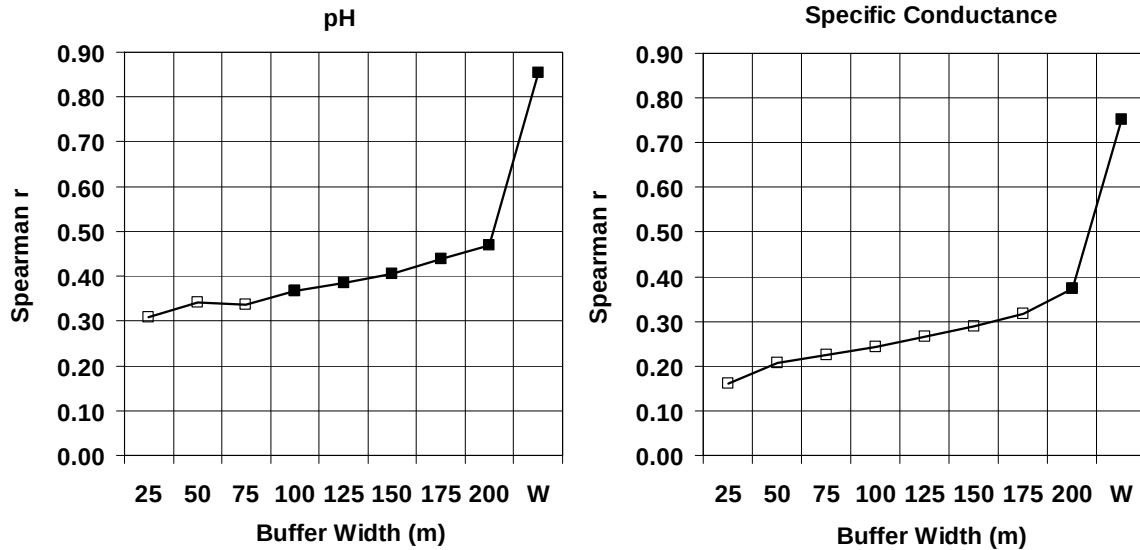


Figure 2. Spearman rank correlations (r) relating pH and specific conductance to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the entire upstream watershed (W). Solid squares denote Spearman rank correlations that were significant at an initial p value of 0.05.

For the subset of 24 impoundments, median nitrite concentrations were below detection at all sites (Appendix 3). Phosphorus concentrations were below detection at all but two of these sites (Appendix 3). The other water-quality variables sampled over four months in 2006 varied in relation to the percentage of altered land in a basin and most were intercorrelated (Table 3 and 4). Although concentrations of $\text{NO}_3\text{-N}$, chloride, and $\text{SO}_4\text{-S}$ were positively correlated with altered land, based on the Kruskal-Wallis ANOVAs, only $\text{NO}_3\text{-N}$ differed between land-use groups ($p = 0.003^{**}$). The post-hoc tests indicated that $\text{NO}_3\text{-N}$ differed between Group I and Group V ($p = 0.003$) impoundments.

The results of the Kruskal-Wallis ANOVAs based on the subset of 20 diatom-sampling sites were similar to those obtained using the full data set. The ANOVAs revealed a difference in pH ($p = 0.006^{**}$) and specific conductance ($p = 0.042^{**}$) between land-use groups. Based on the post-hoc tests, the pH ($p = 0.021$) and specific conductance ($p = 0.029$) of Group I impoundments differed from Group V. As with the full data set, both pH ($r = 0.77$, $p < 0.001^{**}$) and specific conductance ($r = 0.73$, $p < 0.001^{**}$) were positively correlated with the percentage of altered land in a basin. Canopy cover at the 20 diatom-sampling sites did not differ between land-use groups ($p = 0.833$).

Shoreline habitats. Mean nearshore-water depth for the 30 impoundments was similar across groups, with group means (± 1 SD) ranging from 38.9 ± 17.3 cm for the Group III sites to 45.1 ± 5.9 cm for the Group V sites (Table 1). Sediments other than sand or mud (muck or silt) were rarely encountered. Sand was the dominant sediment at most sites, whereas mud was dominant at only four sites. Because mud values are generally the inverse of the sand values, the substrate analysis was limited to the frequency of occurrence of sand. The Kruskal-Wallis ANOVAs revealed no difference in water depth, substrate, or vegetation cover between land-use groups.

Table 3. Spearman rank correlations between water-quality variables and the percentage of altered land (developed land and upland agriculture) in a basin for a subset of 24 impoundments. Median values used in the correlations were based on four samples collected in June, August, October, and December 2006. For all correlations, $n = 24$. All correlations except pH vs. specific conductance and $\text{SO}_4\text{-S}$ were significant following the Bonferroni adjustment. The three-year (2003-2005) median pH and specific conductance values for the full set of 30 impoundments were also positively correlated with the percentage of altered land in a drainage basin (pH: $r = 0.85$, $p < 0.001^{**}$ and specific conductance: $r = 0.75$, $p < 0.001^{**}$).

	Altered Land	pH	Specific conductance	$\text{NO}_3\text{-N}$	$\text{SO}_4\text{-S}$
pH	0.82				
Specific conductance	0.62	0.40			
$\text{NO}_3\text{-N}$	0.76	0.69	0.52		
$\text{SO}_4\text{-S}$	0.54	0.24	0.69	0.56	
Chloride	0.64	0.53	0.92	0.59	0.57

Table 4. Group median water-quality values (mg L^{-1}) from a subset of 24 impoundments. The five land-use groups are characterized by the percentage of altered land (developed land and upland agriculture) in the associated watersheds. Significance levels (p) are shown for each Kruskal-Wallis ANOVA. Only nitrate-nitrogen ($\text{NO}_3\text{-N}$) differed significantly between groups both before and after the Bonferroni adjustment. Refer to Table 1 for the range of altered-land percentages assigned to each group.

		I	II	III	IV	V
Variable	p	$n = 8$	$n = 3$	$n = 3$	$n = 3$	$n = 7$
$\text{NO}_3\text{-N}$	0.003**	0.04	0.07	0.24	0.18	0.27
$\text{SO}_4\text{-S}$	0.071	1.2	1.3	1.8	1.3	1.9
Chloride	0.099	5.5	6.9	11.1	8.4	13.7

Vegetation

Herbaceous species. A total of 188 herbaceous species were encountered in the vegetation surveys (Appendix 4). The overall mean (± 1 SD) herbaceous richness for all impoundments was 33.9 ± 10.8 . Mean herbaceous-species richness ranged from 26.4 ± 8.0 for Group I impoundments to 42.5 ± 14.0 for Group IV impoundments (Figure 3). Although species richness did not differ between groups ($p = 0.053$), between-group differences in the percentage of restricted-native ($p = 0.036^*$), widespread-native ($p = 0.024^*$), and nonnative ($p = 0.002^{**}$) species were observed. Post-hoc tests attributed these differences to a higher percentage of restricted-native species in Group I compared to Group V ($p = 0.019$) impoundments, a lower percentage of nonnative species in Group I compared to Group V ($p < 0.001$) impoundments, and a higher percentage of widespread-native species in Group IV compared to Group V ($p = 0.034$) impoundments.

Richness and biogeographical attributes also varied along water-quality and land-use gradients (Table 5). Herbaceous-species richness increased, the percentage of restricted-native species decreased, and the percentage of nonnative species increased as pH and the percentage of altered land in a watershed increased. The percentage of restricted-native and nonnative species

also varied with specific conductance. The relationship between altered land and the percentage of nonnative plants did not improve when the proximity of altered land was considered (Figure 4).

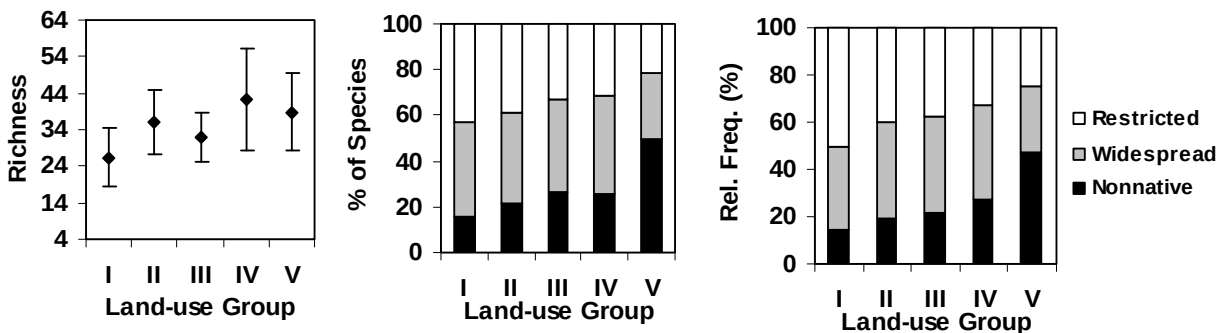


Figure 3. Mean (± 1 SD) herbaceous-species richness by land-use group and mean percentage biogeographic composition and relative frequency by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

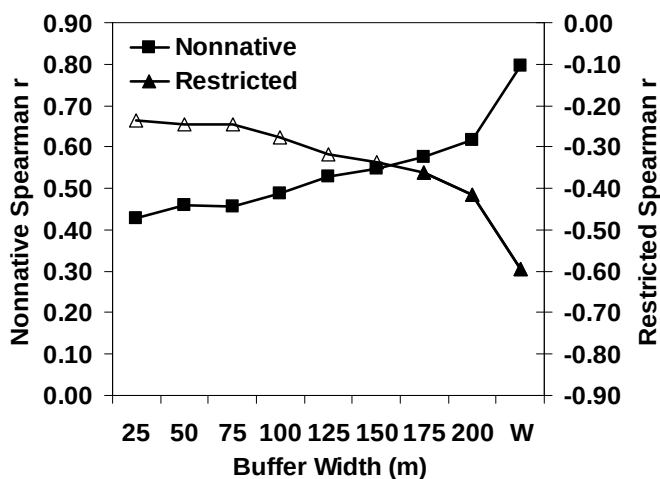


Figure 4. Spearman rank correlations (r) relating the percentage of restricted-native and nonnative herbaceous-plant species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). Solid symbols denote Spearman rank correlations that were significant at an initial *p* value of 0.05.

Table 5. Spearman rank correlations between herbaceous-species attributes and watershed-disturbance variables. Biogeographic values represent the percentage of the total number of species classified as restricted native, widespread native, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, $n = 30$.

Attribute	Altered land			pH			Specific conductance	
	r	p		r	p		r	p
Species richness	0.50	0.005	**	0.56	0.001	**	0.29	0.126
% Restricted native	-0.60	0.001	**	-0.64	<0.001	**	-0.41	0.023 *
% Widespread native	-0.32	0.088		-0.33	0.075		-0.28	0.132
% Nonnative	0.80	<0.001	**	0.81	<0.001	**	0.54	0.002 **

The MRPP analysis showed an overall difference in herbaceous-species composition between land-use groups ($A = 0.055$, $p < 0.001$). Post-hoc comparisons revealed a difference between Group I and Groups III ($A = 0.029$, $p = 0.035^*$), IV ($A = 0.058$, $p = 0.002^{**}$), and V ($A = 0.066$, $p < 0.001^{**}$) and between Group II and Group V ($A = 0.033$, $p = 0.006^{**}$) impoundments.

The between-group differences revealed by the MRPP analysis were associated with a contrast in the biogeography of herbaceous species identified through the indicator-species analysis (Table 6). The more heavily altered sites were characterized by a greater number of nonnative-herbaceous-indicator species, with the highest number of nonnative-species indicators found in Group V impoundments. Conversely, the less-altered sites were characterized by native-herbaceous-indicator species.

The logistic regression analyses revealed a positive relationship between the percentage of altered land and the occurrence of at least 10% ($p = 0.001^{**}$), 20% ($p < 0.001^{**}$), 30% ($p = 0.003^{**}$), and 40% ($p < 0.001^{**}$) nonnative-herbaceous species in an impoundment (Figure 5). The probability of nonnative species comprising at least 10% of all species increased rapidly and was 100% when altered land covered 10% of a watershed. The probability of encountering plant assemblages with a greater percentage of nonnative species increased more slowly as the percentage of altered land increased.

Table 6. Biogeography of herbaceous-indicator species associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

Comparisons													
	All groups					I-III		I-IV		I-V		II-V	
	I	II	III	IV	V	I	III	I	IV	I	V	II	V
Biogeography													
Restricted native	0	2	0	1	0	0	1	0	4	4	0	4	0
Widespread native	0	1	1	6	0	1	1	0	9	3	5	5	0
Nonnative	0	0	1	2	16	0	4	0	8	0	19	0	1

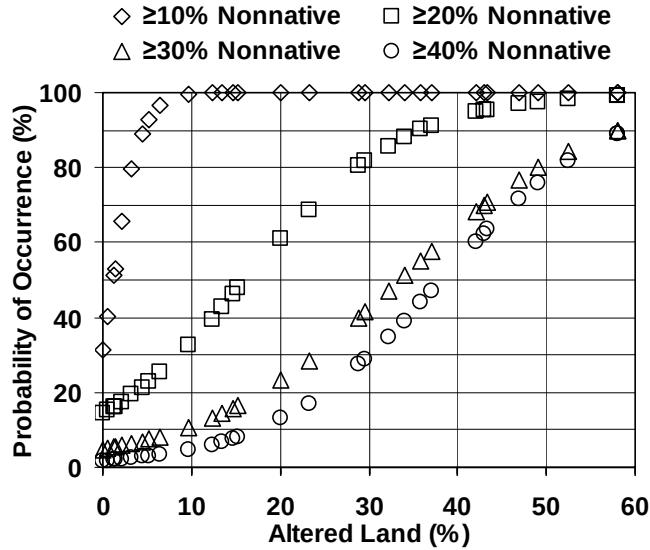


Figure 5. Logit curves describing the probability of encountering at least 10%, 20%, 30%, or 40% nonnative-herbaceous species at varying percentages of upstream-altered land.

Woody species. A total of 64 woody species were found during the vegetation surveys (Appendix 4). Mean (± 1 SD) woody-species richness ranged from 14.1 ± 7.3 for Group V impoundments to 21.8 ± 4.8 for Group III impoundments (Figure 6). The percentage of both restricted-native ($p = 0.037^*$) and nonnative woody species ($p = 0.029^*$) differed between impoundment groups. Post-hoc tests attributed these differences to a higher percentage of restricted-native species ($p = 0.026$) and a lower percentage of nonnative species ($p = 0.045$) in Group I compared to Group V impoundments.

The correlation analysis revealed that the percentage of restricted-native species decreased and the percentage of nonnative species increased as pH, specific conductance, and the percentage of altered land increased (Table 7). The relationship between the percentage of restricted- and nonnative-woody species and altered land was similar regardless of whether proximate or watershed-wide land use was considered (Figure 7).

The MRPP analysis revealed an overall difference in the composition of woody vegetation between land-use groups ($A = 0.070$, $p = 0.003$). The post-hoc comparisons indicated differences between Group I and Groups IV ($A = 0.055$, $p = 0.015^*$) and V ($A = 0.088$, $p = 0.002^{**}$) and between Group III and Groups IV ($A = 0.088$, $p = 0.019^*$) and V ($A = 0.124$, $p = 0.004^{**}$).

Based on the indicator-species analysis, restricted-native indicator species were associated with Group I and were absent from Group IV and Group V impoundments (Table 8). A single nonnative-indicator species, poison ivy (*Toxicodendron radicans*), was associated with the contrast between Groups I and IV. Similarly, only one nonnative-indicator species, Virginia creeper (*Parthenocissus quinquefolia*), was associated with the contrast between Groups I and V. The contrast between Group III and Groups IV and V was also associated with the presence of restricted-native-indicator species in Group III impoundments and the absence of these species in Groups IV and V (Table 8).

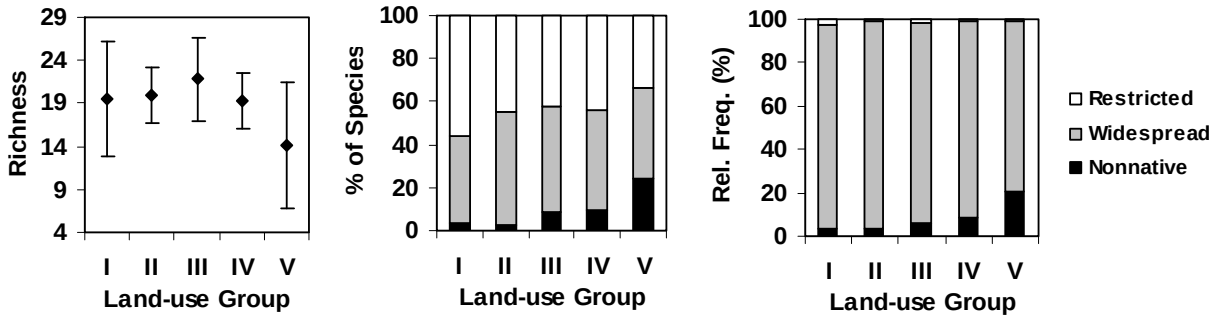


Figure 6. Mean ($\pm$ 1 SD) woody-species richness by land-use group and mean percentage biogeographic composition and relative frequency by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

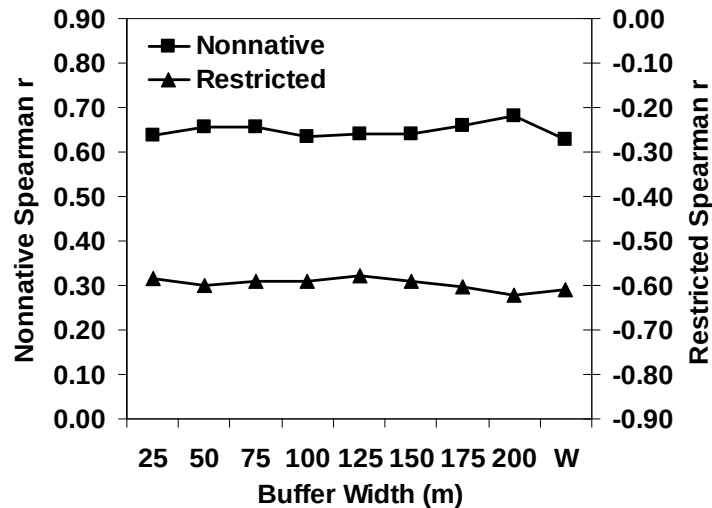


Figure 7. Spearman rank correlations (r) relating the percentage of restricted-native and nonnative woody-plant species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). All correlations were significant at the initial p value of 0.05.

As with herbaceous species, a positive relationship was found between the percentage of altered land and the occurrence of $\geq 10\%$ ($p = 0.003^{**}$) and $\geq 20\%$ ($p = 0.035^{**}$) nonnative-woody species in an impoundment (Figure 8). However, unlike herbaceous species, the probability of nonnative species comprising at least 10% or 20% of all classified species increased more slowly as the percentage of altered land in a watershed increased and did not reach 100%. The probability of encountering $\geq 30\%$ or $\geq 40\%$ nonnative species was not modeled because nonnative-woody species exceeded 30% at only one impoundment.

Table 7. Spearman rank correlations between woody-species attributes and watershed-disturbance variables. Biogeographic values represent the percentage of the total number of species classified as restricted native, widespread native, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, $n = 30$.

Attribute	Altered land		pH		Specific conductance	
	r	p	r	p	r	p
Species richness	-0.19	0.314	0.00	0.985	-0.20	0.287
% Restricted native	-0.61	<0.001 **	-0.71	<0.001 **	-0.38	0.041 *
% Widespread native	0.13	0.494	0.28	0.137	-0.04	0.820
% Nonnative	0.63	<0.001 **	0.63	<0.001 **	0.47	0.009 **

Table 8. Biogeography of woody-indicator species associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

Biogeography	Comparisons												
	All groups					I-IV		I-V		III-IV		III-V	
	I	II	III	IV	V	I	IV	I	V	III	IV	III	V
Restricted native	2	0	4	0	0	3	0	8	0	3	0	6	0
Widespread native	0	0	1	1	0	1	3	1	1	1	1	4	0
Nonnative	0	0	1	0	2	0	1	0	1	0	0	1	0

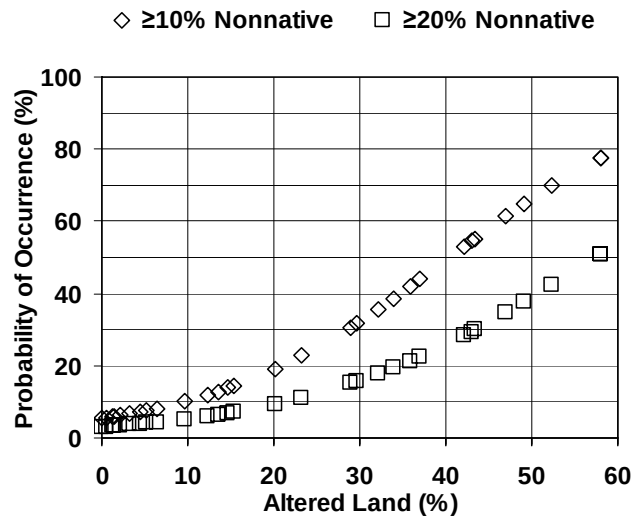


Figure 8. Logit curves describing the probability of encountering at least 10% or 20% nonnative woody species at varying percentages of upstream-altered land. The probability of encountering at least 30% or 40% nonnative species was not modeled because nonnative-woody species exceeded 30% at only one impoundment.

Diatoms

A total of 169 taxa, including 16 identified only to genus, were collected from the 20 sites (Appendix 5). Three small and difficult to distinguish species of *Aulacoseira*, including *A. distans*, *A. paraglabra*, and *A. distans* var. *septentrionalis*, were combined as one composite species in the analysis. For similar reasons, *Staurosirella pinnata* and *Staurosirella pinnata* var. *lancettula* were combined, as were *Stauroforma* sp. and *Stauroforma exiguaformis*. Combining these species resulted in a final total of 165 taxa. Neither richness nor pH classes were found to differ between land-use groups (Figure 9).

Analysis of dominant species indicated that the percentage of species classified as acidobiontic-acidophilous diatoms decreased as the percentage of altered land in a watershed increased (Table 9). The opposite trend was observed for indifferent species. Specific conductance was positively correlated with species richness and the percentage of both indifferent and alkalibiontic-alkaliphilous species and negatively correlated with the percentage of acidobiontic-acidophilous species. An increase in the percentage of indifferent species was the only trend found for pH. The logistic regression analysis also revealed a positive relationship between the percentage of altered land and the probability of encountering diatom assemblages in which the combined percentage of indifferent and alkalibiontic-alkaliphilous species comprised at least 10% ($p = 0.005^{**}$) and 20% ($p = 0.013^{**}$) of the total number of dominant-diatom species (Figure 10). Although the probability of encountering assemblages in which the indifferent and alkalibiontic-alkaliphilous species together comprised at least 30% ($p = 0.113$) and 40% ($p = 0.067$) of the total number of dominant species is also shown in Figure 10, the relationships were not significant.

Results of the MRPP analysis of the diatom data showed an overall difference in composition between land-use groups ($A = 0.084$, $p < 0.031$). Post-hoc comparisons revealed differences between Group I and Groups IV ($A = 0.093$, $p = 0.029^{*}$) and V ($A = 0.105$, $p = 0.006^{*}$). The separation of groups in the MRPP analysis was associated with a contrast in the pH class of species identified through the indicator-species analysis (Table 10). The contrast between Group I and Group IV was characterized by the presence of Group IV indicator species classified as indifferent and alkalibiontic-alkaliphilous. In the comparison between Group I and Group V, all six Group I indicators were acidobiontic-acidophilous diatoms, whereas eight of 10 Group V indicator species were indifferent or alkalibiontic-alkaliphilous diatoms.

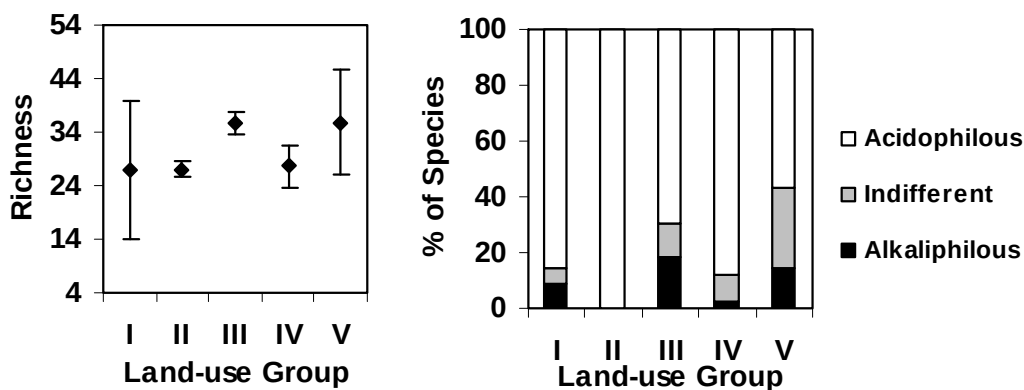


Figure 9. Mean (± 1 SD) diatom-species richness by land-use group and mean relative abundance by pH class and land-use group. Refer to Table 1 for altered-land-percentage ranges. The number of impoundments (n) for each land-use group was: Group I (7), II (2), III (2), IV (3), and V (6).

Table 9. Spearman rank correlations between diatom-species attributes and watershed-disturbance variables. The pH-category values represent the percentage of the total number of dominant-diatom species classified as acidobiontic-acidophilous, alkalibiontic-alkaliphilous, and indifferent (circumneutral). Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, n = 20.

Attribute	Altered land			pH			Specific conductance		
	r	p		r	p		r	p	
Species richness	0.41	0.075		0.35	0.127		0.70	0.001	**
% acidobiontic-acidophilous	-0.54	0.013	**	-0.33	0.159		-0.69	0.001	**
% indifferent (circumneutral)	0.71	<0.001	**	0.52	0.019	*	0.53	0.016	**
% alkalibiontic-alkaliphilous	0.34	0.148		0.25	0.282		0.61	0.005	**

Table 10. Diatom pH classes associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of dominant pH-indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

pH Class	Comparisons									
	All groups					I-IV		I-V		
	I	II	III	IV	V	I	IV	I	V	
Acidobiontic-acidophilous	0	4	2	1	0	1	6	6	1	
Indifferent	0	0	2	0	2	0	5	0	5	
Alkalibiontic-alkaliphilous	0	0	1	1	0	0	2	0	3	
Unclassified	0	1	1	1	1	0	1	0	1	

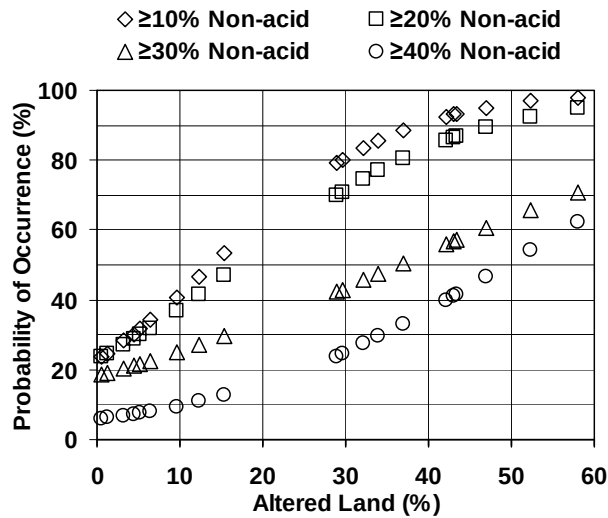


Figure 10. Logit curves describing the probability of encountering diatom assemblages in which non-acid (indifferent and alkalibiontic-alkaliphilous) species comprised at least 10%, 20%, 30%, or 40% of the total number of dominant-diatom species at varying percentages of upstream-altered land.

Fish

Twenty fish species were collected during the surveys, including six restricted species, six widespread species, and eight nonnative species (Table 11). A total of 8,300 individual fish were collected from the 30 impoundments, including 5,712 individuals identified to the species level and 2,588 individuals identified only to the genus level. Those identified only to genus (i.e., *Esox*, *Enneacanthus*, and *Lepomis*) were excluded from the analysis. The overall relative abundance of restricted, widespread, and nonnative species was 18%, 59%, and 23%, respectively.

Of the four species-richness measures, only nonnative-species richness differed between land-use groups ($p = 0.003^{**}$). Post-hoc tests revealed that nonnative-species richness was lower for Group I impoundments compared to Group V impoundments ($p = 0.005$).

The percentage of restricted species ($p = 0.017^{**}$), widespread species ($p = 0.015^{**}$), and nonnative species ($p = 0.005^{**}$) differed between land-use groups (Figure 11). Based on post-hoc tests, the percentage of restricted species was higher ($p = 0.027$) and the percentage of nonnative species was lower ($p = 0.011$) in Group I impoundments compared to Group V impoundments. Post-hoc tests also indicated that the percentage of widespread species was higher ($p = 0.023$) for Group I impoundments compared to Group III impoundments.

Table 11. Fish species collected from 30 Pinelands impoundments. Refer to Table 2 for explanation of biogeographic classifications.

Restricted Species	
<i>Acantharchus pomotis</i>	mud sunfish
<i>Ameiurus natalis</i>	yellow bullhead
<i>Aphredoderus sayanus</i>	pirate perch
<i>Enneacanthus chaetodon</i>	blackbanded sunfish
<i>Enneacanthus obesus</i>	banded sunfish
<i>Etheostoma fusiforme</i>	swamp darter
Widespread Species	
<i>Anguilla rostrata</i>	American eel
<i>Enneacanthus gloriosus</i>	bluespotted sunfish
<i>Erimyzon oblongus</i>	creek chubsucker
<i>Esox niger</i>	chain pickerel
<i>Noturus gyrinus</i>	tadpole madtom
<i>Umbra pygmaea</i>	eastern mudminnow
Nonnative Species	
<i>Ameiurus nebulosus</i>	brown bullhead
<i>Fundulus diaphanus</i>	banded killifish
<i>Lepomis gibbosus</i>	pumpkinseed
<i>Notemigonus crysoleucas</i>	golden shiner
<i>Perca flavescens</i>	yellow perch
<i>Lepomis macrochirus</i>	bluegill
<i>Micropterus salmoides</i>	largemouth bass
<i>Pomoxis nigromaculatus</i>	black crappie

The relative abundance of restricted species ($p = 0.003^{**}$) and nonnative species ($p = 0.001^{**}$) also differed between land-use groups (Figure 11). Based on post-hoc tests, the relative abundance of restricted species was higher in Group I impoundments compared to Groups IV ($p = 0.037$) and V ($p = 0.008$) impoundments. In contrast, the relative abundance of nonnative species was lower in Group I compared to Groups IV ($p = 0.004$) and V ($p = 0.011$).

Total species richness and the percentage and relative abundance of nonnative species increased and the percentage and relative abundance of restricted species decreased as the percentage of upstream-altered land and pH increased (Table 12). Altered land and the percentage of widespread species were also positively correlated. Specific conductance was positively correlated only with the percentage of nonnative species. As with herbaceous-plant species, the strongest relationship between altered land and the percentage of restricted- and nonnative-fish species was found at the watershed level (Figure 12).

The MRPP analyses revealed an overall difference in both the frequency of occurrence ($A = 0.087$, $p = 0.001$) and relative abundance ($A = 0.076$, $p = 0.006$) of fish species between the five land-use groups. Post-hoc comparisons based on frequency of occurrence data revealed differences between land-use Group I and Groups II ($A = 0.035$, $p = 0.038^*$), IV ($A = 0.122$, $p < 0.001^{**}$), and V ($A = 0.103$, $p < 0.001^{**}$), Groups III and IV ($A = 0.081$, $p = 0.036^*$), and Groups III and V ($A = 0.069$, $p = 0.016^{**}$). Post-hoc comparisons based on relative-abundance data indicated differences between impoundment Group I and Groups IV ($A = 0.140$, $p = 0.001^{**}$) and V ($A = 0.075$, $p = 0.002^{**}$) and between Group III and IV ($A = 0.185$, $p = 0.021^*$). Similar results were obtained when individuals that were identified only to genus were also included in the two MRPP analyses.

Differences between impoundment groups revealed by the MRPP analysis of relative-abundance data reflected the contrast in the biogeography of fish species identified through the indicator-species analysis (Table 13). Impoundments in the least altered drainages were characterized by native-fish-indicator species, whereas impoundments in more heavily altered basins were characterized by a greater number of nonnative-fish-indicator species.

Logistic regression results revealed a positive relationship between the percentage of upstream-altered land and the occurrence of at least 10% ($p < 0.001^{**}$), 20% ($p < 0.001^{**}$), 30% ($p < 0.001^{**}$), and 40% ($p = 0.036^{**}$) nonnative-fish species in an assemblage (Figure 13). For example, the probability of encountering a fish assemblage comprised of at least 10% or 20% non-native fish is about 100% when altered land covers 30% of a watershed.

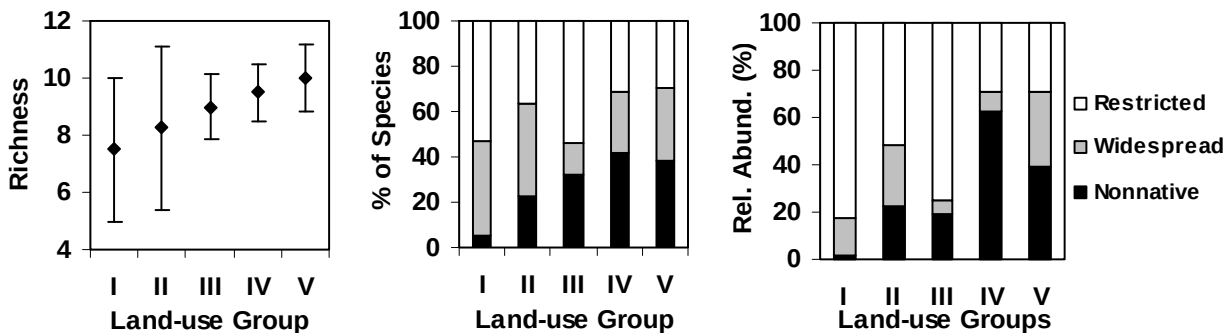


Figure 11. Mean (± 1 SD) fish-species richness by land-use group and mean percentage biogeographic composition and relative abundance by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

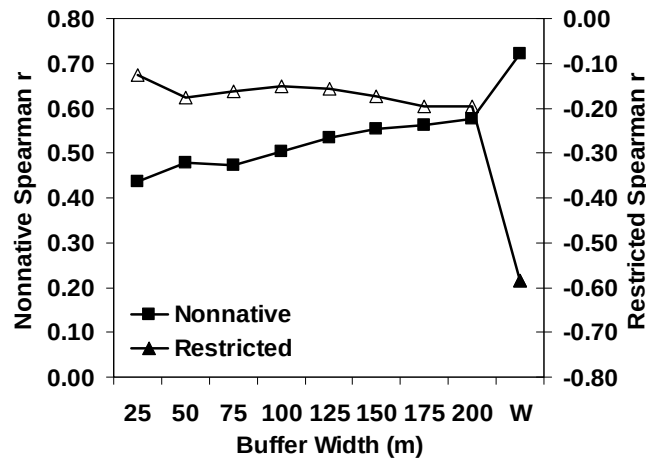


Figure 12. Spearman rank correlations (r) relating the percentage of restricted-native and nonnative fish species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). Open symbols denote Spearman rank correlations that were not significant at an initial p value of 0.05.

Table 12. Spearman rank correlation results between fish-species attributes and watershed-disturbance variables. Biogeographic attributes include both the percentage of the total number of fish species (% species) and the relative abundance of individuals (% individuals) classified as restricted, widespread, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, $n = 30$.

Attribute	Altered land			pH			Specific conductance	
	r	p		r	p		r	p
Species richness	0.47	0.008 **		0.42	0.022 **		0.33	0.073
% Restricted species	-0.59	<0.001 **		-0.69	<0.001 **		-0.36	0.053
% Widespread species	-0.40	0.027 **		-0.32	0.090		-0.24	0.205
% Nonnative species	0.72	<0.001 **		0.79	<0.001 **		0.42	0.019 *
% Restricted individuals	-0.63	<0.001 **		-0.81	<0.001 **		-0.15	0.415
% Widespread individuals	-0.02	0.919		0.15	0.430		-0.14	0.467
% Nonnative individuals	0.73	<0.001 **		0.79	<0.001 **		0.34	0.067

Table 13. Biogeography of fish species associated with land-use groups shown to be different through the MRPP analysis based on relative-abundance data. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

Biogeography	Comparisons										
	All groups					I-IV		I-V		III-IV	
	I	II	III	IV	V	I	IV	I	V	III	IV
Restricted native	1	0	1	0	0	2	0	2	0	1	0
Widespread native	0	1	0	0	0	1	1	0	0	0	0
Nonnative	0	0	0	3	1	0	4	0	4	0	1

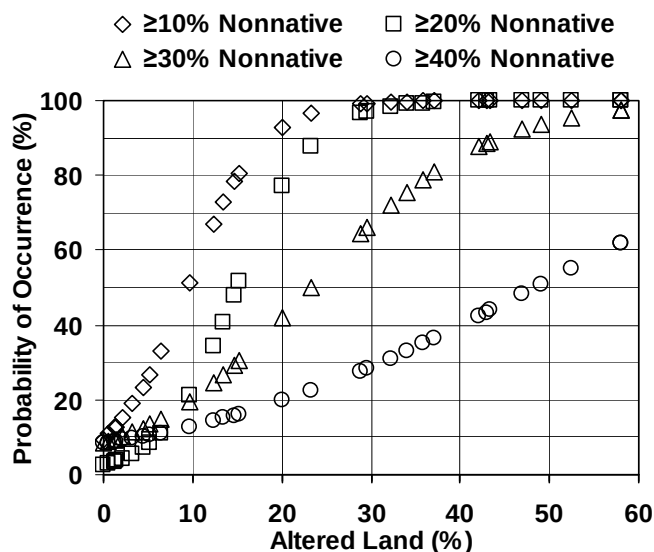


Figure 13. Logit curves describing the probability of encountering at least 10%, 20%, 30%, or 40% nonnative-fish species at varying percentages of upstream-altered land.

Anurans

Seven anuran species were heard during the surveys, including two restricted species, three widespread species, and two nonnative species (Table 14). Nonnative-species richness differed between the five land-use groups ($p = 0.010^{**}$). Post-hoc tests revealed that nonnative-species richness was lower in Group I compared to Group V impoundments ($p = 0.032$). The percentage of species classified as restricted species ($p = 0.045^{*}$) and nonnative species ($p = 0.001^{**}$) also differed between land-use groups (Figure 14). Post-hoc tests revealed no difference between individual impoundment groups for the percentage of restricted species, but the percentage of nonnative species was lower ($p = 0.001$) in Group I compared to Group V impoundments.

A total of 408 individuals were heard calling at the 30 impoundments. As previously mentioned, this number is conservative because the maximum number of individuals counted for a species during a visit was limited to ten or fewer. Restricted, widespread, and nonnative species represented 35%, 45%, and 20% of the total number of anurans heard. The relative abundance of restricted species ($p = 0.045^{*}$) and nonnative species ($p < 0.001^{**}$) differed between land-use groups (Figure 14). Post-hoc tests revealed no differences between individual impoundment groups for the percentage of restricted species, but the percentage of nonnative species was lower ($p < 0.001$) for Group I compared to Group V impoundments.

The percentage and relative abundance of restricted species decreased and the percentage and relative abundance of nonnative species increased as pH, specific conductance, and the percentage of upstream altered land increased (Table 15). Neither the percentage nor the relative abundance of widespread species was related to any of the watershed-disturbance variables. The relationship between altered land and the percentage of restricted and nonnative species was strongest at the watershed scale (Figure 15).

Table 14. Anuran species heard calling from 30 Pinelands impoundments. Refer to Table 2 for explanation of biogeographic classifications.

Restricted Species		
<i>Hyla andersonii</i>		Pine Barrens treefrog
<i>Rana virgatipes</i>		carpenter frog
Widespread Species		
<i>Bufo woodhousei fowleri</i>		Fowler's toad
<i>Rana clamitans melanota</i>		green frog
<i>Rana utricularia</i>		southern leopard frog
Nonnative Species		
<i>Acris c. crepitans</i>		northern cricket frog
<i>Rana catesbeiana</i>		bullfrog

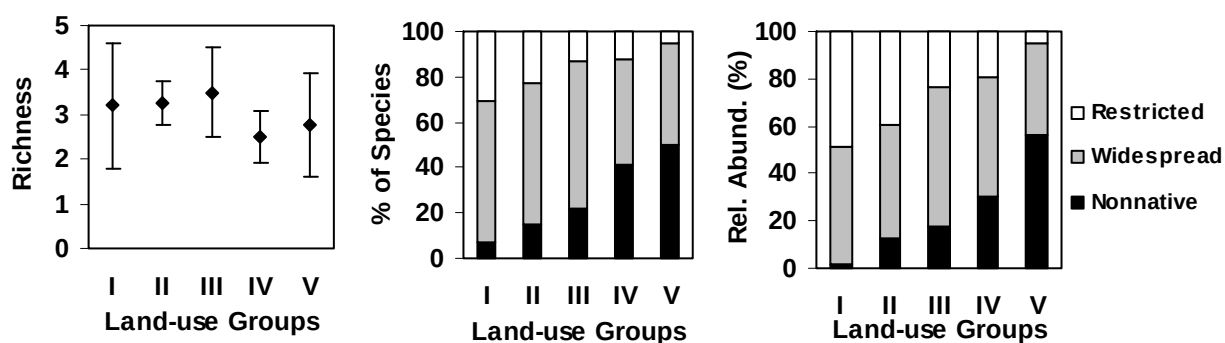


Figure 14. Mean (± 1 SD) anuran-species richness by land-use group and mean percentage biogeographic composition and relative abundance by biogeographic class and land-use group. Refer to Table 1 for altered-land-percentage ranges and impoundment-sample size for each land-use group.

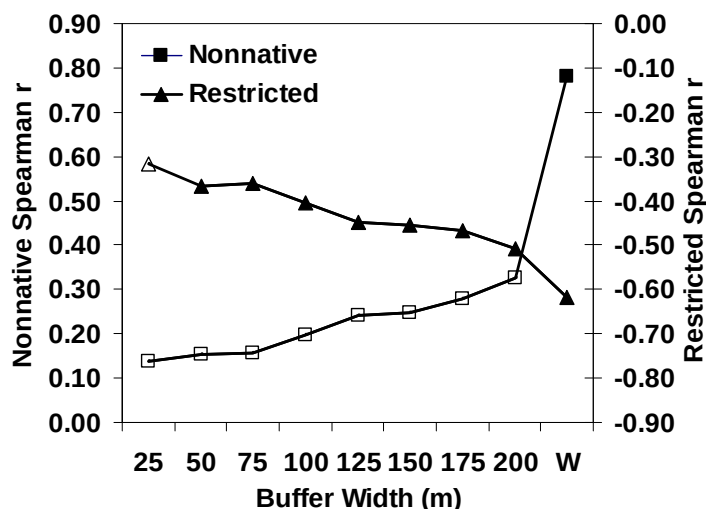


Figure 15. Spearman rank correlation (r) relating the percentage of nonnative-anuran species to the percentage of altered land in cumulative buffers ranging from 0-25 m, 0-50 m, etc. and to the percentage of altered land in the upstream watershed (W). Open symbols denote Spearman rank correlations that are not significant at an initial p value of 0.05.

Results of the MRPP analyses indicated an overall difference in both the presence-absence ($A = 0.097$, $p = 0.005$) and relative abundance ($A = 0.101$, $p = 0.013$) of anuran species between the five land-use groups. Post-hoc comparisons completed on anuran presence-absence data revealed differences between impoundment Group I and Groups IV ($A = 0.102$, $p = 0.006^*$) and V ($A = 0.120$, $p = 0.001^{**}$). Post-hoc comparisons of relative-abundance data indicated differences between land-use Groups I and V ($A = 0.221$, $p < 0.001^{**}$) and between Group II and V ($A = 0.116$, $p = 0.020^*$). Differences between impoundment groups revealed by the MRPP analysis of anuran relative abundance were associated with a contrast in the biogeography of anuran species identified through the indicator-species analysis (Table 16). Group I impoundments were characterized by two native-anuran indicator species, including the restricted carpenter frog and the widespread Fowler's toad, whereas the most heavily altered Group V impoundments were characterized by the nonnative bullfrog.

Table 15. Spearman rank correlation results between anuran-species attributes and watershed-disturbance variables. Biogeographic attributes include both the percentage of the total number of anuran species (% species) and the relative abundance of individuals (% individuals) classified as restricted, widespread, and nonnative. Related tests significant before and after the Bonferroni adjustment are indicated with a single and double asterisk, respectively. For all tests, $n = 30$.

Attribute	Altered Land			pH			Specific Conductance	
	r	p		r	p		r	p
Species richness	-0.32	0.088		-0.29	0.118		-0.21	0.274
% Restricted species	-0.62	<0.001	**	-0.64	<0.001	**	-0.39	0.031 *
% Widespread species	-0.24	0.194		-0.20	0.298		-0.09	0.622
% Nonnative species	0.78	<0.001	**	0.74	<0.001	**	0.45	0.013 **
% Restricted individuals	-0.59	0.001	**	-0.65	<0.001	**	-0.44	0.014 *
% Widespread individuals	-0.03	0.866		0.02	0.923		0.17	0.381
% Nonnative individuals	0.80	<0.001	**	0.81	<0.001	**	0.39	0.032 *

The restricted carpenter frog was heard calling from 16 impoundments and the nonnative bullfrog was heard at 20 impoundments. These two species were heard calling together at eight sites, including at least one impoundment from each of the five land-use groups. Carpenter frog larvae were collected from 12 impoundments and bullfrog larvae were found at 14 impoundments. Tadpoles were present only at sites where adults of the species were heard calling. Tadpoles of both species were found together at one Group IV impoundment and two Group V impoundments.

The frequency of occurrence of carpenter frog adults and larvae decreased, whereas the frequency of occurrence of bullfrog adults and larvae increased along the watershed-disturbance gradient represented by the five impoundment groups (Figure 16). Logistic regression results revealed a negative relationship between the percentage of upstream-altered land and the occurrence of carpenter frog adults ($p = 0.003^{**}$) and tadpoles ($p = 0.046^{**}$) and a positive relationship between upstream altered land and the occurrence of bullfrog adults ($p < 0.001^{**}$) and tadpoles ($p < 0.001^{**}$) (Figure 17). For both species, the predicted probability of hearing adults was higher than the predicted probability of finding larvae, but the adult and larval probabilities converged for each species as the percentage of upstream-altered land increased. The probability of encountering adult and larval carpenter frogs was about 10% for impoundments in the most degraded watersheds, whereas the probability of encountering adult and larval bullfrogs was nearly 100% at these sites.

Table 16. Biogeography of anuran species associated with land-use groups shown to be different through the MRPP analysis. Values represent the number of indicator species in each land-use group for each comparison. Refer to Table 1 for the range of altered-land percentages assigned to each group.

Biogeography	Comparisons								
	All groups					I-V		II-V	
	I	II	III	IV	V	I	V	II	V
Restricted	0	0	0	0	0	1	0	1	0
Widespread	0	0	1	0	0	1	0	1	0
Nonnative	0	0	0	0	2	0	1	0	1

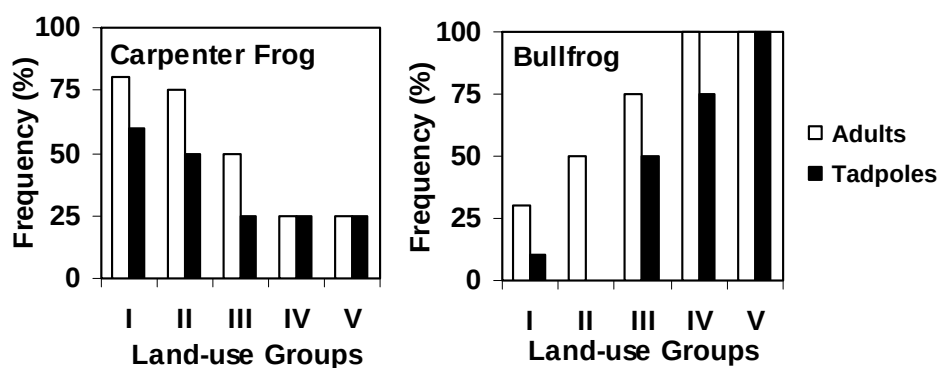


Figure 16. Frequency of occurrence of carpenter frog and bullfrog adults and tadpoles for five impoundment land-use groups. Refer to Table 1 for altered-land-percentage ranges associated with each land-use group.

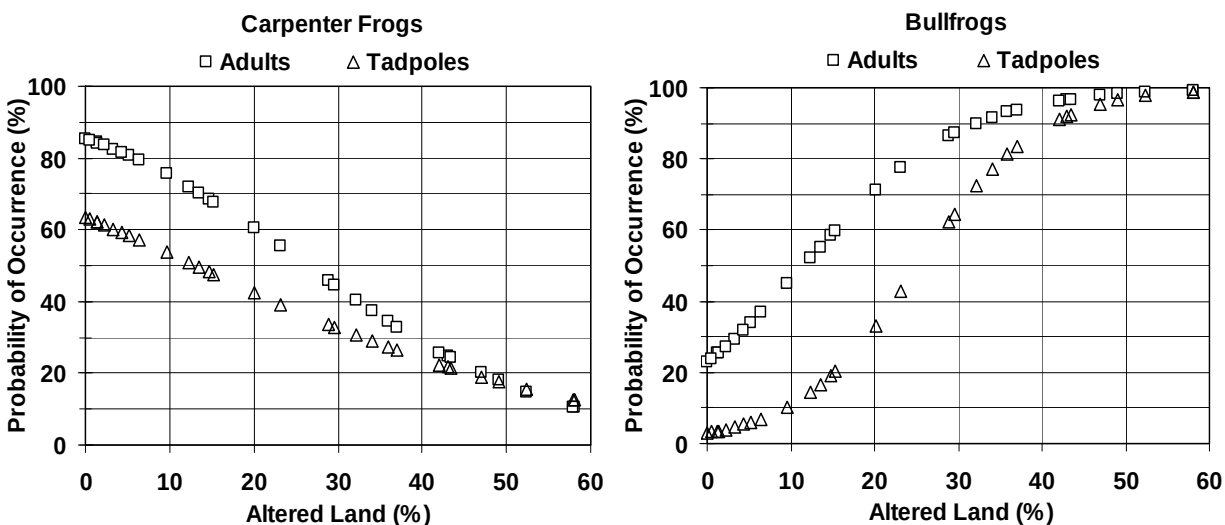


Figure 17. Logit curves describing the probability of encountering carpenter frog and bullfrog adults and tadpoles at varying percentages of upstream-altered land.

SUMMARY

Differences in water-quality and species-composition between land-use groups were most apparent when comparing impoundments in watersheds with less than 10% altered land and those in watersheds with $\geq 40\%$ altered land (Table 17). Differences in community composition between impoundments in the least-altered watersheds and both Group IV (30-39.9% altered land) and Group V ($\geq 40\%$ altered land) impoundments were evident across taxonomic groups, suggesting that at least for the impoundments we studied, community-composition variables are more sensitive measures of degradation thresholds than either water-quality or species-richness measures.

Table 17. Summary of water-quality, species-richness, and species-composition variables that differed between land-use groups. Water-quality and species-richness results were based on Kruskal-Wallis ANOVAs. Species-richness results are due to differences in restricted-, widespread-, and/or nonnative-species richness. Species-composition results were based on MRPP analyses, with results based on fish-frequency and anuran-presence/absence data represented by open symbols and results based on fish- and anuran-relative-abundance data represented by closed symbols. Land-use-group comparisons are ordered according to the number of variables shown to differ. Refer to Table 1 for the range of altered-land percentages assigned to each group.

Variables	Land-use Group Comparisons							
	I-V	I-IV	II-V	III-IV	III-V	I-III	I-II	IV-V
Water Quality	pH	■						
	Specific conductance	■		■				
	NO ₃ -N	■						
Species Richness	Herbaceous plants	■						■
	Woody plants	■						
	Fish	■				■		
	Anurans	■						
Species Composition	Herbaceous plants	■	■	■		■		
	Woody plants	■	■		■	■		
	Diatoms	■	■					
	Fish	□■	□■		□■	□		□
	Anurans	□■	□	■				

The relationships between both biological-community and water-quality gradients and watershed-disturbance gradients were similar to those reported in other Pinelands studies (Zampella and Laidig 1997, Zampella and Bunnell 1998, Zampella et al. 2006a, 2006b, 2007a, 2007b). Specific conductance, pH, and NO₃-N thresholds were also similar to those reported by Zampella et al. (2007a) for streams in the Mullica River Basin. Unlike the present study, chloride and sulfate concentrations in the Mullica River Basin streams differed between different altered-land-use classes. The finding that the relationship between altered land and both pH and

specific conductance did not improve when the proximity of altered land was considered is also similar to that reported by Zampella et al. (2007a).

The contrast in species composition between reference sites, represented by impoundments with less than 10% altered land in the associated watersheds, and the more highly altered impoundments was consistent across taxonomic groups. Restricted-native plant, fish, and anuran species, and diatoms more typical of acid waters, characterized the reference-site impoundments, whereas nonnative plant and animal species and diatoms typical of circumneutral and alkaline waters were associated with the more degraded impoundments.

The relationship between altered land and pH, specific conductance, and nonnative herbaceous-plant, fish, and anuran species was stronger when using watershed-wide land use rather than adjacent land use. Species richness was not a consistent indicator of watershed disturbance across all taxonomic groups.

Even though the contrast between land-use groups from opposite ends of the watershed-disturbance gradient was most evident, the correlation, logistic regression, and graphical analyses indicated that variations in environmental and biological conditions occurred along a disturbance gradient represented by an increase in the percentage of upstream-altered land associated with each impoundment. As Booth et al. (2002) indicated, although a progressive decline in biological conditions may be evident only in more heavily altered watersheds, significant degradation can occur at any level of disturbance, and biological indicators typically demonstrate a continuum of responses to human disturbance rather than a threshold response.

ACKNOWLEDGEMENTS

Jennifer Ciraolo and Kimberly Spiegel assisted with various aspects of the study, including the collection of water-quality samples and data entry. Rex Lowe identified all diatoms. Funding for this study was provided by a grant from the U. S. Environmental Protection Agency (Wetlands Protection State Development Grant CD98237801-0) with additional funding from the National Park Service and the Pinelands Commission. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U. S. Government. Mention of trade names or commercial products does not constitute their endorsement by the U. S. Government.

LITERATURE CITED

- Anderson, J. R., E. E. Hardy, J. T. Roach, and R. E. Witmer. 1976. A land use and land cover classification system for use with remote sensor data. U.S. Geological Survey Professional Paper 964.
- Arnold, C. L. and C. J. Gibbons. 1996. Impervious surface coverage: the emergence of a key environmental indicator. *Journal of the American Planning Association* 62:243-258.
- Booth, D. B., D. Hartley, and R. Jackson. 2002. Forest cover, impervious-surface area, and the mitigation of stormwater impacts. *Journal of the American Water Resources Association* 38:835-845.
- Carpenter, K. D. and I. R. Waite. 2000. Relations of habitat-specific algal assemblages to land use and water chemistry in the Willamette Basin, Oregon. *Environmental Monitoring and Assessment* 64:247-257.
- Carpenter, S. R., N. F. Caraco, D. L. Correll, R. W. Howarth, A. N. Sharples, and V. H. Smith. 1998. Nonpoint pollution of surface waters with phosphorus and nitrogen. *Ecological Applications* 8:559-568.
- Charles D. F. 1985. Relationships between surface sediment diatom assemblages and lakewater characteristics in Adirondack lakes. *Ecology* 66:994-1011.
- Conant, R. 1979. A zoogeographical review of the amphibians and reptiles of southern New Jersey, with emphasis on the Pine Barrens. Pages 467-488 in R.T.T. Forman, editor. *Pine Barrens: ecosystem and landscape*. Academic Press, New York, New York, USA.
- Conant, R. and J. T. Collins. 1998. A field guide to reptiles and amphibians of eastern and central North America, 3rd Edition. Houghton Mifflin Co., Boston, Massachusetts, USA.
- Dixit, S. S., J. P. Smol, D. F. Charles, R. M. Hughes, S. G. Paulsen, and G. B. Collins. 1999. Assessing water quality changes in the lakes of the northeastern United States using sediment diatoms. *Canadian Journal of Fisheries and Aquatic Sciences* 56:131-152.
- Dow, C. L. and R. A. Zampella. 2000. Specific conductance and pH as indicators of watershed disturbance in streams of the New Jersey Pinelands, USA. *Environmental Management* 26:437-445.
- Dufrêne, M. and P. Legendre. 1997. Species assemblages and indicator species: the need for a flexible asymmetrical approach. *Ecological Monographs* 67:345-366.
- Gleason, H. A. and A. Cronquist. 1991. *Manual of vascular plants of northeastern United States and adjacent Canada*, 2nd Edition. New York Botanical Garden, Bronx, New York, USA.
- Hastings, R.W. 1984. The fishes of the Mullica River, a naturally acid water system of the New Jersey Pine Barrens. *Bulletin of the New Jersey Academy of Science* 29:9-23.
- Herlihy, A. T., J. L. Stoddard, and C. B. Johnson. 1998. The relationship between stream chemistry and watershed land cover data in the Mid-Atlantic Region, U.S. *Water, Air, and Soil Pollution* 105:377-386.
- Johnson, L. B., C. Richards, G. E. Host, and J. W. Arthur. 1997. Landscape influences on water chemistry in midwestern stream ecosystems. *Freshwater Biology* 37:193-208.
- Klein, R. D. 1979. Urbanization and stream quality impairment. *Water Resources Bulletin* 15: 948-963.
- Leland, H. V. and S. D. Porter. 2000. Distribution of benthic algae in the upper Illinois River basin in relation to geology and land use. *Freshwater Biology* 44:279-301.
- Lenat, D. R. and J. K. Crawford. 1994. Effects of land use on water quality and aquatic biota of three North Carolina Piedmont streams. *Hydrobiologia* 294:185-199.

- Lowe, R. L. 1974. Environmental requirements and pollution tolerance of freshwater diatoms. EP A-670/4-74-005. U. S. Environmental Protection Agency, Cincinnati, Ohio, USA.
- May, C. W., R. R. Horner, J. R. Karr, B. W. Mar, and E. B. Welch. 1997. Effects of urbanization on small streams in the Puget Sound ecoregion. *Watershed Protection Techniques* 2:483-494.
- McCune, B. and M. J. Mefford. 1999. PC-ORD. Multivariate analysis of ecological data, Version 4. MjM Software Design, Gleneden Beach, Oregon, USA.
- McCune, B. and J. B. Grace. 2002. Analysis of ecological communities. MjM Software Design, Gleneden Beach, Oregon, USA.
- Meriläinen, J. 1967. The diatom flora and the hydrogen-ion concentration of the water. *Annales Botanici Fennici* 4:51-58.
- Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, Inc., New York, New York, USA.
- New Jersey Division of Fish and Game. 1950. Fisheries survey report no. 1. Lakes and ponds. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey, USA.
- New Jersey Division of Fish and Game. 1951. Fisheries survey report no. 2. Lakes and ponds. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey, USA.
- New Jersey Division of Fish and Game. 1957. Fisheries Survey Report no. 3. Lakes and ponds. New Jersey Department of Conservation and Economic Development, Trenton, New Jersey, USA.
- Osborne, L. L. and M. J. Wiley. 1988. Empirical relationships between land use/cover and stream water quality in an agricultural watershed. *Journal of Environmental Management* 26:9-27.
- Page, L. M. and B. M. Burr. 1991. A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Co., New York, New York, USA.
- Patrick, R. 1996. Rivers of the United States. Volume III: the eastern and southeastern states. John Wiley and Sons, Inc., New York, New York, USA.
- Patrick, R., B. Matson, and L. Anderson. 1979. Streams and lakes in the Pine Barrens. Pages 169-193 in R.T.T. Forman, editor. *Pine Barrens: ecosystem and landscape*. Academic Press, New York, New York, USA.
- Rhodes, A. L., R. M. Newton, and A. Pufall. 2001. Influences of land use on water quality of a diverse New England watershed. *Environmental Science and Technology* 35:3640-3645.
- Rice, W. R. 1989. Analyzing tables of statistical tests. *Evolution* 43:223-225.
- Rice, W. R. 1990. A consensus combined p-value test and family-wide significance of component tests. *Biometrics* 46:303-308.
- Siegel, S. and N. J. Castellan, Jr. 1988. Nonparametric statistics for the behavioral sciences. Second Edition. McGraw-Hill Inc., New York, New York, USA.
- Sliva, L. and D. D. Williams. 2001. Buffer zone versus whole catchment approaches to studying land use impact on river water quality. *Water Research* 35:3462-3472.
- Standard Methods for the Examination of Water and Wastewater. 1998. 20th Edition. American Public Health Association, American Water Works Association, Water Environment Federation, Washington D.C., USA.
- Steedman, R. J. 1988. Modification and assessment of an index of biotic integrity to quantify stream quality in southern Ontario. *Canadian Journal of Fisheries and Aquatic Sciences* 45:492-501.
- Stepenuck, K. F., R. L. Crunkilton and L. Wang. 2002. Impacts of urban landuse on macroinvertebrate communities in southeastern Wisconsin streams. *Journal of the American Water Resources Association* 38:1041-1051.
- Stone, W. 1911. The plants of southern New Jersey. Report of the New Jersey State Museum 1910. Trenton, New Jersey, USA.

- Tufford, D. L., C. L. Samarghitan, H. N. Mckellar, Jr., D. E. Porter, and J. R. Hussey. 2003. Impacts of urbanization on nutrient concentrations in small southeastern coastal streams. *Journal of the American Water Resources Association* 39:301-312.
- van Dam, H., A. Mertens, and J. Sinkeldam. 1994. A coded checklist and ecological indicator values of freshwater diatoms from The Netherlands. *Netherlands Journal of Aquatic Ecology* 28:117-133.
- Wacker, P. O. 1979. Human exploitation of the New Jersey Pine Barrens before 1900. Pine Barrens: ecosystem and landscape. Pages 3-23 in R.T.T. Forman, editor. *Pine Barrens: ecosystem and landscape*. Academic Press, New York, New York, USA.
- Waite, I. R., and K. D. Carpenter. 2000. Associations among fish assemblage structure and environmental variables in Willamette Basin Streams, Oregon. *Transactions of the American Fisheries Society* 129:754-770.
- Wang, L., J. Lyons, P. Kanehl, and R. Gatti. 1997. Influences of watershed land use on habitat quality and biotic integrity in Wisconsin streams. *Fisheries* 22:6-12.
- Zampella, R. A. 1994. Characterization of surface water quality along a watershed disturbance gradient. *Water Resources Bulletin* 30:605-611.
- Zampella, R. A. and J. F. Bunnell. 1998. Use of reference-site fish assemblages to assess aquatic degradation in Pinelands streams. *Ecological Applications* 8:645-658.
- Zampella, R. A. and J. F. Bunnell. 2000. The distribution of anurans in two river systems of a Coastal Plain watershed. *Journal of Herpetology* 34:210-221.
- Zampella, R. A. and K. J. Laidig. 1997. Effect of watershed disturbance on Pinelands stream vegetation. *Journal of the Torrey Botanical Society* 124:52-66.
- Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin: a report to the Pinelands Commission on the status of the landscape and selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.
- Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2003. The Rancocas Creek Basin: a report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.
- Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2005. The Great Egg Harbor River Watershed Management Area: a report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.
- Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2006a. Using multiple indicators to evaluate the ecological integrity of a coastal plain stream system. *Ecological Indicators* 6:644-663.
- Zampella, R. A., J. F. Bunnell, K. J. Laidig, and N. A. Procopio. 2006b. The Barnegat Bay Watershed: a report to the Pinelands Commission on the status of selected aquatic and wetland resources. Pinelands Commission, New Lisbon, New Jersey, USA.
- Zampella, R. A., N. A. Procopio, R. G. Lathrop, and C. L. Dow. 2007a. Relationship of land-use/land-cover patterns and surface-water quality in the Mullica River Basin. *Journal of the American Water Resources Association* 43:594-604.
- Zampella, R. A., K. J. Laidig, and R. L. Lowe. 2007b. Distribution of diatoms in relation to land use and pH in blackwater Coastal Plain streams. *Environmental Management* 39:369-384.

Appendix 1. Site-location information for 43 impoundments in the New Jersey Pinelands. An asterisk next to the site code denotes the 13 impoundments that were not selected for biological surveys. With one exception (HHOCUSHM), site codes match those used in previous Pinelands Commission reports. Latitude, longitude, and USGS 7.5 minute topographic quadrangle names are in parentheses. Latitude and longitude represent the water-quality sampling points. Sites are ordered alphabetically by impoundment name.

Impoundment Name and Description	Site Code
Atco Lake Waterford Twp., Camden Co. (lat 39°45'32.42", long 74°53'00.58", Clementon quad).	MHAATCOL*
Atsion Lake Waterford Twp., Camden Co. (lat 39°44'25.42", long 74°43'35.57", Atsion quad).	MMUATSIO
Bamber Lake Lacey Twp., Ocean Co. (lat 39°53'50.25", long 74°18'58.63", Keswick Grove quad).	CCEBAMBR
Batsto Lake Washington Twp., Burlington Co. (lat 39°38'31.50", long 74°38'59.62", Atsion quad).	BBATLAKE
Breeches Branch Impoundment Washington Twp., Burlington Co. (lat 39°44'04.20", long 74°29'31.47", Oswego Lake quad).	OBRESTRM*
Cedar Lake Buena Vista Twp., Atlantic Co. (lat 39°35'07.29", long 74°54'06.21", Buena quad).	HMAJACKS*
Centennial Lake Medford Twp., Burlington Co. (lat 39°50'31.91", long 74°50'58.25", Medford Lakes quad).	WHACENTL*
Chatsworth Lake Woodland Twp., Burlington Co. (lat 39°48'51.99", long 74°32'49.34", Chatsworth quad).	WWE532LK
Country Lake Pemberton Twp., Burlington Co. (lat 39°56'48.68", long 74°33'20.12", Browns Mills quad).	GPOWISSA
Cranes Lake Monroe Twp., Gloucester Co. (lat 39°37'14.09", long 74°55'37.29", Buena quad).	HHORT538
Cushman Lake Folsom Boro, Gloucester Co. (lat 39°35'44.03", long 74°52'00.64", Newtonville quad).	HHOCUSHM
Davenport Impoundment Lacey Twp., Ocean Co. (lat 39°55'35.97", long 74°20'17.97", Keswick Grove quad).	RDALACEL
Diamond Lake Monroe Twp., Gloucester Co. (lat 39°36'42.06", long 74°55'08.27", Buena quad).	HHODIAMO*
Egg Harbor City Lake Egg Harbor City Twp., Atlantic Co. (lat 39°33'33.20", long 74°36'24.18", Green Bank quad)	LINLAKEU
Hammonton Lake Hammonton Twp., Atlantic Co. (lat 39°37'51.67", long 74°46'16.13", Hammonton quad).	LHAMLAKE
Harrisville Pond Washington/Bass River Twp., Burlington Co. (lat 39°39'48.45", long 74°31'24.44", Jenkins quad).	OOSHARLK*
Horicon Lake Lakehurst Twp., Ocean Co. (lat 40°00'34.82", long 74°19'06.74", Lakehurst quad).	TUNHORIC
Howardsville Impoundment Barnegat Twp., Ocean Co. (lat 39°49'01.34", long 74°21'59.93", Brookville quad).	OOSHOWIM
Indian Mills Lake Shamong Twp., Burlington Co. (lat 39°47'41.70", long 74°44'29.73", Indian Mills quad).	BMULAKED
Jennings Lake Evesham Twp., Burlington Co. (lat 39°51'56.45", long 74°53'40.96", Clementon quad).	WBAJENNL
Kettle Run Impoundment Medford Twp., Burlington Co. (lat 39°49'05.01", long 74°51'40.11", Medford Lakes quad).	WKEGIRLS
Lady's Lake Waterford/Medford Twp., Camden/Burlington Co. (lat 39°47'09.39", long 74°51'36.53", Medford Lakes quad).	MMULADYL
Lake Absegami Bass River Twp., Burlington Co. (lat 39°37'37.79", long 74°25'54.80", New Gretna quad).	AEAABSDW

Impoundment Name and Description	Site Code
Lake Albert	HMAALBER
Buena Vista Twp., Atlantic Co. (lat 39°35'25.42", long 74°51'46.62", Newtonville quad).	
Lake Fred	LMOSTOCK
Galloway Twp., Atlantic Co. (lat 39°29'44.82", long 74°31'40.83", Green Bank quad).	
Lake Pine	WHAPINEL*
Medford Twp., Burlington Co. (lat 39°51'59.41", long 74°50'53.73", Medford Lakes quad).	
Manahawkin Lake	MMIMANAH*
Stafford Twp., Ocean Co. (lat 39°41'46.62", long 74°15'35.91", West Creek quad).	
Maple Lake	LSTMAPLE
Estell Manor City, Atlantic Co. (lat 39°24'19.58", long 74°46'35.54", Dorothy quad).	
Mimosa Lake	WHATRPON
Medford Twp., Burlington Co. (lat 39°50'42.31", long 74°50'45.59", Medford Lakes quad).	
Mount Misery Impoundment	GMOUCAMP*
Pemberton Twp., Burlington Co. (lat 39°55'44.97", long 74°31'52.13", Browns Mills quad).	
Oswego Lake	OOSWLAKE
Washington/Bass River Twp., Burlington Co. (lat 39°44'04.11", long 74°29'31.46", Oswego Lake quad).	
Pakim Pond	GCOPAKIM
Woodland Twp., Burlington Co. (lat 39°52'51.98", long 74°31'56.83", Browns Mills quad).	
Paradise Lake	NALPARAD
Hammonton Twp., Atlantic Co. (lat 39°41'05.64", long 74°43'35.56", Atsion quad).	
Pilgrim Lake	AWEPILGL
Bass River Twp., Burlington Co. (lat 39°37'27.38", long 74°26'45.22", New Gretna quad).	
Presidential Lake	GBIPRES*
Pemberton Twp., Burlington Co. (lat 39°54'38.13", long 74°34'41.00", Browns Mills quad).	
Shadow Lake	BINSHADW
Shamong Twp., Burlington Co. (lat 39°48'22.73", long 74°46'12.31", Medford Lakes quad)	
Success Lake	TSHSUCCE
Jackson Twp., Ocean Co. (lat 40°03'31.48", long 74°23'29.58", Cassville quad).	
Sunset Lake	HWHSUNSL
Monroe Twp., Gloucester Co. (lat 39°38'05.30", long 74°57'51.84", Williamstown quad).	
Taunton Lake	WHATAUNT*
Medford Twp., Burlington Co. (lat 39°51'10.24", long 74°51'14.50", Medford Lakes quad).	
Timber Lakes - lower	HHOWHITE*
Monroe Twp., Gloucester Co. (lat 39°38'18.14", long 74°56'53.92", Williamstown quad).	
Turn Mill Pond	TSHTURNL
Jackson Twp., Ocean Co. (lat 40°03'39.84", long 74°26'23.36", Cassville quad).	
Victory Lake	HWHWHITE*
Monroe Twp., Gloucester Co. (lat 39°38'02.01", long 74°56'59.82", Williamstown quad).	
Wells Mills Lake	COYWELLS
Ocean Twp., Ocean Co. (lat 39°47'37.26", long 74°16'34.74", Brookville quad).	

Appendix 2. Environmental variables for 30 impoundments in the New Jersey Pinelands. Specific conductance and pH were measured during 2003-2005. Plants, fish, and anurans were sampled at all 30 impoundments. An “x” indicates impoundments where diatoms and nutrients were also sampled. Impoundments are ordered by increasing percentage of altered land within each land-use group. Altered land represents the combined percentages of developed land and upland agriculture. Refer to Table 1 for the range of altered-land percentages assigned to each group and Appendix 1 for impoundment-site descriptions.

Site Name	Land-use Group	Developed Land (%)	Upland Agriculture (%)	Altered Land (%)	Lake Area (ha)	Median pH	Median Specific Conductance ($\mu\text{S cm}^{-1}$)	Mean Water Depth (cm)	Mean Frequency of Occurrence of Sand (%)	Median Emergent-cover Rank	Median Floating-cover Rank	Median Submerged-cover Rank	Diatoms	Nutrients
Howardsville Imp.	I	0.0	0.0	0.0	5.7	4.38	45.9	30.1	81.1	0.0	0.0	5.0		
Pilgrim Lake	I	0.4	0.2	0.6	8.6	4.58	35.2	42.3	75.6	1.0	0.0	5.0	x	x
Bamber Lake	I	0.8	0.5	1.3	24.4	4.76	30.2	45.5	64.4	0.0	2.0	5.0	x	x
Oswego Lake	I	1.0	0.4	1.4	44.2	4.42	40.0	41.6	60.0	2.0	0.5	0.0		x
Pakim Pond	I	2.2	0.0	2.2	1.8	4.14	51.5	49.6	53.3	1.5	0.0	1.5		
Lake Absegami	I	3.3	0.0	3.3	21.3	4.40	80.0	34.1	100.0	2.0	0.0	0.0	x	x
Wells Mills Lake	I	4.0	0.4	4.4	9.6	4.68	52.7	38.9	58.9	1.0	0.0	3.0	x	x
Chatsworth Lake	I	2.9	2.3	5.2	34.0	4.31	52.1	37.1	90.0	2.0	0.0	0.0	x	x
Horicon Lake	I	5.7	0.7	6.4	24.0	4.34	57.6	56.9	53.3	0.0	0.3	3.5	x	x
Country Lake	I	8.0	1.6	9.6	16.3	4.48	58.5	26.8	93.3	0.0	0.0	0.0	x	x
Atsion Lake	II	9.5	2.8	12.3	41.3	4.69	53.3	46.9	91.1	0.0	0.0	2.0	x	x
Maple Lake	II	11.1	2.4	13.5	12.4	5.98	38.2	49.6	88.9	1.0	0.0	3.0		
Batsto Lake	II	5.4	9.3	14.7	27.4	5.54	47.2	37.9	86.7	3.0	0.5	1.5		x
Success Lake	II	6.7	8.6	15.3	23.6	4.49	55.5	29.6	63.3	0.5	0.0	0.0	x	x
Egg Harbor City Lake	III	11.0	9.1	20.1	7.3	4.29	62.0	21.5	96.7	0.0	0.0	5.0		x
Mimosa Lake	III	23.0	0.2	23.2	2.9	5.78	57.1	60.1	100.0	0.0	0.0	3.0		
Lake Fred	III	13.4	15.5	28.9	15.1	5.72	74.9	28.5	74.4	0.3	0.5	5.0	x	x
Kettle Run Imp.	III	27.7	1.9	29.6	4.1	6.12	77.9	45.3	75.6	0.0	2.0	1.5	x	x
Lake Albert	IV	7.6	24.6	32.2	7.7	6.22	49.5	44.1	93.3	0.5	0.0	0.5	x	x
Cushman Lake	IV	18.9	15.1	34.0	26.8	6.26	56.8	33.9	97.8	0.0	0.0	1.0	x	x
Davenport Imp.	IV	35.1	0.8	35.9	9.9	4.84	69.5	45.9	68.9	0.5	1.0	1.5		
Turn Mill Pond	IV	13.1	23.9	37.0	27.5	6.27	84.1	37.0	76.7	0.0	0.5	4.0	x	x
Shadow Lake	V	28.7	13.4	42.1	3.5	6.03	87.3	47.8	28.9	0.3	0.5	2.0	x	x
Paradise Lake	V	18.8	24.2	43.0	8.9	6.17	76.8	56.6	21.1	1.5	0.0	2.0	x	x
Sunset Lake	V	25.3	18.1	43.4	19.4	6.65	53.3	40.2	76.7	1.5	0.0	1.5	x	x
Cranes Lake	V	24.3	22.7	47.0	15.3	6.63	61.8	39.7	93.3	1.5	2.0	4.5	x	x
Lady's Lake	V	42.2	6.9	49.1	4.6	6.63	164.2	46.4	66.7	0.0	0.5	5.0		
Jennings Lake	V	50.8	1.6	52.4	1.2	6.78	173.7	43.0	1.7	1.0	1.0	5.0	x	x
Indian Mills Lake	V	23.8	34.2	58.0	13.2	6.57	214.5	47.7	5.6	0.0	4.5	0.0	x	x
Hammonton Lake	V	52.3	5.8	58.1	24.8	6.64	121.5	39.1	91.1	0.0	0.0	5.0		x

Appendix 3. Water-quality data for 43 impoundments in the New Jersey Pinelands. With four exceptions, water-quality sampling occurred at the outflow of the impoundments. For the four exceptions, sampling occurred at the outflow of the lower Egg Harbor City Lake, at the inflow of Oswego Lake, downstream from Mount Misery Lake at Route 70, and downstream from Pilgrim Lake at Stage Road. For water-quality variables, SC = specific conductance, D.O. = dissolved oxygen, DOC = dissolved organic carbon, NO₂-N = nitrite as nitrogen, NO₃-N = nitrate as nitrogen, PO₄-P = orthophosphate as phosphorus, SO₄-S = sulphate as sulphur, and Cl = chloride. Values below detection limits (NO₂-N = 0.05 mg L⁻¹, NO₃-N = 0.03 mg L⁻¹, and PO₄-P = 0.05 mg L⁻¹) are noted with ND. Refer to Appendix 1 for impoundment-site descriptions.

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L ⁻¹)	D.O. (%)	Temp. (°C)	DOC (mg L ⁻¹)	NO ₂ -N (mg L ⁻¹)	NO ₃ -N (mg L ⁻¹)	PO ₄ -P (mg L ⁻¹)	SO ₄ -S (mg L ⁻¹)	Cl (mg L ⁻¹)
Atco Lake	04/28/03	13:10	6.31	164.4			21.7						
Atco Lake	05/19/03	13:40	6.60	169.0			20.3						
Atco Lake	06/24/03	13:15	6.08	137.0			27.2						
Atco Lake	07/15/03	12:10	6.35	126.0			24.8						
Atco Lake	08/25/03	12:15	6.68	147.8			24.5						
Atco Lake	10/21/03	9:30	6.31	152.3			14.0						
Atco Lake	03/23/04	12:50	6.51	192.0			10.6						
Atco Lake	04/19/04	13:40	6.63	164.3			23.9						
Atco Lake	05/10/04	13:50	6.57	158.5			26.6						
Atco Lake	06/08/04	14:00	6.39	156.1			28.3						
Atco Lake	08/19/04	13:50	6.48	159.8			27.8						
Atco Lake	09/13/04	13:20	6.37	146.7			26.4						
Atco Lake	10/12/04	12:54	6.14	141.5			15.4						
Atco Lake	03/21/05	12:35	6.30	223.0			11.2						
Atco Lake	04/19/05	12:15	6.34	174.6			20.6						
Atco Lake	05/09/05	12:55	6.36	166.2			22.1						
Atco Lake	06/13/05	13:10	6.52	154.4			29.5						
Atco Lake	07/12/05	13:04	6.71	152.9			31.0						
Atco Lake	08/17/05	13:41	6.65	156.4			28.5						
Atco Lake	09/06/05	13:32	6.58	156.2			25.2						
Atsion Lake	04/29/03	10:25	4.54	61.1			18.5						
Atsion Lake	05/20/03	10:25	4.61	55.3			16.4						
Atsion Lake	06/25/03	9:45	4.21	49.0			25.6						
Atsion Lake	07/14/03	10:45	4.73	43.0			25.0						
Atsion Lake	08/21/03	10:35	4.73	51.7			27.1						
Atsion Lake	10/20/03	15:05	4.79	45.9			15.4						
Atsion Lake	03/23/04	15:30	4.53	66.0			7.9						
Atsion Lake	04/19/04	11:00	4.88	65.4			17.8						
Atsion Lake	05/10/04	11:00	4.64	57.2			19.8						
Atsion Lake	06/08/04	10:50	4.86	52.4			24.1						
Atsion Lake	08/19/04	10:37	4.38	54.2			23.3						
Atsion Lake	09/13/04	10:35	4.51	47.8			22.5						
Atsion Lake	10/12/04	10:25	4.61	44.2			14.5						
Atsion Lake	03/21/05	10:19	4.59	58.3			9.3						
Atsion Lake	04/19/05	15:45	4.73	56.3			18.6						
Atsion Lake	05/09/05	10:36	4.76	55.3			15.6						
Atsion Lake	06/13/05	10:33	4.65	51.9			26.6						
Atsion Lake	07/12/05	10:23	4.80	55.6			25.6						
Atsion Lake	08/17/05	10:21	4.92	48.8			24.7						
Atsion Lake	09/06/05	11:05	5.09	45.1			22.6						
Atsion Lake	04/18/06	11:11	4.97	56.6	9.16	94.2	17.0						
Atsion Lake	05/10/06	10:01	4.77	49.6	8.52	89.0	17.5						
Atsion Lake	06/19/06	11:11	4.87	35.5	6.11	78.6	26.5	9.3	ND	0.079	ND	1.00	6.65
Atsion Lake	07/19/06	10:00	4.45	56.1	7.42	88.8	27.1						
Atsion Lake	08/14/06	11:07	4.62	47.7	5.25	62.5	24.7	33.5	ND	0.067	ND	1.39	8.28
Atsion Lake	09/20/06	10:10	4.08	64.5	7.38	78.4	19.8						
Atsion Lake	10/16/06	10:38	4.36	49.8	8.48	75.1	12.1	8.5	ND	0.038	ND	0.99	6.44
Atsion Lake	11/20/06	10:05	3.89	53.3	9.59	81.7	9.8						
Atsion Lake	12/04/06	10:58	4.43	52.0	9.70	96.6	8.3	9.9	ND	0.092	ND	1.35	7.13
Bamber Lake	04/30/03	11:45	4.63	33.8			16.5						
Bamber Lake	05/21/03	11:40	5.72	31.3			16.4						
Bamber Lake	06/26/03	13:00	4.27	29.0			24.9						
Bamber Lake	07/16/03	14:10	3.95	24.0			23.1						
Bamber Lake	08/22/03	10:35	4.78	33.9			24.3						
Bamber Lake	10/20/03	10:30	4.83	32.9			11.3						
Bamber Lake	03/24/04	10:50	4.39	31.0			6.4						
Bamber Lake	04/20/04	15:00	4.59	36.4			19.7						
Bamber Lake	05/11/04	15:10	4.82	30.0			24.3						
Bamber Lake	06/10/04	13:00	4.91	28.0			25.4						
Bamber Lake	08/20/04	14:15	4.57	41.9			28.0						
Bamber Lake	09/14/04	14:20	5.05	22.1			22.4						
Bamber Lake	10/13/04	14:47	5.07	25.1			15.0						
Bamber Lake	03/22/05	14:20	4.72	27.8			9.8						
Bamber Lake	04/20/05	13:15	4.64	33.1			17.5						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Bamber Lake	05/10/05	14:28	4.73	30.3			17.8						
Bamber Lake	06/14/05	12:31	4.98	29.8			27.6						
Bamber Lake	07/13/05	13:08	4.64	32.8			25.1						
Bamber Lake	08/18/05	14:15	5.03	25.5			25.3						
Bamber Lake	09/07/05	12:27	5.72	29.0			22.2						
Bamber Lake	04/19/06	12:25	4.82	25.5	9.47	98.3	16.7						
Bamber Lake	05/11/06	11:41	5.04	22.2	8.65	89.9	16.6						
Bamber Lake	06/20/06	12:31	5.00	19.3	8.21	87.2	24.9	3.8	ND	ND	ND	0.48	3.31
Bamber Lake	07/20/06	12:20	4.98	25.4	8.01	83.2	26.9						
Bamber Lake	08/15/06	12:40	4.92	23.0	8.13	93.5	23.3	4.0	ND	ND	ND	0.54	4.48
Bamber Lake	09/21/06	12:26	4.86	38.8	7.94	78.3	17.2						
Bamber Lake	10/17/06	9:06	4.67	34.3	9.07	83.7	11.0	6.5	ND	ND	ND	0.68	4.07
Bamber Lake	11/21/06	12:25	3.98	35.6	9.01	93.2	8.3						
Bamber Lake	12/05/06	12:10	4.34	36.1	8.65	70.3	5.4	6.3	ND	ND	ND	0.91	3.99
Batsto Lake	04/29/03	15:00	4.75	52.1			17.2						
Batsto Lake	05/20/03	13:50	5.83	45.8			15.7						
Batsto Lake	06/25/03	12:35	4.65	41.0			22.4						
Batsto Lake	07/14/03	13:35	5.51	33.0			22.2						
Batsto Lake	08/21/03	13:45	5.87	50.3			24.1						
Batsto Lake	10/20/03	14:30	5.56	38.6			13.3						
Batsto Lake	03/24/04	14:30	4.54	60.0			6.8						
Batsto Lake	04/20/04	10:50	4.08	57.5			18.5						
Batsto Lake	05/11/04	11:25	5.62	52.2			20.9						
Batsto Lake	06/09/04	14:00	5.88	42.7			23.0						
Batsto Lake	08/20/04	10:12	5.12	51.3			23.1						
Batsto Lake	09/14/04	11:05	5.48	44.6			19.8						
Batsto Lake	10/13/04	11:00	5.40	37.0			13.1						
Batsto Lake	03/22/05	11:05	5.34	50.8			8.8						
Batsto Lake	04/20/05	9:25	4.55	52.1			15.9						
Batsto Lake	05/10/05	10:51	5.67	47.6			16.0						
Batsto Lake	06/14/05	9:02	5.83	46.8			24.4						
Batsto Lake	07/13/05	9:21	5.60	66.7			23.8						
Batsto Lake	08/17/05	16:00	5.92	46.2			23.6						
Batsto Lake	09/07/05	8:35	5.77	32.2			17.8						
Batsto Lake	04/18/06	13:55	5.61	38.0	8.94	90.2	15.9						
Batsto Lake	05/10/06	13:33	6.11	34.9	8.91	89.5	16.8						
Batsto Lake	06/20/06	9:11	5.93	30.5	8.08	93.5	23.2	5.4	ND	0.239	ND	0.89	5.31
Batsto Lake	07/19/06	13:35	5.77	41.2	7.83	79.8	28.9						
Batsto Lake	08/14/06	14:47	6.33	27.0	6.45	78.4	20.8	5.6	ND	0.084	ND	0.95	4.67
Batsto Lake	09/20/06	13:58	4.45	51.2	7.65	73.8	17.2						
Batsto Lake	10/16/06	14:55	4.50	54.1	8.75	86.6	10.4	7.8	ND	0.086	ND	1.65	6.98
Batsto Lake	11/20/06	13:40	4.13	54.1	9.32	98.1	9.5						
Batsto Lake	12/04/06	10:11	4.83	52.6	9.55	78.7	7.3	9.0	ND	0.193	ND	1.58	6.48
Breeches Branch Imp.	05/21/03	13:50	4.66	48.2			17.3						
Breeches Branch Imp.	06/26/03	15:25	4.05	39.0			31.2						
Breeches Branch Imp.	07/16/03	11:40	3.11	35.0			19.5						
Breeches Branch Imp.	08/22/03	12:50	4.25	43.9			29.2						
Breeches Branch Imp.	10/20/03	12:35	4.34	42.3			14.2						
Breeches Branch Imp.	03/24/04	13:15	4.12	49.0			9.9						
Breeches Branch Imp.	04/20/04	12:30	4.15	51.7			21.4						
Breeches Branch Imp.	05/11/04	12:52	4.30	44.4			26.0						
Breeches Branch Imp.	06/10/04	9:20	4.74	34.9			25.3						
Breeches Branch Imp.	08/20/04	11:43	4.36	45.1			27.8						
Breeches Branch Imp.	09/14/04	12:05	4.42	37.6			23.7						
Breeches Branch Imp.	10/13/04	12:20	4.30	42.6			15.7						
Breeches Branch Imp.	03/22/05	12:05	4.18	45.1			11.2						
Breeches Branch Imp.	04/20/05	11:10	4.08	49.7			18.2						
Breeches Branch Imp.	05/10/05	12:14	4.30	42.1			19.5						
Breeches Branch Imp.	06/14/05	10:14	4.29	41.7			28.6						
Breeches Branch Imp.	07/13/05	10:28	4.33	43.8			26.3						
Breeches Branch Imp.	08/18/05	11:20	4.31	44.7			25.3						
Breeches Branch Imp.	09/07/05	9:46	4.55	40.3			22.1						
Breeches Branch Imp.	04/19/06	10:26	4.30	38.3	8.53	87.5	17.0						
Breeches Branch Imp.	05/11/06	10:00	4.38	37.6	7.45	81.4	18.0						
Breeches Branch Imp.	06/20/06	10:58	4.36	27.7	5.85	70.9	27.2	5.4	ND	ND	ND	0.80	3.31
Breeches Branch Imp.	07/20/06	10:40	4.25	40.1	6.89	77.9	28.0						
Breeches Branch Imp.	08/15/06	11:14	4.16	37.3	7.48	91.9	24.9	4.8	ND	ND	ND	1.41	4.56
Breeches Branch Imp.	09/21/06	10:46	4.18	45.3	6.55	74.3	18.3						
Breeches Branch Imp.	10/16/06	13:10	4.25	44.6	6.78	80.5	16.8	9.5	ND	ND	ND	0.88	4.54
Breeches Branch Imp.	11/21/06	10:45	3.75	50.1	7.89	87.9	9.0						
Breeches Branch Imp.	12/05/06	9:50	3.87	48.9	7.39	58.2	5.7	14.3	ND	ND	ND	0.83	3.63

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Cedar Lake	04/28/03	14:45	5.02	57.4			22.0						
Cedar Lake	05/19/03	15:10	5.53	54.9			21.6						
Cedar Lake	06/24/03	14:30	4.91	41.0			26.8						
Cedar Lake	07/15/03	13:50	5.61	43.0			26.6						
Cedar Lake	08/25/03	13:50	6.23	63.7			28.6						
Cedar Lake	10/21/03	13:00	5.94	50.1			15.3						
Cedar Lake	03/23/04	14:15	5.46	49.0			9.4						
Cedar Lake	04/19/04	14:50	5.71	50.0			22.5						
Cedar Lake	05/10/04	14:55	6.04	49.4			25.2						
Cedar Lake	06/09/04	11:15	5.97	51.7			24.3						
Cedar Lake	08/19/04	15:44	6.11	55.8			26.4						
Cedar Lake	09/13/04	14:40	6.06	53.3			23.2						
Cedar Lake	10/12/04	14:10	6.10	50.6			15.6						
Cedar Lake	03/21/05	13:50	5.79	58.1			9.9						
Cedar Lake	04/19/05	13:25	6.25	54.5			19.0						
Cedar Lake	05/09/05	14:14	6.24	58.0			20.8						
Cedar Lake	06/13/05	14:20	6.35	61.4			27.5						
Cedar Lake	07/12/05	14:10	6.10	51.4			27.3						
Cedar Lake	08/17/05	14:49	6.52	56.5			25.4						
Cedar Lake	09/06/05	14:44	6.76	59.8			23.9						
Centennial Lake	04/28/03	11:40	4.95	72.7			17.7						
Centennial Lake	05/19/03	11:35	5.71	70.9			14.7						
Centennial Lake	06/24/03	12:15	4.73	56.0			20.9						
Centennial Lake	07/15/03	11:20	5.58	55.0			25.0						
Centennial Lake	08/25/03	11:35	6.73	81.2			24.7						
Centennial Lake	10/21/03	10:10	6.15	68.2			15.2						
Centennial Lake	03/23/04	10:30	4.73	63.0			7.0						
Centennial Lake	04/19/04	12:40	4.90	63.7			19.4						
Centennial Lake	05/10/04	12:55	5.34	70.3			23.5						
Centennial Lake	06/08/04	12:50	5.97	74.1			26.7						
Centennial Lake	08/19/04	12:52	5.36	69.2			27.2						
Centennial Lake	09/13/04	12:20	5.57	62.6			24.1						
Centennial Lake	10/12/04	11:58	5.80	58.4			15.6						
Centennial Lake	03/21/05	11:41	5.27	76.5			9.1						
Centennial Lake	04/19/05	11:20	5.37	63.9			17.6						
Centennial Lake	05/09/05	12:01	5.51	72.5			16.2						
Centennial Lake	06/13/05	11:55	6.35	75.5			28.8						
Centennial Lake	07/12/05	12:11	6.30	73.7			27.7						
Centennial Lake	08/17/05	12:34	6.55	72.4			27.3						
Centennial Lake	09/06/05	12:47	6.78	75.9			24.9						
Chatsworth Lake	04/30/03	14:55	4.14	63.6			20.3						
Chatsworth Lake	05/21/03	14:15	5.00	59.3			17.1						
Chatsworth Lake	06/25/03	14:10	4.04	46.0			28.7						
Chatsworth Lake	07/14/03	14:55	4.32	43.0			25.7						
Chatsworth Lake	08/21/03	15:00	4.31	51.9			28.1						
Chatsworth Lake	10/20/03	15:50	4.41	48.7			14.4						
Chatsworth Lake	03/23/04	9:30	3.96	58.0			6.0						
Chatsworth Lake	04/19/04	10:30	4.62	63.0			16.4						
Chatsworth Lake	05/10/04	10:20	4.21	54.5			20.7						
Chatsworth Lake	06/08/04	10:10	4.31	50.4			23.0						
Chatsworth Lake	08/19/04	10:07	4.21	53.3			23.5						
Chatsworth Lake	09/13/04	10:05	4.83	36.9			21.8						
Chatsworth Lake	10/12/04	9:57	4.49	40.8			14.2						
Chatsworth Lake	03/21/05	9:47	4.19	54.1			9.3						
Chatsworth Lake	04/19/05	9:50	3.65	55.0			15.9						
Chatsworth Lake	05/09/05	10:00	4.19	52.2			16.3						
Chatsworth Lake	06/13/05	9:56	4.15	52.7			26.1						
Chatsworth Lake	07/12/05	9:50	4.34	50.7			27.4						
Chatsworth Lake	08/17/05	9:49	4.73	42.5			24.6						
Chatsworth Lake	09/06/05	10:30	5.72	45.6			21.4						
Chatsworth Lake	04/19/06	9:06	4.23	47.2	8.65	90.7	17.3						
Chatsworth Lake	05/10/06	9:20	4.46	43.8	8.60	86.9	15.7						
Chatsworth Lake	06/19/06	10:38	5.27	29.0	6.26	74.7	24.9	7.5	ND	ND	ND	1.08	4.68
Chatsworth Lake	07/19/06	9:20	4.09	47.9	6.49	53.2	28.6						
Chatsworth Lake	08/14/06	10:00	5.23	38.8	6.03	69.0	22.2	8.7	ND	ND	ND	1.41	7.61
Chatsworth Lake	09/20/06	9:41	4.15	44.3	6.24	61.4	18.5						
Chatsworth Lake	10/16/06	9:32	4.09	50.5	8.37	62.5	12.4	7.0	ND	ND	ND	1.18	5.35
Chatsworth Lake	11/20/06	9:23	3.46	64.1	9.46	89.6	9.2						
Chatsworth Lake	12/04/06	9:12	3.61	58.4	9.82	98.3	6.6	14.3	ND	ND	0.111	1.34	5.66
Country Lake	04/30/03	16:00	4.29	67.6			21.3						
Country Lake	05/21/03	15:25	5.22	68.3			17.2						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Country Lake	06/26/03	11:05	4.15	50.0			25.9						
Country Lake	07/16/03	10:15	4.73	48.0			24.6						
Country Lake	08/22/03	14:15	4.52	58.9			26.7						
Country Lake	10/20/03	16:35	4.91	56.1			13.6						
Country Lake	03/24/04	8:30	4.25	56.0			6.6						
Country Lake	04/19/04	8:45	3.84	64.1			15.5						
Country Lake	05/10/04	9:10	3.84	63.5			20.1						
Country Lake	06/08/04	9:05	4.68	68.9			22.0						
Country Lake	08/19/04	9:10	4.46	54.6			24.0						
Country Lake	09/13/04	9:00	4.83	56.4			21.5						
Country Lake	10/12/04	8:55	4.50	52.0			14.7						
Country Lake	03/21/05	8:57	4.16	61.7			8.2						
Country Lake	04/19/05	8:45	4.40	54.7			15.9						
Country Lake	05/09/05	9:05	4.39	56.3			15.4						
Country Lake	06/13/05	9:01	4.54	58.1			27.0						
Country Lake	07/12/05	8:55	4.44	83.2			26.0						
Country Lake	08/17/05	8:52	5.06	59.9			24.5						
Country Lake	09/06/05	9:18	4.91	62.4			22.7						
Country Lake	04/19/06	8:35	4.25	53.6	8.45	85.8	16.4						
Country Lake	05/10/06	8:55	4.51	55.6	7.68	80.3	16.9						
Country Lake	06/19/06	10:10	4.60	43.6	6.57	79.7	24.3	13.9	ND	ND	ND	1.46	7.16
Country Lake	07/19/06	8:40	4.31	53.4	6.65	72.1	27.8						
Country Lake	08/15/06	14:40	4.81	57.0	7.04	84.5	25.9	19.1	ND	ND	ND	1.51	13.38
Country Lake	09/20/06	9:00	4.24	46.5	6.43	64.8	17.8						
Country Lake	10/16/06	8:58	3.92	61.0	8.69	84.9	12.7	12.9	ND	0.042	0.085	1.54	7.06
Country Lake	11/21/06	15:30	4.45	62.3	7.82	85.3	8.8						
Country Lake	12/05/06	14:35	4.44	67.3	8.42	68.9	7.6	18.7	ND	0.073	ND	1.49	6.54
Cranes Lake	04/29/03	12:10	6.44	70.4			19.9						
Cranes Lake	05/19/03	15:45	6.35	65.9			15.6						
Cranes Lake	06/24/03	15:10	5.99	53.0			27.1						
Cranes Lake	07/15/03	14:40	6.53	54.0			26.6						
Cranes Lake	08/25/03	14:35	6.83	61.0			26.7						
Cranes Lake	10/21/03	12:45	6.76	59.1			16.0						
Cranes Lake	03/23/04	14:00	6.20	64.0			7.6						
Cranes Lake	04/19/04	14:30	6.48	61.8			21.5						
Cranes Lake	05/10/04	14:35	6.73	65.6			24.7						
Cranes Lake	06/09/04	11:50	6.64	61.8			25.7						
Cranes Lake	08/19/04	15:17	6.80	66.7			27.8						
Cranes Lake	09/13/04	14:20	6.75	58.3			25.7						
Cranes Lake	10/12/04	13:50	6.56	54.9			15.6						
Cranes Lake	03/21/05	13:30	6.44	81.8			9.4						
Cranes Lake	04/19/05	13:10	6.62	67.1			19.2						
Cranes Lake	05/09/05	13:54	6.86	72.4			20.2						
Cranes Lake	06/13/05	13:58	7.00	66.3			29.3						
Cranes Lake	07/12/05	13:52	6.37	60.7			30.0						
Cranes Lake	08/17/05	14:31	6.78	60.4			28.0						
Cranes Lake	09/06/05	14:28	6.82	61.4			25.1						
Cranes Lake	04/19/06	15:32	6.72	69.4	8.73	98.5	20.5						
Cranes Lake	05/10/06	15:25	5.40	69.8	8.89	89.0	20.1						
Cranes Lake	06/19/06	14:25	6.72	50.7	7.28	91.3	27.5	6.8	ND	0.136	ND	0.95	7.17
Cranes Lake	07/19/06	15:30	5.38	67.2	8.42	80.3	28.1						
Cranes Lake	08/14/06	15:41	6.16	59.1	5.10	68.8	26.5	6.4	ND	0.069	ND	1.57	10.16
Cranes Lake	09/20/06	16:00	5.18	68.5	8.12	74.6	18.3						
Cranes Lake	10/16/06	17:28	5.71	55.4	7.80	73.7	14.9	7.5	ND	0.164	ND	1.20	7.18
Cranes Lake	11/20/06	15:35	4.23	52.4	9.68	89.5	8.1						
Cranes Lake	12/04/06	15:40	5.58	39.7	9.24	85.2	7.3	10.2	ND	0.387	ND	1.44	7.35
Cushman Lake	04/28/03	14:30	5.43	63.0			19.1						
Cushman Lake	05/19/03	14:45	5.93	59.1			15.6						
Cushman Lake	06/24/03	14:15	5.18	50.0			23.1						
Cushman Lake	07/15/03	13:25	6.16	47.0			24.8						
Cushman Lake	08/25/03	13:30	6.44	58.0			27.9						
Cushman Lake	10/21/03	13:45	6.37	56.7			16.5						
Cushman Lake	03/23/04	14:40	5.62	60.0			8.2						
Cushman Lake	04/19/04	15:20	5.48	56.5			20.4						
Cushman Lake	05/10/04	15:30	6.28	56.5			26.2						
Cushman Lake	06/09/04	11:00	6.29	53.6			25.9						
Cushman Lake	08/19/04	16:15	6.56	59.8			28.6						
Cushman Lake	09/13/04	15:15	6.34	55.1			28.1						
Cushman Lake	10/12/04	14:38	6.50	53.2			16.9						
Cushman Lake	03/21/05	14:24	5.86	72.4			9.7						
Cushman Lake	04/19/05	13:45	6.24	59.8			18.8						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Cushman Lake	05/09/05	14:54	6.04	56.9			19.3						
Cushman Lake	06/13/05	14:47	6.67	57.2			29.7						
Cushman Lake	07/12/05	14:52	6.02	52.4			27.6						
Cushman Lake	08/17/05	15:11	6.78	50.0			28.1						
Cushman Lake	09/06/05	15:10	6.87	59.2			25.1						
Cushman Lake	04/18/06	12:14	5.91	60.7	7.89	82.2	17.9						
Cushman Lake	05/10/06	14:20	6.39	58.3	7.84	88.3	21.0						
Cushman Lake	06/19/06	15:22	6.33	44.9	8.14	104.7	27.9	8.3	ND	0.087	ND	0.97	8.30
Cushman Lake	07/19/06	14:25	6.29	56.2	7.03	84.2	28.0						
Cushman Lake	08/14/06	16:05	6.25	59.1	6.43	74.6	28.0	11.6	ND	ND	ND	1.43	12.70
Cushman Lake	09/20/06	14:46	6.15	47.6	6.85	71.5	18.2						
Cushman Lake	10/16/06	17:48	5.77	54.2	7.96	89.3	15.2	6.9	ND	0.102	ND	1.19	8.07
Cushman Lake	11/20/06	14:30	5.72	62.5	9.25	94.2	8.8						
Cushman Lake	12/04/06	14:30	5.59	55.6	8.66	83.6	8.1	10.4	ND	0.252	ND	1.42	8.51
Davenport Imp.	04/30/03	11:30	4.70	74.9			18.0						
Davenport Imp.	05/21/03	11:25	5.53	63.4			16.4						
Davenport Imp.	06/26/03	12:50	4.54	53.0			29.5						
Davenport Imp.	07/16/03	14:20	4.64	54.0			26.5						
Davenport Imp.	08/22/03	10:25	4.87	74.1			26.3						
Davenport Imp.	10/20/03	10:15	5.18	66.3			12.4						
Davenport Imp.	03/24/04	10:40	5.15	61.0			7.1						
Davenport Imp.	04/20/04	15:15	4.53	73.4			22.0						
Davenport Imp.	05/11/04	15:20	4.83	72.6			27.6						
Davenport Imp.	06/10/04	13:10	4.84	71.7			27.9						
Davenport Imp.	08/20/04	14:24	4.67	76.3			30.2						
Davenport Imp.	09/14/04	14:30	4.91	64.6			21.6						
Davenport Imp.	10/13/04	14:55	5.08	64.5			16.9						
Davenport Imp.	03/22/05	14:30	4.76	72.8			10.2						
Davenport Imp.	04/20/05	13:20	4.74	75.8			19.8						
Davenport Imp.	05/10/05	14:45	4.80	70.2			19.7						
Davenport Imp.	06/14/05	12:38	4.93	71.3			29.1						
Davenport Imp.	07/13/05	13:14	4.79	67.6			26.1						
Davenport Imp.	08/18/05	12:25	5.09	68.7			25.9						
Davenport Imp.	09/07/05	12:34	5.54	66.2			23.0						
Diamond Lake	04/29/03	12:30	6.26	66.9			20.5						
Diamond Lake	05/19/03	15:55	5.94	101.7			15.7						
Diamond Lake	06/24/03	15:15	5.75	43.0			27.2						
Diamond Lake	07/15/03	14:50	5.99	48.0			24.9						
Diamond Lake	08/25/03	14:50	6.68	58.0			26.4						
Diamond Lake	10/21/03	12:50	6.51	56.5			15.8						
Diamond Lake	03/23/04	14:05	6.20	63.0			8.3						
Diamond Lake	04/19/04	14:40	5.85	57.9			21.5						
Diamond Lake	05/10/04	14:45	6.46	59.6			23.2						
Diamond Lake	06/09/04	12:00	6.40	56.8			26.2						
Diamond Lake	08/19/04	15:25	6.67	58.3			27.2						
Diamond Lake	09/13/04	14:25	6.52	53.8			24.6						
Diamond Lake	10/12/04	13:57	6.58	50.7			15.2						
Diamond Lake	03/21/05	13:38	6.26	74.1			9.0						
Diamond Lake	04/19/05	13:15	6.55	61.6			19.3						
Diamond Lake	05/09/05	14:02	6.71	63.4			20.4						
Diamond Lake	06/13/05	14:09	6.49	62.9			29.2						
Diamond Lake	07/12/05	14:00	6.28	55.5			29.5						
Diamond Lake	08/17/05	14:37	6.74	58.0			28.4						
Diamond Lake	09/06/05	14:35	6.83	55.7			25.4						
Egg Harbor City Lake	04/29/03	14:45	4.08	75.8			19.9						
Egg Harbor City Lake	05/20/03	13:05	4.40	77.7			17.4						
Egg Harbor City Lake	06/25/03	12:15	4.05	56.0			26.9						
Egg Harbor City Lake	07/14/03	13:15	4.34	54.0			25.3						
Egg Harbor City Lake	08/21/03	13:15	4.21	55.4			28.9						
Egg Harbor City Lake	10/20/03	13:55	4.31	61.9			15.7						
Egg Harbor City Lake	03/24/04	15:00	4.08	67.0			9.9						
Egg Harbor City Lake	04/20/04	10:25	4.25	66.8			19.4						
Egg Harbor City Lake	05/11/04	11:00	4.26	64.3			25.1						
Egg Harbor City Lake	06/09/04	13:40	4.48	58.5			28.3						
Egg Harbor City Lake	08/20/04	9:50	6.07	62.1			24.5						
Egg Harbor City Lake	09/14/04	10:45	4.42	57.6			23.9						
Egg Harbor City Lake	10/13/04	10:39	4.39	58.4			15.2						
Egg Harbor City Lake	03/22/05	10:50	4.23	69.4			10.2						
Egg Harbor City Lake	04/20/05	9:45	3.98	68.9			17.5						
Egg Harbor City Lake	05/10/05	10:28	4.25	62.1			16.7						
Egg Harbor City Lake	06/14/05	8:43	4.33	61.5			27.8						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Egg Harbor City Lake	07/13/05	9:00	4.41	58.9			26.5						
Egg Harbor City Lake	08/18/05	9:15	4.15	71.7			26.2						
Egg Harbor City Lake	09/07/05	8:14	5.69	53.3			21.2						
Egg Harbor City Lake	04/18/06	14:16	4.33	60.4	9.05	98.2	19.4						
Egg Harbor City Lake	05/11/06	8:32	4.37	60.3	8.42	90.2	18.6						
Egg Harbor City Lake	06/20/06	8:41	4.55	43.2	6.02	76.8	26.1	6.6	ND	0.080	ND	1.86	6.06
Egg Harbor City Lake	07/20/06	9:02	4.33	58.7	8.16	85.1	28.6						
Egg Harbor City Lake	08/15/06	10:12	4.18	55.5	7.14	83.3	25.9	8.5	ND	ND	ND	2.28	8.30
Egg Harbor City Lake	09/21/06	9:10	4.28	60.1	8.03	81.1	18.8						
Egg Harbor City Lake	10/16/06	15:20	4.23	57.3	7.98	77.1	16.1	7.1	ND	ND	ND	1.72	5.81
Egg Harbor City Lake	11/21/06	9:07	3.35	68.3	9.16	95.1	10.1						
Egg Harbor City Lake	12/05/06	8:42	4.04	65.9	9.64	79.2	5.3	11.2	ND	ND	ND	1.61	5.97
Hammonton Lake	04/28/03	13:25	6.48	118.6			19.3						
Hammonton Lake	05/20/03	11:05	6.96	114.4			17.7						
Hammonton Lake	06/25/03	10:20	6.52	77.0			26.5						
Hammonton Lake	07/14/03	11:20	6.63	89.0			25.6						
Hammonton Lake	08/21/03	11:05	6.65	132.1			27.5						
Hammonton Lake	10/20/03	14:40	6.80	110.2			16.7						
Hammonton Lake	03/23/04	13:15	7.05	130.0			9.0						
Hammonton Lake	04/19/04	15:45	6.67	122.8			20.7						
Hammonton Lake	05/11/04	9:10	6.90	118.4			23.0						
Hammonton Lake	06/09/04	10:00	7.59	120.8			25.4						
Hammonton Lake	08/20/04	9:02	7.13	150.6			27.4						
Hammonton Lake	09/14/04	9:55	6.72	120.7			23.9						
Hammonton Lake	10/13/04	9:46	6.37	97.2			14.9						
Hammonton Lake	03/21/05	14:50	6.45	183.6			9.8						
Hammonton Lake	04/19/05	15:10	6.00	127.6			20.9						
Hammonton Lake	05/10/05	9:32	6.62	119.8			18.0						
Hammonton Lake	06/14/05	7:54	6.91	122.1			27.8						
Hammonton Lake	07/13/05	8:10	6.43	122.4			25.8						
Hammonton Lake	08/17/05	15:37	6.50	138.9			29.7						
Hammonton Lake	09/07/05	7:15	6.10	145.2			22.0						
Hammonton Lake	04/18/06	13:30	6.78	125.9	8.02	82.5	18.4						
Hammonton Lake	05/10/06	13:12	6.91	117.2	8.33	90.2	21.0						
Hammonton Lake	06/20/06	7:35	6.45	98.2	7.25	87.6	25.9	8.7	ND	0.130	ND	0.54	22.19
Hammonton Lake	07/19/06	13:18	6.84	118.2	7.58	81.2	29.2						
Hammonton Lake	08/14/06	13:56	6.57	112.3	6.21	76.6	27.5	10.0	ND	ND	ND	0.36	30.19
Hammonton Lake	09/20/06	13:50	6.67	124.3	7.33	78.7	19.4						
Hammonton Lake	10/16/06	16:20	6.12	90.0	8.93	83.9	16.9	6.5	ND	0.076	ND	0.70	15.17
Hammonton Lake	11/20/06	13:23	6.08	111.2	8.57	91.3							
Hammonton Lake	12/04/06	9:58	4.98	92.2	9.01	93.3	7.8	8.0	ND	0.325	ND	1.16	16.18
Harrisville Pond	04/29/03	16:10	4.31	50.4			17.4						
Harrisville Pond	05/20/03	15:15	4.63	50.6			16.2						
Harrisville Pond	06/25/03	13:35	4.15	36.0			24.5						
Harrisville Pond	07/14/03	14:30	4.42	34.0			23.7						
Harrisville Pond	08/21/03	14:45	4.44	45.3			24.7						
Harrisville Pond	10/20/03	12:50	4.42	46.0			12.7						
Harrisville Pond	03/24/04	13:30	3.84	43.0			6.8						
Harrisville Pond	04/20/04	11:29	3.87	52.5			18.1						
Harrisville Pond	05/11/04	11:45	4.44	44.1			22.9						
Harrisville Pond	06/09/04	14:30	4.41	39.9			23.8						
Harrisville Pond	08/20/04	10:43	4.25	49.7			25.4						
Harrisville Pond	09/14/04	11:55	4.41	40.7			22.6						
Harrisville Pond	10/13/04	12:00	4.35	42.2			13.9						
Harrisville Pond	03/22/05	11:55	4.34	42.8			9.6						
Harrisville Pond	04/20/05	10:55	4.19	48.7			17.6						
Harrisville Pond	05/10/05	11:52	4.31	42.0			17.3						
Harrisville Pond	06/14/05	10:02	4.39	43.1			27.0						
Harrisville Pond	07/13/05	10:16	4.33	42.7			24.7						
Harrisville Pond	08/18/05	10:40	4.39	39.9			23.9						
Harrisville Pond	09/07/05	9:34	4.55	45.5			20.5						
Horicon Lake	04/30/03	11:10	4.42	71.8			15.9						
Horicon Lake	05/21/03	11:00	5.21	61.6			15.6						
Horicon Lake	06/26/03	12:30	4.02	51.0			23.6						
Horicon Lake	07/16/03	14:50	3.61	46.0			25.2						
Horicon Lake	08/22/03	9:55	4.44	53.4			25.1						
Horicon Lake	10/20/03	9:55	4.45	56.2			12.2						
Horicon Lake	03/24/04	9:15	4.16	68.0			5.7						
Horicon Lake	04/20/04	15:30	4.20	72.4			19.6						
Horicon Lake	05/11/04	15:45	4.32	61.8			26.4						
Horicon Lake	06/10/04	13:30	4.47	55.2			26.1						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Horicon Lake	08/20/04	14:47	4.25	72.4			28.2						
Horicon Lake	09/14/04	14:45	4.29	49.6			20.9						
Horicon Lake	10/13/04	15:12	4.38	51.7			15.6						
Horicon Lake	03/22/05	14:45	4.26	61.0			9.5						
Horicon Lake	04/20/05	13:40	4.33	65.8			18.7						
Horicon Lake	05/10/05	15:03	4.34	57.2			18.3						
Horicon Lake	06/14/05	12:54	4.44	58.0			28.1						
Horicon Lake	07/13/05	13:31	4.32	58.3			26.1						
Horicon Lake	08/18/05	15:25	4.56	48.0			25.2						
Horicon Lake	09/07/05	13:08	4.74	51.1			24.2						
Horicon Lake	04/19/06	12:56	4.27	60.4	8.97	94.3	18.0						
Horicon Lake	05/11/06	12:00	4.41	53.1	8.25	83.9	16.4						
Horicon Lake	06/20/06	12:55	4.41	41.5	7.22	87.7	25.2	5.2	ND	0.042	ND	1.03	7.53
Horicon Lake	07/20/06	12:35	4.38	48.7	7.92	78.8	27.8						
Horicon Lake	08/15/06	13:00	4.47	46.1	7.09	89.5	24.2	6.6	ND	ND	ND	1.18	9.66
Horicon Lake	09/21/06	12:40	4.22	51.2	7.65	77.8	18.1						
Horicon Lake	10/17/06	9:25	4.26	68.7	8.49	87.7	12.0	8.9	ND	ND	ND	1.42	7.81
Horicon Lake	11/21/06	12:40	3.84	54.5	8.93	88.7	8.7						
Horicon Lake	12/05/06	12:30	4.20	72.9	9.72	75.3	5.8	10.3	ND	ND	ND	1.39	7.60
Howardsville Imp.	04/30/03	13:50	4.52	44.7			16.3						
Howardsville Imp.	05/21/03	13:00	4.29	50.5			16.5						
Howardsville Imp.	06/26/03	14:40	4.35	34.0			29.4						
Howardsville Imp.	07/16/03	12:10	5.13	26.0			25.4						
Howardsville Imp.	08/22/03	12:10	4.38	49.3			28.5						
Howardsville Imp.	10/20/03	12:05	4.51	42.3			13.4						
Howardsville Imp.	03/24/04	12:55	4.38	40.0			8.5						
Howardsville Imp.	04/20/04	13:40	4.36	47.1			19.8						
Howardsville Imp.	05/11/04	14:35	4.87	36.8			23.5						
Howardsville Imp.	06/10/04	11:40	5.56	39.1			23.0						
Howardsville Imp.	08/20/04	12:45	4.70	48.2			27.6						
Howardsville Imp.	09/14/04	12:55	4.27	46.2			24.9						
Howardsville Imp.	10/13/04	13:15	4.35	45.6			16.5						
Howardsville Imp.	03/22/05	13:55	4.22	50.0			9.9						
Howardsville Imp.	04/20/05	12:50	4.41	48.4			20.2						
Howardsville Imp.	05/10/05	13:02	4.43	39.6			18.9						
Howardsville Imp.	06/14/05	11:08	4.34	48.5			29.5						
Howardsville Imp.	07/13/05	11:22	4.90	33.4			24.6						
Howardsville Imp.	08/18/05	12:10	4.16	46.1			26.8						
Howardsville Imp.	09/07/05	10:46	4.30	53.5			23.8						
Indian Mills Lake	04/29/03	9:55	6.41	216.0			19.0						
Indian Mills Lake	05/20/03	9:55	6.94	207.0			17.9						
Indian Mills Lake	06/25/03	9:10	6.40	155.0			25.6						
Indian Mills Lake	07/14/03	10:20	6.96	171.0			26.3						
Indian Mills Lake	08/21/03	10:05	8.12	205.0			26.4						
Indian Mills Lake	10/20/03	15:20	6.72	210.0			15.2						
Indian Mills Lake	03/23/04	10:00	6.56	284.0			6.1						
Indian Mills Lake	04/19/04	11:15	6.51	210.0			19.1						
Indian Mills Lake	05/10/04	11:10	8.76	226.0			21.7						
Indian Mills Lake	06/08/04	11:10	9.03	219.0			23.8						
Indian Mills Lake	08/19/04	10:50	6.70	215.0			25.6						
Indian Mills Lake	09/13/04	10:45	6.54	214.0			24.3						
Indian Mills Lake	10/12/04	10:37	6.12	208.0			14.0						
Indian Mills Lake	03/21/05	10:30	6.26	252.0			10.0						
Indian Mills Lake	04/19/05	10:15	6.36	231.0			18.1						
Indian Mills Lake	05/09/05	10:47	9.76	221.0			17.6						
Indian Mills Lake	06/13/05	10:44	6.80	230.0			28.3						
Indian Mills Lake	07/12/05	10:57	6.47	176.9			29.3						
Indian Mills Lake	08/17/05	10:58	6.53	209.0			25.9						
Indian Mills Lake	09/06/05	11:44	6.57	244.0			24.8						
Indian Mills Lake	04/18/06	10:53	7.02	222.0	10.10	101.3	16.4						
Indian Mills Lake	05/10/06	11:02	8.98	218.0	11.39	121.5	17.2						
Indian Mills Lake	06/19/06	12:07	7.16	180.6	12.10	154.5	28.3	9.1	ND	1.510	ND	6.64	30.85
Indian Mills Lake	07/19/06	11:08	6.42	141.2	10.05	118.3	28.8						
Indian Mills Lake	08/14/06	12:14	6.52	238.0	6.11	62.1	25.1	11.4	ND	0.660	ND	11.06	52.42
Indian Mills Lake	09/20/06	11:30	6.22	153.6	9.48	89.9	19.2						
Indian Mills Lake	10/16/06	10:55	5.68	184.9	8.34	77.1	12.2	10.3	ND	2.069	ND	5.92	24.00
Indian Mills Lake	11/20/06	11:13	5.33	132.5	10.14	101.3	10.2						
Indian Mills Lake	12/04/06	11:06	5.27	221.0	9.26	88.3	6.9	7.0	ND	2.684	ND	5.37	25.64
Jennings Lake	04/28/03	10:25	6.59	163.3			15.7						
Jennings Lake	05/19/03	11:10	7.01	169.5			13.4						
Jennings Lake	06/24/03	11:40	6.81	139.0			23.5						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Jennings Lake	07/15/03	10:50	6.32	119.0			23.0						
Jennings Lake	08/25/03	11:05	6.76	144.5			23.1						
Jennings Lake	10/21/03	10:40	6.92	164.7			13.8						
Jennings Lake	03/23/04	12:00	6.72	224.0			7.1						
Jennings Lake	04/19/04	12:20	6.83	202.0			19.8						
Jennings Lake	05/10/04	12:30	7.10	172.2			22.0						
Jennings Lake	06/08/04	12:42	7.21	180.1			25.1						
Jennings Lake	08/19/04	12:23	6.86	169.2			25.5						
Jennings Lake	09/13/04	11:55	6.65	174.1			22.1						
Jennings Lake	10/12/04	11:39	6.48	162.8			13.2						
Jennings Lake	03/21/05	11:38	6.71	307.0			9.9						
Jennings Lake	04/19/05	11:00	6.55	178.8			15.4						
Jennings Lake	05/09/05	11:38	7.16	182.8			17.0						
Jennings Lake	06/13/05	11:42	6.91	185.4			27.2						
Jennings Lake	07/12/05	11:58	6.24	181.1			26.8						
Jennings Lake	08/17/05	12:17	6.80	173.3			26.2						
Jennings Lake	09/06/05	12:30	6.71	192.9			21.9						
Jennings Lake	04/18/06	9:39	6.40	206.0	8.44	80.0	14.3						
Jennings Lake	05/10/06	11:50	6.79	193.4	7.92	81.7	17.7						
Jennings Lake	06/19/06	13:10	6.60	144.3	6.37	94.1	26.7	12.3	ND	0.123	ND	2.75	26.54
Jennings Lake	07/19/06	11:55	6.56	124.3	6.98	75.1	28.2						
Jennings Lake	08/14/06	12:55	6.23	194.8	7.19	85.4	23.3	11.5	ND	ND	ND	4.62	47.32
Jennings Lake	09/20/06	12:25	6.07	177.3	6.55	72.5	18.5						
Jennings Lake	10/16/06	12:03	6.15	159.1	8.98	84.2	10.6	9.3	ND	0.193	ND	3.80	26.23
Jennings Lake	11/20/06	12:00	5.44	114.7	8.56	85.4	9.4						
Jennings Lake	12/04/06	12:09	5.54	169.9	9.69	80.9	6.7	11.3	ND	0.455	ND	4.14	27.61
Kettle Run Imp.	04/28/03	11:50	5.76	67.1			17.3						
Kettle Run Imp.	05/19/03	12:20	6.66	77.4			14.1						
Kettle Run Imp.	06/24/03	12:25	5.82	70.0			22.1						
Kettle Run Imp.	07/15/03	11:35	5.48	58.0			22.6						
Kettle Run Imp.	08/25/03	11:45	6.86	84.4			23.0						
Kettle Run Imp.	10/21/03	10:00	6.60	71.1			14.2						
Kettle Run Imp.	03/23/04	12:20	5.93	70.0			7.3						
Kettle Run Imp.	04/19/04	13:00	5.47	79.2			18.7						
Kettle Run Imp.	05/10/04	13:15	6.28	78.8			21.2						
Kettle Run Imp.	06/08/04	13:30	6.27	79.6			22.4						
Kettle Run Imp.	08/19/04	13:20	6.13	72.8			24.7						
Kettle Run Imp.	09/13/04	12:45	6.07	71.9			22.7						
Kettle Run Imp.	10/12/04	12:20	5.67	69.4			14.4						
Kettle Run Imp.	03/21/05	12:03	5.54	96.2			9.3						
Kettle Run Imp.	04/19/05	11:45	5.70	78.4			16.5						
Kettle Run Imp.	05/09/05	12:22	6.11	81.0			16.7						
Kettle Run Imp.	06/13/05	12:21	6.41	81.6			26.6						
Kettle Run Imp.	07/12/05	12:33	6.35	80.0			26.4						
Kettle Run Imp.	08/17/05	13:00	6.48	80.3			25.2						
Kettle Run Imp.	09/06/05	13:08	6.69	75.6			22.4						
Kettle Run Imp.	04/18/06	10:09	6.13	81.3	10.55	106.9	16.0						
Kettle Run Imp.	05/10/06	12:23	6.67	75.9	9.25	94.2	17.5						
Kettle Run Imp.	06/19/06	13:40	6.72	61.4	8.89	107.5	26.2	5.1	ND	0.434	ND	1.53	11.85
Kettle Run Imp.	07/19/06	12:30	6.57	71.2	8.89	89.5	27.1						
Kettle Run Imp.	08/14/06	13:15	6.30	72.2	8.89	95.8	23.5	6.5	ND	0.322	ND	2.02	16.42
Kettle Run Imp.	09/20/06	12:51	6.33	68.9	8.42	85.3	17.3						
Kettle Run Imp.	10/16/06	12:28	4.96	73.9	8.90	85.5	12.9	4.6	ND	0.594	ND	1.76	11.11
Kettle Run Imp.	11/20/06	12:35	5.88	69.3	9.41	95.4	9.0						
Kettle Run Imp.	12/04/06	12:27	5.59	83.4	9.91	77.4	8.2	6.0	ND	0.802	ND	1.65	9.92
Lady's Lake	04/28/03	12:50	5.96	187.3			19.6						
Lady's Lake	05/19/03	13:20	6.73	228.0			20.1						
Lady's Lake	06/24/03	13:00	6.20	141.0			26.1						
Lady's Lake	07/15/03	12:00	6.23	142.0			25.2						
Lady's Lake	08/25/03	12:05	7.02	164.2			25.0						
Lady's Lake	10/21/03	9:45	6.70	146.4			14.0						
Lady's Lake	03/23/04	12:30	6.76	158.0			7.3						
Lady's Lake	04/19/04	13:25	6.45	176.2			20.9						
Lady's Lake	05/10/04	13:30	6.79	168.3			24.9						
Lady's Lake	06/08/04	13:45	7.08	164.2			26.4						
Lady's Lake	08/19/04	13:40	6.75	151.1			27.1						
Lady's Lake	09/13/04	13:05	6.65	151.3			25.1						
Lady's Lake	10/12/04	12:42	5.82	137.6			14.9						
Lady's Lake	03/21/05	12:20	6.33	406.0			9.8						
Lady's Lake	04/19/05	12:00	6.30	193.0			18.5						
Lady's Lake	05/09/05	12:41	6.53	187.9			19.3						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Lady's Lake	06/13/05	12:54	7.20	180.1			29.3						
Lady's Lake	07/12/05	12:50	6.37	165.8			28.2						
Lady's Lake	08/17/05	13:30	6.62	152.0			27.5						
Lady's Lake	09/06/05	13:21	6.64	151.0			24.9						
Lake Absegami	04/29/03	15:50	4.27	83.5			18.2						
Lake Absegami	05/20/03	14:40	4.62	78.2			20.6						
Lake Absegami	06/25/03	13:20	4.11	70.0			23.3						
Lake Absegami	07/14/03	14:10	4.56	59.0			26.0						
Lake Absegami	08/21/03	14:20	4.51	79.0			28.9						
Lake Absegami	10/20/03	13:00	4.57	61.7			14.5						
Lake Absegami	03/24/04	14:00	4.30	72.0			10.0						
Lake Absegami	04/20/04	11:50	3.88	93.5			18.7						
Lake Absegami	05/11/04	12:25	4.41	83.8			24.1						
Lake Absegami	06/09/04	15:00	4.38	74.7			27.8						
Lake Absegami	08/20/04	11:11	4.46	74.2			28.1						
Lake Absegami	09/14/04	11:35	4.53	67.9			24.3						
Lake Absegami	10/13/04	11:35	4.55	61.8			16.0						
Lake Absegami	03/22/05	11:30	4.37	82.9			9.6						
Lake Absegami	04/20/05	10:30	4.28	95.8			17.9						
Lake Absegami	05/10/05	11:37	4.35	85.8			16.7						
Lake Absegami	06/14/05	9:42	4.32	94.4			27.9						
Lake Absegami	07/13/05	10:00	4.41	80.9			26.6						
Lake Absegami	08/18/05	10:15	4.39	93.1			27.1						
Lake Absegami	09/07/05	9:17	4.62	94.1			22.6						
Lake Absegami	04/19/06	9:58	4.28	81.7	8.72	90.8	17.5						
Lake Absegami	05/11/06	9:20	4.46	89.8	7.95	83.7	18.7						
Lake Absegami	06/20/06	10:21	4.39	72.7	6.42	78.6	27.1	5.0	ND	0.098	ND	1.32	17.55
Lake Absegami	07/20/06	9:50	4.35	78.5	7.65	76.4	28.4						
Lake Absegami	08/15/06	10:50	4.24	80.4	7.80	91.3	25.7	5.3	ND	ND	ND	1.22	23.60
Lake Absegami	09/21/06	9:55	4.19	74.3	7.34	70.1	18.5						
Lake Absegami	10/16/06	14:23	4.31	76.2	9.09	82.8	16.4	5.3	ND	ND	ND	0.87	14.05
Lake Absegami	11/21/06	9:55	3.78	68.5	8.65	86.4	9.8						
Lake Absegami	12/05/06	9:23	4.01	90.2	9.54	77.6	6.6	8.0	ND	ND	ND	1.15	18.43
Lake Albert	04/28/03	14:15	5.63	52.3			18.5						
Lake Albert	05/19/03	14:30	5.83	54.2			14.6						
Lake Albert	06/24/03	14:00	4.91	42.0			21.5						
Lake Albert	07/15/03	13:00	5.31	39.0			24.4						
Lake Albert	08/25/03	13:20	6.21	51.3			26.6						
Lake Albert	10/21/03	15:30	6.22	46.5			16.3						
Lake Albert	03/23/04	14:30	5.89	44.0			8.6						
Lake Albert	04/19/04	15:00	5.63	50.0			21.5						
Lake Albert	05/10/04	15:10	6.15	48.1			24.6						
Lake Albert	06/09/04	10:40	6.28	48.6			24.5						
Lake Albert	08/19/04	16:00	6.63	52.0			29.2						
Lake Albert	09/13/04	15:00	6.49	45.4			27.8						
Lake Albert	10/12/04	14:20	6.42	42.8			17.6						
Lake Albert	05/09/05	14:41	6.51	49.5			19.4						
Lake Albert	06/13/05	14:39	6.63	51.4			29.0						
Lake Albert	07/12/05	14:40	6.35	49.4			27.4						
Lake Albert	08/17/05	15:16	6.72	52.7			27.8						
Lake Albert	09/06/05	15:25	4.76	58.9			25.1						
Lake Albert	04/18/06	12:36	6.30	50.6	8.54	90.5	18.0						
Lake Albert	05/10/06	14:35	6.08	53.4	7.78	86.8	21.0						
Lake Albert	06/19/06	15:10	6.30	37.9	8.21	105.4	28.5	7.6	ND	0.148	ND	0.81	5.79
Lake Albert	07/19/06	14:40	5.98	55.6	6.81	75.4	28.5						
Lake Albert	08/14/06	16:25	6.42	46.3	5.41	74.1	25.4	10.5	ND	ND	ND	1.04	8.09
Lake Albert	09/20/06	15:01	5.80	48.8	6.68	72.3	18.7						
Lake Albert	10/16/06	18:08	5.82	45.5	7.42	75.0	15.8	6.5	ND	0.214	ND	1.00	5.34
Lake Albert	11/20/06	14:45	5.25	68.3	8.81	85.5	9.3						
Lake Albert	12/04/06	14:48	5.54	47.4	9.52	84.5	8.2	8.9	ND	0.349	ND	1.47	6.25
Lake Fred	04/29/03	14:00	5.19	79.2			20.9						
Lake Fred	05/20/03	12:45	5.74	75.3			19.1						
Lake Fred	06/25/03	11:40	4.82	61.0			26.1						
Lake Fred	07/14/03	12:44	5.57	60.0			25.4						
Lake Fred	08/21/03	12:50	6.09	94.3			28.5						
Lake Fred	10/20/03	13:40	5.60	64.1			14.1						
Lake Fred	03/24/04	15:20	5.12	72.0			10.7						
Lake Fred	04/20/04	10:00	5.03	74.5			20.8						
Lake Fred	05/11/04	10:35	5.47	76.8			24.9						
Lake Fred	06/09/04	13:15	5.73	71.1			27.7						
Lake Fred	08/20/04	9:30	6.35	70.4			26.9						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Lake Fred	09/14/04	10:25	6.08	79.0			23.2						
Lake Fred	10/13/04	10:20	6.25	64.3			14.5						
Lake Fred	03/22/05	10:30	5.45	78.8			10.8						
Lake Fred	04/20/05	10:00	4.95	83.1			18.6						
Lake Fred	05/10/05	10:00	5.83	73.6			17.1						
Lake Fred	06/14/05	8:24	5.99	78.8			27.5						
Lake Fred	07/13/05	8:38	6.10	81.2			26.3						
Lake Fred	08/18/05	9:35	5.71	73.2			25.9						
Lake Fred	09/07/05	7:53	6.15	85.6			20.2						
Lake Fred	04/18/06	14:48	5.85	78.4	8.82	97.4	19.5						
Lake Fred	05/11/06	7:55	5.83	72.3	8.33	88.6	18.3						
Lake Fred	06/20/06	8:19	6.35	57.7	6.79	85.2	25.8	6.0	ND	ND	ND	2.08	10.79
Lake Fred	07/20/06	8:30	5.42	68.9	8.01	81.0	28.3						
Lake Fred	08/15/06	9:30	5.28	76.6	6.87	74.0	25.2	6.4	ND	ND	ND	3.09	18.34
Lake Fred	09/21/06	8:28	5.32	64.5	7.98	78.4	18.6						
Lake Fred	10/16/06	15:38	5.17	75.2	7.64	86.5	15.4	4.5	ND	0.155	ND	2.35	11.39
Lake Fred	11/21/06	8:35	4.58	72.5	9.01	91.4	9.7						
Lake Fred	12/05/06	8:12	4.18	83.6	9.91	68.4	5.0	8.7	ND	0.331	ND	2.50	10.85
Lake Pine	04/28/03	10:10	5.82	90.5			16.8						
Lake Pine	05/19/03	10:55	6.32	93.6			14.5						
Lake Pine	06/24/03	11:25	5.21	26.0			20.9						
Lake Pine	07/15/03	10:35	6.17	61.0			24.8						
Lake Pine	08/25/03	10:55	6.39	76.6			24.6						
Lake Pine	10/21/03	10:55	6.41	78.7			14.6						
Lake Pine	03/23/04	10:55	5.50	72.0			5.2						
Lake Pine	04/19/04	12:00	5.34	72.9			20.1						
Lake Pine	05/10/04	12:05	5.94	78.3			22.4						
Lake Pine	06/08/04	12:10	6.28	85.5			25.1						
Lake Pine	08/19/04	12:00	5.75	80.1			25.2						
Lake Pine	09/13/04	11:35	5.76	74.3			23.3						
Lake Pine	10/12/04	11:10	5.98	72.7			14.0						
Lake Pine	03/21/05	11:00	6.06	124.3			9.1						
Lake Pine	04/19/05	10:45	5.95	77.4			16.4						
Lake Pine	05/09/05	11:24	7.12	79.7			17.1						
Lake Pine	06/13/05	11:20	6.18	83.7			28.2						
Lake Pine	07/12/05	11:30	6.11	80.7			26.3						
Lake Pine	08/17/05	11:28	6.33	79.8			26.6						
Lake Pine	09/06/05	12:16	6.57	81.1			24.6						
Manahawkin Lake	04/30/03	13:00	5.65	103.1			16.5						
Manahawkin Lake	05/21/03	12:05	5.46	104.6			17.3						
Manahawkin Lake	06/26/03	13:40	5.82	75.0			26.5						
Manahawkin Lake	07/16/03	12:55	5.81	73.0			23.1						
Manahawkin Lake	08/22/03	11:15	6.10	106.4			26.7						
Manahawkin Lake	10/20/03	11:30	6.01	93.5			12.9						
Manahawkin Lake	03/24/04	12:00	5.92	120.0			7.0						
Manahawkin Lake	04/20/04	14:00	6.13	99.4			19.1						
Manahawkin Lake	05/11/04	14:10	6.34	101.7			23.0						
Manahawkin Lake	06/10/04	12:30	6.92	99.3			29.6						
Manahawkin Lake	08/20/04	13:38	5.78	110.2			28.1						
Manahawkin Lake	09/14/04	13:20	6.24	93.0			23.2						
Manahawkin Lake	10/13/04	14:12	5.95	94.8			15.4						
Manahawkin Lake	03/22/05	13:00	6.18	118.5			9.6						
Manahawkin Lake	04/20/05	12:25	5.93	112.4			21.4						
Manahawkin Lake	05/10/05	13:50	6.19	103.4			17.6						
Manahawkin Lake	06/14/05	11:55	6.88	109.5			29.1						
Manahawkin Lake	07/13/05	12:33	5.61	99.5			26.2						
Manahawkin Lake	08/18/05	12:50	6.14	117.1			25.2						
Manahawkin Lake	09/07/05	11:52	5.88	121.6			23.6						
Maple Lake	04/29/03	13:20	4.73	40.5			20.4						
Maple Lake	05/20/03	11:50	6.39	52.7			17.4						
Maple Lake	06/25/03	11:00	4.73	35.0			25.6						
Maple Lake	07/14/03	12:05	5.17	32.0			23.4						
Maple Lake	08/21/03	11:55	5.86	42.9			26.6						
Maple Lake	10/21/03	14:20	6.64	37.2			16.1						
Maple Lake	03/24/04	16:00	5.32	34.0			9.4						
Maple Lake	04/20/04	9:25	4.95	42.0			19.9						
Maple Lake	05/11/04	10:00	5.82	94.3			22.5						
Maple Lake	06/09/04	12:40	6.06	36.9			27.1						
Maple Lake	08/20/04	7:52	6.32	35.9			25.9						
Maple Lake	09/13/04	15:50	6.43	35.6			27.3						
Maple Lake	10/12/04	15:10	6.39	33.1			17.0						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Maple Lake	03/22/05	9:50	5.83	38.8			8.5						
Maple Lake	04/19/05	14:35	5.17	39.0			18.7						
Maple Lake	05/09/05	15:30	5.90	36.4			17.6						
Maple Lake	06/13/05	15:40	6.41	39.2			30.8						
Maple Lake	07/12/05	15:30	6.20	37.5			28.3						
Maple Lake	08/17/05	16:40	6.65	39.0			29.7						
Maple Lake	09/06/05	16:00	6.70	48.0			25.8						
Mimosa Lake	04/28/03	11:30	5.47	54.8			17.7						
Mimosa Lake	05/19/03	11:25	6.16	56.8			15.1						
Mimosa Lake	06/24/03	12:10	5.32	48.0			22.9						
Mimosa Lake	07/15/03	11:10	5.68	41.0			24.7						
Mimosa Lake	08/25/03	11:25	6.54	54.7			25.8						
Mimosa Lake	10/21/03	10:20	6.49	52.7			14.6						
Mimosa Lake	03/23/04	10:40	4.82	51.0			7.3						
Mimosa Lake	04/19/04	12:45	5.24	57.1			18.9						
Mimosa Lake	05/10/04	13:00	5.67	57.0			22.4						
Mimosa Lake	06/08/04	13:00	6.25	57.3			24.9						
Mimosa Lake	08/19/04	13:00	5.88	58.0			25.8						
Mimosa Lake	09/13/04	12:30	5.50	54.5			23.4						
Mimosa Lake	10/12/04	12:03	5.92	53.3			15.4						
Mimosa Lake	03/21/05	11:47	5.22	66.4			8.8						
Mimosa Lake	04/19/05	11:30	5.17	59.5			17.0						
Mimosa Lake	05/09/05	12:10	5.51	62.9			16.8						
Mimosa Lake	06/13/05	12:08	6.07	63.5			27.9						
Mimosa Lake	07/12/05	12:17	6.35	62.0			26.9						
Mimosa Lake	08/17/05	12:42	6.43	61.5			27.5						
Mimosa Lake	09/06/05	12:52	6.70	63.0			23.9						
Mount Misery Imp.	04/30/03	15:40	4.19	55.1			16.4						
Mount Misery Imp.	05/21/03	15:05	5.64	48.4			13.4						
Mount Misery Imp.	06/26/03	10:50	3.99	41.0			20.6						
Mount Misery Imp.	07/16/03	10:25	3.49	31.0			19.1						
Mount Misery Imp.	08/22/03	14:00	4.70	83.9			25.3						
Mount Misery Imp.	10/20/03	16:30	4.56	38.1			11.9						
Mount Misery Imp.	03/24/04	8:40	4.24	44.0			4.1						
Mount Misery Imp.	04/19/04	9:45	4.37	54.2			14.5						
Mount Misery Imp.	05/10/04	9:25	4.32	45.2			15.6						
Mount Misery Imp.	06/08/04	9:20	4.45	38.1			18.4						
Mount Misery Imp.	08/19/04	9:20	4.20	44.7			19.7						
Mount Misery Imp.	09/13/04	9:15	4.49	38.1			17.0						
Mount Misery Imp.	10/12/04	9:05	4.44	35.6			11.6						
Mount Misery Imp.	03/21/05	9:07	4.28	43.1			7.4						
Mount Misery Imp.	04/19/05	8:55	4.36	41.4			12.3						
Mount Misery Imp.	05/09/05	9:16	4.23	38.2			12.6						
Mount Misery Imp.	06/13/05	9:11	4.32	41.4			21.6						
Mount Misery Imp.	07/12/05	9:04	4.37	74.4			21.3						
Mount Misery Imp.	08/17/05	9:02	4.80	35.1			19.5						
Mount Misery Imp.	09/06/05	9:30	4.75	36.2			17.2						
Oswego Lake	05/21/03	13:40	5.36	71.6			12.9						
Oswego Lake	06/26/03	15:10	4.06	40.0			24.7						
Oswego Lake	07/16/03	11:30	4.35	36.0			26.7						
Oswego Lake	08/22/03	12:40	4.92	36.6			21.6						
Oswego Lake	10/20/03	12:30	4.65	33.4			11.4						
Oswego Lake	03/24/04	13:10	4.28	47.0			8.3						
Oswego Lake	04/20/04	12:40	4.26	58.2			18.0						
Oswego Lake	05/11/04	13:00	4.42	45.5			21.4						
Oswego Lake	06/10/04	9:30	4.67	39.8			20.7						
Oswego Lake	08/20/04	11:53	4.31	45.1			23.3						
Oswego Lake	09/14/04	12:15	4.61	35.0			18.6						
Oswego Lake	10/13/04	12:30	4.43	35.7			12.6						
Oswego Lake	03/22/05	12:15	4.31	44.3			9.3						
Oswego Lake	04/20/05	11:15	4.09	49.5			15.6						
Oswego Lake	05/10/05	12:22	4.35	42.7			16.1						
Oswego Lake	06/14/05	10:20	4.50	38.2			22.4						
Oswego Lake	07/13/05	10:38	4.40	42.1			22.1						
Oswego Lake	08/18/05	11:25	4.54	35.5			20.2						
Oswego Lake	09/07/05	9:53	4.63	39.1			17.2						
Oswego Lake	04/19/06	10:36	4.42	36.9	8.84	83.7	12.7						
Oswego Lake	05/11/06	10:30	4.51	43.4	7.86	82.9	18.5						
Oswego Lake	06/20/06	11:12	4.47	27.3	7.45	82.4	20.9	4.3	ND	ND	ND	1.11	3.38
Oswego Lake	07/20/06	11:10	4.46	51.2	7.42	79.7	28.5						
Oswego Lake	08/15/06	11:27	4.30	34.0	7.43	76.3	20.4	3.7	ND	ND	ND	1.49	4.23

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Oswego Lake	09/21/06	11:15	4.24	49.8	7.36	80.2	18.8						
Oswego Lake	10/16/06	13:25	4.22	44.7	7.80	72.4	11.2	8.3	ND	ND	ND	0.80	4.94
Oswego Lake	11/21/06	11:15	3.96	61.3	8.42	89.7	9.5						
Oswego Lake	12/05/06	10:00	3.91	46.8	7.82	54.3	5.1	7.9	ND	ND	ND	1.22	4.83
Pakim Pond	04/30/03	15:10	3.94	75.7			21.0						
Pakim Pond	05/21/03	14:30	4.63	76.3			16.3						
Pakim Pond	06/26/03	10:20	3.83	56.0			22.0						
Pakim Pond	07/16/03	10:40	3.90	42.0			24.5						
Pakim Pond	08/22/03	13:25	4.30	62.0			30.2						
Pakim Pond	10/20/03	16:10	4.18	55.2			15.0						
Pakim Pond	03/23/04	9:10	3.89	63.0			5.2						
Pakim Pond	04/19/04	10:15	4.55	65.1			15.3						
Pakim Pond	05/10/04	10:05	4.15	34.4			19.3						
Pakim Pond	06/08/04	9:50	4.04	45.3			21.9						
Pakim Pond	08/19/04	9:45	4.01	62.7			22.4						
Pakim Pond	09/13/04	9:45	4.16	49.4			20.1						
Pakim Pond	10/12/04	9:39	4.19	45.0			13.0						
Pakim Pond	03/21/05	9:32	4.05	54.4			5.8						
Pakim Pond	04/19/05	9:25	3.36	50.3			13.5						
Pakim Pond	05/09/05	9:44	4.13	51.3			13.7						
Pakim Pond	06/13/05	9:41	4.05	48.7			25.5						
Pakim Pond	07/12/05	9:34	4.16	51.6			24.6						
Pakim Pond	08/17/05	9:30	4.56	48.0			23.3						
Pakim Pond	09/06/05	10:11	4.34	46.2			21.9						
Paradise Lake	04/29/03	10:50	5.80	76.8			16.9						
Paradise Lake	05/20/03	10:50	6.22	81.9			16.4						
Paradise Lake	06/25/03	9:55	5.34	50.0			21.9						
Paradise Lake	07/14/03	11:00	5.86	60.0			22.7						
Paradise Lake	08/21/03	10:45	5.80	85.2			23.4						
Paradise Lake	10/20/03	14:20	6.28	74.1			12.9						
Paradise Lake	03/23/04	15:20	5.74	70.0			8.7						
Paradise Lake	04/19/04	16:00	5.38	70.0			21.4						
Paradise Lake	05/11/04	8:30	6.20	78.8			19.9						
Paradise Lake	06/09/04	9:35	6.47	76.7			22.3						
Paradise Lake	08/20/04	8:40	6.35	80.1			24.3						
Paradise Lake	09/14/04	9:35	6.28	76.0			21.1						
Paradise Lake	10/13/04	9:30	5.71	70.6			12.2						
Paradise Lake	03/21/05	15:15	6.26	95.2			10.1						
Paradise Lake	04/19/05	15:30	6.23	75.6			19.8						
Paradise Lake	05/10/05	9:05	6.14	77.9			15.9						
Paradise Lake	06/14/05	7:25	6.27	83.2			25.9						
Paradise Lake	07/12/05	10:36	5.57	68.3			25.0						
Paradise Lake	08/17/05	10:37	6.10	84.3			23.7						
Paradise Lake	09/06/05	11:23	6.20	81.5			21.9						
Paradise Lake	04/18/06	11:29	6.36	76.2	9.11	88.5	14.9						
Paradise Lake	05/10/06	10:24	6.12	73.1	9.28	91.5	15.8						
Paradise Lake	06/19/06	11:38	6.18	58.7	8.47	100.3	24.4	6.1	ND	0.402	ND	1.32	10.04
Paradise Lake	07/19/06	10:22	5.70	72.9	7.14	88.2	26.7						
Paradise Lake	08/14/06	11:26	5.78	74.4	8.24	92.1	21.0	6.6	ND	0.413	ND	1.95	15.29
Paradise Lake	09/20/06	10:38	5.52	68.5	6.99	74.3	17.0						
Paradise Lake	10/16/06	10:24	5.03	69.1	9.73	84.8	9.1	7.8	ND	0.464	ND	1.77	9.32
Paradise Lake	11/20/06	10:27	4.17	65.8	8.74	89.5	8.6						
Paradise Lake	12/04/06	10:35	4.99	74.1	9.83	81.8	7.0	7.3	ND	0.722	ND	2.12	10.81
Pilgrim Lake	04/29/03	15:20	4.38	39.7			18.5						
Pilgrim Lake	05/20/03	14:15	4.58	52.1			18.2						
Pilgrim Lake	06/25/03	13:05	4.34	29.0			24.3						
Pilgrim Lake	07/14/03	13:55	4.78	27.0			23.8						
Pilgrim Lake	08/21/03	14:30	4.68	41.7			26.4						
Pilgrim Lake	10/20/03	13:15	4.51	44.5			13.3						
Pilgrim Lake	03/24/04	13:50	4.20	35.0			8.7						
Pilgrim Lake	04/20/04	11:40	3.90	39.8			18.9						
Pilgrim Lake	05/11/04	12:05	4.59	34.2			21.9						
Pilgrim Lake	06/09/04	14:40	4.65	31.5			24.7						
Pilgrim Lake	08/20/04	10:58	4.48	42.4			25.5						
Pilgrim Lake	09/14/04	11:45	4.72	29.6			22.7						
Pilgrim Lake	10/13/04	11:46	4.59	31.3			14.3						
Pilgrim Lake	03/22/05	11:40	4.58	34.4			9.5						
Pilgrim Lake	04/20/05	10:45	4.24	36.9			16.5						
Pilgrim Lake	05/10/05	11:21	4.58	32.4			16.3						
Pilgrim Lake	06/14/05	9:24	4.68	30.8			25.8						
Pilgrim Lake	07/13/05	9:44	4.65	35.8			25.1						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Pilgrim Lake	08/18/05	10:25	4.56	35.6			25.5						
Pilgrim Lake	09/07/05	9:01	5.08	35.4			21.3						
Pilgrim Lake	04/19/06	9:37	4.40	31.1	9.25	93.2	16.0						
Pilgrim Lake	05/11/06	9:01	4.73	28.3	9.05	95.7	17.6						
Pilgrim Lake	06/20/06	9:50	4.54	23.2	7.31	90.8	25.3	4.9	ND	0.061	ND	0.65	3.71
Pilgrim Lake	07/20/06	9:32	4.68	30.3	8.85	86.4	27.6						
Pilgrim Lake	08/15/06	10:36	4.34	29.4	7.80	83.4	23.3	4.9	ND	ND	ND	0.72	4.97
Pilgrim Lake	09/21/06	9:38	4.50	28.7	8.23	82.4	17.9						
Pilgrim Lake	10/16/06	14:08	4.31	37.0	8.16	82.9	13.0	7.4	ND	ND	ND	0.74	4.01
Pilgrim Lake	11/21/06	9:37	4.14	40.5	9.85	96.4	8.8						
Pilgrim Lake	12/05/06	9:08	4.02	44.3	9.86	86.7	5.0	7.4	ND	ND	ND	0.98	4.40
Presidential Lake	04/30/03	15:30	4.41	50.2			20.3						
Presidential Lake	05/21/03	14:50	5.14	59.8			17.5						
Presidential Lake	06/26/03	10:40	4.34	36.0			22.3						
Presidential Lake	07/16/03	10:35	4.45	38.0			23.2						
Presidential Lake	08/22/03	13:45	4.73	55.3			25.1						
Presidential Lake	10/20/03	16:20	4.85	47.7			13.7						
Presidential Lake	03/24/04	8:51	4.45	40.0			6.8						
Presidential Lake	04/19/04	10:00	4.73	44.8			17.6						
Presidential Lake	05/10/04	9:45	4.58	47.2			19.7						
Presidential Lake	06/08/04	9:30	4.78	45.1			20.7						
Presidential Lake	08/19/04	9:28	4.49	41.9			23.4						
Presidential Lake	09/13/04	9:30	4.93	50.8			20.4						
Presidential Lake	10/12/04	9:17	4.84	43.8			12.3						
Presidential Lake	03/21/05	9:16	4.67	42.7			8.6						
Presidential Lake	04/19/05	9:10	4.61	42.6			16.0						
Presidential Lake	05/09/05	9:25	4.78	43.3			16.0						
Presidential Lake	06/13/05	9:21	4.74	50.1			26.0						
Presidential Lake	07/12/05	9:17	4.72	55.0			24.5						
Presidential Lake	08/17/05	9:13	5.53	54.7			23.0						
Presidential Lake	09/06/05	9:47	5.70	87.2			20.6						
Shadow Lake	04/29/03	10:00	5.88	89.0			18.4						
Shadow Lake	05/20/03	10:05	6.00	83.3			16.2						
Shadow Lake	06/25/03	9:25	4.91	71.0			21.4						
Shadow Lake	07/14/03	10:30	6.67	70.0			22.1						
Shadow Lake	08/21/03	10:15	6.22	80.3			24.7						
Shadow Lake	10/20/03	15:30	6.34	82.3			14.4						
Shadow Lake	03/23/04	10:10	5.83	87.0			6.3						
Shadow Lake	04/19/04	11:30	5.25	92.8			19.2						
Shadow Lake	05/10/04	11:25	5.91	93.0			19.5						
Shadow Lake	06/08/04	11:25	6.03	82.9			23.5						
Shadow Lake	08/19/04	11:03	5.51	90.2			23.6						
Shadow Lake	09/13/04	11:00	6.02	88.6			21.9						
Shadow Lake	10/12/04	10:50	6.08	82.6			12.8						
Shadow Lake	03/21/05	10:43	6.07	89.8			9.7						
Shadow Lake	04/19/05	10:25	6.20	87.6			17.0						
Shadow Lake	05/09/05	11:03	7.57	91.6			18.1						
Shadow Lake	06/13/05	10:56	5.86	88.8			26.6						
Shadow Lake	07/12/05	11:11	5.80	88.7			25.5						
Shadow Lake	08/17/05	11:10	6.14	85.3			24.1						
Shadow Lake	09/06/05	11:57	6.61	80.1			23.4						
Shadow Lake	04/18/06	10:36	6.15	87.4	9.52	98.2	16.5						
Shadow Lake	05/10/06	11:16	5.83	82.4	8.03	84.5	18.0						
Shadow Lake	06/19/06	12:16	6.65	66.2	8.89	113.6	28.0	11.1	ND	ND	ND	2.44	11.78
Shadow Lake	07/19/06	11:21	6.04	72.4	7.76	80.5	26.9						
Shadow Lake	08/14/06	12:32	5.38	82.8	6.18	83.0	25.7	7.6	ND	0.138	ND	3.27	19.63
Shadow Lake	09/20/06	11:43	5.85	70.1	7.34	75.4	17.3						
Shadow Lake	10/16/06	11:15	5.39	95.7	8.23	88.2	11.2	12.4	ND	0.308	ND	3.93	12.25
Shadow Lake	11/20/06	11:26	5.78	67.6	9.54	90.3	8.8						
Shadow Lake	12/04/06	11:33	5.11	99.5	9.09	89.9	7.4	12.4	ND	0.275	ND	3.72	15.18
Success Lake	04/30/03	10:45	4.28	65.7			17.3						
Success Lake	05/21/03	10:35	4.95	59.4			16.7						
Success Lake	06/26/03	12:10	4.26	46.0			27.5						
Success Lake	07/16/03	15:15	4.09	42.0			26.9						
Success Lake	08/22/03	9:40	4.72	49.7			26.5						
Success Lake	10/20/03	9:35	4.70	53.7			12.3						
Success Lake	03/24/04	9:40	4.25	58.0			6.0						
Success Lake	04/20/04	13:55	3.77	61.5			21.2						
Success Lake	05/11/04	16:05	4.41	57.0			27.7						
Success Lake	06/10/04	14:00	4.79	51.1			28.4						
Success Lake	08/20/04	15:14	4.50	61.4			30.1						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Success Lake	09/14/04	15:05	4.56	45.6			21.8						
Success Lake	10/13/04	15:35	4.47	47.6			16.4						
Success Lake	03/22/05	15:10	4.34	56.8			10.4						
Success Lake	04/20/05	14:00	4.45	61.9			20.0						
Success Lake	05/10/05	15:23	4.38	54.6			17.7						
Success Lake	06/14/05	13:15	4.60	52.9			28.8						
Success Lake	07/20/05	9:35	4.61	57.1			27.1						
Success Lake	08/18/05	15:50	4.94	50.4			26.7						
Success Lake	09/07/05	13:29	4.91	56.3			23.5						
Success Lake	04/19/06	13:25	4.40	57.0	8.24	88.8	19.3						
Success Lake	05/11/06	12:40	4.53	53.0	8.01	83.5	16.9						
Success Lake	06/20/06	13:20	4.60	39.1	7.45	91.2	26.1	14.3	ND	ND	ND	0.95	6.52
Success Lake	07/20/06	13:28	4.44	51.2	7.98	80.2	26.9						
Success Lake	08/15/06	13:50	4.81	54.5	7.26	80.5	24.8	15.2	ND	ND	ND	1.19	13.02
Success Lake	09/21/06	13:32	4.36	55.3	7.78	77.3	17.2						
Success Lake	10/17/06	9:49	4.33	60.7	7.47	77.9	11.9	12.8	ND	ND	ND	1.40	7.07
Success Lake	11/21/06	13:33	3.94	61.3	8.98	90.2	8.4						
Success Lake	12/05/06	13:15	4.34	61.3	8.58	73.4	5.6	14.2	ND	ND	ND	1.55	7.01
Sunset Lake	04/29/03	11:55	6.47	58.4			20.8						
Sunset Lake	05/19/03	15:25	6.53	57.5			15.7						
Sunset Lake	06/24/03	14:55	6.00	49.0			30.4						
Sunset Lake	07/15/03	14:10	6.62	46.0			27.7						
Sunset Lake	08/25/03	14:05	6.65	65.4			26.2						
Sunset Lake	10/21/03	12:35	6.70	51.4			16.4						
Sunset Lake	09/13/04	14:10	6.67	50.4			26.9						
Sunset Lake	10/12/04	13:40	6.50	48.4			16.1						
Sunset Lake	03/21/05	13:20	6.40	57.3			9.5						
Sunset Lake	04/19/05	12:55	6.69	52.5			20.9						
Sunset Lake	05/09/05	13:40	6.91	53.9			20.9						
Sunset Lake	06/13/05	13:48	6.86	56.5			29.5						
Sunset Lake	07/12/05	13:39	6.49	45.9			30.3						
Sunset Lake	08/17/05	14:22	6.73	53.3			28.9						
Sunset Lake	09/06/05	14:28	6.92	62.5			25.2						
Sunset Lake	04/18/06	13:01	6.29	55.9	8.48	92.6	18.0						
Sunset Lake	05/10/06	14:58	4.68	65.1	8.61	85.6	19.8						
Sunset Lake	06/19/06	15:42	6.49	39.1	6.75	92.9	28.9	7.9	ND	ND	ND	0.84	6.00
Sunset Lake	07/19/06	15:02	4.72	68.1	8.54	86.7	27.8						
Sunset Lake	08/14/06	16:31	5.81	49.9	5.31	66.7	28.0	9.7	ND	ND	ND	1.24	9.48
Sunset Lake	09/20/06	15:26	4.53	64.7	8.15	80.1	18.1						
Sunset Lake	10/16/06	17:15	5.56	46.7	7.50	81.9	15.7	6.1	ND	ND	ND	1.12	6.24
Sunset Lake	11/20/06	15:07	3.68	53.7	9.84	84.6	9.8						
Sunset Lake	12/04/06	15:10	5.54	35.0	8.36	79.8	7.9	8.1	ND	0.386	ND	1.34	6.65
Taunton Lake	06/24/03	12:00	4.93	58.0			21.3						
Taunton Lake	07/15/03	11:00	5.93	59.0			24.8						
Taunton Lake	08/25/03	11:20	6.61	84.5			24.5						
Taunton Lake	10/21/03	10:30	6.13	71.2			14.5						
Taunton Lake	03/23/04	10:50	4.90	63.0			5.2						
Taunton Lake	04/19/04	12:30	5.17	70.5			18.6						
Taunton Lake	05/10/04	12:45	5.54	72.0			22.1						
Taunton Lake	06/08/04	12:25	5.96	76.7			24.1						
Taunton Lake	08/19/04	12:37	5.58	69.9			25.1						
Taunton Lake	09/13/04	12:10	5.78	68.6			23.0						
Taunton Lake	10/12/04	11:50	6.22	65.4			15.3						
Taunton Lake	03/21/05	11:10	5.32	80.1			8.7						
Taunton Lake	04/19/05	11:10	5.63	69.4			16.2						
Taunton Lake	05/09/05	11:51	5.52	75.2			16.7						
Taunton Lake	06/13/05	11:31	5.87	77.8			27.6						
Taunton Lake	07/12/05	11:41	5.62	75.2			26.4						
Taunton Lake	08/17/05	11:37	6.33	78.4			26.5						
Taunton Lake	09/06/05	12:41	6.81	79.9			24.3						
Timber Lakes - lower	04/29/03	11:45	6.37	76.4			20.4						
Timber Lakes - lower	05/19/03	15:30	6.41	71.9			15.8						
Timber Lakes - lower	06/24/03	15:00	6.07	55.0			29.0						
Timber Lakes - lower	07/15/03	14:20	6.67	60.0			26.1						
Timber Lakes - lower	08/25/03	14:15	6.71	73.0			27.0						
Timber Lakes - lower	10/21/03	12:00	6.53	66.2			16.3						
Timber Lakes - lower	03/23/04	13:50	6.44	70.0			8.2						
Timber Lakes - lower	04/19/04	14:10	6.47	65.5			20.8						
Timber Lakes - lower	05/10/04	14:15	6.71	72.7			22.7						
Timber Lakes - lower	06/09/04	11:35	6.67	69.3			25.8						
Timber Lakes - lower	08/19/04	15:00	6.75	68.5			27.5						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Timber Lakes - lower	09/13/04	13:45	6.56	66.0			26.0						
Timber Lakes - lower	10/12/04	13:24	6.27	62.5			15.4						
Timber Lakes - lower	03/21/05	13:09	6.46	85.4			10.4						
Timber Lakes - lower	04/19/05	12:40	6.56	73.4			19.4						
Timber Lakes - lower	05/09/05	13:23	6.67	75.8			19.9						
Timber Lakes - lower	06/13/05	13:36	6.90	75.4			29.1						
Timber Lakes - lower	07/12/05	13:29	6.36	65.0			30.4						
Timber Lakes - lower	08/17/05	14:10	6.79	72.5			28.4						
Timber Lakes - lower	09/06/05	14:16	6.74	67.7			25.1						
Turn Mill Pond	04/30/03	10:20	6.16	84.1			17.4						
Turn Mill Pond	05/21/03	10:20	6.62	85.1			16.7						
Turn Mill Pond	06/26/03	11:40	6.18	59.0			28.6						
Turn Mill Pond	07/16/03	15:30	6.06	64.0			27.7						
Turn Mill Pond	08/22/03	9:30	6.48	82.6			26.8						
Turn Mill Pond	10/20/03	9:25	6.60	89.3			12.6						
Turn Mill Pond	03/24/04	10:00	6.37	74.0			7.1						
Turn Mill Pond	04/20/04	16:20	5.91	84.5			20.4						
Turn Mill Pond	05/11/04	16:30	6.47	84.2			26.9						
Turn Mill Pond	06/10/04	14:30	6.81	83.5			27.8						
Turn Mill Pond	08/20/04	15:47	6.34	94.3			29.4						
Turn Mill Pond	09/14/04	15:25	6.12	70.4			23.7						
Turn Mill Pond	10/13/04	16:15	5.82	72.3			16.7						
Turn Mill Pond	03/22/05	15:30	6.24	86.4			12.0						
Turn Mill Pond	04/20/05	14:25	5.93	100.7			21.2						
Turn Mill Pond	05/10/05	15:48	6.23	88.1			19.9						
Turn Mill Pond	06/14/05	13:50	6.75	92.3			29.6						
Turn Mill Pond	07/20/05	9:15	6.70	80.6			28.6						
Turn Mill Pond	08/18/05	16:10	6.30	80.3			27.3						
Turn Mill Pond	09/07/05	14:00	5.89	90.2			26.3						
Turn Mill Pond	04/19/06	13:58	6.25	93.7	9.34	104.2	20.6						
Turn Mill Pond	05/11/06	13:23	6.24	83.4	8.68	82.1	18.1						
Turn Mill Pond	06/20/06	13:40	6.11	64.8	8.15	93.5	26.7	7.1	ND	ND	ND	1.67	12.77
Turn Mill Pond	07/20/06	14:58	6.16	78.9	8.42	83.3	28.2						
Turn Mill Pond	08/15/06	14:10	5.81	82.9	7.02	81.7	25.7	7.9	ND	ND	ND	1.70	22.11
Turn Mill Pond	09/21/06	15:03	5.98	76.2	8.18	79.2	18.5						
Turn Mill Pond	10/17/06	10:15	5.45	76.9	8.42	75.5	13.2	4.9	ND	ND	ND	1.85	12.65
Turn Mill Pond	11/21/06	15:03	5.14	81.3	9.42	93.3	9.2						
Turn Mill Pond	12/05/06	14:10	5.31	74.2	8.62	71.7	5.5	6.9	ND	0.179	ND	1.90	10.52
Victory Lake	04/29/03	12:05	6.53	60.7			20.9						
Victory Lake	05/19/03	15:20	6.41	58.4			19.5						
Victory Lake	06/24/03	14:45	6.25	50.0			29.7						
Victory Lake	07/15/03	14:00	6.56	50.0			28.3						
Victory Lake	08/25/03	14:00	6.73	68.3			27.5						
Victory Lake	10/21/03	12:25	6.81	57.8			16.2						
Victory Lake	03/23/04	13:55	6.58	50.0			8.4						
Victory Lake	04/19/04	14:20	6.06	56.6			22.6						
Victory Lake	05/10/04	14:25	6.81	57.6			25.1						
Victory Lake	06/09/04	11:30	6.63	53.4			27.2						
Victory Lake	08/19/04	15:06	6.98	59.8			28.3						
Victory Lake	09/13/04	13:55	6.77	55.4			25.9						
Victory Lake	10/12/04	13:33	6.48	53.1			15.4						
Victory Lake	03/21/05	13:14	6.56	62.8			9.8						
Victory Lake	04/19/05	12:45	6.67	56.3			19.8						
Victory Lake	05/09/05	13:30	6.91	56.1			20.0						
Victory Lake	06/13/05	13:42	6.98	63.4			30.0						
Victory Lake	07/12/05	13:35	6.56	52.5			31.4						
Victory Lake	08/17/05	14:14	6.72	60.0			29.2						
Victory Lake	09/06/05	14:19	6.83	57.7			25.3						
Wells Mills Lake	04/30/03	12:30	4.66	61.8			17.6						
Wells Mills Lake	05/21/03	12:30	4.65	49.8			16.3						
Wells Mills Lake	06/26/03	14:10	4.32	46.0			29.1						
Wells Mills Lake	07/16/03	13:30	4.84	40.0			26.3						
Wells Mills Lake	08/22/03	11:50	4.81	112.7			27.9						
Wells Mills Lake	10/20/03	11:00	4.64	55.6			12.1						
Wells Mills Lake	03/24/04	11:20	4.50	52.0			8.0						
Wells Mills Lake	04/20/04	14:30	4.64	58.4			21.3						
Wells Mills Lake	05/11/04	13:40	4.70	54.3			25.0						
Wells Mills Lake	06/10/04	12:00	4.61	55.8			26.8						
Wells Mills Lake	08/20/04	13:12	4.59	64.2			29.1						
Wells Mills Lake	09/14/04	13:45	4.91	36.8			23.7						
Wells Mills Lake	10/13/04	13:38	4.80	40.5			15.5						

Impoundment	Date	Time	pH	SC ($\mu\text{S cm}^{-1}$)	D.O. (mg L^{-1})	D.O. (%)	Temp. ($^{\circ}\text{C}$)	DOC (mg L^{-1})	NO ₂ -N (mg L^{-1})	NO ₃ -N (mg L^{-1})	PO ₄ -P (mg L^{-1})	SO ₄ -S (mg L^{-1})	Cl (mg L^{-1})
Wells Mills Lake	03/22/05	13:30	4.69	47.8			10.8						
Wells Mills Lake	04/20/05	11:50	4.77	54.1			18.9						
Wells Mills Lake	05/10/05	13:23	4.61	53.4			18.1						
Wells Mills Lake	06/14/05	11:30	4.82	51.4			28.0						
Wells Mills Lake	07/13/05	11:58	4.55	54.5			26.1						
Wells Mills Lake	08/18/05	13:25	4.88	50.4			26.2						
Wells Mills Lake	09/07/05	11:18	5.22	48.2			22.2						
Wells Mills Lake	04/19/06	11:32	4.62	47.3	9.35	97.5	17.2						
Wells Mills Lake	05/11/06	11:00	4.88	42.9	10.08	105.8	17.5						
Wells Mills Lake	06/20/06	11:54	4.90	34.3	8.74	110.3	26.5	3.9	ND	0.061	ND	0.70	7.80
Wells Mills Lake	07/20/06	11:37	4.78	38.7	9.87	101.2	27.5						
Wells Mills Lake	08/15/06	12:02	4.72	36.2	8.76	89.1	24.9	3.9	ND	ND	ND	0.64	9.46
Wells Mills Lake	09/21/06	11:43	4.67	42.8	8.92	92.7	17.8						
Wells Mills Lake	10/17/06	8:30	4.62	51.5	9.47	85.5	11.5	5.2	ND	ND	ND	0.83	8.21
Wells Mills Lake	11/21/06	11:42	4.24	48.8	9.94	142.7	8.7						
Wells Mills Lake	12/05/06	11:40	4.33	57.4	9.12	68.9	5.1	6.1	ND	ND	ND	0.96	8.20

Appendix 4. Frequency of occurrence values for plant species found at 30 impoundments in the New Jersey Pinelands. Values represent the number of plots (10 maximum) where a species was found. Biogeographic classifications are based on Stone (1911) and include restricted-native (R), widespread-native (W), and nonnative (N) categories. Unclassified species are indicated with a hyphen. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Appendix 1 for site descriptions, and Appendix 7 for sample dates.

Species	Common Name	Group I								Group II			Group III			Group IV			Group V														
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horton Lake	County Lake	Astion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake		
<u>Herbaceous plants:</u> <i>Acalypha gracilens</i> <i>Agrostis altissima</i> <i>Agrostis</i> sp. <i>Ambrosia artemisiifolia</i> <i>Amphicarpaea bracteata</i> <i>Andropogon virginicus</i> var. <i>abbreviatus</i> <i>Andropogon virginicus</i> var. <i>virginicus</i> <i>Apios americana</i> <i>Asclepias incarnata</i> <i>Aster nemoralis</i> <i>Aster novi-belgii</i> <i>Aster</i> sp. <i>Bartonia paniculata</i> <i>Bartonia virginica</i> <i>Bidens connata</i> <i>Bidens coronata</i> <i>Bidens discoidea</i> <i>Bidens</i> sp. <i>Boehmeria cylindrica</i> <i>Brasenia schreberi</i> <i>Cabomba caroliniana</i> <i>Callitriche heterophylla</i> <i>Carex albolutescens</i> <i>Carex atlantica</i> <i>Carex atlantica</i> var. <i>capillacea</i> <i>Carex bullata</i> <i>Carex comosa</i>	Biogeography	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-			
	slender three-seeded mercury	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	tall bent-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-		
	upland bent-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-		
	common ragweed	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	
	hog-peanut	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	
	bushy beard-grass	-	-	-	-	2	1	1	-	1	-	1	-	1	9	-	-	1	1	1	-	1	2	-	-	-	-	-	-	-	-	-	
	broomsedge	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	groundnut	-	-	1	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	3	-	-	
	swamp milkweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	
	bog aster	-	-	1	-	1	-	3	-	2	-	6	1	1	-	2	-	-	-	1	-	1	-	-	-	-	1	-	-	-	-	-	
	New York aster	-	-	3	-	-	-	-	-	1	4	-	3	-	1	-	-	-	4	3	1	1	4	-	1	3	4	-	1	-	-	-	-
	aster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	
	twining bartonia	W	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	yellow bartonia	W	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	purple-stemmed beggar ticks	N	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-
	northern tickseed-sunflower	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	6	1	1	-	-	-	-	-	2	-	6	-	-	-	-	-
	small beggar ticks	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	2	-	-	-	-	-	-	-
	beggar ticks	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	5	-	-	1	-	2	-	-	-	5	5	2	-	2	6	-
	false nettle	N	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	4	7	3	-
	water shield	R	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-
	fanwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	larger water starwort	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	1	-	-	-	-	-	-
	greenish-white sedge	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-
	Atlantic sedge	R	-	6	1	-	-	-	-	-	1	2	-	-	-	-	2	-	-	2	1	-	-	-	-	-	-	5	-	-	-	-	-
	Howe's sedge	W	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	button sedge	R	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-
	bottle-brush sedge	N	-	-	-	-	1	-	-	1	-	-	4	-	-	1	-	-	-	-	2	2	-	1	7	-	-	-	-	1	-	2	-

Species	Common Name	Group I							Group II			Group III			Group IV			Group V																	
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Abssegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batiso Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonon Lake				
<i>Carex</i> spp. <i>Carex crinita</i> <i>Carex exilis</i> <i>Carex folliculata</i> <i>Carex livida</i> <i>Carex lurida</i> <i>Carex pensylvanica</i> <i>Carex striata</i> <i>Carex stricta</i> <i>Carex trisperma</i>	fringed sedge	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	coast sedge	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-				
	long sedge	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	livid sedge	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-				
	salow sedge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	4	-				
	Pennsylvania sedge	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
	Walter's sedge	-	8	3	4	6	1	7	3	5	-	3	-	-	1	2	8	1	1	4	1	-	4	2	4	-	2	-	-	-	-	-			
	tussock sedge	-	-	-	-	-	-	-	-	-	2	3	-	-	-	-	6	5	-	-	-	-	2	-	-	-	-	-	-	3	-	-			
	three-fruited sedge	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	knapweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-		
<i>Cerato</i> spp. <i>Ceratophyllum echinatum</i> <i>Chasmanthium laxum</i> <i>Chrysopsis mariana</i> <i>Cinna arundinacea</i> <i>Cladium mariscoides</i> <i>Commelina communis</i> <i>Cuscuta</i> sp. <i>Cyperus dentatus</i> <i>Cyperus retrorsus</i> <i>Cyperus strigosus</i> <i>Daucus carota</i> <i>Decodon verticillatus</i> <i>Desmodium</i> sp. <i>Diodia teres</i> <i>Drosera filiformis</i> <i>Drosera intermedia</i> <i>Drosera rotundifolia</i> <i>Dulichium arundinaceum</i> <i>Echinochloa muricata</i> <i>Eclipta prostrata</i> <i>Elatine minima</i> <i>Eleocharis acicularis</i> <i>Eleocharis flavescens</i> var. <i>olivacea</i>	prickly hornwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-			
	slender spike-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-		
	Maryland golden aster	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-		
	wood-reed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	twig-rush	-	1	2	-	4	-	-	2	-	-	-	-	-	2	1	-	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	
	Asiatic dayflower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	dodder	1	-	-	1	-	-	-	-	-	-	-	-	-	3	-	1	1	1	1	4	2	3	-	3	-	6	2	2	7	1	-	-		
	toothed cyperus	-	7	-	-	-	-	-	7	-	-	-	1	-	4	7	-	1	6	-	6	6	2	2	-	2	-	1	-	3	-	-	-	-	
	Pine Barrens cyperus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	straw-colored cyperus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	3	-	-	-	
<i>Drosera</i> spp. <i>Drosera carota</i> <i>Decodon verticillatus</i> <i>Desmodium</i> sp. <i>Diodia teres</i> <i>Drosera filiformis</i> <i>Drosera intermedia</i> <i>Drosera rotundifolia</i> <i>Dulichium arundinaceum</i> <i>Echinochloa muricata</i> <i>Eclipta prostrata</i> <i>Elatine minima</i> <i>Eleocharis acicularis</i> <i>Eleocharis flavescens</i> var. <i>olivacea</i>	wild carrot	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	swamp loosestrife	-	5	-	2	-	1	1	2	2	-	9	1	7	-	1	9	4	4	2	10	5	8	1	7	8	9	3	10	4	-	-	-	-	-
	tick trefoil	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	
	buttonweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	thread-leaved sundew	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	spatulate-leaved sundew	2	7	8	4	5	1	4	2	3	-	6	1	3	5	-	-	3	-	3	-	7	2	-	-	-	1	-	-	-	-	-	-	-	
	round-leaved sundew	-	1	4	1	4	-	4	-	4	-	-	-	1	-	-	-	-	1	1	-	-	1	-	-	-	5	-	-	-	-	-	-	-	
	three-way sedge	8	8	7	2	7	1	-	9	2	-	2	3	6	9	2	1	2	5	1	-	6	1	5	2	-	1	6	4	-	-	-	-	-	-
	American barnyard grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
	false daisy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	4	1	-	-	-	
<i>Eleocharis</i> spp. <i>Eleocharis acicularis</i> <i>Eleocharis flavescens</i> var. <i>olivacea</i>	waterwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
	needle spike-rush	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	1	6	3	-	4	-	-	-	-	-	6	3	-	-	-	-	-	-
	green spike-rush	-	-	-	-	1	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-

Species	Common Name	Group I							Group II			Group III			Group IV			Group V														
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atison Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonon Lake	
<i>Eleocharis microcarpa</i>	small-fruited spike-rush	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
<i>Eleocharis ovata</i>	blunt spike-rush	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	1	5	3	-	
<i>Eleocharis palustris</i>	creeping spike-rush	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	
<i>Eleocharis robbinsii</i>	Robbin's spike-rush	R	4	3	3	8	-	8	1	-	-	-	-	7	-	-	-	3	-	-	-	-	-	-	5	1	2	-	-	1	-	
<i>Eleocharis tenuis</i>	slender spike-rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	
<i>Eleocharis tuberculosa</i>	tubercled spike-grass	R	1	1	-	5	-	-	-	-	-	-	-	-	2	-	-	-	1	4	1	-	2	1	-	-	-	-	-	-	-	
<i>Elodea nuttallii</i>	Nuttall's water-weed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Erechtites hieracifolia</i>	pilewort	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	
<i>Erigeron strigosus</i>	rough fleabane	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	
<i>Eriocaulon aquaticum</i>	seven-angled pipewort	R	9	6	7	-	-	10	-	1	-	-	10	5	-	1	-	1	-	-	-	1	-	-	-	-	-	-	-	-	4	-
<i>Eriocaulon parkeri</i>	Parker's pipewort	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eriophorum virginicum</i>	tawny cotton-grass	W	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eupatorium dubium</i>	eastern joe-pye weed	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	
<i>Eupatorium pilosum</i>	rough boneset	W	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eupatorium resinosum</i>	pine barrens boneset	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eupatorium rotundifolium</i>	round-leaved boneset	W	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Euthamia tenuifolia</i>	slender-leaved goldenrod	W	2	-	-	-	-	-	1	-	-	1	-	1	1	-	-	2	-	2	2	1	2	-	-	-	-	2	-	-	-	-
<i>Galium tinctorium</i>	stiff marsh bedstraw	N	-	-	-	-	-	-	1	-	-	-	2	-	-	-	4	4	4	-	-	-	-	6	1	1	5	4	5	5	-	-
<i>Glyceria obtusa</i>	blunt manna-grass	W	-	3	-	-	-	-	2	-	2	2	-	1	1	-	2	2	3	2	4	4	3	7	2	-	5	5	1	-	-	-
<i>Hibiscus moscheutos</i>	swamp rose mallow	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-
<i>Hypericum canadense</i>	Canada Saint John's-wort	W	-	-	-	-	-	-	-	-	1	-	3	1	-	-	-	-	1	-	-	-	3	-	-	-	2	-	-	-	-	-
<i>Hypericum mutilum</i>	dwarf Saint John's-wort	N	-	1	-	-	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	1	5	2	1	4	-
<i>Impatiens capensis</i>	spotted touch-me-not	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	-	1	3	3	-	7	-	-
<i>Iris prismatica</i>	slender blue flag	W	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Iris versicolor</i>	larger blue flag	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	-	-	-	-	-	7	-	-	-	1	-
<i>Juncus acuminatus</i>	sharp-fruited rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
<i>Juncus biflorus</i>	two-flowered rush	R	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Juncus canadensis</i>	Canada rush	W	1	-	1	-	1	3	-	-	-	2	-	3	3	-	-	6	4	4	2	1	4	4	-	-	-	4	-	-	-	-
<i>Juncus effusus</i>	common rush	W	3	5	-	-	-	-	-	6	-	1	-	4	-	-	-	5	3	-	1	-	5	6	3	1	4	5	4	1	-	-
<i>Juncus militaris</i>	bayonet rush	R	2	-	7	-	9	-	8	-	-	1	-	8	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-
<i>Juncus pelocarpus</i>	brown-fruited rush	W	7	2	3	5	-	6	4	3	-	-	5	4	9	-	-	-	5	5	-	8	3	-	1	-	1	-	-	-	-	-
<i>Juncus tenuis</i>	slender rush	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Lachnanthes caroliniana</i>	redroot	R	2	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

Species	Common Name	Group I								Group II			Group III			Group IV			Group V														
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammondon Lake		
<i>Leersia oryzoides</i>	rice cut-grass	-	2	3	1	2	-	1	6	1	4	3	6	3	6	-	3	4	4	7	6	5	4	9	4	4	8	10	4	1			
<i>Lemna</i> sp.	duckweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	5	10	-		
<i>Lepidium virginicum</i>	wild pepper-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-			
<i>Lobelia cardinalis</i>	cardinal flower	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	6			
<i>Ludwigia alternifolia</i>	seedbox	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	1	-	-		
<i>Ludwigia palustris</i>	water purslane	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	4	-	1	2	-	1		
<i>Ludwigia sphaerocarpa</i>	globe-fruited seedbox	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-		
<i>Lycopodium alopecuroides</i>	foxtail-clubmoss	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Lycopodium amplexans</i>	sessile-leaved water	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
	hoarhound	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Lycopus uniflorus</i>	northern bugleweed	-	-	3	-	-	-	-	-	5	-	1	5	1	2	-	3	-	4	10	9	-	4	9	3	1	4	3	-	1	-		
<i>Lycopus virginicus</i>	Virginia bugleweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	-	6	1	1		
<i>Lysimachia terrestris</i>	swamp loosestrife	-	-	4	1	-	-	1	1	3	-	2	5	3	6	-	3	7	5	2	1	2	1	3	1	1	3	6	3	-	1	-	
<i>Melilotus alba</i>	white sweet clover	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Microstegium vimineum</i>	stiltgrass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	2	2	-	-	-	-	5	-		
<i>Mikania scandens</i>	climbing hempweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-		
<i>Mitchella repens</i>	partridge berry	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Muhlenbergia uniflora</i>	late-flowering dropseed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Myriophyllum humile</i>	low water milfoil	10	9	2	-	-	-	-	-	5	-	-	2	6	-	10	-	8	3	-	-	-	1	3	1	-	-	1	-	-	-	-	
<i>Najas quadelupensis</i>	southern water-nymph	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5		
<i>Nuphar variegata</i>	bullhead lily	-	3	6	9	2	-	-	6	7	-	-	5	-	3	5	-	9	1	-	7	-	8	10	-	5	9	6	7	1	6		
<i>Nymphaea odorata</i>	white water lily	-	-	5	2	5	-	4	-	2	-	-	9	10	4	4	-	-	-	-	-	-	9	5	-	6	-	3	-	-	-		
<i>Nymphoides cordata</i>	floating heart	-	-	-	-	-	-	-	-	-	-	3	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Onoclea sensibilis</i>	sensitive fern	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	5	-		
<i>Orontium aquaticum</i>	golden club	-	-	-	-	-	-	-	3	1	-	7	-	4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Osmunda cinnamomea</i>	cinnamon fern	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	4	1	1	-	-	-	1	-	1	1	-	1	-	-	-	-	
<i>Oxalis</i> sp.	wood sorrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3		
<i>Oxypolis rigidior</i>	cowbane	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Panicum clandestinum</i>	deertongue grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1	4	1	-		
<i>Panicum longifolium</i>	long-leaved panic-grass	2	-	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-		
<i>Panicum</i> sp.	panic-grass	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	1	-	-	1	-	-	-	1	1	-	-		
<i>Panicum verrucosum</i>	warty panic-grass	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	5	-	-	-	-	-	-	-		
<i>Panicum virgatum</i>	switchgrass	3	7	-	-	-	-	-	1	1	1	-	-	-	4	2	1	2	-	1	3	1	3	-	-	-	-	1	-	-	-	-	
<i>Paspalum</i> sp.	bead-grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-		

Species	Common Name	Group I								Group II			Group III			Group IV			Group V													
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Aislon Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammondon Lake	
<i>Peltandra virginica</i>	arrow arum	-	-	8	4	8	-	3	1	5	-	3	7	1	3	-	-	2	-	2	3	-	3	-	-	4	-	8	-	6	2	1
<i>Phalaris arundinacea</i>	reed canary grass	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	
<i>Phragmites australis</i>	common reed	-	-	-	-	-	-	-	-	1	-	-	4	-	1	-	-	1	1	8	4	1	5	6	7	5	-	7	-	9	2	-
<i>Pilea pumila</i>	cleareweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3	-	
<i>Plantago aristata</i>	bracted plantain	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	
<i>Pogonia ophioglossoides</i>	rose pogonia	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Polygala brevifolia</i>	short-leaved milkwort	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Polygala cruciata</i>	cross-leaved milkwort	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Polygonum arifolium</i>	halberd-leaved tearthumb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-
<i>Polygonum hydropiperoides</i>	mild water pepper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	4	-	-	-	5	5	-	-	
<i>Polygonum lapathifolium</i>	dock-leaved smartweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Polygonum pensylvanicum</i>	Pennsylvania smartweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Polygonum punctatum</i>	dotted smartweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-	2	3	9	4	-	-
<i>Polygonum sagittatum</i>	arrow-leaved tearthumb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
<i>Polygonum</i> sp.	smartweed	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	7	-	5
<i>Pontederia cordata</i>	pickerel-weed	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Potamogeton confervoides</i>	alga-like pondweed	-	-	5	4	-	7	-	-	10	-	-	-	-	3	-	3	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-
<i>Potamogeton diversifolius</i>	hair-like pondweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	3	-	6	9	-	4	3	5	-	-	5	-
<i>Potamogeton epihydrus</i>	Nuttall's pondweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-
<i>Potamogeton oakesianus</i>	Oakes' pondweed	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Potamogeton pusillus</i>	small pondweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	2	-	1
<i>Potamogeton</i> sp.	pondweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Proserpinaca pectinata</i>	cut-leaved mermaid-weed	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pteridium aquilinum</i>	bracken	-	-	-	-	-	1	-	-	-	-	4	-	-	-	-	-	-	2	2	2	-	-	-	-	-	-	2	-	-	-	-
<i>Rhexia mariana</i>	Maryland meadow beauty	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
<i>Rhexia virginica</i>	Virginia meadow beauty	2	1	-	1	-	-	-	-	-	-	-	2	-	2	-	-	1	-	2	1	-	4	-	-	-	-	-	-	-	-	-
<i>Rhynchospora alba</i>	white beaked-rush	-	5	2	-	5	-	7	-	4	-	5	1	4	6	1	-	1	1	-	7	1	-	-	-	-	5	-	-	-	-	-
<i>Rhynchospora capitellata</i>	small-headed beaked-rush	-	1	2	-	2	-	-	-	-	-	-	1	-	7	-	-	-	-	2	1	-	4	-	-	-	-	-	1	-	-	-
<i>Rhynchospora chalarocephala</i>	loose-headed beaked-rush	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	3	1	-	-	-	-	1	-	-	-	-	-	-	-	-
<i>Rhynchospora macrostachya</i>	horned beaked-rush	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-
<i>Sabatia difformis</i>	lance-leaved sabatia	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sagittaria engelmanniana</i>	Engelmann's arrowhead	-	-	-	2	5	-	-	4	2	-	2	-	4	6	1	-	-	-	-	-	5	1	-	1	-	3	3	-	-	-	-
<i>Sagittaria latifolia</i>	broad-leaved arrowhead	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-

Species	Common Name	Group I								Group II			Group III			Group IV			Group V													
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake	
Biogeography	<i>Sarracenia purpurea</i>	R	-	3	5	2	5	-	1	-	1	-	3	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	
	<i>Schizachyrium scoparium</i>	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Scirpus cyperinus</i>	W	2	4	2	-	-	-	1	-	1	-	-	-	-	-	1	-	4	1	1	1	1	1	1	-	-	3	5	4	-	
	<i>Scirpus pungens</i>	W	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	
	<i>Scirpus subterminalis</i>	R	-	-	8	8	6	4	5	1	3	-	-	-	4	4	6	-	3	2	1	-	5	3	-	3	1	5	5	-	1	
	<i>Sclerolepis uniflora</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Scutellaria lateriflora</i>	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	2	1	1	-	
	<i>Solidago gigantea</i>	N	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Solidago odora</i>	W	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Solidago</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
	<i>Sorghastrum nutans</i>	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Sparganium americanum</i>	R	-	4	2	-	-	-	-	1	-	-	-	-	1	2	1	-	-	-	-	-	1	2	1	3	1	3	3	-	-	-
	<i>Thelypteris palustris</i>	N	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-	-
	<i>Triadenum virginicum</i>	W	3	5	6	4	6	-	7	3	7	4	4	9	5	8	1	7	8	7	10	6	10	9	7	4	6	8	9	5	2	4
	<i>Typha latifolia</i>	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	3	1	1	-
	<i>Utricularia cornuta</i>	R	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Utricularia fibrosa</i>	R	-	-	-	2	3	1	3	-	-	-	-	-	-	-	5	-	-	-	-	-	-	2	-	-	-	1	9	-	-	-
	<i>Utricularia inflata</i>	R	-	4	3	-	-	-	-	10	-	-	8	3	7	-	-	8	9	9	6	10	3	8	10	1	-	4	1	-	-	9
	<i>Utricularia juncea</i>	R	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-
	<i>Utricularia purpurea</i>	R	3	-	-	-	1	1	1	-	10	-	-	1	6	4	6	-	9	9	5	1	8	10	-	10	10	9	10	-	-	5
<i>Utricularia subulata</i>	R	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Verbena hastata</i>	N	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Vernonia noveboracensis</i>	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	
<i>Viola lanceolata</i>	W	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	3	-	1	-	4	4	-	5	-	-	-	-	-	10
<i>Wolffia</i> sp.	N	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Woodwardia areolata</i>	W	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Xerophyllum asphodeloides</i>																																
<i>Xyris difformis</i>	R	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Xyris smalliana</i>	R	-	-	1	-	3	-	2	1	-	-	1	-	-	5	-	-	1	-	-	-	3	-	-	-	-	-	-	-	-	-	
<i>Xyris</i> Small's yellow-eyed grass	R	-	3	-	4	-	2	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Woody plants:																																
<i>Acer rubrum</i>	R	7	8	9	9	5	2	6	5	10	9	7	8	5	5	8	8	9	10	8	10	8	4	3	4	8	8	9	8	-	7	
<i>Albizia julibrissin</i>	N	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Alnus serrulata</i>	W	-	-	4	-	-	-	-	-	1	-	-	-	-	3	-	-	-	-	2	-	-	-	-	-	-	-	5	-	1	-	2

Species	Common Name	Group I							Group II			Group III			Group IV			Group V																
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake			
Biogeography	<i>Amelanchier canadensis</i>	-	1	3	-	-	1	-	2	1	-	3	-	1	-	-	1	-	2	-	4	-	-	-	-	1	-	1	1	-	-			
	<i>Aronia arbutifolia</i>	-	1	2	6	3	3	2	-	6	3	5	1	2	-	-	5	4	3	6	2	7	1	1	-	3	-	-	4	6	-	8		
	<i>Betula populifolia</i>	1	-	1	-	1	-	-	-	1	5	-	-	-	-	-	-	4	1	2	-	-	-	1	-	-	1	-	-	-	-	-		
	<i>Cephalanthus occidentalis</i>	-	-	-	-	-	-	-	-	1	5	3	1	1	4	-	-	4	1	2	4	5	-	3	-	1	2	7	-	3	1	-	1	
	<i>Chamaecyparis thyoides</i>	-	7	10	8	9	2	9	5	9	5	8	2	4	3	10	-	6	2	4	4	4	3	-	-	-	-	5	4	-	4	-	4	
	<i>Chamaedaphne calyculata</i>	-	9	9	9	6	5	7	6	9	7	6	-	6	8	9	5	7	9	1	4	5	4	-	3	-	5	4	-	1	-	1		
	<i>Clematis terniflora</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Clethra alnifolia</i>	2	5	8	5	8	5	6	2	10	7	7	9	2	8	8	5	8	10	8	9	8	7	2	4	5	8	6	10	-	7	-	7	
	<i>Cornus florida</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	
	<i>Diospyros virginiana</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Eubotrys racemosa</i>	9	4	6	3	4	4	5	2	4	4	9	3	3	2	4	3	5	4	5	2	8	1	-	4	2	5	8	2	-	7	-	7	
	<i>Gaultheria procumbens</i>	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Gaylussacia baccata</i>	-	-	-	-	3	-	-	-	-	1	2	1	-	-	-	4	1	-	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Gaylussacia dumosa</i>	-	-	-	1	4	2	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	
	<i>Gaylussacia frondosa</i>	-	1	-	7	6	4	5	-	6	-	5	4	3	1	4	4	1	4	-	1	3	-	-	-	3	-	1	2	-	5	-	5	
	<i>Hypericum densiflorum</i>	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Ilex glabra</i>	3	2	1	6	9	4	3	-	3	1	7	2	3	1	3	1	6	3	2	3	-	-	-	-	3	1	1	-	-	4	-	4	
	<i>Ilex laevigata</i>	-	-	1	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	<i>Ilex opaca</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	
	<i>Ilex verticillata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	
<i>Itea virginica</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-		
<i>Juniperus virginiana</i>	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Kalmia angustifolia</i>	3	5	7	4	3	6	7	1	10	3	6	1	2	5	8	4	2	10	1	-	3	1	-	1	-	1	-	1	3	-	-	-		
<i>Kalmia latifolia</i>	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	7	1	5	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	
<i>Liquidambar styraciflua</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-		
<i>Lonicera japonica</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	
<i>Lyonia ligustrina</i>	-	1	3	-	1	1	-	-	4	1	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-		
<i>Lyonia mariana</i>	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
<i>Magnolia virginiana</i>	-	2	1	-	-	-	-	-	-	-	-	4	1	-	-	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-		
<i>Myrica pensylvanica</i>	-	4	2	2	-	2	5	-	2	-	3	1	-	1	-	4	1	1	2	-	3	-	-	-	-	-	-	-	-	-	1	-		
<i>Nyssa sylvatica</i>	1	2	-	2	1	-	1	-	3	2	4	4	-	-	-	-	4	5	4	-	4	4	3	-	3	1	-	2	1	-	5	-		
<i>Parthenocissus quinquefolia</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	1	1	-	4	1	-		
<i>Pinus echinata</i>	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-		

Species	Common Name	Group I								Group II			Group III			Group IV			Group V												
		Howardsville Imp.	Pilgrim Lake	Bamber Lake	Oswego Lake	Pakim Pond	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Astion Lake	Maple Lake	Batsto Lake	Success Lake	Egg Harbor City Lk.	Mimosa Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Davenport Imp.	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Lady's Lake	Jennings Lake	Indian Mills Lake	Hammonton Lake
<i>Pinus rigida</i>	pitch pine	5	3	1	8	8	1	-	1	2	5	7	3	1	2	3	4	7	5	4	8	1	1	-	1	-	1	-	-	-	3
<i>Pinus virginiana</i>	Virginia pine	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
<i>Prunus serotina</i>	black cherry	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Quercus alba</i>	white oak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
<i>Quercus ilicifolia</i>	scrub oak	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Quercus marilandica</i>	black-jack oak	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
<i>Quercus phellos</i>	willow oak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Quercus prinus</i>	chestnut oak	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	-
<i>Quercus</i> sp.	oak	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Quercus velutina</i>	black oak	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-
<i>Rhododendron viscosum</i>	swamp azalea	1	4	7	7	5	4	4	-	8	4	7	5	2	2	7	1	2	4	1	1	2	1	-	2	2	2	-	6	-	6
<i>Rhus copallina</i>	winged sumac	-	-	1	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Robinia pseudoacacia</i>	black locust	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rosa multiflora</i>	multiflora rose	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Rosa palustris</i>	swamp rose	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	5	-	-
<i>Rubus hispida</i>	swamp dewberry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	3	-	1	-	-	1	-	-	-	-	-	-
<i>Rubus</i> sp.	blackberry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-	2
<i>Salix</i> sp.	willow	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sassafras albidum</i>	sassafras	-	1	1	-	-	-	-	-	1	1	-	-	1	-	-	2	-	1	-	-	-	-	-	-	1	-	-	-	-	-
<i>Smilax glauca</i>	glaucous greenbrier	2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	1	-	-	-
<i>Smilax rotundifolia</i>	common greenbrier	-	2	-	2	-	-	-	-	1	2	2	5	2	-	-	-	-	1	4	1	3	2	-	2	-	1	4	7	-	2
<i>Spiraea</i> sp.	<i>Spiraea</i>	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Spiraea tomentosa</i>	steeplesbush	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	2	-	-	-
<i>Toxicodendron radicans</i>	poison ivy	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	1	-	-	-
<i>Vaccinium corymbosum</i>	highbush blueberry	9	5	7	8	6	4	7	3	8	4	5	5	2	6	8	7	10	8	1	7	2	5	-	3	3	6	7	5	-	5
<i>Vaccinium macrocarpon</i>	large cranberry	5	8	3	2	5	-	2	1	2	3	1	-	-	6	-	-	-	2	-	1	2	2	1	-	-	-	1	-	-	-
<i>Viburnum dentatum</i>	southern arrowwood	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Viburnum nudum</i> var. <i>nudum</i>	naked withe-rod	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-

Appendix 5. The number of diatom cells of each species collected at 20 impoundments in the New Jersey Pinelands in 2006. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group. Slides at Indian Mills Lake were heavily colonized by bryozoa and the diatom cells were largely broken. Refer to Appendix 1 for impoundment-site descriptions.

Species	Group I					Group II		Group III	Group IV		Group V										
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake	
<i>Achnanthes subatomoides</i> (Hust.) L.-B. & Archb. <i>Achnanthes</i> sp. <i>Achnanthidium exiguum</i> (Grun.) Czarn. <i>Achnanthidium minutissimum</i> (Kütz.) Czarn. <i>Actinella punctata</i> Lewis <i>Amphipleura pellucida</i> (Kütz.) Kütz. <i>Amphora ovalis</i> (Kütz.) Kütz. <i>Amphora perpusilla</i> (Grun.) Grun. <i>Asterionella ralfsii</i> W. Smith <i>Aulacoseira ambigua</i> (Grun.) Simons. <i>Aulacoseira crassipunctata</i> Krammer <i>Aulacoseira distans</i> (Ehrenb.) Simons. <i>Aulacoseira distans</i> var. <i>septentrionalis</i> Camburn and Charles <i>Aulacoseira granulata</i> (Ehr.) Simons. <i>Aulacoseira nygaardii</i> (Camburn) Camburn & Charles <i>Aulacoseira paraglabra</i> Camb. <i>Brachysira foliis</i> (Ehr.) Ross <i>Brachysira serians</i> (Brébisson ex Kützing) Round & Mann <i>Brachysira vitrea</i> (Grun.) R. Ross <i>Caloneis lewisii</i> Patr. <i>Cavinula pseudoscutiformis</i> (Hust.) Mann & Stickle <i>Chamaepinnularia mediocris</i> (Krasske) Lange-Bertalot <i>Chamaepinnularia</i> sp. <i>Cocconeis pediculus</i> Ehr. <i>Cocconeis placentula</i> Ehr. <i>Cocconeis</i> cf. <i>pseudothumensis</i> Reichardt <i>Craticula</i> sp. <i>Ctenophora pulchella</i> Breb.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	
	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	6	
	-	-	12	-	-	-	-	-	-	-	8	4	2	54	2	10	41	64	52	16	
	50	6	2	3	6	57	-	17	-	-	2	-	-	-	8	-	-	-	-	-	
	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	
	-	-	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
	16	2	27	-	3	-	2	-	52	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	
	-	-	-	-	35	174	5	12	44	6	34	-	2	13	16	2	1	-	1	2	
	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	19	-	-	-	
	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	
	-	-	-	-	66	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	18	3	-	-	-	-	4	-	2	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	
	-	2	2	2	1	-	-	-	-	-	8	6	-	2	-	-	-	-	1	-	-
	-	2	-	-	-	-	-	-	-	-	34	63	7	5	22	19	8	8	1	1	1
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	
-	-	-	-	30	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	1	20	-	59	-	-	1	1	1	4	4	-	-	10	-	1	2	24	15	-	
-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	8	

Species	Group I						Group II		Group III	Group IV		Group V								
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
<i>Cyclotella atomus</i> Hust.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Cyclotella meneghiniana</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	61
<i>Cyclotella ocellata</i> Pant.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Cymbella affinis</i> Kütz.	-	-	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella</i> cf. <i>aequalis</i> W. Sm. ex Grev.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella cuspidata</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	1	5	-	-	-	-	4	-
<i>Cymbella microcephala</i> Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Cymbella perpusilla</i> A. Cleve	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Decussata placenta</i> (Ehr.) Lange-Bert. & Metzeltin	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Diadsmis confervacea</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	1
<i>Discostella pseudostelligera</i> (Hust.) Houk & Klee	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Discostella stelligera</i> (Cleve & Grunow) Houk & Klee	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-
<i>Encyonema lunatum</i> (W. Sm.) V.H.	-	-	-	-	-	-	-	-	-	11	34	35	12	3	-	3	9	14	-	-
<i>Encyonema minutum</i> (Hilse in Rabenhorst) Mann	-	-	2	-	-	-	-	-	-	2	-	-	-	2	6	-	2	9	7	2
<i>Entomoneis ornata</i> (J. W. Bail.) Reim.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Eucocconeis flexella</i> (Kütz.) Cl.	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
<i>Eunotia bidentula</i> W. Sm.	-	30	-	6	-	1	-	1	-	-	-	-	1	-	-	-	-	-	-	-
<i>Eunotia bigibba</i> var. <i>pumila</i> Grun.	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia bilunaris</i> (Ehrenberg) Mills	3	2	-	-	-	6	167	3	-	4	-	-	2	-	1	-	-	3	27	-
<i>Eunotia carolina</i> Patr.	-	-	2	-	-	16	2	-	-	61	86	-	3	-	6	-	69	4	-	1
<i>Eunotia curvata</i> (Kütz.) Lagerst.	-	-	-	1	-	2	-	-	-	-	-	-	-	3	1	-	20	-	-	-
<i>Eunotia curvata</i> fo. <i>bergii</i> Woodhead & Tweed	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia curvata</i> var. <i>subarcuata</i> (Naegeli ex Kütz.) Woodhead & Tweed	-	1	1	3	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
<i>Eunotia denticulata</i> (Breb. ex Kütz.) Rabenh.	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia diadon</i> Ehr.	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-
<i>Eunotia exigua</i> (Brébisson ex Kützing) Rabenhorst	-	-	-	-	11	-	157	2	-	-	2	-	-	-	-	-	2	-	-	1
<i>Eunotia fallax</i> A. Cleve	4	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia flexuosa</i> Breb. ex Kütz.	33	6	-	3	1	1	1	-	2	29	48	203	82	78	-	170	3	44	-	-
<i>Eunotia formica</i> Ehr.	-	-	2	-	-	4	-	-	-	-	-	-	-	-	1	-	2	-	-	-
<i>Eunotia incisa</i> W. Sm. ex Greg.	-	-	2	53	1	-	105	2	39	-	-	5	2	17	63	21	-	36	118	3
<i>Eunotia</i> cf. <i>lapponica</i> Grun. ex A. Cleve	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Species	Group I						Group II		Group III	Group IV		Group V								
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
<i>Eunotia cf. maior</i> (Smith) Rabenhorst	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-
<i>Eunotia minor</i> (Kütz.) Grun.	-	-	-	-	-	-	-	4	1	-	3	-	-	-	-	-	-	-	-	-
<i>Eunotia naegelii</i> Migula	112	26	19	79	-	7	-	294	2	116	1	28	288	18	6	25	87	43	2	-
<i>Eunotia parallela</i> Ehr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Eunotia pectinalis</i> (O. F. Müll.) Rabh.	-	-	2	19	68	55	2	30	44	60	5	9	23	21	88	14	18	52	106	9
<i>Eunotia perpusilla</i> Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Eunotia rhomboidea</i> Hust.	-	1	3	-	6	13	10	-	-	6	8	15	-	4	7	13	33	2	1	-
<i>Eunotia serra</i> Ehr.	-	1	-	-	4	1	-	-	1	-	-	-	-	-	-	-	-	1	1	-
<i>Eunotia serra</i> var. <i>diadema</i> (Ehr.) Patr.	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	18	-	-	1
<i>Eunotia</i> sp. (coarse, only girdle views)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-
<i>Eunotia</i> sp. (fine, only girdle views)	-	4	-	-	-	-	-	-	-	-	-	16	8	-	-	-	-	-	-	1
<i>Fragilaria</i> sp.	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Fragilaria vaucheriae</i> (Kütz.) Peterson	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	2	9
<i>Fragilariaforma constricta</i> (Ehr.) Williams & Round	-	-	1	-	-	2	5	-	13	-	-	-	-	-	-	-	-	-	-	3
<i>Fragilariaforma</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<i>Frustulia amphipleuroides</i> (Grun.) Cleve-Euler	-	2	2	1	3	13	-	-	6	-	-	12	-	-	-	-	-	-	-	-
<i>Frustulia pseudomagaliesmontana</i> Camburn & Charles	-	4	7	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Frustulia rhomboides</i> (Ehr.) De Toni	3	3	3	5	-	1	1	5	4	1	3	-	2	-	-	-	2	-	1	-
<i>Frustulia crassinervia</i> (Bréb) Lange-Bertalot & Krammer	2	9	13	6	17	2	-	9	5	6	27	43	2	8	1	11	10	13	1	-
<i>Frustulia saxonica</i> Rabh.	-	4	1	9	2	2	-	8	1	3	1	32	-	-	1	3	4	-	-	-
<i>Frustulia</i> sp.	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Frustulia vulgaris</i> (Thwaites) De Toni	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
<i>Gomphonema acuminatum</i> Ehr.	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	10	16	25	-	-
<i>Gomphonema affine</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
<i>Gomphonema angustatum</i> (Kütz.) Rabenh.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Gomphonema angustatum</i> var. <i>sarcophagus</i> (Greg.) Grun.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Gomphonema gracile</i> Ehr.	-	-	2	-	-	-	-	-	-	29	2	-	1	2	-	-	1	2	10	-
<i>Gomphonema intricatum</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
<i>Gomphonema parvulum</i> (Kütz.) Kütz.	-	-	-	-	-	-	-	-	-	14	17	8	3	8	14	5	5	2	55	13
<i>Gomphonema subclavatum</i> (Grun.) Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1
<i>Gomphonema truncatum</i> Ehr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-

Species	Group I					Group II		Group III	Group IV		Group V									
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
<i>Gomphonema variostriatum</i> Camburn & Charles	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-	-	-	-
<i>Gomphonema</i> sp.	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	8	1	-
<i>Hantzschia amphioxys</i> Eh.	-	2	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Hippodonta hungarica</i> (Grunow) Lange-Bert	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2
<i>Kobayasiella</i> sp.	-	1	9	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Lennicola hungarica</i> (Grun.) Round & Basson	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43
<i>Melosira arentii</i> (Kolbe) Nagumo & Kobayasi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Melosira varians</i> Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<i>Meridion circulare</i> (Grev.) C.Agardh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-
<i>Navicula cryptocephala</i> Kütz.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Navicula cryptotenella</i> Lange-Bert. ex Krammer et Lange-Bert.	-	-	1	-	-	-	-	-	-	2	-	1	-	2	-	-	27	-	2	2
<i>Navicula</i> cf. <i>leptostriata</i> Jorgensen	-	-	-	1	-	-	-	3	-	-	8	26	-	3	-	2	-	-	-	-
<i>Navicula notha</i> Wallace	-	-	-	2	-	-	-	-	-	-	-	-	-	7	-	-	-	6	-	-
<i>Navicula radiosa</i> var. <i>parva</i> Wallace	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
<i>Navicula</i> sp.	1	-	1	-	2	-	1	-	-	-	-	-	-	-	5	1	-	-	-	7
<i>Neidium affine</i> (Ehr.) Pfitz.	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
<i>Neidium ampliatum</i> (Ehr.) Krammer	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Neidium ladogensense</i> var. <i>densestriatum</i> (Østrup) Foged	-	-	-	-	-	8	4	3	-	-	-	-	-	-	-	-	-	-	-	-
<i>Neidium saccoense</i> Reim.	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-	-	-
<i>Neidium</i> sp.	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nitzschia acicularis</i> (Kütz.) W. Sm.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
<i>Nitzschia amphibia</i> Grun.	-	-	-	-	-	-	6	4	-	-	-	-	-	-	-	-	-	-	3	17
<i>Nitzschia</i> cf. <i>vitrea</i> Norman	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Nitzschia frustulum</i> (Kütz.) Grun.	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
<i>Nitzschia</i> cf. <i>frustulum</i> var. <i>bulnheimiana</i> (Rabenh.) Grunow	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Nitzschia microcephala</i> Grun.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
<i>Nitzschia palea</i> (Kütz.) W. Sm.	-	-	-	-	-	-	24	-	-	6	-	-	-	-	2	-	-	-	4	8
<i>Nitzschia paleacea</i> (Grun. in Cleve & Grun.) Grun.	-	-	-	-	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	-
<i>Nitzschia recta</i> Hantzsch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Nitzschia scalaris</i> (Ehr.)W. Smith	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
<i>Nitzschia</i> sp.	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1	-	-	-	4	5

Species	Group I					Group II		Group III	Group IV		Group V									
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
<i>Nupela</i> sp.	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Opephora</i> sp.	-	-	2	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
<i>Peronia heribaudi</i> Brun and Per.	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	-
<i>Pinnularia abaujensis</i> (Pant.) R. Ross	-	-	2	-	-	7	-	-	-	-	-	-	-	-	2	-	-	-	-	-
<i>Pinnularia biceps</i> Greg.	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia brauniana</i> (Grun.) Mills	-	-	1	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia</i> cf. <i>divergentissima</i> (Grun.) Cl.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	2	-	-	-	-
<i>Pinnularia microstauron</i> (Ehr.) Cl.	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia microstauron</i> var. <i>adironackensis</i> Camburn & Charles	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia pulchella</i> (Boyer) Krammer	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
<i>Pinnularia rupestris</i> Hantz.	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia subanglica</i> Krammer	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Pinnularia subcapitata</i> Greg.	-	-	-	-	3	12	-	5	3	-	6	-	-	-	-	-	-	2	-	-
<i>Pinnularia</i> sp. (girdle view)	-	-	1	-	-	2	-	2	-	-	-	-	-	-	2	-	-	-	-	-
<i>Placoneis exigua</i> (Greg. ex Grun.) Meresch.	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Placoneis gastrum</i> (Ehrenberg) Meresch.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Planothidium dubium</i> (Grunow) Round & Bukht.	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Planothidium lanceolatum</i> (Bréb.) Lange-Bert.	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
<i>Pseudostaurosira brevisiriata</i> (Grun.) Williams & Round	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	55
<i>Rhoicosphenia curvata</i> (Kütz.) Grunow	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-
<i>Rossethidium pusillum</i> (Grun.) Round & Bukhtiyarova	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-
<i>Sellaphora laevisima</i> (Kütz.) Mann	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Sellaphora pupula</i> (Kütz.) Mer.	-	-	2	-	-	-	-	-	-	-	2	-	-	-	13	-	4	-	-	7
<i>Sellaphora rectangularis</i> (W.Greg.) Lange-Bert. & Metzeltin	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cf. <i>Sellaphora seminulum</i> (Grun.) D. Mann	-	-	2	-	4	8	-	1	-	1	-	-	-	-	-	-	-	-	-	15
<i>Semiorbis hemicyclus</i> (Ehrenb.) Patr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Stauroforma exiguiformis</i> (Lange-Bert.) Flower, Jones & Round	-	-	-	-	-	-	-	-	-	-	-	-	2	3	1	136	-	109	-	2
<i>Stauroforma</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-
<i>Stauroneis anceps</i> Ehr.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Stauroneis livingstonii</i> Reim	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
<i>Stauroneis phoenicenteron</i> (Nitz.) Ehr.	-	-	2	-	-	-	-	-	-	1	1	-	-	-	1	-	2	-	-	-

Species	Group I						Group II	Group III	Group IV		Group V									
	Pilgrim Lake	Bamber Lake	Lake Absegami	Wells Mills Lake	Chatsworth Lake	Horicon Lake	Country Lake	Atsion Lake	Success Lake	Lake Fred	Kettle Run Imp.	Lake Albert	Cushman Lake	Turn Mill Pond	Shadow Lake	Paradise Lake	Sunset Lake	Cranes Lake	Jennings Lake	Indian Mills Lake
<i>Stauroneis smithii</i> var. <i>incisa</i> Pant.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
<i>Staurosira construens</i> Ehr.	-	-	85	-	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-	-
<i>Staurosira construens</i> var. <i>venter</i> (Ehr.) Hamilton	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	5	-	-	-
<i>Staurosirella pinnata</i> var. <i>lancettula</i> (Schumann) Siver & Hamilton	-	-	75	-	4	-	-	-	-	-	33	-	26	83	33	-	59	-	3	1
<i>Staurosirella pinnata</i> (Ehrenberg) Williams & Round	-	-	27	-	-	-	-	-	-	4	-	-	-	6	-	-	5	-	3	-
<i>Stenopterobia curvula</i> (W. Sm.) Kram.	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	2	-	-	-
<i>Stenopterobia delicatissima</i> (Lewis) Bréb. ex Van H.	-	4	-	-	3	-	-	2	2	2	-	-	-	-	-	-	-	-	-	-
<i>Stenopterobia delicatissima</i> (Lewis) Bréb. ex Van H.	-	-	-	-	-	-	-	1	-	-	10	18	2	-	-	-	-	-	-	-
<i>Stenopterobia densestriata</i> (Hust.) Krammer	-	-	-	-	-	-	-	1	4	2	-	-	-	-	-	-	2	-	-	-
<i>Stenopterobia</i> sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
<i>Surirella angustata</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Surirella linearis</i> W. Sm.	-	-	2	-	6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Synedra</i> cf. <i>famelica</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	1	-
<i>Synedra radians</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	1	-
<i>Synedra rumpens</i> Kütz.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-
<i>Synedra rumpens</i> var. <i>fragilarioides</i> Grunow in Van Heurck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	142
<i>Synedra ulna</i> (Nitzsch) Ehr.	-	-	8	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	27	21
<i>Tabellaria binialis</i> (Ehr.) Grun. in Van Heurck	-	-	9	1	25	15	-	5	35	1	-	-	-	5	-	-	-	-	-	-
<i>Tabellaria flocculosa</i> (Roth.) Kütz.	-	5	-	1	-	-	-	-	2	22	12	18	4	57	140	45	6	3	-	7
<i>Tabellaria quadrisepiata</i> Knudson	276	375	97	264	155	74	-	66	218	24	17	1	14	36	39	16	4	4	-	-
Total number of diatom cells counted	500	500	504	500	500	500	500	500	500	500	500	500	500	500	500	500	500	508	500	506

Appendix 6. Fish-abundance values for individual sample plots at 30 impoundments in the New Jersey Pinelands. Impoundments and species are ordered alphabetically. Refer to Table 11 for fish common names and Appendix 1 for impoundment-site descriptions.

Impoundment	Plot	<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Ameiurus nebulosus</i>	<i>Anguilla rostrata</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus gloriosus</i>	<i>Enneacanthus obesus</i>	<i>Enneacanthus species</i>	<i>Erimyzon oblongus</i>	<i>Esox niger</i>	<i>Esox species</i>	<i>Etheostoma fusiforme</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Lepomis species</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chryssoleucas</i>	<i>Noturus gyrinus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>	<i>Umbra pygmaea</i>	Total	
Atsion Lake	1	-	1	-	-	-	1	-	-	-	4	-	-	4	-	-	-	-	-	-	-	-	-	-	10	
	2	-	1	-	2	-	1	1	-	1	-	-	-	2	-	2	-	2	-	-	-	-	-	-	12	
	3	-	-	-	-	-	9	1	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	17	
	4	-	-	-	-	-	-	-	-	-	-	1	-	5	-	1	-	-	-	-	-	-	-	-	7	
	5	-	2	-	-	1	10	2	-	1	-	-	-	5	-	-	-	-	-	-	-	-	-	-	21	
	6	-	1	-	-	-	3	3	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	10	
	7	-	-	-	-	-	1	-	-	-	-	2	-	3	-	-	-	-	-	-	-	-	-	-	6	
	8	-	1	-	-	-	-	4	2	1	4	1	-	5	-	-	-	-	-	-	-	-	-	-	18	
	9	-	-	-	-	1	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	8	
	10	-	1	-	-	-	6	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	8	
Bamber Lake	1	-	-	-	-	-	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	21
	2	1	2	-	-	-	-	-	9	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	21	36
	3	-	1	-	-	1	1	-	10	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	4	22
	4	-	-	-	-	-	-	-	4	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	1	8
	5	-	-	-	-	2	11	-	20	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	3	39
	6	-	-	-	-	-	1	-	3	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	8
	7	1	-	-	-	2	5	-	7	4	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	22
	8	-	-	-	-	1	2	-	3	2	-	1	-	3	-	-	-	-	-	-	-	-	-	-	-	12
	9	-	-	-	-	1	-	-	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	5
	10	1	-	-	-	1	1	-	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Batsto Lake	1	-	-	-	-	-	21	2	3	3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	32
	2	-	-	-	-	-	22	1	-	4	-	-	-	2	-	1	-	-	5	-	-	-	-	-	-	35
	3	-	-	-	1	-	5	1	-	1	-	4	-	-	-	-	-	1	-	-	-	-	-	-	-	13
	4	-	-	-	-	-	11	2	-	2	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	17
	5	-	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	8
	6	-	-	-	-	1	30	2	1	1	-	4	-	3	-	-	-	-	-	-	-	-	-	-	-	42
	7	-	-	-	-	-	14	9	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	25
	8	-	-	-	-	-	25	5	-	2	-	2	-	1	-	-	-	1	-	-	-	-	-	-	-	36
	9	-	-	-	1	-	25	-	-	2	-	1	-	3	-	-	-	1	-	-	-	-	-	-	-	33
	10	-	-	-	-	-	11	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Chatsworth Lake	1	-	-	-	-	-	1	-	3	1	-	-	-	38	-	-	-	-	-	-	-	-	-	-	-	43
	2	-	2	-	-	1	21	1	8	16	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	55
	3	-	-	-	-	-	6	-	7	2	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	25
	4	-	-	-	-	-	13	-	9	5	-	-	-	27	-	-	-	-	-	-	-	-	-	-	-	54
	5	-	-	-	-	-	19	2	14	3	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	41
	6	-	-	-	-	-	7	-	1	-	-	1	-	4	-	-	-	-	-	-	-	-	-	-	-	13
	7	-	-	-	-	1	34	5	9	7	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	58
	8	-	-	-	-	-	5	-	-	1	-	-	-	14	-	-	-	-	-	-	-	-	-	-	-	20
	9	-	-	-	-	-	2	-	-	2	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	9
	10	-	1	-	-	-	11	1	-	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	18
Country Lake	1	-	-	-	-	-	6	-	-	-	-	-	-	9	-	-	-	-	1	-	-	-	-	-	-	16
	2	1	-	-	-	-	2	-	1	2	-	-	-	8	-	-	-	1	-	-	-	-	-	-	-	15
	3	2	3	1	-	-	3	-	10	11	-	-	-	6	-	-	-	1	-	-	-	-	-	-	-	37
	4	-	-	-	-	-	-	-	-	5	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	9
	5	-	1	1	-	-	4	-	-	4	-	1	-	3	-	-	-	-	-	-	-	1	-	-	15	
	6	-	-	1	-	-	-	-	1	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	7
	7	8	5	-	-	2	5	-	16	87	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	124
	8	1	8	12	-	4	-	-	14	85	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	127

Impoundment	Plot	<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Ameiurus nebulosus</i>	<i>Anguilla rostrata</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus gloriosus</i>	<i>Enneacanthus obesus</i>	<i>Enneacanthus species</i>	<i>Erinyzon oblongus</i>	<i>Esox niger</i>	<i>Esox species</i>	<i>Etheostoma fusiforme</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Lepomis species</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chryssoleucas</i>	<i>Noturus gyrinus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>	<i>Umbra pygmaea</i>	Total
Crane Lake	9	7	4	2	-	-	5	-	12	24	-	1	-	-	-	3	-	-	-	-	-	-	-	-	58
	10	4	4	102	-	-	-	-	3	4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	118
	1	-	-	4	-	-	-	5	-	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	13
	2	-	-	1	-	-	-	9	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	11
	3	-	1	4	-	-	-	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	10
	4	1	1	3	-	-	-	9	-	-	-	3	-	-	-	-	-	-	1	-	-	-	-	-	18
	5	-	-	-	-	-	-	1	-	-	-	1	-	-	-	2	-	-	1	-	-	-	-	-	5
	6	-	-	2	-	-	-	2	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	7
	7	-	-	-	-	-	-	15	-	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-	18
	8	-	-	1	-	1	-	3	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	7
	9	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	1	-	2	-	-	-	-	-	6
	10	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	5	-	-	-	-	-	7
Davenport Imp.	1	-	3	-	-	-	-	-	24	5	-	-	-	-	-	-	-	-	-	-	-	-	-	1	33
	2	-	1	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	3	-	-	-	-	1	15
	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	3
	4	-	-	-	-	-	-	-	1	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	8
	5	-	1	-	-	-	-	-	10	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	15
	6	-	-	-	-	-	-	-	1	-	-	-	-	-	-	4	1	1	1	-	-	-	-	-	8
	7	-	-	-	-	-	-	-	2	1	-	-	-	-	-	2	4	1	1	-	-	-	-	-	11
	8	-	-	-	-	-	-	-	2	9	-	-	-	-	-	-	1	-	-	-	-	-	-	-	12
	9	-	-	-	-	-	-	-	2	4	1	1	-	-	-	-	2	-	2	-	-	-	-	-	12
	10	-	2	-	-	1	-	-	2	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-	9
Egg Harbor City Lake	1	1	6	-	-	-	1	-	6	7	-	1	-	2	-	-	-	-	-	-	-	-	-	-	24
	2	-	-	-	-	1	11	1	4	2	-	1	-	1	-	-	-	-	-	-	-	-	-	-	21
	3	-	2	-	-	1	5	-	5	4	-	1	-	2	-	-	-	-	-	-	-	-	-	-	20
	4	1	-	-	-	-	3	-	-	4	-	-	-	4	-	-	-	-	-	-	-	-	-	-	12
	5	-	1	-	-	-	5	-	6	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	17
	6	3	-	-	-	-	19	-	6	4	-	2	-	3	-	-	-	-	-	-	-	-	-	-	37
	7	-	-	-	-	-	14	1	3	1	-	2	-	1	-	-	-	-	-	-	-	-	-	-	22
	8	1	1	-	-	1	5	1	6	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	20
	9	-	2	-	-	2	7	-	11	4	-	3	-	-	-	-	-	-	-	-	-	-	-	-	29
	10	-	1	-	-	1	1	-	7	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	12
Hammonton Lake	1	-	-	-	-	-	-	1	-	1	-	-	-	3	-	-	2	44	3	18	-	2	-	-	74
	2	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1	2	45	-	30	-	-	-	-	80
	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-	5	1	27	-	-	-	-	-	-	35
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	37	3	1	-	-	-	-	43
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	25	1	-	-	-	-	-	27
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	27	-	20	-	1	1	-	50
	8	-	-	-	-	-	-	5	-	1	-	1	-	4	-	-	-	27	1	6	-	1	-	-	46
	9	-	-	-	-	-	-	2	-	-	-	-	-	-	-	20	10	5	3	-	-	-	-	-	40
	10	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	23	1	3	-	-	1	-	29
Horicon Lake	1	-	-	-	-	-	2	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
	2	-	-	-	-	-	7	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	3	-	-	-	-	-	17	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21
	4	-	1	-	-	2	22	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35
	5	-	1	-	-	9	12	-	10	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35
	6	-	-	-	-	-	7	-	5	-	-	2	-	2	-	-	-	-	-	-	-	-	-	-	16
	7	1	1	-	-	2	17	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
	8	-	-	-	-	6	5	-	17	2	3	1	-	19	-	-	-	-	-	-	-	-	-	5	58
	9	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	4

Impoundment	Plot	<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Ameiurus nebulosus</i>	<i>Anguilla rostrata</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus gloriosus</i>	<i>Enneacanthus obesus</i>	<i>Enneacanthus species</i>	<i>Erinyzon oblongus</i>	<i>Esox niger</i>	<i>Esox species</i>	<i>Etheostoma fusiforme</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Lepomis species</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chryssoleucas</i>	<i>Noturus gyrinus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>	<i>Umbra pygmaea</i>	Total
	10	-	-	-	-	1	14	-	11	4	-	1	-	1	-	-	-	-	-	-	-	-	-	-	32
Howardsville Imp.	1	-	-	-	-	-	-	-	26	-	-	-	-	41	-	-	-	-	-	-	-	-	-	-	67
	2	-	-	-	-	-	5	-	21	1	-	-	-	14	-	-	-	-	-	-	-	-	-	11	52
	3	-	-	-	-	-	2	-	28	3	-	1	-	3	-	-	-	-	-	-	-	-	-	1	38
	4	-	-	-	-	-	-	-	6	-	-	-	-	3	-	-	-	-	-	-	-	-	-	2	11
	5	-	-	-	-	-	-	-	14	-	-	-	-	6	-	-	-	-	-	-	-	-	-	1	21
	6	-	-	-	-	-	-	-	4	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	5
	7	-	-	-	-	-	7	-	28	3	-	-	-	6	-	-	-	-	-	-	-	-	-	1	45
	8	-	-	-	-	-	2	-	18	1	-	1	-	7	-	-	-	-	-	-	-	-	-	2	31
	9	-	-	-	-	-	4	-	36	4	-	-	1	1	-	-	-	-	-	-	-	-	-	1	47
	10	-	-	-	-	-	1	-	21	-	-	-	-	4	-	-	-	-	-	-	-	-	-	7	33
Indian Mills Lake	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	2	6	-	-	-	-	-	-	10
	2	-	-	-	1	-	-	-	-	-	1	-	-	3	-	2	1	12	-	-	-	-	-	-	20
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	10	58	-	-	-	-	-	-	75
	4	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	2	13	-	-	-	-	-	-	19
	5	-	-	-	-	-	-	-	-	-	-	-	-	6	-	3	2	1	-	-	-	-	-	-	12
	6	-	-	-	-	-	-	-	-	-	-	-	-	1	-	9	5	26	-	-	-	-	-	1	42
	7	-	-	-	-	3	-	-	-	-	1	-	-	5	-	5	38	67	-	-	-	-	-	2	121
	8	-	-	1	-	3	-	-	-	-	-	-	-	10	-	-	25	116	-	-	-	-	-	-	155
	9	-	-	-	-	2	-	-	-	-	-	-	-	7	-	1	28	33	5	-	-	-	-	-	76
	10	-	-	1	-	1	-	-	-	-	-	-	-	16	-	1	9	65	1	-	-	-	-	-	94
Cushman Lake	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	3	7	31	-	-	-	-	1	-	43
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	8	-	-	-	-	-	-	21
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	24	41	-	-	1	-	-	-	72
	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	9	63	24	1	-	-	1	-	-	100
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	56	77	-	-	1	-	-	-	143
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	15	20	-	-	-	-	-	-	37
	7	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	10	23	-	-	-	-	-	-	37
	8	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	8	25	2	2	-	-	-	-	39
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	5	16	-	-	-	-	-	-	-	-	21
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	4	-	-	-	-	1	-	7
Jennings Lake	1	-	-	-	-	-	-	24	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	27
	2	-	-	-	-	-	-	19	-	-	-	3	-	-	-	-	-	-	1	-	-	-	-	-	23
	3	-	-	-	-	-	-	6	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	8
	4	-	-	-	-	-	-	4	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	6
	5	-	-	-	-	1	-	7	-	2	-	2	1	-	-	-	-	-	-	-	1	-	-	3	17
	6	-	-	-	-	-	-	24	-	-	1	1	-	-	-	-	3	-	3	-	-	-	-	-	32
	7	-	-	1	-	-	-	33	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	2	39
	8	-	-	-	-	-	-	4	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	5
	9	-	-	-	-	-	-	11	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	14
	10	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	4
Kettle Run Imp.	1	-	-	-	-	-	6	-	6	-	-	-	-	3	-	-	5	-	1	-	-	-	-	3	24
	2	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	6
	3	-	-	-	-	-	2	-	3	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	9
	4	-	-	-	-	-	3	-	1	1	-	-	-	7	-	1	3	-	-	-	-	-	-	1	17
	5	1	-	-	-	-	18	-	-	3	-	-	-	2	-	-	1	-	-	-	-	-	-	-	25
	6	-	-	-	-	-	1	-	-	3	-	-	-	3	-	-	1	-	1	-	-	-	1	-	10
	7	-	1	-	-	-	-	8	5	-	-	-	-	4	-	-	-	-	-	-	-	-	-	1	19
	8	-	-	-	-	-	1	-	-	-	-	-	-	4	-	2	-	-	-	-	-	-	-	-	7
	9	-	-	-	-	-	16	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	1	20
	10	-	-	-	-	-	17	-	3	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	24

Impoundment	Plot	<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Ameiurus nebulosus</i>	<i>Anguilla rostrata</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus gloriosus</i>	<i>Enneacanthus obesus</i>	<i>Enneacanthus species</i>	<i>Erinyzon oblongus</i>	<i>Esox niger</i>	<i>Esox species</i>	<i>Etheostoma fusiforme</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Lepomis species</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chryssoleucas</i>	<i>Noturus gyrinus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>	<i>Umbra pygmaea</i>	Total
Lady's Lake	1	-	-	-	-	-	22	-	4	4	-	1	-	-	-	1	-	-	1	-	-	-	-	-	33
	2	-	1	-	-	-	15	-	5	2	1	1	-	-	-	-	-	-	5	4	-	-	-	1	35
	3	-	-	-	-	-	16	-	5	1	-	1	-	-	-	-	-	-	3	-	-	-	-	-	26
	4	-	-	-	-	-	21	-	8	3	-	4	-	2	-	-	-	-	1	-	-	-	-	-	39
	5	-	-	-	-	-	5	-	1	2	-	3	-	2	-	-	3	-	-	-	-	-	-	-	16
	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	7	2	-	-	-	-	-	11
	7	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	1	3	3	-	-	-	-	-	11
	8	-	-	-	-	-	3	-	1	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	9
	9	-	-	-	-	-	23	-	5	1	1	1	-	-	-	-	2	-	-	-	-	-	-	-	33
	10	-	-	-	-	-	6	-	2	1	-	3	-	-	-	-	-	-	-	-	-	-	-	-	12
Lake Absegami	1	-	-	-	-	-	-	-	10	6	-	3	-	-	-	-	-	-	-	-	-	-	-	-	19
	2	-	-	-	-	-	-	-	12	15	1	-	-	7	-	-	-	-	-	-	-	-	-	-	35
	3	-	-	-	-	-	-	-	2	-	-	1	-	3	-	-	-	-	-	-	-	-	-	-	6
	4	-	-	-	-	-	-	-	1	-	-	1	-	15	-	-	-	-	-	-	-	-	-	-	17
	5	-	-	-	-	-	-	-	-	-	-	1	-	14	-	-	-	-	-	-	-	-	-	-	15
	6	-	-	-	-	-	-	-	1	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	5
	7	-	-	-	-	-	-	-	15	8	-	-	-	13	-	-	-	-	-	-	-	-	-	-	36
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	20
	10	-	-	-	-	-	-	-	1	-	-	-	-	26	-	-	-	-	-	-	-	-	-	1	28
Lake Albert	1	-	-	-	-	-	1	1	1	-	-	-	-	17	-	14	3	40	-	-	-	-	-	-	77
	2	-	-	-	-	-	1	-	-	-	-	1	-	7	-	2	3	11	-	-	-	-	-	-	25
	3	-	-	-	-	1	1	2	-	-	-	3	-	-	-	1	23	26	-	-	-	-	-	-	57
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	3	-	-	-	-	-	-	6
	5	-	-	-	-	-	2	3	-	-	-	-	-	1	-	9	20	41	-	-	-	-	-	-	76
	6	-	-	-	-	-	1	-	-	-	-	-	-	4	-	7	22	7	-	-	-	-	-	-	41
	7	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	6	135	1	-	-	-	-	-	144
	8	-	-	-	-	-	1	-	-	-	-	-	-	2	-	20	25	8	-	-	-	-	-	-	56
	9	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	24	289	-	-	-	-	-	-	314
	10	1	-	-	-	-	13	1	-	-	-	-	-	8	-	-	-	25	-	-	-	-	-	-	48
Lake Fred	1	-	-	3	-	-	1	-	38	1	-	1	-	-	-	-	-	1	-	-	-	-	-	4	49
	2	-	1	-	-	-	29	-	11	4	-	-	-	1	-	-	-	1	-	-	-	-	-	3	50
	3	-	-	1	-	-	-	-	8	7	-	-	-	-	-	-	-	2	-	-	-	-	-	6	24
	4	-	-	-	-	-	-	-	5	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
	5	-	-	-	-	-	2	-	2	-	-	-	-	-	-	1	-	-	17	-	-	-	-	-	22
	6	-	-	-	-	-	17	-	13	5	-	-	-	4	-	-	-	4	-	-	-	-	-	-	43
	7	-	6	2	-	-	148	-	26	1	-	1	-	2	-	1	1	-	-	-	-	-	-	9	197
	8	-	-	-	-	-	1	-	5	-	-	3	-	3	-	1	-	2	-	-	-	-	-	-	15
	9	-	-	-	-	-	14	-	14	10	-	-	-	1	-	-	-	1	-	-	-	-	-	3	43
	10	-	1	-	-	-	32	-	12	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	48
Maple Lake	1	-	-	-	-	-	-	7	-	2	-	-	-	-	-	-	4	31	-	-	-	-	-	4	48
	2	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	2	17	1	-	-	-	-	3	24
	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	4	18	-	-	-	-	-	-	23
	4	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	6	27	1	-	-	-	-	2	38
	5	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	102	33	2	-	-	-	-	2	142
	6	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	10	1	1	-	-	-	-	-	13
	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	8	2	-	-	-	-	-	14
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	16	-	-	-	-	-	-	24
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	-	-	24
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	9	-	-	-	-	-	-	-	12
Mimosa Lake	1	-	1	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	5

Impoundment	Plot	<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Ameiurus nebulosus</i>	<i>Anguilla rostrata</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus gloriosus</i>	<i>Enneacanthus obesus</i>	<i>Enneacanthus species</i>	<i>Erinnyzoon oblongus</i>	<i>Esox niger</i>	<i>Esox species</i>	<i>Etheostoma fusiforme</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Lepomis species</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chryssoleucas</i>	<i>Noturus gyrinus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>	<i>Umbra pygmaea</i>	Total
	2	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	6	-	-	-	-	-	8
	3	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	-	-	-	-	-	6
	4	-	-	-	-	-	2	-	-	-	-	-	-	1	-	1	2	-	3	-	-	-	-	-	9
	5	-	-	-	-	-	4	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	7
	6	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	-	-	7	-	-	-	-	-	10
	7	-	-	-	-	-	-	-	2	-	-	-	-	14	-	-	-	-	2	-	-	-	-	-	18
	8	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	5
	9	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	5
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	5	-	-	-	1	-	9
Oswego Lake	1	-	-	-	-	-	3	-	-	1	3	-	-	7	-	-	-	-	-	-	-	-	-	-	14
	2	-	1	-	-	-	1	-	1	-	27	-	-	3	-	-	-	-	-	-	-	-	-	-	33
	3	-	4	-	-	-	-	-	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11
	4	-	-	-	-	-	2	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	4
	5	-	1	-	-	-	2	-	2	2	17	1	-	4	-	-	-	-	-	-	-	-	-	-	29
	6	-	-	-	-	-	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
	7	-	-	-	-	-	5	9	3	3	32	-	-	17	-	-	-	-	-	-	-	-	-	-	69
	8	-	-	-	-	-	13	13	5	3	6	1	-	3	-	-	-	-	-	-	-	-	-	-	44
	9	-	1	-	-	-	10	4	5	2	4	-	-	1	-	-	-	-	-	-	-	-	-	1	28
	10	-	-	-	-	-	3	2	2	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	10
Pakim Pond	1	-	-	-	-	-	-	-	15	4	-	1	-	-	-	-	-	-	-	-	-	-	-	-	20
	2	-	-	-	-	-	-	-	7	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
	3	-	-	-	-	-	-	-	5	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
	4	-	-	-	-	-	-	-	13	5	-	1	-	-	-	-	-	-	-	-	-	-	-	2	21
	5	-	-	-	-	-	-	-	6	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12
	6	-	-	-	-	-	-	-	9	13	-	1	-	-	-	-	-	-	-	-	-	-	-	-	23
	7	-	-	-	-	-	-	-	7	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	13
	8	-	-	-	-	-	-	-	4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
	9	-	-	-	-	-	-	-	4	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	8
	10	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Paradise Lake	1	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	1	-	1	-	-	-	-	-	5
	2	-	-	-	-	-	-	-	-	-	16	3	-	-	-	-	-	1	-	-	-	-	-	-	20
	3	-	-	-	-	-	2	1	-	1	5	1	-	-	-	-	15	-	2	-	-	-	-	-	27
	4	-	-	-	-	-	6	3	1	-	5	1	-	-	-	-	7	-	1	-	-	-	-	-	24
	5	-	-	-	-	-	5	1	-	-	9	3	-	-	-	-	2	-	-	-	-	-	-	-	20
	6	-	-	-	-	-	1	7	-	-	2	5	-	3	-	-	1	-	-	-	-	-	-	-	19
	7	-	-	-	-	-	23	-	4	-	2	2	-	-	-	-	-	-	-	-	1	-	-	4	36
	8	-	-	-	-	-	12	1	6	-	10	4	-	-	-	-	-	-	-	-	-	-	-	-	33
	9	-	-	-	-	-	2	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	6
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pilgrim Lake	1	-	1	-	-	-	7	3	7	-	16	-	-	4	-	-	-	-	-	-	-	-	-	1	39
	2	-	-	-	-	-	8	1	8	4	21	-	-	1	-	-	-	-	-	-	-	-	-	2	45
	3	-	1	-	-	-	11	1	10	5	2	1	-	-	-	-	-	-	-	-	-	-	-	4	35
	4	-	2	-	1	-	11	-	6	7	2	-	-	-	-	-	-	-	-	-	-	-	-	5	34
	5	-	1	-	-	-	5	-	4	6	5	1	-	1	-	-	-	-	-	-	-	-	-	4	27
	6	-	2	-	-	-	6	2	7	5	-	1	-	-	-	-	-	-	-	-	-	-	-	-	23
	7	-	1	-	-	-	12	1	3	3	-	1	-	1	-	-	-	-	-	-	-	-	-	-	22
	8	-	1	-	-	-	1	2	6	1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	13
	9	-	1	-	1	-	1	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	7
	10	-	2	-	-	-	2	3	3	9	-	1	-	-	-	-	-	-	-	-	-	-	-	1	21
Shadow Lake	1	1	2	-	-	1	-	-	3	3	1	-	-	4	-	1	-	-	-	-	-	-	-	-	16
	2	-	-	-	-	-	-	-	17	3	3	-	-	6	-	-	1	-	-	-	-	-	-	4	34

Impoundment	Plot	<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Ameiurus nebulosus</i>	<i>Anguilla rostrata</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus gloriosus</i>	<i>Enneacanthus obesus</i>	<i>Enneacanthus species</i>	<i>Erinyzon oblongus</i>	<i>Esox niger</i>	<i>Esox species</i>	<i>Etheostoma fusiforme</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Lepomis species</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chrysoleucas</i>	<i>Noturus gyrinus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>	<i>Umbra pygmaea</i>	Total
	3	1	-	-	-	4	-	-	3	3	-	1	-	-	-	-	1	-	-	-	-	-	-	-	13
	4	-	-	-	-	-	-	-	-	5	1	-	-	10	-	-	-	-	-	-	-	-	-	-	16
	5	1	-	-	-	1	-	-	10	1	7	1	-	17	-	-	-	-	-	-	-	-	-	-	38
	6	1	-	-	-	2	-	-	6	4	1	1	-	8	-	-	-	-	-	-	-	-	-	-	23
	7	-	-	-	-	2	-	-	6	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	13
	8	1	-	-	-	-	-	-	3	-	3	1	-	6	-	-	1	-	-	-	-	-	-	-	15
	9	-	-	-	-	-	-	-	5	3	-	1	-	-	-	1	1	-	-	-	-	-	-	-	11
	10	-	-	-	-	2	-	-	7	8	1	2	-	2	-	-	-	-	-	-	-	-	-	-	22
Success Lake	1	-	2	-	-	2	-	10	10	8	-	1	-	-	-	-	-	-	-	-	-	-	-	-	33
	2	-	1	-	-	1	-	4	3	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	12
	3	-	1	-	-	9	-	5	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20
	4	-	5	-	-	3	-	9	25	11	-	-	-	3	-	-	-	-	-	-	-	-	-	3	59
	5	-	2	-	-	-	-	1	3	4	-	1	-	7	-	-	-	-	-	-	-	-	-	-	18
	6	1	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	17
	7	-	1	-	-	3	-	18	19	1	-	2	-	6	-	-	-	-	-	-	-	-	-	3	53
	8	-	2	-	-	1	-	3	6	7	-	-	-	4	-	-	-	-	-	-	-	-	-	-	23
	9	-	-	-	-	1	-	5	9	6	-	-	-	1	-	-	-	-	-	-	-	-	-	-	22
	10	-	2	-	-	-	-	4	22	20	-	1	-	1	-	-	-	-	-	-	-	-	-	-	50
Sunset Lake	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	1	-	-	-	-	-	4
	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	3	-	-	-	-	-	5
	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	8
	4	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
	5	-	-	-	-	-	-	-	2	1	-	1	-	-	-	-	-	-	4	2	-	-	-	-	10
	6	-	-	-	-	2	-	-	4	1	-	-	-	-	-	-	-	-	1	-	-	-	-	3	11
	7	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	2	-	-	-	-	-	6
	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	6	-	-	-	-	-	7
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	-	-	-	-	3
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	6	-	-	-	-	-	-	7
Turn Mill Pond	1	-	-	-	-	-	-	-	-	2	-	-	-	1	-	-	3	13	-	-	-	-	-	-	19
	2	-	-	-	-	-	-	-	-	7	-	-	-	4	1	-	-	3	2	-	1	-	-	-	18
	3	-	-	-	-	-	-	-	-	4	-	-	-	10	1	-	-	18	1	-	-	-	-	-	34
	4	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	16	-	-	-	-	-	-	19
	5	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	9	-	-	-	-	-	-	-	11
	6	-	-	-	-	-	-	6	-	1	-	1	-	2	1	-	1	4	2	-	1	-	-	-	19
	7	-	-	-	-	-	-	-	-	3	-	1	-	1	-	-	14	2	-	-	-	-	-	-	21
	8	-	1	-	-	-	-	-	-	1	-	1	-	1	3	-	2	3	-	-	-	-	-	-	12
	9	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	3	10	1	-	-	-	-	-	15
	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	11	-	-	-	-	-	-	13
Wells Mills Lake	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	3
	2	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
	3	3	-	-	-	1	-	-	9	9	-	1	-	-	-	-	-	-	-	-	-	-	-	6	29
	4	1	-	-	-	-	-	-	2	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
	5	-	1	-	-	-	-	-	4	10	-	4	-	-	-	-	-	-	-	-	-	-	-	1	20
	6	-	3	-	-	1	-	-	2	10	6	-	-	-	-	-	-	-	-	-	-	-	-	1	23
	7	1	4	-	-	-	-	-	5	1	2	1	-	-	-	-	-	-	3	-	-	-	-	-	17
	8	-	1	-	-	1	-	-	3	5	6	1	-	-	-	-	-	-	1	-	-	-	-	-	18
	9	-	-	-	-	-	-	-	5	2	-	1	-	-	-	-	-	-	-	-	-	-	-	1	9
	10	-	-	-	-	-	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7

Appendix 7. Frequency of occurrence values for fish species collected from 30 impoundments in the New Jersey Pinelands. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Table 2 for explanation of biogeographic classifications, Table 11 for fish common names, and Appendix 1 for site descriptions.

Impoundment	Survey Date	Land-use Group	Restricted-native Species						Widespread-native Species						Nonnative Species							
			<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus obesus</i>	<i>Etheostoma fusiforme</i>	<i>Anguilla rostrata</i>	<i>Enneacanthus gloriosus</i>	<i>Erismyzon oblongus</i>	<i>Esox niger</i>	<i>Noturus gyrinus</i>	<i>Umbra pygmaea</i>	<i>Ameiurus nebulosus</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chrysolaus</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>
Howardsville Imp.	07/08/04	I	-	-	-	6	10	10	-	-	-	2	-	8	-	-	-	-	-	-	-	-
Pilgrim Lake	08/03/05	I	-	9	-	10	10	4	2	7	5	7	-	7	-	-	-	-	-	-	-	-
Bamber Lake	10/02/03	I	3	2	6	7	10	5	-	-	1	7	-	5	-	-	-	-	-	-	-	-
Oswego Lake	07/21/04	I	-	4	-	9	8	8	-	4	7	3	-	1	-	-	-	-	-	-	-	-
Pakim Pond	08/11/04	I	-	-	-	-	10	-	-	-	-	5	-	1	-	-	-	-	-	-	-	-
Lake Absegami	09/30/04	I	-	-	-	-	7	8	-	-	1	4	-	1	-	-	-	-	-	-	-	-
Wells Mills Lake	09/07/05	I	3	4	4	-	9	-	-	-	3	5	-	5	-	-	-	-	2	-	-	-
Chatsworth Lake	09/09/04	I	-	2	2	10	7	9	-	4	-	3	-	-	-	-	-	-	-	-	-	-
Horicon Lake	10/03/03	I	1	3	5	9	9	4	-	1	1	3	-	1	-	-	-	-	-	-	-	-
Country Lake	07/13/05	I	6	6	2	6	7	9	-	-	-	2	-	-	6	-	1	-	1	-	1	-
Atsion Lake	08/12/04	II	-	6	2	7	2	8	1	5	4	4	-	-	-	-	2	-	-	-	-	-
Maple Lake	09/21/05	II	-	-	-	-	-	-	-	6	-	-	-	4	-	-	-	9	5	-	-	-
Batsto Lake	08/24/05	II	-	-	1	10	2	5	2	7	1	8	-	-	-	-	1	-	7	-	-	-
Success Lake	09/05/03	II	1	8	7	-	10	6	-	9	-	4	-	3	-	-	-	-	1	-	-	-
Egg Harbor City Lake	09/14/05	III	4	6	5	10	9	8	-	3	-	9	-	-	-	-	-	-	-	-	-	-
Mimosa Lake	08/19/05	III	-	4	-	3	1	9	-	-	-	-	-	-	-	-	2	2	8	-	-	1
Lake Fred	07/22/04	III	-	3	-	8	10	5	-	-	-	3	-	6	3	-	3	1	7	-	-	-
Kettle Run Imp.	09/15/04	III	1	1	-	9	6	10	-	-	-	-	-	6	-	-	2	4	3	-	-	1
Lake Albert	09/16/04	IV	1	-	1	7	1	8	-	4	-	2	-	-	-	-	7	9	1	-	-	-
Cushman Lake	08/26/04	IV	-	-	-	-	-	1	-	4	-	-	2	-	-	1	8	9	2	1	1	2
Davenport Imp.	08/17/05	IV	-	4	1	-	9	2	-	-	3	1	-	2	-	-	2	5	6	-	-	-
Turn Mill Pond	09/11/03	IV	-	1	-	-	-	9	-	2	-	4	2	-	-	4	-	6	5	-	-	-
Shadow Lake	09/22/04	V	5	1	6	-	9	8	-	-	7	6	-	1	-	-	2	4	-	-	-	-
Paradise Lake	09/02/04	V	-	-	1	7	4	1	-	4	8	9	1	1	-	-	-	3	1	2	-	-
Sunset Lake	07/20/05	V	-	-	1	-	2	1	-	-	-	3	-	1	-	-	3	2	9	1	-	-
Crane Lake	07/21/05	V	1	2	1	-	-	1	-	9	1	6	-	-	6	-	3	3	8	-	-	-
Lady's Lake	08/04/04	V	-	1	-	9	8	2	-	-	2	7	-	1	-	-	1	5	6	1	-	-
Jennings Lake	08/05/04	V	-	-	1	-	-	-	-	10	1	8	3	3	1	-	-	3	2	-	-	-
Indian Mills Lake	07/28/04	V	-	-	4	-	-	8	1	-	3	-	-	2	2	-	9	10	2	-	-	-
Hammonton Lake	07/29/04	V	-	-	-	-	-	3	-	5	-	2	-	-	-	-	3	8	6	6	3	2
Overall			10	18	17	16	23	26	4	16	15	25	4	19	5	2	15	16	19	5	3	4

Appendix 8. Mean relative-abundance values for fish species collected from 30 stream impoundments in the New Jersey Pinelands. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Table 2 for explanation of biogeographic classifications, Table 11 for fish common names, and Appendix 1 for site descriptions.

Impoundment	Survey Date	Land-use Group	Restricted-native Species						Widespread-native Species						Nonnative Species							
			<i>Acantharchus pomotis</i>	<i>Ameiurus natalis</i>	<i>Aphredoderus sayanus</i>	<i>Enneacanthus chaetodon</i>	<i>Enneacanthus obesus</i>	<i>Etheostoma fusiforme</i>	<i>Anguilla rostrata</i>	<i>Enneacanthus gloriosus</i>	<i>Erimyzon oblongus</i>	<i>Esox niger</i>	<i>Noturus gyrinus</i>	<i>Umbra pygmaea</i>	<i>Ameiurus nebulosus</i>	<i>Fundulus diaphanus</i>	<i>Lepomis gibbosus</i>	<i>Lepomis macrochirus</i>	<i>Micropterus salmoides</i>	<i>Notemigonus chrysoleucas</i>	<i>Perca flavescens</i>	<i>Pomoxis nigromaculatus</i>
Howardsville Imp.	07/08/04	I	-	-	-	5.1	63.7	22.5	-	-	-	0.6	-	8.0	-	-	-	-	-	-	-	-
Pilgrim Lake	08/03/05	I	-	7.6	-	27.7	27.5	2.3	2.0	7.2	13.0	5.2	-	7.5	-	-	-	-	-	-	-	-
Bamber Lake	10/02/03	I	2.3	1.1	6.6	11.8	38.6	16.2	-	-	0.5	6.8	-	16.1	-	-	-	-	-	-	-	-
Oswego Lake	07/21/04	I	-	6.1	-	27.5	13.3	16.0	-	8.1	27.1	1.6	-	0.4	-	-	-	-	-	-	-	-
Pakim Pond	08/11/04	I	-	-	-	-	93.3	-	-	-	-	5.5	-	1.3	-	-	-	-	-	-	-	-
Lake Absegami	09/30/04	I	-	-	-	-	28.1	65.1	-	-	0.6	5.8	-	0.4	-	-	-	-	-	-	-	-
Wells Mills Lake	09/07/05	I	5.5	6.6	7.0	-	49.3	-	-	-	10.5	7.3	-	11.2	-	-	-	-	2.6	-	-	-
Chatsworth Lake	09/09/04	I	-	1.2	0.5	41.3	13.9	39.0	-	2.5	-	1.7	-	-	-	-	-	-	-	-	-	-
Horicon Lake	10/03/03	I	0.4	1.0	5.7	45.6	28.0	15.0	-	1.0	0.5	1.8	-	0.9	-	-	-	-	-	-	-	-
Country Lake	07/13/05	I	6.4	6.9	1.5	13.1	17.7	35.6	-	-	-	1.2	-	-	15.1	-	0.9	-	0.6	-	0.9	-
Atsion Lake	08/12/04	II	-	5.9	1.8	24.6	2.2	29.2	2.2	8.1	16.1	6.4	-	-	-	-	3.7	-	-	-	-	-
Maple Lake	09/21/05	II	-	-	-	-	-	-	-	11.3	-	-	-	10.2	-	-	-	71.0	7.5	-	-	-
Batsto Lake	08/24/05	II	-	-	0.2	70.8	1.3	3.3	1.2	8.7	0.4	8.4	-	-	-	-	0.3	-	5.3	-	-	-
Success Lake	09/05/03	II	0.6	7.0	9.9	-	41.2	10.2	-	23.5	-	1.8	-	4.7	-	-	-	-	1.0	-	-	-
Egg Harbor City Lake	09/14/05	III	3.3	7.7	3.4	35.6	29.8	10.8	-	1.6	-	7.9	-	-	-	-	-	-	-	-	-	-
Mimosa Lake	08/19/05	III	-	8.9	-	11.9	1.1	30.2	-	-	-	-	-	-	-	-	3.1	5.6	38.0	-	-	1.1
Lake Fred	07/22/04	III	-	0.7	-	31.3	40.9	3.7	-	-	-	2.3	-	6.6	1.3	-	1.2	0.1	12.0	-	-	-
Kettle Run Imp.	09/15/04	III	0.5	0.7	-	39.4	13.9	25.5	-	-	-	-	-	7.0	-	-	3.5	5.8	2.3	-	-	1.4
Lake Albert	09/16/04	IV	0.4	-	0.3	8.0	0.3	17.6	-	2.2	-	1.7	-	-	-	-	17.7	50.7	1.1	-	-	-
Cushman Lake	08/26/04	IV	-	-	-	-	-	0.7	-	3.2	-	-	0.5	-	-	2.4	20.5	65.4	1.6	1.4	0.1	4.2
Davenport Imp.	08/17/05	IV	-	5.7	1.7	-	42.1	8.8	-	-	3.8	1.3	-	1.0	-	-	8.2	17.3	10.1	-	-	-
Turn Mill Pond	09/11/03	IV	-	1.3	-	-	-	31.3	-	7.6	-	9.5	2.0	-	-	6.5	-	30.0	11.8	-	-	-
Shadow Lake	09/22/04	V	3.2	1.5	9.1	-	34.5	32.2	-	-	7.8	5.1	-	1.3	-	-	2.0	3.2	-	-	-	-
Paradise Lake	09/02/04	V	-	-	0.6	27.7	6.1	1.8	-	3.9	29.7	20.0	0.3	1.2	-	-	-	3.9	2.2	2.7	-	-
Sunset Lake	07/20/05	V	-	-	2.0	-	6.2	6.7	-	-	-	16.1	-	3.0	-	-	5.9	7.0	50.8	2.2	-	-
Crane Lake	07/21/05	V	0.6	1.6	1.4	-	-	2.9	-	40.2	0.6	7.8	-	-	13.9	-	8.8	3.7	18.7	-	-	-
Lady's Lake	08/04/04	V	-	0.3	-	49.3	12.5	2.0	-	-	0.6	7.3	-	0.3	-	-	0.3	14.0	12.1	1.2	-	-
Jennings Lake	08/05/04	V	-	-	0.7	-	-	-	-	75.6	0.3	11.6	3.7	3.0	0.3	-	-	3.3	1.4	-	-	-
Indian Mills Lake	07/28/04	V	-	-	2.1	-	-	23.8	1.3	-	3.9	-	-	1.0	0.6	-	22.3	43.5	1.5	-	-	-
Hammonton Lake	07/29/04	V	-	-	-	-	-	5.8	-	5.6	-	0.8	-	-	-	-	12.3	24.1	14.1	33.5	1.7	2.1

Appendix 9. Anuran-abundance values for 30 impoundments in the New Jersey Pinelands. Abundance values represent the number of vocalizing adults up to a maximum of ten individuals. For carpenter frogs and bullfrogs, shaded values indicate that larvae were present. Weather codes are 0 = clear, 1 = cloudy, 2 = overcast, 3 = fog/haze, 4 = breezy, 5 = drizzle, 6 = constant rain, 7 = showers, 8 = thunder storm occurred within one hour, and 9 = thunderstorm. Impoundments are ordered by increasing percentage of altered land within each land-use group. Refer to Table 1 for the range of altered-land percentages assigned to each group, Table 2 for explanation of biogeographic classifications, and Appendix 1 for impoundment-site descriptions.

Impoundment	Land-use Group	Survey Date	Time	Weather	Air Temp. (deg. C)	Relative Humidity (%)	Restricted-native Species		Widespread-native Species			Nonnative Species	
							<i>Hyla andersonii</i> (Pine Barrens treefrog)	<i>Rana virgatipes</i> (carpenter frog)	<i>Bufo woodhousii fowleri</i> (Fowler's toad)	<i>Rana clamitans melanota</i> (green frog)	<i>Rana utricularia</i> (southern leopard frog)	<i>Acris c. crepitans</i> (northern cricket frog)	<i>Rana catesbeiana</i> (bullfrog)
Howardsville Imp.	I	06/14/05	11:10 PM	0	23.5	86.5	3	10	-	10	1	-	1
Pilgrim Lake	I	06/05/05	11:23 PM	0	21.0	90.0	-	10	2	2	-	-	-
Bamber Lake	I	06/14/05	10:33 PM	0	26.0	76.5	3	10	5	3	-	-	1
Oswego Lake	I	06/05/05	9:32 PM	0	22.5	82.5	-	10	3	-	-	-	-
Pakim Pond	I	06/05/05	9:30 PM	0	22.5	82.5	-	10	7	1	-	-	-
Lake Absegami	I	06/05/05	11:40 PM	0	20.5	90.0	4	6	4	1	3	-	-
Wells Mills Lake	I	06/14/05	11:40 PM	0,4	27.0	78.0	-	-	2	10	-	-	-
Chatsworth Lake	I	06/05/05	9:53 PM	0	22.0	82.5	-	6	3	2	-	-	-
Horicon Lake	I	06/14/05	9:55 PM	0	27.5	70.5	-	10	5	-	-	-	1
Country Lake	I	06/05/05	8:43 PM	0	25.0	76.5	-	-	2	-	-	-	-
Atsion Lake	II	06/09/05	9:05 PM	1,4	24.5	84.0	-	3	4	3	-	-	-
Maple Lake	II	06/07/05	10:25 PM	0	22.0	90.5	-	-	2	8	-	-	8
Batsto Lake	II	06/05/05	12:10 AM	0	20.5	90.0	-	10	2	1	-	-	1
Success Lake	II	06/14/05	9:25 PM	0	27.0	70.5	-	10	6	2	-	-	-
Egg Harbor City Lake	III	06/07/05	9:25 PM	0,4	25.5	74.0	-	10	2	4	2	-	1
Mimosa Lake	III	06/28/05	9:07 PM	2,4	24.5	84.0	-	-	1	5	-	-	2
Lake Fred	III	06/07/05	9:40 PM	0	25.5	76.5	-	-	5	-	1	-	4
Kettle Run Imp.	III	06/09/05	11:15 PM	0,4	24.0	84.0	-	8	-	10	1	-	-
Lake Albert	IV	06/07/05	11:25 PM	0,4	24.0	80.0	-	-	-	3	-	-	3
Cushman Lake	IV	06/07/05	11:40 PM	0,4	24.5	76.5	-	-	5	1	-	-	2
Davenport Imp.	IV	06/14/05	10:20 PM	0	28.0	71.0	-	10	-	-	-	-	3
Turn Mill Pond	IV	06/14/05	9:00 PM	0	27.0	70.5	-	-	6	5	-	-	3
Shadow Lake	V	06/09/05	9:35 PM	1,4	24.0	84.0	-	-	-	6	-	-	2
Paradise Lake	V	06/05/05	12:50 AM	0	20.0	90.0	-	4	2	4	-	-	7
Sunset Lake	V	06/07/05	12:25 AM	0	23.0	86.5	-	-	1	-	-	-	5
Crane Lake	V	06/07/05	12:10 AM	0	23.0	86.5	-	4	2	4	-	10	6
Lady's Lake	V	06/09/05	10:10 PM	1	23.5	84.0	-	-	3	4	-	-	4
Jennings Lake	V	06/09/05	11:40 PM	0,4	23.5	86.5	-	-	-	10	-	-	9
Indian Mills Lake	V	06/09/05	9:18 PM	1,4	24.5	80.0	-	-	-	3	-	-	4
Hammonton Lake	V	06/07/05	1:05 AM	0	23.0	88.0	-	-	-	-	-	2	4

