

New York State Water Quality Assessment

Clean Lakes Assessment

According to the best available estimates, New York State has 7,650 ponded bodies of water (lakes, ponds, reservoirs, etc.) covering a surface area of over 790,000 acres (not including Lakes Ontario and Erie, which collectively cover more than 3,000,000 acres within New York's borders alone). For this assessment, New York State considers lakes, ponds and reservoirs included in the current state indexing system as "significant" waters. The reporting system in New York State does not distinguish between what might be defined as private versus public lakes, since all of the waters of the state are considered public (public versus private status is usually conferred upon issues of access, not ownership of the waters themselves). As such, this report will consider all sampled waters to be significant publicly owned and subject to assessment in this document. The assessment has been conducted on a total of 1,931 different significant water bodies representing 516,200 acres of surface area (not including Lake Ontario); about 75 percent of these waters are located in the Adirondack Region of the state. This statewide total represents a larger number than reported in 1996, since more than 45 previously unsampled lakes are included in this report.

The characterization of trophic status has been conducted using total phosphorus, chlorophyll *a*, and Secchi transparency, along with true color to distinguish waters which are stained or "colored" from organic material and have low transparency. True, or soluble, color of the water is a surrogate of organic material in the water and should be included in the evaluation since phosphorus associated with the organic material is unavailable for uptake by organisms but is contained in the total phosphorus results reported from water quality analysis.

About 54 percent (1047) of the total (1,931) waters in which trophic indicators and color were measured had true color values less than or equal to 30 mg/l platinum color units, comprising a surface area of 428,560 acres. These waters were classified into trophic state using total phosphorus and Secchi transparency. There were 227 waters classified as eutrophic based on total phosphorus, 163 waters classified as eutrophic based on Secchi transparency, and 143 waters classified as eutrophic based on chlorophyll *a*. Chlorophyll *a* was not very useful in this analysis since relatively few waters (only about 30 percent of the 1,931 assessed) had chlorophyll *a* data available.

Only 165 of the 884 waters with true color values greater than 30 mg/l Pt could be classified into trophic state, using available chlorophyll *a* data (color readings have not been obtained for the balance of the assessed waters (80)). Based on this criterion, 9 waters were oligotrophic, 81 waters were mesotrophic and 75 waters were eutrophic.

Acidity status was assessed using midsummer pH of the surface water. Waters are considered impaired if pH is < 5.0, threatened if pH is ≥ 5.0 and ≤ 6.0 , and acceptable if pH is > 6.0. A total of 1,978 waters in New York State, including 1,376 waters through the Adirondack Lake Survey Corporation study, were assessed for acidity. There were 363 ponded waters impaired, 316 waters threatened, and 1299 waters had acceptable conditions. The waters impaired by acidity represent less than two percent of the total surface area included in the current assessment.

Significant Waters and the Lakes Inventory

New York State uses an indexing system to identify ponded waters within the state. The pond number, or *P-#*, is the number that has been assigned to a specific ponded water by the NYSDEC in Part 800 of its *Codes, Rules and Regulations*.⁷ These rules and regulations pertain to Article 15 of the New York State Environmental Conservation Law.⁸ With reference to the *Guidelines for the Preparation of the 1990 State Water Quality Assessment (305(b) Report)*,⁹ New York State defines "significant" waters as those lakes, ponds and reservoirs that are included in the indexing system at the present time.

Although New York State has over 7,600 ponded waters within its boundaries, not all of these waters are indexed and included in the state inventory at the present time, and the exact number of ponded waters is not known. Surface area is one fundamental limitation that precludes certain waters within the state from being included in the inventory since waters below a certain size will not appear on USGS topographic maps. The Division of Water has regularly updated the *Codes, Rules and Regulations* to reclassify some waters and add many of the ponded waters that are not indexed.

A partial inventory of state waters is included in *Characteristics of New York State Lakes; Gazetteer of Lakes, Ponds and Reservoirs*, 3rd Edition (1987), which lists nearly 3,500 ponded waters that have surface areas greater than 6.4 acres, appear on USGS 7.5 minute topographic maps, are named and indexed. The 6.4 acre, or 0.01 square mile, surface area was the minimum size included in the previous gazetteer by Greeson and Robinson¹⁰ and has remained the minimum ponded water acreage in all recent updates. A summary of different categories of ponded waters within the state with reference to the current inventory process is presented below.

Table B-1			
Categories of Ponded Waters in New York State			
Number of Lakes/Ponds	Lake/Pond Characteristics		
	Size/Surface Area	Included in Inventory	Named Lake/Pond
135	Greater than 500 acres	yes	yes
2,911	6.4 to 500 acres	yes	yes and no
832	less than 6.4 acres	yes	yes and no
3770 (est)	less than 6.4 acres	no	yes and no

The total number of lake waterbodies in the state is currently estimated to be 7,849 representing a total cumulative surface area estimated to be over 790,000 acres (not including Lakes Ontario and Erie).

Lake Assessment Methods

⁷ State of New York. 1984. Official Compilation of Codes, Rules and Regulations. Title 6, Volumes A-F, New York State Department of State.

⁸ State Of New York. 1984. Environmental Conservation Law of New York. Volumes 1-11, New York State Department of State.

⁹ United States Environmental Protection Agency. 1997. Guidelines for the Preparation of the State Water Quality Assessment (305(b) Report) and Electronic Updates. Assessment and Watershed Protection Division (4503F), Washington, D.C.

¹⁰ Greeson, P. E. and F. L. Robinson. 1970. Characteristics of New York State Lakes. Part I. Gazetteer of Lakes, Ponds and Reservoirs. Bulletin 68, U. S. Geological Survey and N. Y. S. Department of Environmental Conservation. 124 p.

The data that were used to prepare this lake assessment were compiled from several local, State and Federal sources. Samples included in the current assessment were collected between 1982 and 2007. The 1982 cutoff corresponds with a previous lake water quality assessment report submitted to USEPA by New York State (Mikol, 1983), as well as a distinct 25 year interval. The sources of data in the present report are the Adirondack Lake Survey (NYS Department of Environmental Conservation and Empire State Electric Energy Research Corporation, 1984 through 1987), the Eastern Lake Survey (USEPA, 1984) which was Phase IA of the National Surface Water Survey, the Lake Classification and Inventory Project (NYSDEC, 1982 through 1991, and beginning again in 1996 until the present day), the Citizens' Statewide Lake Assessment Program (NYSDEC, 1986 through the present), the Water Quality Surveillance Network (NYSDEC, 1982 to 1986), the Rensselaer County Water Quality Program (1990), the Adirondack Effects Assessment Program (AEAP; Rensselaer Polytechnic Institute, NYSDEC, and other institutions, 1994-present) and various Clean Lakes Projects and special studies. Water quality data for approximately 150 lakes throughout the state were also collected by the USEPA and USFWS through the Environmental Monitoring and Assessment Program (EMAP)-Surface Water and TIME (Temporally Integrated Monitoring of Ecosystems) programs (1991 through 1996), but these data have only been released for individual lakes through 1993; all later data cannot be included in this assessment. Systematic monitoring of the eleven Finger Lakes was commenced in 1996 by the NYSDEC Lake Services Section and Upstate Freshwater Institute, and continues through the present. All of the data were collected and analyzed using USEPA approved quality assurance - quality control protocols. Except for several of the Clean Lakes Projects and the Rensselaer County data, all laboratory analyses were conducted by either NYSDEC or New York State Department of Health laboratories prior to 1998. Beginning in 1998, analyses were performed by either one or more contract laboratories (for sampling conducted for the LCI, Finger Lakes, and AEAP programs, and CSLAP after 2000) or the NYS Department of Health (CSLAP prior to 2002).

All data were obtained from the original sources in computer compatible form and were entered into a database using Microsoft Excel, running on an Dell Pentium computer. Although the full database contains information on a wide variety of water quality measurements, the present draft of this report has been restricted to a summary of parameters related to trophic classification and acidity status, unless otherwise noted.

The data were coded with a single character to identify the source. The codes were *L* (NYSDEC Lake Classification and Inventory), *C* (Citizens' Statewide Lake Assessment Program), *B* (NYSDEC Biota Survey), *W* (NYSDEC Water Quality Surveillance Network), *A* (Adirondack Lake Survey Corporation), *E* (USEPA Eastern Lake Survey), *R* (Rensselaer County), *T* (TIME and USEPA/USFWS EMAP Program), *P* (RPI/NYSDEC/etc. Adirondack Effects Assessment program), *F* (Finger Lakes study), and *S* (Special studies). An *M* (multiple source) indicates that more than one program collected information on the ponded water.

Certain identifying information has been presented for most of the lakes and ponds in the data summary including the name of the water body, the index number (*Pond No.*) which consists of the watershed number and the pond number, the surface area (*Surf. Area*) in hectares (ha), the current water quality classification (*W.Q.Class.*), and the county code (*County*) for the location of the water body.

The water quality data summary was produced using **EXCEL** to calculate average or median values for the various parameters included in the assessment. The data summary represents samples that were collected during midsummer from the upper portion of the water column (sample depth ≤ 3 m). Data summaries were prepared for the following parameters: Secchi depth (*Secchi*, in meters), trophic state based upon Secchi (*Secchi T.S.*), chlorophyll *a* (*Chl a*, in $\mu\text{g/l}$), trophic state based upon Chlorophyll *a* (*Chl a T.S.*), total phosphorus (*TotP*, in mg/l), trophic state based upon total phosphorus (*TotP T.S.*), pH (*pH*, in standard

units), pH status (*pH Status*), acid neutraling capacity (*ANC*, in $\mu\text{eq/l}$), true color (*True Color*, in mg Pt units/l), and the source of the data (*Code*). For lakes from which samples were collected over several years or programs, reported averages correspond to the summer mean values from all programs averaged over the number of years sampled. Although median values may be used for some calculations, unless otherwise noted, all calculations for central tendency are based on sample mean.

The USEPA Eastern Lakes Survey (ELS) data collected on 240 ponded waters were not incorporated into the calculation of average values for the data summary since the ELS field sampling was conducted during the fall, not midsummer, of 1984. As a result, significant differences occurred in the values of certain parameters collected from the same ponded water by one source during midsummer and by the ELS during the fall.

Lake Trophic Status

The current assessment has employed the traditional classification of trophic status, i.e., oligotrophy, mesotrophy and eutrophy, as a framework for water quality assessment by using the values and ranges for transparency, total phosphorus and chlorophyll *a* outlined in Table 8.

Table B-2			
Assessment Criteria for Lake Trophic Status			
Parameter	Oligotrophic	Mesotrophic	Eutrophic
Transparency (m)	> 5	2 - 5	< 2
Total Phosphorus ($\mu\text{g/l}$)	< 10	10 - 20	> 20
Chlorophyll <i>a</i> ($\mu\text{g/l}$)	< 2	2 - 8	> 8

The values and ranges of values generally agree with trophic status criteria that are reported in the literature, although the ranges for chlorophyll *a* are somewhat lower than have been used in historical versions of this report. The present report will highlight any apparent discrepancies or “trends” that are actually the result of the shift in reporting ranges. New York State has not adopted a statistical definition related to the categories hypereutrophic or dystrophic; therefore, these categories are not included here.

Classification of trophic status using traditional criteria has very limited application in certain regions of New York State, however. In the Adirondacks and Catskills, for example, transparency is not a good indicator for all water bodies since many waters are stained or "colored" and have low transparency from humic and fulvic acids. The presence of these compounds in the water indicates the incomplete microbial decomposition of the organic compounds of green plants and does not necessarily relate to productivity. True, or soluble, color of the water is a surrogate of this organic material and should be included in the evaluation of trophic status since phosphorus associated with organic material in the water is unavailable for uptake by organisms but is a portion of the total phosphorus analyzed in water samples. Information presented in Table 9 from an analysis of trophic status in the Adirondacks¹¹ illustrates the significance of adding true color to the classification of trophic status. The results are total phosphorus and true color analyses for 1469 Adirondack waters that were sampled by the ALSC between 1984 and 1987.

¹¹Sutherland, J. W., S. A. Kishbaugh, J. A. Bloomfield, W. T. Lavery, and F. E. VanAlstyne. 1990. Water Resources and Water Quality in the Adirondack Park. Issue Paper #5e in Volume II, Technical Reports, Commission on the Adirondacks in the Twenty-first Century. Division of Water, NYSDEC, Albany, N.Y. 141 p.

Just over 50 percent (730) of the Adirondack waters surveyed had high color imparted by organic material, and most of these waters had moderate to high levels of unavailable phosphorus associated with the organic material and part of the total phosphorus fraction. The balance (638) of the waters surveyed are clear, and can be separated into trophic categories, based on phosphorus concentration, as shown in Table 10.

Table B-3 True Color as Indicator of Trophic Status in the Adirondacks and Catskills				
True Color	Total Phosphorus			Total Lakes/Ponds
	<10	10 - 20	> 20	
≤ 30	314	225	99	638
> 30	76	296	358	730
Total Lakes/Ponds	390 (29%)	521 (38%)	457 (33%)	1,368

As shown in the tables, evaluating the trophic status of Adirondack waters without consideration of true color would lead to 33 percent (457) of the waters being categorized as eutrophic instead of 15 percent (99) of the waters.

Table B-4 Lake Trophic Status for “Clear” Waters (True Color > 30)			
	Oligotrophic	Mesotrophic	Eutrophic
Total Phosphorus (µg/l)	< 10	10 - 20	> 20
Total Lakes/Ponds	314 (49%)	225 (35%)	99 (15%)

Since about 75 percent of the water bodies included on the current water quality assessment list for New York State are within the Adirondack Region, true color has been incorporated into the current analysis of trophic status as an indicator of organic material (and associated phosphorus). Adding this information allows clearwater lakes and ponds (true color ≤ 30 mg Pt/l, or simply 30 Pt/l) to be distinguished from waters with a visible stained appearance (true color > 30 mg Pt/l). In ponded waters with visible color (true color > 30 mg Pt/l), the Secchi depth was not included in the evaluation of trophic condition. If a value for true color was not available then the soluble organic carbon (SOC) value was used instead. If the SOC was greater than 7.0 mg/l, the Secchi was not used to assess trophic status. Both true color and SOC typically are used to characterize the level of yellow organic (humic and fulvic) acids.

There is one other limitation in the current assessment that must be mentioned. Chlorophyll *a*, although a

good indicator of trophic state, was not very useful in the current analysis since relatively few waters (only 30 percent of the 1,931 assessed for trophic indicators) had any chlorophyll *a* data. Most of the water quality data for this assessment were collected by the ALSC during the Adirondack survey, 1984 through 1987, and chlorophyll *a* was not one of the parameters sampled in this program.

The results of the current assessment of trophic status of significant waterbodies are presented in Table 11 and show number of waters and surface area in acres (in brackets) for each category (these area data do not include Lake Ontario).

If it is assumed that an equivalent percentage (in the assessed database) of unassessed lake numbers and lake areas possess color readings less than 30 Pt_u, then trophic conditions in weakly colored waters are not known for approximately 3200 lakes comprising an area of 230,000 acres.

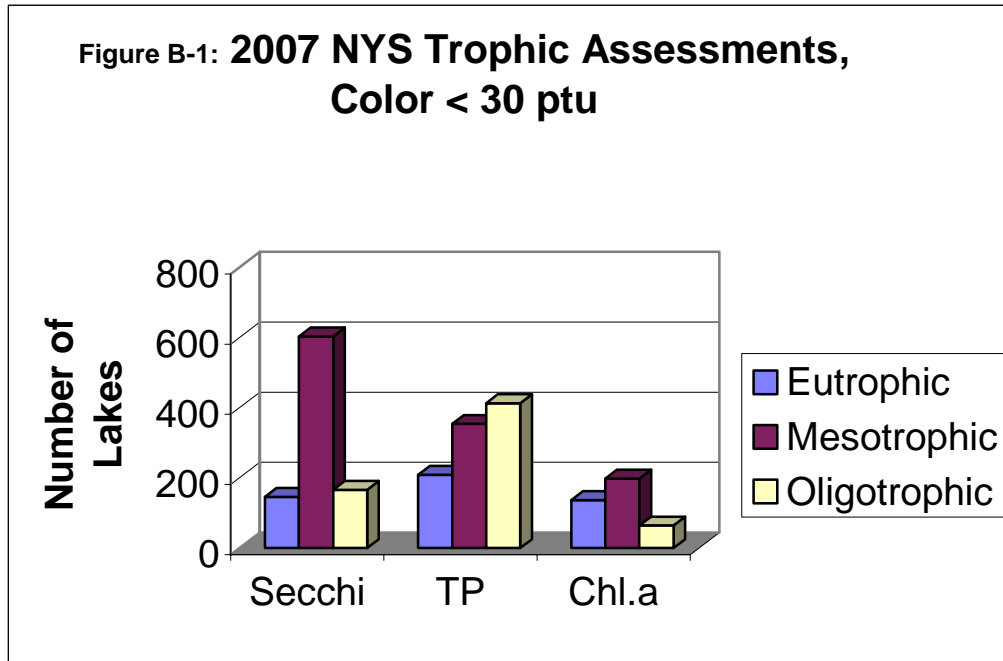
A total of 884 waters in the current assessment had true color values greater than 30 mg/l Pt, and total phosphorus and Secchi transparency were not used to evaluate the trophic status. Unfortunately, only 165 of these waters had chlorophyll *a* data and could be classified. The results are presented in Table 12.

Table B-5				
Lake/Pond Condition for Waters with True Color \leq 30				
(1047 Lakes/Ponds covering 428,562 acres)				
Assessment Based on:	Oligotrophic	Mesotrophic	Eutrophic	No Data
Total Phosphorus	428 lakes (122,002 Ac)	380 (240,728)	227 (64,904)	12 (928)
Secchi	166 (107,586)	636 (282,493)	163 (37,240)	82 (1,244)
Chlorophyll	64 (65,474)	201 (261,368)	143 (72,184)	639 (29,536)

Table B-6				
Lake/Pond Condition for Waters with True Color $>$ 30				
(884 Lakes/Ponds covering 38,376 acres)				
Assessment Based on:	Oligotrophic	Mesotrophic	Eutrophic	No Data
Chlorophyll	9 (3,953)	81 (9,154)	75 (6,632)	719 (18,637)

The discrepancy between the totals for some of the assessment indicators in Table 11 is due to the lack of data for some indicators (for example, some lakes were sampled for phosphorus only, or for phosphorus and water clarity only). A total of 228 waters were excluded from the above analyses because true color data were not available. If it is assumed that an equivalent percentage (in the assessed database) of unassessed lake numbers and lake areas possess color readings greater than 30 Pt_u, then trophic conditions in highly colored waters are not known for approximately 2700 lakes comprising an area of 25,000 acres. The

evaluation of trophic status itemized above is presented graphically in Figure B-1.



In summary, a total of 1,930 waters are included in the current water quality assessment, and about 75 percent of these waters are located in the Adirondack Region of the state. About 54 percent (1047) of the total waters assessed had true color values less than 30 mg/l Pt and these waters were classified into trophic state using total phosphorus, Secchi transparency, and chlorophyll *a*. There were 227 waters classified as eutrophic based on total phosphorus, 163 waters classified as eutrophic based on Secchi transparency, and 143 waters classified as eutrophic based on chlorophyll *a*. Only 165 of the 884 waters with true color values greater than 30 mg/l Pt could be classified into trophic state at the present time, using chlorophyll *a* data.

The itemization of trophic status for the ELS waters surveyed in New York State is presented in Table 13. As mentioned previously, these data were kept separate from the remainder of the database since the ELS was conducted during the fall instead of during midsummer. Chlorophyll *a* was not determined by the ELS, and so the assessment of trophic status is based upon total phosphorus, Secchi depth and true color. There were 158 of the 240 ELS waters with true color ≤ 30 mg/l Pt and the assessment of trophic state is presented below. Seventy-eight ELS waters had true color values > 30 mg/l Pt and were not assessed for trophic state. True color was missing in 4 ELS waters (surface area = 410.0 acres), and these waters were not included in the current analysis.

Table B-6**Lake/Pond Condition for ELS Waters with True Color \leq 30 Ptu****(158 Lakes/Ponds covering 69,262 acres)**

Assessment Based on:	Oligotrophic	Mesotrophic	Eutrophic	No Data
Total Phosphorus	99 lakes (58,522 Ac)	20 (4,392)	13 (981)	26 (5,367)
Secchi	41 (53,950)	91 (11,105)	26 (4,206)	0 (0)

It has been determined that at least half of the 240 waters sampled by the ELS also were sampled by some other program in the current dataset.

Water Quality Standards Applicable to Poned Waters

New York State classifies all surface waters by *best use*, a designation that takes into account such factors as stream flow, existing water quality, and the past, present and desired uses of the waters and bordering lands. Best use is defined as the use that requires the "cleanest" water and includes drinking waters, swimming, fish (or shellfish) propagation and survival. For example, all surface fresh and salt waters must be safe, at least, for aquatic organisms, all fresh groundwater must be protected for drinking water supply. Although waters are classified to achieve best use, including all uses that require less demanding water quality standards, the best use may not be achievable under current conditions. A summary of New York State Water Quality Classifications is presented in Appendix B of this report. NYSDEC continues to reclassify waters within the state as better information becomes available to aid in this process.

The water quality standards most applicable to New York State lakes are the standards corresponding to pH, and dissolved oxygen, although guidance values and safety requirements on swimming beaches are also applicable to total phosphorus concentrations and water clarity, respectively. While other numeric or narrative water quality standards may be of concern for individual waters within the state, either the existing database does not support broad assessment of the resources of the state for applicable standards (such as bacteria) or the standards are not violated for the vast majority of waterbodies in the state. The state pH standard for all waters Class C or higher is between 6.5 and 8.5. For Class D waters, the pH standard is between 6.5 and 9.5

The state dissolved oxygen standard is as follows: for all but Class D and A-special lakes (none in either category assessed in this report):

“For cold waters suitable for trout spawning, the DO concentration shall not be less than 7.0 mg/L from other than natural conditions. For trout waters, the minimum daily average shall not be less than 6.0 mg/L, and at no time shall the concentration be less than 5.0 mg/L. For non-trout waters, the minimum daily average shall not be less than 5.0 mg/L, and at no time shall the DO concentration be less than 4.0 mg/L”.

Evaluation of lake DO data can be confounded by the time of sampling (samples generally collected prior to June or after September may correspond to destratified lake conditions, in which temperature and oxygen concentrations are usually uniform throughout the water column), depth of the lake (shallow lakes and ponds may not thermally stratify, limiting shifts in DO to the microlayer just above the sediment-water interface, a zone difficult to accurately monitor), and samples collected outside the deepest hole in the lake.

It may be most appropriate to evaluate oxygen conditions only in waterbodies sufficiently deep (say > 5 meters) to thermally stratify, during the period in which thermal stratification is stable (generally June through September).

The phosphorus guidance value for Class B and higher waters corresponds to 0.020 mg/L. No such value has been designated for any lakes classified as Class C or lower.

The minimum recommended (by the NYS Department of Health Sanitary Code) water clarity for designated swimming beaches is 4 feet (= 1.2 meters). While this recommendation could apply to all Class B and higher waters (and even to many of the Class C waters that are used for contact recreation), the lack of an inventory of waterbodies with “designated” swimming beaches precludes a strict application of this recommendation. However, the water clarity database will be presented for the purposes of broadly assessing water quality conditions as related to potential for swimming impairments.

Table 14 summarizes the extent to which these standards and/or guidance values have been violated. pH, water clarity, and phosphorus criteria are evaluated against mean values for each analyte, while the dissolved oxygen criteria is evaluated against minimum values within the hypolimnion. While most of the sampling programs include pH, water clarity, and phosphorus among the measured parameters, dissolved oxygen data are either not universally collected (for example, in CSLAP or in some isothermal lakes) or have not been electronically stored (in the ALSC and many other monitoring programs from prior to 1990). It should also be noted that, in many monitoring programs such as the ALSC project, oxygen “profiles” are often limited to discrete samples at a small number of points (usually two) within the water column.

The data in Table 14 suggest that violation of water quality standards and/or guidance values or criteria is common among assessed lakes. The violations of the pH standard and phosphorus guidance value have been discussed above. A relatively small number of lakes have experienced systematic violations of the recommended water clarity readings at swimming beaches. It is likely that a larger percentage of sampled lakes have experienced occasionally low water clarity readings; as such, these figures may not accurately reflect the percentage of lakes in which poor water clarity results in at least some aesthetic and bathing impairments. However, these figures also include some moderately colored waters and a small number of very shallow lakes for which water clarity is measurable (i.e. the Secchi disk is not visible while sitting on the lake bottom) but is nonetheless adversely affected by lake depth. In other words, these figures also include some waterbodies for which water clarity may not be an accurate “water quality” indicator. Table 14 also suggests that, at least among the relatively small number of assessed waterbodies, dissolved oxygen standards are commonly violated, and anoxic conditions (functionally defined as DO readings < 1 mg/l to account for inaccuracies in very low level dissolved oxygen measurements and the lack of DO data within the last meter or two of water depth immediately above the sediment-water interface) are routinely experienced. This table shows that **more than 70% of assessed waters that are thermally stratified experience hypoxia in the hypolimnion.** There has been much discussion about the occurrence of “natural” DO depletion in lakes due to morphometry and focusing. Without sediment coring data for the vast majority of these lakes, it is impossible to separate out natural and culturally-induced DO depletion in these lakes. It must also be conceded that Table 14 reflects a database (mostly publicly accessible, moderately sized, moderately high profile LCI lakes, often with some pre-sampling evidence of water quality problems that led to its inclusion in the monitoring program) that may not be fully representative of the “typical” NYS lake. However, the high percentage of assessed lakes experiencing hypoxic conditions suggests that this phenomenon needs to be far more closely monitored and evaluated. The NYSDEC will devote significant effort in the upcoming 305b cycle to fully assessing the existing (electronic and hard copy) dissolved oxygen database, recognizing the limitations inherent in comprehensively evaluating the paucity of full profile data, as well as a renewed effort to collect additional full water column profiles in all subsequently sampled lakes

**Table B-7
Statewide Assessment of Lake Water Quality**

Water Quality Indicator		Water Quality Criterion	Percent of All Lakes that: (Percent of Assessed Lakes that:)			
			Violate Standard	Meet Standard	Sampled, but Not Assessed**	Sampled, but Not for this Indicator
pH	Lower	6.5 SU	44%	56%	< 1%	< 1%
	Upper	8.5 SU	1%	98%	< 1%	< 1%
Dissolved Oxygen	Trout Waters	5.0-6.0 mg/l	7% (71%)	5% (29%)	83%	6%
	Non-Trout Water	4.0 mg/l	7% (75%)	2% (25%)	82%	10%
	Hypoxia*	4.0 mg/l	7% (71%)	3% (29%)	83%	8%
	Anoxia*	1.0 mg/l	--- (59%)	--- (41%)		
Total Phosphorus (Class B and higher)		20 µg/l	30%	68%	< 1%	2%
Water Clarity (Class B and higher)		1.2 m	7%	83%	10%	< 1%

* Analysis limited to thermally stratified lakes sampled from June through September.

** Dissolved Oxygen data for these lakes have either not been converted to electronic formats or were not collected as part of depth profiles, thus limiting their utility. It is anticipated that subsequent editions of the 305(b) Report will include these data.

New York State Lake Programs

Lake water quality monitoring by New York State is currently being conducted by the NYSDEC and includes the following ongoing components: the Citizens' Statewide Lake Assessment Program (CSLAP), the Lake Classification and Inventory (LCI) Survey, the Lake Champlain Monitoring Program and special studies involving acid rain, lake use impairment, USEPA Clean Lakes projects, special projects as related to local, short-term problem assessment, and other miscellaneous activities. The NYSDEC Inland Lakes and Freshwater Section also works jointly with other institutions in other contemporary or recently completed lake monitoring projects, including the Adirondack Effects Assessment Program (AEAP, with RPI and others), Finger Lakes Monitoring (with UFI), the Environmental Monitoring and Assessment Program (EMAP, with USEPA, USFWS, and others), and stormwater monitoring of tributaries to several NYS lakes, including Lake George and several NYC reservoirs.

The *Citizens' Statewide Lake Assessment Program* was started in 1986 and is a scientific and educational program in which citizen volunteers are trained to collect water quality information. The program is a cooperative effort between the NYSDEC and the Federation of Lake Associations, Inc., a coalition of organizations dedicated to the preservation and restoration of all lakes, ponds and rivers throughout New York State. During 2007, there were about 225 lakes and ponds associated with the program, although only about 90-100 are actively sampled in any particular year. Biweekly sampling begins in mid-June and continues for 15 weeks through early October. Water quality data collected as part of the program include Secchi disk transparency and the following chemical parameters: total phosphorus, nitrate-nitrogen, true color, pH, specific conductance, and chlorophyll *a*. At some lakes, dissolved oxygen, lake level, amount and pH of precipitation, and aquatic plant populations also are assessed. Volunteer monitors also complete user and (since 1992) field perception surveys, the latter of which are cross-referenced against instantaneous water quality data collected to provide a linkage between public opinion and measured eutrophication parameters. These linkages are being utilized to develop phosphorus guidance values serving as the endpoint in the revision of aforementioned phosphorus effluent TOGS.

The *Lake Classification and Inventory Program*¹² was initiated in 1982. Each year, approximately 10-25 water bodies are sampled in a specific geographic region of the State. The waters selected for sampling are considered to be the most significant in that particular region, both in terms of water quality and level of public access. Samples are collected for pH, ANC, specific conductance, temperature, oxygen, chlorophyll *a*, nutrients and plankton at the surface and with depth at the deepest point of the lake, four-seven times per year (with stratified lakes sampled more frequently than shallow lakes). Sampling generally begins during May and ends in October. This project had been suspended after 1992, due to resource (mostly staff time) limitations, but was resumed on a smaller lakeset beginning again in 1996. Since 1998, this program has been geographically linked with the Rotating Intensive Basin Sampling (RIBS) stream monitoring program conducted by the NYSDEC Bureau of Watershed Assessment. LCI sites are chosen within the RIBS monitoring basins (Susquehanna River basin in 2003, Long Island Sound/Atlantic Ocean and Lake Champlain basins in 2004, Genesee and Delaware River basins in 2005, the Mohawk and Niagara Rivers basins in 2006, Upper Hudson River and Seneca/Oneida/Oswego Rivers basins in 2007, and the Lake Champlain, Lower Hudson River, and Atlantic Ocean/Long Island Sound basin in 2008) from among the waterbodies listed on the NYS Priority Waterbodies List for which water quality data are incomplete or absent, or from the largest lakes in the respective basin in which no water quality data exists within the NYSDEC database. Sampling via this program is also conducted in two year intervals, with limited (1-2x) sampling in the first year for lakes without water quality data, and monthly for NYS PWL lakes for which

¹²New York State Department of Environmental Conservation. 1982. New York State Lake Classification and Inventory Annual Report - 1982. Bureau of Water Research, Albany, N.Y.

data are incomplete. These are referred to as “mass attack” and “rotating basin” sampling, respectively, after the RIBS stream sampling model (to complete the model, the NYS ambient lakes monitoring program considers the CSLAP and Finger Lakes dataset to be the “fixed site” or “index lake” network sites).

New York State Lake Restoration Efforts

NYSDEC does not have an organizational unit that is responsible for statewide lake management. However, within the Division of Water, the Inland Lakes and Freshwaters Section (ILFS) comes the closest to fulfilling that responsibility. The ILFS (previously referred to as the Lake Services Section, or LSS) consists of five scientists, three engineers, one technician, and associated support staff (from the NYSDEC regions) who work on various aspects of lake management. The ILFS is responsible for administering the Federal Clean Lakes Program and equivalent State-funded projects. In recent State Fiscal Years, the latter consisted of projects exceeding \$1 million, affecting more than 50 lakes. The State-funded projects are not part of a competitive grants program, but rather the State legislature determines annual eligibility for funding. The ILFS staff is then responsible for working with the locality to prepare a Program Narrative, developed with the guidelines contained in the Federal Clean Lakes Rules and Regulations. A second difference between the Federal and State programs is that monitoring, diagnosis, feasibility and implementation can all be conducted simultaneously by the locality. The State program has no requirement for phased design and implementation.

The ILFS staff also assists local governments in the conduct of specific State and Federal Clean Lakes Projects. They also are responsible for carrying out all the lake monitoring for NYSDEC (except for fish sampling). The LSS staff also acts as a liaison to the public for lake-related matters and are involved in the preparation of Lake Management Plans for specific lakes. This responsibility has necessarily been reduced by the limited scope of the Federal Clean Lakes Program in recent years.

In most lake restoration projects, a cooperative agreement between the public and governmental agencies must be reached to ensure success. Working relationships between federal (USDA-SCS, USEPA), state (NYSDEC, NYSDOH), county planning or environmental management councils, health, lake protection and preservation districts, and local offices all contribute to the management of the lake and surrounding watershed.

Restoration Techniques

The techniques used for lake restoration can be categorized as in-lake treatments and watershed management programs. Watershed management involves the implementation of methods to reduce nutrients and/or sediments from entering the lake. This requires the identification of the problem(s), assessment of the magnitude of the problem(s), and the development of management practices/controls to mitigate the controllable problem(s). Most restoration projects consist of a combination of in-lake and watershed management techniques in order to achieve long-term benefits.

In-lake restoration techniques are typically applied after nutrient reduction or diversion plans have been accomplished. The purpose of employing in-lake restoration techniques is to remove the sediments and/or nutrients to reduce algal blooms, reduce the nuisance growth of aquatic plants and eliminate oxygen depletions in the deeper waters. The method selected will be determined in large part by what is causing the water quality impairment. In some instances, the use of multiple restoration methods may be required.

The following is a discussion of in-lake restoration techniques that have been conducted in New York State through USEPA Clean Lakes Phase II projects or other lake management efforts. The list is ranked by the frequency of use as a restoration technique, although it is likely that locally-funded and sponsored projects utilize some techniques such as drawdown and mechanical weed harvesting more frequently. Several techniques which have not been utilized within the State Clean Lakes process, but to some extent via “private” projects, include lake aeration/circulation, dilution/flushing, and biological controls, such as sterile

grass carp. These techniques will be discussed at the end of this section. The use of aquatic herbicides and algaecides has not been associated with any Clean Lakes projects, although these lake management strategies have been commonly utilized by lake communities and managers.

Physical or Mechanical Techniques

Dredging has been used more frequently in New York than any other type of in-lake physical restoration technique, with the possible exception of drawdown. Used in conjunction with diversion or measures to reduce siltation upstream, dredging removes the sediments that may continue to be a significant source of nutrients to the overlying water column. This technique is also useful to control aquatic plant growth by the reduction in light penetration to the deeper waters.

There are two types of dredging for lake restoration projects, hydraulic and dry excavation. The method selected will depend upon the degree of treatment required, lake morphology, whether the lake can be drained properly and cost. The use of dry excavation has been utilized on eight Phase II projects in New York State, while hydraulic dredging has been used on two other Phase II restoration or demonstration projects since 1976. Smaller scale dredging activities have been conducted on many more small NYS lakes.

The disposal of the spoils from the dredging operation, the disruption of the littoral zone and benthic fauna and flora, destruction of wetland habitat (including the submergent vegetation), increased turbidity to the surrounding waters and possible impairment of use during the dredging operation all have increased the difficulty of obtaining the necessary environmental permits that are required to initiate new projects. Restrictions on the location of new spoils area and new, more restrictive weight limits for dump trucks also have contributed substantially to an increase in the costs of these projects.

The benefits derived from a dredging project generally are considered to last longer than the benefits derived from other lake restoration techniques, thus ameliorating the cost differences.

Small-scale dredging projects, particularly drawdown excavation, are much more common than in-lake or hydraulic dredging projects in New York State, although navigational dredging (to deepen a waterway to open or enhance navigation) and dredging to clean up contaminants is more common in river systems and some portions of lakes. These projects including dredging on the Great Lakes and Cumberland Bay in Lake Champlain, and Collins Lake. Excavation dredging was performed at Belmont Lake in Long Island for the control of fanwort in the early 1970s, and a number of lakes in the past (Central Park Lake, Hyde Park Lake and Van Cortlandt Park Lake in New York City, Steinmetz Lake in Schenectady, Delaware Park Lake in Buffalo, Washington Park Lake, Tivoli Lake, Buckingham Lake, and Hampton Manor Lake in the Albany area, Scudders Pond in Long Island, etc.). Navigational dredging was conducted in Glen Lake in 2006. There have also been proposed dredging projects (Lake Montauk, Lake George, Cuba Lake, Tannery Pond, Quaker/Red House Lake, etc.) in recent years for navigation or water quality improvement rather than for weed control. The removal of sediment as a medium to enhance weed growth (and water deepening) may result in reduction in nuisance weed growth. Projects associated with the federal Clean Lakes program are described below.

Phosphorus precipitation/inactivation is also used in conjunction with nutrient diversion or reduction. The degree of treatment, i.e. the amount of chemical applied, determines which method is being utilized. Phosphorus precipitation is employed when the lake sediments are not a significant source of nutrients. Phosphorus inactivation is used in all other applications.

The object of phosphorus precipitation is to add enough chemical to bind with the soluble phosphorus in the water column, forming a chemical floc which then settles to the bottom. Phosphorus inactivation not only strips the phosphorus in the water column, but enough additional chemicals are applied to form a barrier on top of the sediments that inhibits the release of phosphorus back into the water. The expected benefits from phosphorus inactivation may last several years.

Alum is the chemical most often used for phosphorus precipitation/inactivation. The addition of alum will lower the pH of the water, through a series of chemical reactions. If the pH is lowered below 4.5, the aluminum can be solubilized and create a toxicity problem to fish and invertebrates. The dosage rates of alum has to be carefully determined and monitored during the application to maintain the pH above 4.5.

In New York, Saratoga Lake and Irondequoit Bay have been treated with alum in an experimental manner to determine its effectiveness in phosphorus inactivation. The Irondequoit Bay, treated during the summer of 1987, has increased water clarity, reduced levels of chlorophyll *a* and lowered phosphorus levels within the hypolimnetic waters. The long-term effect on the recycling of nutrients from the sediments will be determined by further monitoring. There was no appreciable improvement in the water quality in Saratoga Lake as a result of the alum application. This was due to the small treatment area and low application rates. An experimental low-level alum treatment is presently (2001 onward) being conducted (and closely monitored) in Kinderhook Lake. This technique will be utilized more often in the future, possibly to replace dredging in certain cases due to costs and environmental considerations. It may be especially well suited in small lakes or ponds to control algal blooms, provided these lakes have significant internal nutrient loading.

Lake-Level Drawdown has been used to control the growth of aquatic vegetation in near shore areas where lake levels can be controlled. Since drawdown effects only plants growing near shore, it is often utilized in conjunction with other in-lake restoration techniques. The control of vegetation is achieved through the freezing action on the exposed sediments during the winter months. Not all vegetation responds to the freezing action in the same manner. While some species may be affected negatively, others may not be affected at all, or may actually increase in abundance.

Drawdown during the winter months also allows ice scouring to disrupt the roots of plants. The exposed soils are compacted and much of the fine grained organic materials are removed to deeper waters. Another advantage of this technique is that it requires little or no expense.

In addition to possible shift in aquatic plant species, drawdown can result in increased turbidity and/or algae blooms. The turbidity increase is usually the result of a lack of vegetation along the shoreline which acted as a buffer to the wave energy. Lowering of the lake during the winter months may also result in a fish kill if an insufficient amount of water volume remains. Lake levels need to be restored to near normal by spring to provide adequate fish spawning areas. Finally, lake residents are often concerned that the lake will not reach its normal lake level by summer. There is no guarantee that adequate runoff will fill the lake by the time people want to use it.

Drawdown has been commonly utilized at many New York State lakes, most often for benefits not associated (or directly geared toward) aquatic plant control. The NYS lakes for which drawdown was used as a weed control method include Galway Lake (Saratoga County), Saratoga Lake, and Greenwood Lake (on the New Jersey/New York border), and some of the lakes in the Fulton Chain of Lakes (interior Adirondacks) for controlling Eurasian watermilfoil, Forest Lake in the southern Adirondacks to control Elodea and pondweed, and Minerva Lake (southern Adirondacks) for the control of native plants. Most of these have been fairly successful, although immediately after drawdown a different mix of invasive plants have often colonized and dominated the aquatic plant community before the lakes reached equilibrium after a few years. For example, the dominant plants in Robinson Pond (Columbia County) shifted from Eurasian watermilfoil to bushy pondweed after the lake was regularly drawn down (for maintaining fisheries habitat downstream rather than for weed control), although this shift reversed several years later..

Mechanical Aquatic Plant Harvesting is restricted to applications where macrophyte growth impairs the use of the lake. The aquatic harvesters cut and remove vegetation below the surface of the water and transport the biomass to a conveyor for disposal away from the lake. Although the plants will grow back, some species requiring several harvests during a growing season, this technique removes the vegetation and associated nutrients from the lake. There also is evidence that the long-term harvesting, especially late in the season, causes some disruption to the growth cycle of some species of plants.

Although harvesting is only a temporary solution to vegetation problems and generally is not fundable as a sole restoration technique through the Clean Lakes Program, it has been used on the Saratoga Lake project in conjunction with other lake restoration techniques and watershed management programs. In fact, this technique is the most commonly used short-term method of vegetation control by lakes in this State, whether done “formally” with full-sized mechanical harvesters, informally with cutting bars and hand removal of floating plants, or individual cutting with plants removed from downwind shorelines.

Mechanical harvesters have been seen on lakes large and small throughout the state for many years, although in recent years the use of herbicides has largely superseded harvesting as the most common means for “whole lake” control of nuisance plants. While the use of harvesters in New York State dates back at least to the 1950s, the most significant regional activities originated with the advent of the Aquatic Vegetation Control Program in the Finger Lakes region in the late 1980s. In this program, state (member item) funds were provided to several counties in the Finger Lakes Region to conduct a variety of lake management activities. In some counties, this included the purchase of mechanical weed harvesters or harvesting services for several Finger Lakes, embayments to Lake Ontario, and some smaller waterbodies in these counties. The harvesting program at Chautauqua Lake has been used to evaluate nutrient removal from harvesting operations. Large lakes outside of the Finger Lakes region that have been harvested include Lake Champlain and Oneida Lake (for water chestnut) and Greenwood Lake (for Eurasian watermilfoil). A statewide inventory of lakes that utilize mechanical harvesters

has not been compiled, in large part due to the lack of regulatory oversight (and therefore a paper trail of permits) in most parts of the state..

Another type of mechanical harvesting, suction harvesting, utilizes divers, hoses, and a pump to create suction to remove aquatic plants. This technique is relatively new, but may provide longer term control of vegetation by removing the roots as well as the plants. The process of having diver(s) remove aquatic plants by suction hoses is more selective at removing only the nuisance species, thus leaving the native plants to recolonize the disturbed area. The removed plants and roots are discharged to a collection basket where they are then properly disposed of.

Suction harvesting is a slow and expensive operation when compared to mechanical harvesters, but is ideally suited as a secondary treatment when combined with rotovating or dredging and for new infestations of exotic plants. This technique has been used in several lakes in New York, including Lake George, East Caroga Lake and Saratoga Lake. Results from these studies indicate suction harvesting to be an effective means for controlling weed populations when applied under the appropriate circumstances.

Rotovating (also called rototilling) is a relatively new form of mechanical control for aquatic vegetation that uses a rototilling machine to cut and dislocate aquatic plants and roots from the sediment, and then removes the cut plants from the lake. **Hydroraking** is essentially the same technique that uses a mechanical rake, and collects and removes some of the cut material.

A rototilling machine is usually mounted on a barge. The machine has a large rotating head with several protruding tines that churn up the sediments, dislodging the roots and plants. The rotating head can be easily positioned with a hydraulic boom winch and winch cable (as hydroraking). The plants are either brought up on the rotator and disposed of on shore, or the floating vegetation is raked up for proper disposal.

There is only a short history of the use of rotovating and hydroraking in New York State, and specific examples have not been documented for any New York State lakes, although rotovating is being used at an increasing frequency in small plots in much larger lakes, particularly in the Finger Lakes region and in western NYS. It is believed that much small scale rotovating- outside individual properties- occurs under the regulatory radar screen, brought to the attention of regulatory agencies only through the vigilance of concerned neighbors

Aeration/Artificial Circulation have been used in other state Clean Lake projects to alleviate depleted oxygen in the hypolimnion with limited success. These two techniques have not been used on any Clean Lake projects in New York, although they have been utilized in privately-funded work. Aeration introduces oxygen to the hypolimnion without disrupting the temperature gradients, while artificial circulation mixes the entire water column. This latter treatment is not recommended in lakes where cold water fish species are present.

The use of imported water to replace existing lake water is referred to as dilution or flushing techniques. The objective is to exchange the high nutrient waters with water that is low in nutrients. The use of groundwater or nearby streams with low nutrient concentrations are sources for flushing. The lack of sufficient water of desirable quality and the cost of operation and maintenance limit the use of this technique.

Shading involves the use of chemical dyes to inhibit light penetration to the lake bottom, ultimately controlling the growth of nuisance aquatic vegetation in areas greater than two to four feet deep. These non-toxic vegetable dyes work by reducing light penetration in the water ("shading"), and by the absorption of wavelengths within the photosynthetically active region of light. Absorbing these wavelengths prevents the plants from photosynthesizing and growing.

The dyes treat the entire waterbody and are usually not used on large lakes due to cost limitations. Dyes are most effective in small waterbodies with little or no flow where the appropriate concentration can be maintained. The duration for treatment for either large or small lakes is a function of water retention time. Dyes will be significantly and quickly diluted or washed downstream in lakes with inflow and outflow.

There is little historical information on the use of shading agents in New York State lakes, although they have been commonly used on ponds, particularly golf course and ornamental ponds, for many years. Perhaps the only large-lake experiments involving lake dyes was in Adirondack Lake in the late 1980s.

Chemical Techniques

Aquatic Herbicides and Algicides have been utilized for the control of nuisance aquatic plants; *herbicides* have been used to reduce populations of excessive rooted aquatic macrophytes, while *algicides* have been used to control nuisance algae growth (including macroalgae such as *Chara*). Herbicides are available in liquid or granular form, utilizing a variety of formulations and active agents. Some herbicides elicit toxic reactions to the plant leaves and/or root structure, while other herbicides disrupt the photosynthetic or metabolic processes in plants. Algicides control algae by toxicity. While algae control has required primarily whole-lake treatments, herbicidal control of nuisance weeds has occurred as both spot and whole-lake treatments. Treatment duration, effectiveness, and selectivity are largely functions of the choice of herbicide, extent and type of plant coverage, bottom sediment structure, hydrologic characteristics of the lake, and other factors.

The primary aquatic herbicides registered for use in New York State are 2,4-D, Endothal (and other like formulations), Diquat, Rodeo, and Sonar. While herbicide treatments have historically focused on a variety of nuisance native and exotic submergent and emergent plants, much attention in recent years has been focused on exotic submergent species, primarily *Myriophyllum spicatum* (Eurasian water milfoil). Sonar, a fluridone-based compound utilized in other states for control of *M. spicatum* (and other nuisance macrophytes), was permitted for use in New York state in 1995, and has been utilized increasingly for the control of *M. spicatum* in NYS lakes (at least 40 lakes larger than 25 acres), although not in any lakes utilizing Clean Lakes funding. However, 2,4-D and other herbicides have a long history of use for controlling Eurasian water milfoil throughout the state. Algicides are primarily formulations of copper-based compounds. Both herbicides and algicides are regulated through an extensive licensing and permitting process by the NYSDEC.

Most of the New York State lakes treated with aquatic herbicides have not been closely studied either before or after treatment. The most closely monitored lakes include Waneta Lake in Schuyler County and Snyders Lake in Rensselaer County, both infected by Eurasian watermilfoil. Permits have been issued for aquatic herbicides in nearly every part

of New York State. In fact, upwards of 500 permits are issued annually, not including purchase permits for small farm ponds. However, in some regions of the state, such as the Adirondacks, no aquatic herbicide permits have been issued. The myriad of reasons include overlapping regulatory authority (the DEC and the Adirondack Park Agency), strong sentiments about the use of herbicides, the presence of and concern for protecting rare and endangered species, and the lack of historical precedent in the use of many aquatic plant control strategies (due in part to the historical lack of problems with invasive plants). A paucity of permits is also the case for lakes in other regions of the state used for potable water intake or encompassing wetland areas, since the permitting rigor is often more significant in these waterbodies. On the other hand, many lakes in the downstate region have been treated with aquatic herbicides.

Copper sulfate has been used for many decades on many New York State lakes- some on an annual basis- and each year is used on more than 300 lakes and ponds throughout the state (mostly small ponds less than 3 acres in size). Most of these small pond treatments have not been well documented, although the NYSDEC has conducted a study of relatively small lakes with persistent copper sulfate treatments.

Biological Techniques

Herbivorous fish control of nuisance aquatic plants have been used for several years on small NYS ponds and lakes, and in the last few years on larger lakes with control structures, though there have been no treatments through the Clean Lakes Program. The use of sterile hybrid grass carp (*Ctenopharyngodon idella* x *Hypophthalmichthys nobilis*) was approved in New York on June 1, 1990, for waterbodies less than five acres, having no inlet or outlet and which lie wholly within the boundaries of the individuals requesting a permit. Up to 15 certified triploid grass carp per acre will be allowed where submergent vegetation and/or duckweed (*Lemnaceae*) occupy over 30% of the water's surface area and significantly impair the intended use of the waterbody. A more rigid permitting process is utilized for applications in larger lakes.

There have been literally thousands of permits issued by the DEC for the use of grass carp since 1991; the vast majority of these are for very small (< 1 acre "farm") ponds with no inlet or outlet and a single landowner. The majority of the stockings appear to be in Finger Lakes region and western New York (nearly 1000 every year), and in the downstate region (nearly 500 per year). The effectiveness of these stockings has not been documented. The grass carp stocking and aquatic plant response of Walton Lake in Orange County, one of the original (experimental) stockings in the state, has been documented by the DEC Division of Fish and Wildlife. Information about other stockings is largely anecdotal

Biomanipulation is another restoration alternative that has not been widely used but may prove useful in some situations. The objective of this technique is to control the growth of algae by increasing the populations of zooplankton which graze on the algae. This is accomplished by reducing or eliminating small fish which feed on the zooplankton by increasing predation or restocking.

Although biomanipulation has been commonly used in New York State as a fisheries management tool, it has not been regularly utilized or documented as a lake management activity to restore or enhance water quality conditions. For example, rotenone has been used within the Adirondacks to restore native brook trout (by removing other fish that

outcompete the brook trout), but this undertaking was not intended to improve water quality. Biomanipulation has largely been limited to either accidental introductions of exotic species (such as zebra mussels or Eurasian watermilfoil) or unintended results from the introductions of fish such as alewives in Conesus Lake. A small scale biomanipulation project has been conducted at Lake Neatahwanta

Herbivorous insects have been increasingly used in NYS lakes to control the growth of nuisance levels of *Myriophyllum spicatum*. Although several different herbivorous insects have been implicated in natural crashes of Eurasian watermilfoil through North America, only two have been reared and stocked in NYS lakes. *Euhrychiopsis lecontei*, the milfoil weevil, is native to many NYS lakes and is stocked commercially by a private company in Ohio. Adult weevils live submersed and lay eggs on milfoil meristems. The larvae eat the meristem and bore down through the stem, consuming the cortex, and then metamorphose lower on the stem. The consumption of meristem and stem mining by larvae are the two main effects of weevils on the plant and this damage can suppress plant growth, reduce root biomass and carbohydrate stores and cause the plant to sink from the water column (information from Ray Newman, University of Minnesota, Department of Fisheries and Wildlife). The milfoil weevil has been stocked in six NYS lakes since 1998. At present there do not appear to be any NYS stocked weevil populations that have become self-sustaining or have been demonstrated to adequately reduce Eurasian watermilfoil populations, although these lake stockings continue to be watched. There is some evidence that native populations of *Euhrychiopsis lecontei* have caused a crash in Eurasian watermilfoil in Findley Lake.

The milfoil moth, *Acentria ephemerella*, has been cited as the cause of a substantial crash of Eurasian watermilfoil in the northern end of Cayuga Lake. Although not native to NYS lakes, it has effectively become naturalized in many lakes since the late 1920s, and is now found in most surveyed NYS lakes. The moth caterpillars use their silken thread to bind milfoil's feathery leaves into individual nests (larval retreats), effectively halting growth of the plant stems. The moth has been introduced experimentally on a small scale into Dryden Lake and on a larger scale into Lincoln Pond. Commercial or other non-experimental stocking activities have not yet been conducted.

Although recent surveys have indicated that both the milfoil weevil and moth are found in most surveyed New York State lakes, the history of herbivorous insect stockings in New York State lakes dates back only to the late 1990s. Aquatic weevils have been stocked in small plots in several small New York State lakes, including Lake Moraine in Madison County, Sepasco Lake in Dutchess County, Findley Lake in Chautauqua County, and Millsite Lake in Jefferson County, as well as an experimental stocking in Saratoga Lake. Each of these projects has exhibited some very limited successes, but in no cases have migration out of the treatment plots, or long-term reductions of milfoil beds, been observed. This has been closely monitored for several years, although longer-term successes have also not been observed.

Current and Completed Clean Lakes Projects.

Over the past 20 years the Department of Environmental Conservation, under the Federal Clean Lakes Program (Section 314 of the Federal Clean Water Act), has conducted 26 lake management and restoration projects on *public* lakes. The various projects cover almost every aspect of lake management from

vegetation harvesting to the control of agricultural runoff. Since 1983, NYSDEC, through its Inland Lakes and Freshwater Section, also has supervised nearly 80 additional projects, financed solely with State funds, amounting to almost \$15 million dollars. These projects, conducted in areas that comprise over 75 percent of the State's population, have improved the use of lakes and ponds as water supplies, and for swimming, fishing, and water-based recreational activities.

The Clean Lakes program is broken down into two components, Phase I and Phase II cooperative agreements. Phase I projects are the diagnostic/feasibility studies to determine a lake's quality, evaluate possible solutions to existing pollution problems and recommend a feasible program to restore or preserve the quality of the lake. A Phase II project is undertaken to implement the recommended methods for controlling pollution entering the lake, and to restore the lake. Applications to the U.S. Environmental Protection Agency (USEPA) for a Clean Lakes project must be made by the NYSDEC. The proposal to conduct a Phase I or Phase II project can be submitted to the NYSDEC by any government entity for a public water body.

Federal cost-sharing for Phase I projects are 70 percent of the total budget, with a maximum Federal grant of \$100,000. Phase II grants are 50/50 cost sharing, with no maximum limit. The match to the Federal grant can be composed of state and/or local monies which are not being matched to any other Federal program.

Prior to 1980, USEPA funded Demonstration projects that were similar, in scope, to the present Phase II projects. New York completed seven of these demonstration projects before the regulation was adopted that established the present Clean Lakes program. Since that time, the State has completed ten Phase I studies, four Phase II projects, and currently has five Phase II programs that are active.

During 1994, the Department submitted six new Phase I applications and one Phase II grant application to USEPA. USEPA Region 2 recommended that one of the Phase I applications be funded while no Phase II studies or other Phase I grant applications be awarded. USEPA Region 2 also recommended funding the state lake water quality assessment grant, used to fund some of the aforementioned monitoring activities. Since funding for Section 314 projects has been eliminated, no additional Phase I or Phase II applications have been submitted to the USEPA since 1994, and some activities funded under the Water Quality Assessment Grant have been transferred to the Nutrient Assessment program.

The following is a summary of the completed and ongoing Clean Lakes projects.

I. Demonstration Projects.

- A. *Washington Park Lake and Buckingham Lake*, City of Albany (\$46,500 Federal, \$46,500 Local). Project completed in 1978. Lakes were dredged of accumulated bottom sediments to restore water depth.
- A. *Hampton Manor Lake*, Town of East Greenbush (\$50,000 Federal, \$50,000 Local). Project completed in 1979. Project consisted of hydraulic dredging to increase water depth.
- B. *Steinmetz Lake*, City of Schenectady (\$36,680 Federal, \$36,680 Local). Project completed in 1979. Restoration consisted of dredging of bottom sediments to increase water depth and to reduce aquatic plant growth.
- C. *Tivoli Lake*, City of Albany (\$202,645 Federal, \$202,645 Local). Project completed in 1981. Restoration included dredging contaminated sediment, diversion of stormwater runoff around the lake, rehabilitation of the earthen dam and establishment of wetland wildlife areas. The Lake was restocked with Largemouth bass, and presently is the only "natural" city park in upstate.
- D. *Central Park Pond*, City of New York (\$498,000 Federal, \$498,000 Local). Project completed in 1981. Project consisted of dredging of accumulated sediment, rehabilitation of inlet and

outlet structures and improvement of shoreline rip-rap. The purpose of the project was to increase water depth, as the pond is in a high use area of Central Park, Manhattan.

- E. *Scudder's Pond*, Village of Sea Cliff and Glen Cove (\$50,000 Federal, \$50,000 Local). Project completed in 1982. Restoration included dredging of accumulated sediment, and construction of sediment traps to treat surface runoff. The pond is part of an environmental recreation area and is used for fishing.
- F. *Ann Lee Pond*, Albany County (\$98,246 Federal, \$98,246 Local). Project completed in 1982. Restoration measures consisted of hydraulic dredging to increase water depth, and repair of the outlet dam. The pond is now used for fishing and is the focus of a wildlife area.

III. Completed Phase I projects

- A. Lake Champlain, NYSDEC (\$234,860 Federal, \$100,654 State). Project period from 6/26/89 to 12/30/93. A cooperative Phase I diagnostic/feasibility study with the State of Vermont, completed as merger with Lake Champlain Management Plan.
- B. Otsego Lake, SUNY Oneonta (\$100,000 Federal, \$50,000 Local). Project period from 7/22/91 to 6/30/97. A diagnostic/feasibility study examining nutrient inputs from the watershed and develop management plan to maintain current water quality.
- C. *Upper Saranac Lake*, NYSDEC and the Upper Saranac Lake Association (\$100,000 Federal, \$136,000 State). Project period from 10/1/94 to 9/30/96. A diagnostic/feasibility study examining nutrient inputs and development of a management plan for the lake and its watershed.
- D. *Chautauqua Lake*, Chautauqua County Planning Dept. (\$100,000 Federal, \$50,000 Local). Project period from 7/22/91 to 4/30/97. A diagnostic/feasibility study examining nutrient inputs and develop management plan to reduce eutrophication in lake.

III. Completed Phase II Projects (Phase I project completed prior to implementation).

- A. *Hyde Park Lake*, Niagara County (\$894,667 Federal, \$894,667 Local). Project completed in 1984. Restoration included dredging of accumulated sediment, excavating the inlet and outlet tributaries and providing for a source of clean make up water for dilution. The lake is in the only park in the City of Niagara Falls, and is used for boating, fishing and aesthetic enjoyment.
- B. *Delaware Park Lake*, City of Buffalo (\$3,741,500 Federal, \$2,000,000 State, \$1,741,500 Local). Project completed in 1985. Restoration included diversion of the incoming stream around the Lake, rerouting of storm sewers, and dredging to remove accumulated sediment. The Lake is in a major city park and is used for fishing, boating and aesthetic enjoyment.
- C. *Lake Ronkonkoma*, Suffolk County (\$335,572 Federal, \$335,572 Local). Project completed in 1986. Project consisted of public land acquisition, and the development of a management plan for the lake and its watershed. Two experimental biofilters for treating stormwater were constructed and evaluated as part of the project.
- D. *Iroquois Lake*, City of Schenectady (\$290,747 Federal, \$240,000 State, \$50,747 Local). Project completed 1987. Restoration consisted of dredging for deepening and vegetation control, stormwater diversion and sealing of the bottom with clean fill. The Lake was restocked with fish and is used for boating, fishing, and aesthetic enjoyment.
- E. *Irondequoit Bay*, Monroe County (\$329,743 Federal, \$165,000 State, \$164,743 Local). Project period 6/1/85 to 12/21/89. Project consisted of alum addition for the control of phosphorus release from deep anoxic sediments. Monroe County also has developed a management plan for reducing urban and agricultural runoff impacts from the Lake's watershed.
- F. *Belmont Lake*, NYSOPR&HP, Suffolk County (\$290,000 Federal, \$290,000 State). Project

period 9/1/83 to 12/21/89. Restoration consists of removal of accumulated bottom sediment for control of the exotic plant fanwort (*Cabomba caroliniana*). The Lake is used extensively for boating, fishing, and aesthetic enjoyment.

- G. *Saratoga Lake*, NYSDEC, Saratoga County (\$339,241 Federal, \$180,000 State, \$159,241 Local). Project period 6/1/84 to 5/31/89. Project consists of water level control, agricultural runoff controls, aquatic vegetation harvesting, alum addition for nutrient inactivation, and formation of a lake management district. The Lake is an excellent warm water fishery with a severe infestation of Eurasian watermilfoil (*Myriophyllum spicatum*).
- H. *Van Cortlandt Park Lake*, City of New York (\$88,759 Federal, \$88,759 Local). Project period 6/1/86 to 5/31/92. Restoration was to consist of dredging to increase water depth, stormwater diversion and the use of existing wetlands to filter stormwater runoff. No work done due to City unable to come up with match for project.
- I. *Collins Lake*, Village of Scotia (\$221,821 Federal, \$110,000 State, \$111,821 Local). Project period 4/1/85 to 3/31/95. Project to include hydraulic dredging to increase water depth by 1 meter to reduce growth of the exotic plant Curlyleaf pondweed (*Potamogeton crispus*). The Lake is used extensively for swimming, boating and fishing.
- J. *Greenwood Lake*, Greenwood Lake Watershed Management District, Inc. (\$369,000 Federal, \$240,000 State, \$129,600 Local). Project period 6/26/89 to 9/30/95. Project to control aquatic vegetation and reduce nutrient loadings to the lake. Methods include drawdown, mechanical harvesting, stormwater management, development of a septic management district, fisheries survey, and a basin-wide sensitive lands management plan.
- K. *Lake George*, NYSDEC (\$367,390 Federal, \$367,390 State/Local). Project period from 6/26/89 to 5/31/93. Project includes aquatic plant management, critical land acquisition, and monitoring. An increase in federal funds for this project is currently being requested.

IV. Special Grants

- A. Water Quality Assessment Grant, NYSDEC (\$50,000 Federal, \$21,429 State). Project period from 9/1/94 to 8/31/96. A grant to assist DEC in the administration of its Lake Water Quality Assessment Program.
- B. Onondaga Lake Management Conference, NYSDEC (\$1,750,000 Federal, \$750,000 State). Project period from 6/26/89 to 9/30/94. A compilation/review of studies to determine additional monitoring necessary and what strategies would succeed in the restoration of Onondaga Lake.
- C. Lake Champlain Management Conference, NYSDEC (\$2,000,000 Federal, \$857,143 State). Project period from to 9/30/94. To convene a management conference to study and address the water quality concern in Lake Champlain. The project is conducted with the State of Vermont.
- D. TMDL-Mini Grant for In-Lake Sedimentation Study (\$15,000 Federal). Project Period 10/1/93 to 9/30/94. A grant to conduct sedimentation chemistry and rate studies on several lakes of various trophic conditions
- E. Nutrient Assessment Grants (two grants, total \$125,000 Federal, \$53,573 State). Project Period 7/1/98 to 9/30/00. A grant to assist DEC administration of its Nutrient Assessment Program.
- F. Nutrient Criteria Development Grant (\$30,000 Federal (EPA Regions I, II, and V), awarded to the NYS Federation of Lake Associations). Project Period 10/1/01-6/30/03. A grant to evaluate the use of lake perception data in developing nutrient criteria

Acidification of Lakes

The assessment of lakes and ponds for acidity in New York State is based upon a system to categorize waters as being in acceptable, threatened or impaired ("affected") condition as determined by midsummer

acidity levels (Pfeiffer and Festa, 1980). The system relates the environmental requirements for survival of endemic fish populations and current acidification status. The categories of pH are

Impaired condition	pH < 5.0 standard units
Threatened condition	pH ≥ 5.0 and ≤ 6.0 standard units
Acceptable condition	pH > 6.0 standard units

In previous 305(b) reports, the presence of a viable fish population also was used to determine acidity status. Although not a direct measure of trophic state, this classification provides important information about the concurrent use impairment due to the severity of the acidification problem.

A total of 1,850 lakes and ponds representing 503,400 acres have been assessed for acidity in New York State (not including Lake Ontario). Most of the information for the current evaluation came from the Adirondack Lakes Survey Corporation field investigations of 1,469 ponded waters between 1984 and 1987. The ELS waters were not sampled during midsummer and are not included in the current assessment. The 1,376 waters included in the current assessment from the ALSC report represent about 50 percent of the total number of water bodies in the Adirondack Region.

The results of the current assessment for acidity status based upon midsummer air-equilibrated pH values are outlined on Table 15 (with the ALSC data summarized in parentheses).

Table B-8 Assessment of Lake Acidification			
	Impaired	Threatened	Acceptable
Air-Equilibrated pH	< 5.0	5.0 - 6.0	> 6.0
Number of Lakes/Ponds	365 (326)	289 (257)	1184 (793)
Percent of Total Assessed	20% (24%)	16% (19%)	64% (58%)
Total Number of Lake Acres	7,210 (4,155)	16,374 (8,030)	436,311 (36,255)

The 365 ponded waters impaired by acidity represents about 20 percent of the total number of lakes, but less than 2% of the total surface area included in the current acidity status assessment.

The specific sources of acidity in the acid deposition that affects Adirondack lakes and ponds are the millions of tons of sulfur dioxide and oxides of nitrogen that are emitted annually into the atmosphere. Deposition of sulfate and nitric acid takes place in both "wet" (precipitation) and "dry" (direct deposition to the ground surface) forms.

Ohio, Pennsylvania and West Virginia, immediately southwest of New York State, are major contributors of sulfur dioxide. In previous years these three states together contribute 21 percent of the sulfur deposition at the Whiteface receptor, 23 percent at the western Adirondack receptor, and 36 percent at the Catskill

receptor. These three states, together with New York State, Ontario and Quebec at one time accounted for most of the sulfur dioxide emissions west of, and within, 1000 km of the Adirondacks, 68 percent of the deposition at Whiteface, 67 percent of the deposition in the western Adirondacks, and 68 percent of the deposition at the Catskill receptor. The remaining 30 percent of the deposition at these three receptors was contributed by several widely separated regions. New York State's contribution to total sulfur deposition at all receptors in New York State ranged from 14 percent to 31 percent.

The predominant contributors to oxides of nitrogen emissions are motor vehicles located in heavily urbanized areas. The largest non-New York contributors to the New York receptors are located immediately to the southwest of the State and include the western Pennsylvania, eastern Ohio, and West Virginia areas. This region contributes about 14 percent of the total emissions sources. The Canadian contribution to nitrate deposition at some receptors is considerably higher than that found for sulfate deposition, which reflects the influence of large Canadian metropolitan areas such as Montreal and Toronto. New York State's contributions to emissions in the general area at one time ranged from 2.6 percent at Muskoka, which is west of New York State, to 32 percent at Brookhaven on the eastern end of Long Island.

Based on ionic contributions and other evidence, acidification of waters in the Adirondacks has occurred primarily from the atmospheric deposition of sulfate. Higher concentrations of nitrate occur during events such as snowmelt and influence short-term changes in pH and ANC.

The NYSDEC began neutralizing certain acidic waters in 1959 as a management tool used to help restore or protect valuable fisheries. The neutralizing material used is agricultural limestone. The NYSDEC liming program has in recent years included 32 waters, all of which are located within the Adirondack Park. As another alternative to mitigate the harmful effects of high acidity, the Lake Acidification Mitigation Project (LAMP) conducted research on watershed liming to determine the effects of liming the entire ecosystem on the water chemistry, terrestrial vegetation and soil biota.

Mitigation Measures for High Phosphorus

More than 40 small lakes have been identified as impaired due to excessive nutrients, warranting their inclusion on the New York State Section 303(d) list. Most of these systems suffer from a lack of nutrient loading data, but most are also found within a single jurisdiction with relatively small watersheds. As such, nutrient loading to these systems could be modeled with relatively simple desk-top modeling programs, leading to the development of total maximum daily load (TMDL) calculations required for 303(d) listed waterbodies. The NYSDEC Division of Water, working with EPA and their consultants, identified candidate waterbodies for inclusion in a small lakes TMDL modeling project, and several representative lake watersheds for calibrating these models. The lack of event-based monitoring data for many of these systems resulted in the choice of a steady-state watershed and lake response model to characterize contemporary nutrient loading and lake conditions, and to predict lake response to changes in nutrient inputs.

The ArcView Generalized Watershed Loading Function (AVGWLF) model was used in combination with BATHTUB to develop three TMDLs for small lakes impaired by phosphorus. The approach employed by an EPA contractor consisted of using AVGWLF to determine mean annual phosphorus loading to the lake, and then using BATHTUB to define the extent to which this load must be reduced to meet the water quality target. This approach required no additional data collection thereby expediting the modeling efforts. These TMDLs did not involve any Waste Load Allocations.

The EPA contractor is also using the AVGWLF model to review watershed loads in several other impaired lakes. Most of these lakes have larger, more complicated watersheds and the TMDLs will need to set Waste Load Allocations for wastewater treatment discharges or Municipal Separate Storm Sewer Systems. This relatively simple, desktop, model-based approach will be adopted to address TMDL development for 40-50 small lake systems throughout New York State.

Mitigation Measures for High Acidity

1. Acid Rain Lakes Total Maximum Daily Load (TMDL)

About 400 waters are included on the New York State Section 303(d) list because of impairment to aquatic life support attributed to acid rain. The majority of these lakes were added to the list in 1998 and were based on chemistry and biologic data from the mid-1980s or prior. The focus of the Acid Rain Lakes restoration strategy/TMDL is limited to those affected lake waters that fall within New York State Adirondack Forest Preserve lands. The reason for limiting the universe of waters to be covered is due to the applicable water quality standards for these waters. The applicable pH standard for most waters outside the Forest Preserve lands is “not less than 6.5.” While this is a scientifically derived standard based on the support of aquatic life, it might not be a realistic standard for all waters of the Adirondacks, where natural limitations such as limited acid neutralizing capacity (ANC), soil characteristics, geology and hydrology and other considerations suggest some of these waters may have never attained a pH of 6.5. Even so, acid rain may still restrict aquatic life support in these waters.

The ultimate goal for all waters would be that they achieve all water quality standards for classified waters and support a full and diverse aquatic community. However, State water quality standards such as the pH standard of 6.5 have not been applied to waters within the Forest Preserve because of the alternative protection provided in Article 14 of the New York State Constitution. If State standards were applied, a TMDL would have to demonstrate that prescribed loading reductions could meet this standard. The lack of specific, numeric water quality standards for Forest Preserve Waters allows for some flexibility in developing interim TMDL endpoints.

The nature of the loading sources responsible for this impairment to New York State waters also complicates the loading reduction strategy called for in this restoration plan. Because significant sources lie outside New York State borders any effective loading reduction strategy must include national (regional) reduction efforts. Beyond any initial reductions, additional reductions are likely to be needed to attain water quality standards and restore uses of at least some of these waters. However the complexity of the transport, deposition, in-water effects and appropriate natural limitations – factors that vary somewhat across the range of 143 target waters – suggest that an incremental/phased approach is appropriate.

While retaining a minimum pH of 6.5 as the ultimate goal for these waters, this phased TMDL uses a hierarchy of interim aquatic life support thresholds. As the emission of acid rain precursors are reduced regionally, monitoring data will be used to assess pH recovery and aquatic life support, and to refine simulation models to see what additional reductions would be necessary to achieve further recovery and a higher level of aquatic life support. This iterative adaptive management cycle is an appropriate strategy to deal with the complexities of restoring these acid rain waters.

2. Northeast Regional Mercury (TMDL)

Seven states— New York, Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont—collaborated with the New England Interstate Water Pollution Control Commission (NEIWPCC) to produce the plan for reducing mercury in the waters of New York State and New England to eliminate fish consumption advisories caused by mercury from air deposition. In the Northeast, elevated levels of mercury in certain fish species, such as large and smallmouth bass and walleye, are of great concern. In New York, more than 80 water bodies have advisories for fish consumption based on elevated levels of mercury. While most of the waters are in the Adirondacks and Catskills, others such as parts of the Hudson and Susquehanna Rivers and Lake Champlain are also affected.

This Northeast regional TMDL will help address the link between mercury emissions and mercury pollution in water and highlights the need for implementation of a comprehensive, nationwide mercury reduction strategy that would improve the natural resources not only in New York, but in all states. The participating states believe that mercury deposition deserves to be a national priority, and requires federal programs to address it. The TMDL acknowledges the success of the Northeast states in eliminating many in-state sources of mercury contamination. Nearly a decade of work has resulted in regional reductions of greater than 70 percent in mercury emissions and discharges, including reductions in emissions from incinerators. As New York State continues to look for new ways to reduce in-state sources of mercury, the TMDL recognizes that the majority of mercury in state waters comes from out-of-state sources. The draft TMDL stipulates the amount by which mercury arriving in the region from out-of-state sources must be reduced if waters are to be removed from the impaired list and the fish consumption advisories rescinded.

The TMDL indicates that by reducing overall mercury deposition to the region by between 86 percent and 98 percent, fish-tissue mercury will decline to levels where fish advisories will no longer be required.

Assessment of Lake Water Quality Trends

The Inland Lakes and Freshwater Section has attempted to provide some preliminary assessments of long term water quality trends of the lakes in New York State. Such an assessment is ultimately limited by the relatively small number of lakes that have been sampled for a sufficient period of time (5-10) years to provide long-term trend analysis and dampen the interannual variability due to changing weather conditions, slight differences in sampling schedules, and other sampling artefacts. Moreover, questions about the

representativeness of the ambient monitoring programs datasets (as a cross section of all NYS lakes, or even lakes within a particular region, size range, or water quality classification) further limits the extrapolation of trend analyses within these datasets to assessments of trends within NYS lakes, however the latter may be defined. The EMAP Program was intended to support the collection of long-term baseline data to identify water quality trends. However, since this section of the report is dealing with water quality data collected primarily since 1982, the paucity of long-term data for the majority of state lakes precludes an adequate trend analysis.

Trend analyses can be attempted in a number of ways. Perhaps the simplest would be to evaluate changes in water quality indicators (trophic status, acidification status, etc.) over defined intervals, such as changes in these indicators by decade of sampling. The historical NYS dataset lends itself to this type of analysis, since many lakes were sampled on only a limited basis in relatively short-term water quality monitoring programs within each of the last four decades- the DEC and Eastern Lakes surveys of the 1970s, the ALSC, LCI and CSLAP programs in the 1980s, and the LCI, CSLAP, and Finger Lakes monitoring programs of the 1990s and 2000s.

Another method is traditional long-term data analyses on continuous datasets, such as those collected via CSLAP. At one time, the Citizens Statewide Lake Assessment Program monitored individual lakes for at least five year intervals. At the end of that time, individual lake associations were provided the option of monitoring the lake at their own expense (using the same sampling procedures, equipment, and laboratory for analyses) or be dropped from the program to include other lakes on the waiting list. Since a five year monitoring program does not generally provide the long-term data to provide a water quality trend, and due to funding restrictions within the program, participating lake associations assumed a portion (appx 5-15%) of the program costs beginning in 2002, and thus were provided opportunities to continue monitoring without five year sampling restrictions. It is anticipated that this may dramatically increase the number of lakes with continuous datasets and provide more years of water quality data for more rigorous trend analysis. At present, 138 CSLAP lakes have been sampled, at present, for at least five years under this program, with 38 lakes sampled for at least 10 years, and 9 lakes sampled for at least 15 years, although they may not have had contiguous records. In recent years, rudimentary statistical analyses have been conducted on individual CSLAP lakes. These analyses can be grouped to provide a summarized simple analysis of water quality trends in these lakes (and by extension a subset of NYS lakes) since the mid-1980s.

There are more than 230 lakes that have been sampled in two or more of the decades of the 1970s, 1980s, 1990s and 2000s (inclusive of 2006) by one or more of the above described monitoring programs and/or ambient water quality monitoring conducted by the NYSDEC during the 1970s but not summarized in this report. However, since many of these programs collected information on a subset of NYS lakes that may not be representative of the entirety of water resources in the state, such as the mostly acidified lakes sampled in the ALSC project, the larger public access lakes sampled in the LCI, and the mostly larger populated lakes sampled through CSLAP, comparing results from one program to the next (and therefore from one "decade" to the next) may not provide great insights about the recent historical condition of NYS lakes.

Among the lakes sampled in two or more decades since the early 1970s, the trophic condition of these lakes are described in Table 16. Trophic status in each decade was evaluated by evaluating the median value for the trophic indicators for the entire decade.

Review of the data in Table 16 shows that comparisons from one decade to the next are extremely difficult since only a small subset of lakes were sampled in the 1970s, 1980s, 1990s, and 2000s. However, with the

larger pool of lakes sampled from the 1970s to the 2000s, from the 1980s to the 2000s, and from the 1990s to 2000s, a tentative assessment of changing trophic status can be presented. This assessment is shown in Table 17.

Table B-9**Trophic Condition of Lakes from the 1970s through 2007**

Trophic Status Based on:	Oligotrophic	Mesotrophic	Eutrophic	Total Lakes/Ponds
1970s Lake Assessment *				
Total Phosphorus	14	9	19	42
Secchi	9	20	12	41
Chlorophyll	5	16	14	35
1980s Lake Assessment **				
Total Phosphorus	56	71	51	177
Secchi	29	108	40	178
Chlorophyll	12	51	30	93
1990s Lake Assessment ***				
Total Phosphorus	100	78	53	231
Secchi	39	130	61	230
Chlorophyll	48	122	61	231
2000s Lake Assessment****				
Total Phosphorus	43	43	26	112
Secchi	18	71	30	119
Chlorophyll	20	57	32	109
* Lakes sampled in the 1970s by the NYSDEC, and also sampled in the 1980s (by the CSLAP, LCI or ALSC programs) and/or in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs). ** Lakes sampled in the 1980s (by the CSLAP, LCI or ALSC programs) and in the 1970s by the NYSDEC, in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs) and/or in 2000 or 2001 via CSLAP or the LCI. *** Lakes sampled in the in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs), and in 1970s by the NYSDEC, the 1980s (by the CSLAP, LCI or ALSC programs) and/or in 2000 or 2001 via CSLAP or the LCI. **** Lakes sampled in 2000 -06 via CSLAP or the LCI and in the 1970s by the NYSDEC, in the 1980s (by the CSLAP, LCI or ALSC programs) and/or in the 1990s (by CSLAP, the LCI, EMAP and/or the AEAP programs).				

It appears that there is a trend toward decreasing productivity (trophy), particularly when evaluating total phosphorus concentrations, in the subset of commonly sampled lakes, although it is clear that the majority of these lakes did not change in trophic status over the twenty years of data collection. The discrepancy

between chlorophyll *a* and the other indicators reflects both the relative lack of chlorophyll *a* data from the 1980s (it was not collected through the ALSC project) and perhaps the greater consistency in the data collected in the 1990s (in which mean values may be unduly influenced by extremely high early and late summer readings, although this was somewhat accounted for by evaluating median values for these indicators). The large “drop” in trophy from the 1980s to the 1990s as assessed by total phosphorus concentrations may be due in part to questionable (overestimated) total phosphorus data from the ALSC (1980s) study. However, in comparing data from common lakes sampled in the LCI (1980s to 2000s) and CSLAP and AEAP programs (1980s to 2000s), where laboratory methodologies are consistent, 20-30% showed a decrease in trophic status (lower productivity) as determined by total phosphorus concentrations, while only 5-10% showed an increase. This may continue to represent decreases in nutrient concentrations in response to the phosphorus detergent ban instituted in the 1970s.

Table B-10 Trophic Condition of Lakes: 1970s to 2000s			
Change in Trophic Status Based on:	Increasing Productivity	Decreasing Productivity	No Change in Productivity / Trophic Status
1970s to 1990s Lake Assessment			
Total Phosphorus	5	12	24
Secchi	7	11	21
Chlorophyll	4	3	27
1970s to 2000s Lake Assessment			
Total Phosphorus	2	8	11
Secchi	4	5	14
Chlorophyll	2	3	14
1980s to 1990s Lake Assessment			
Total Phosphorus	11	41	110
Secchi	17	15	131
Chlorophyll	14	8	65
1980s to 2000s Lake Assessment			
Total Phosphorus	5	15	45
Secchi	11	4	56
Chlorophyll	10	13	27
1990s to 2000s Lake Assessment			
Total Phosphorus	7	9	90
Secchi	13	13	79
Chlorophyll	8	15	83

However, the decrease in trophy over this period, as evaluated by the total phosphorus (and to a lesser extent chlorophyll) data, does not appear to be borne out by changes (responses) in water clarity over this period. Most of the longer-term data sets indicate variable responses in water clarity, with trophic status decreasing (higher clarity) when evaluating the 1970s to 1990s datasets, but increasing (lower clarity) when evaluating the 1980s/90s to 2000s dataset. A closer evaluation of these datasets indicates that most of the decreases in water clarity do not appear to be statistically significant, but are large enough to move the median values for these lakes across the boundaries separating trophic categories (such as a drop in median water clarity from 5.1 meters to 4.9 meters).

Long-term trends can also be evaluated by looking at the summary findings of individual lakes from a consistent data set, such as CSLAP, and attempt to extrapolate consistent findings to the rest of the lakes. Given the non-Gaussian distribution of many of the water quality parameters evaluated in this report, non-parametric tools may be the most effective means for assessing the presence of a water quality trend. However, these tools do not indicate the magnitude of the trend. As such, a combination of parametric and non-parametric tools may need to be employed to evaluate trends.

The Kendall tau ranking coefficient has been utilized by several researches and state water quality agencies to evaluate water quality trends via non-parametric analyses. Kendall tau ranking orders paired observations by one of the variables (say arranging water clarity readings by date). Starting with the left-hand (say earliest date) pair, the number of times that the variable not ordered (in this case clarity readings) is exceeded by the same variable in subsequent pairs is computed as P, and the number of times in which the unordered variable is not exceeded is computed as Q. This computation is completed for each ordered pair, with N= total number of pairs, and the sum of the differences $S = \sum P-Q$. The Kendall tau rank correlation coefficient τ is computed as:

$$\tau = 2S/(N*(N-1))$$

Values for τ range from -1 (complete negative correlation) to +1 (complete positive correlation). As above, strong correlations (or simply “significance”) may be associated with values for τ greater than 0.5 (or less than -0.5), and moderate correlations may be associated with values for τ between 0.3 and 0.5 (or between -0.3 and -0.5), but the “significance” of this correlation must be further computed. Standard charts for computing the probabilities for testing the significance of S are provided in most statistics text books, and for values of N greater than 10, a standard normal deviate D can be computed by calculating the quotient

$$D = S\sqrt{18} / \sqrt{[(N(N-1)(2N+5)]}$$

and attributing the following significance:

$D > 3.29 = 0.05\%$ significance

$2.58 < D < 3.29 = 0.5\%$ significance

$1.96 < D < 2.58 = 2.5\%$ significance

$D < 1.96 = > 2.5\%$ significance

For the purpose of this exercise, 2.5% significance or less is necessary to assign validity (or, using the vernacular above, “significance”) to the trend determined by the Kendall tau correlation. It should be noted again that this evaluation does not determine the magnitude of the trend, but only if a trend is likely to exist.

Parametric trends can be defined by standard best-fit linear regression lines, with the significance of these data customarily defined by the magnitude of the best fit regression coefficient β or R^2). This can be conducted using raw or individual data points, or seasonal summaries (using some indicator of central

tendency, such as mean or median). Since the former can be adversely influenced by seasonal variability and/or imprecision in the length and breadth of the sampling season during any given year, seasonal summaries may provide more realistic measures for long-term trend analyses. However, since the summaries may not adequately reflect variability within any given sampling season, it may be appropriate to compare deviations from seasonal means or medians with the “modeled” change in the mean/median resulting from the regression analyses.

When similar parametric and non-parametric tools are utilized to evaluate long-term trends in NYS lakes, a few assumptions must be adopted:

- Using the non-parametric tools, trend “significance” (defined as no more than appx. 3% “likelihood” that a trend is calculated when none exists) can only be achieved with at least four years of averaged water quality data. When looking at all summer data points (as opposed to data averaging), a minimum of forty data points is required to achieve some confidence in data significance. This corresponds to at least five years of CSLAP data. The “lesson” in these assumptions is that data trends assigned to data sets collected over fewer than five years assume only marginal significance.
- As noted above, summer data only are utilized (as in the previous analyses) to minimize seasonal effects and different sampling schedules around the fringes (primarily May and September) of the sampling season. This reduces the number of data points used to compile averages or whole data sets, but is considered necessary to best evaluate the CSLAP datasets.

As of 2006, there were 157 CSLAP lakes that have been sampled for at least five years. Table 18 summarizes the “trend” indicated from the parametric and non-parametric analyses – the latter consists of both methods indicated in note 1) above, while the former consists of the best-fit analysis of summer (June 15 through September 15) averages for each of the eutrophication indicators (with trends attributable to instances in which deviations in annual means exceed the deviations found in the calculation of any single annual mean). As alluded to earlier, Table 18 includes only those lakes with more than four years of water quality data. When this method is applied to sampling parameters that are more characteristic of succession than cultural eutrophication, such as conductivity, a much higher percentage of significant change occurs (more than 20% of CSLAP lakes sampled for at least five years have exhibited a significant increase in conductivity), suggesting this methodology may be adequate to reveal significant changes. The decrease in chlorophyll *a* readings in the absence of decreasing nutrient concentrations suggests some localized management of algae, such as the use of algacides. However, some of the discrepancy between lower phosphorus and algae levels may reflect the shift in CSLAP laboratories after 2002- algae levels have been lower in many CSLAP lakes since the shift in laboratories.

These data suggest that while most NYS lakes have not demonstrated a significant change, those lakes that have experienced some change show a trend toward less productive conditions. The lesser significance associated with the chlorophyll *a* readings is probably the result of higher sample-to-sample variability associated with this analysis. There does not appear to be any obvious shared characteristics among these lakes. Some are highly productive, others are quite unproductive, some have been actively managed, some have been sampled for only a few years or are small shallow lakes or are located in the western part of the state, while others are just the opposite. As noted above, there does not appear to be any clear pattern between weather and water quality changes. However, all of these lakes may be the long-term beneficiaries of the ban on phosphorus in detergents in the early 1970’s, which with other local circumstances (perhaps locally more “favorable” weather, local management, etc.) has resulted in less productive conditions.

Table B-11 - Trends in Lake Water Quality

Water Quality Indicator	Number (%) of CSLAP Lakes	Acres of Lakes
Total Phosphorus		
Increasing	14 (9%)	17,200
Stable or Fluctuating	96 (56%)	44,900
Decreasing	17 (11%)	50,900
Trend Unknown	35 (24%)	30,500
Secchi Disk:		
Increasing	13 (8%)	55,300
Stable or Fluctuating	107 (61%)	61,800
Decreasing	13 (8%)	4,400
Trend Unknown	34% (22%)	21,700
Chlorophyll <i>a</i>:		
Increasing	7 (4%)	700
Stable or Fluctuating	90 (57%)	112,500
Decreasing	28 (18%)	11,300
Trend Unknown	32 (20%)	18,800

Appendix C

New York State Water Quality Assessment

2008 Groundwater Assessment

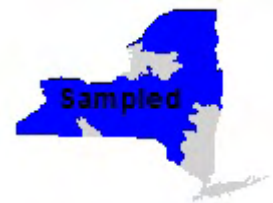
Groundwater Assessment

Each day, ground water directly touches the lives of approximately six million New York State residents, or about one-third of the state's population, as their source of residential drinking water using an estimated average 110 gallons per day each. This and an untold number of additional state and non-state residents also incorporate New York's ground water into their daily activities, while away from home, to an extent that is often unseen. This may include use at work, school, recreation, or leisure activities, and amounts associated with the manufacture or production of goods and services.⁹

New York's population dependence on ground water is considerable (Figure XX). Of New York State's 62 counties a total of 27 (44%) are more than half dependent on ground water for their combined public and self-supplied domestic water needs. Even more telling, seven counties (Cortland, Nassau, Queens, Suffolk, Schenectady, Chenango, and Tioga) representing a population of 5.3 million people, are more than 95% dependent on ground water.

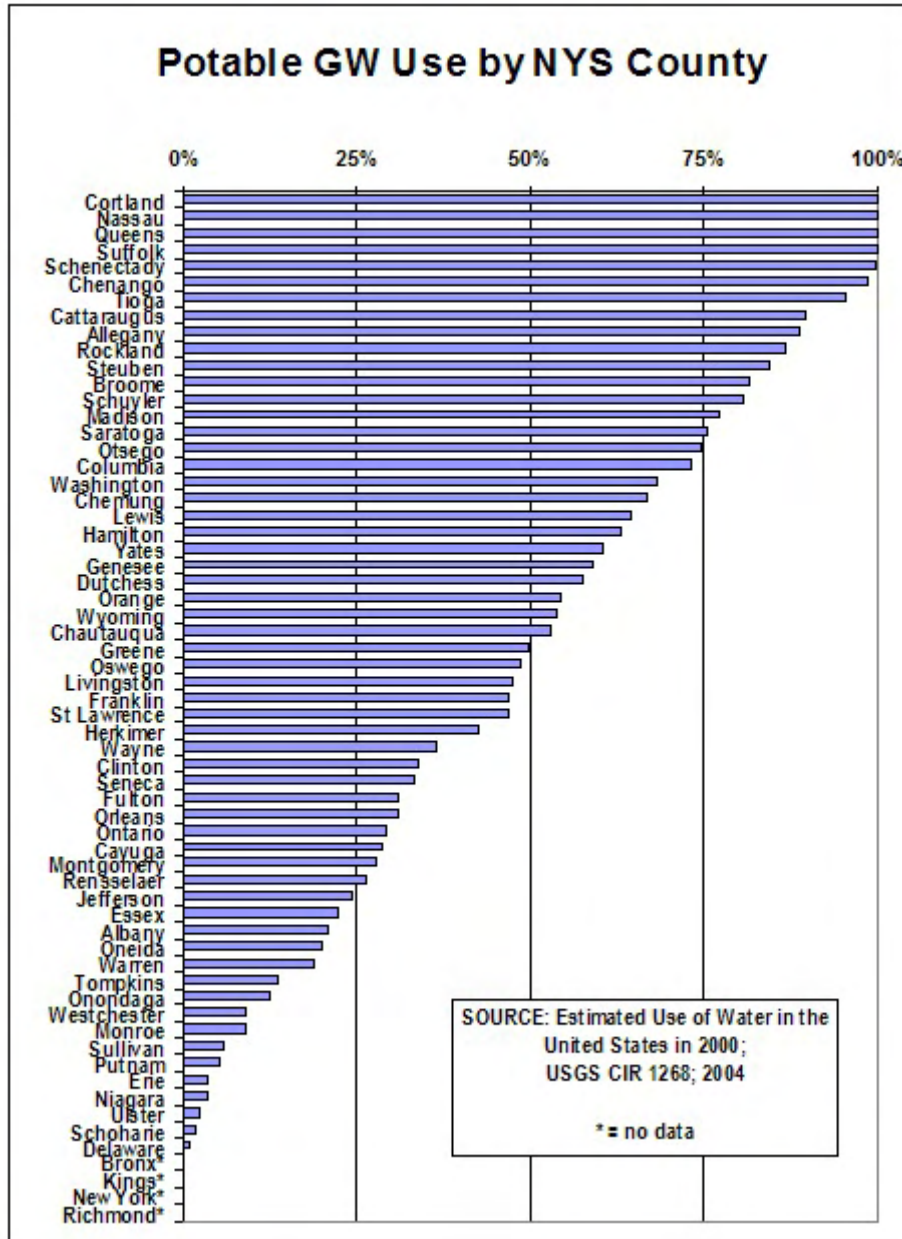
New York State's considerable dependence on ground water points out the critical need to protect the quality of this vital resource. The following sections focus on potential sources of contamination that commonly threaten ground water and the programs or activities New York State has established to minimize the effects these potential sources will have on the state's ground water resource. Finally, tables 19 and 20 provide a snapshot of the extent of ground water contamination in NYS as well as the ambient quality of ground water for a selected area of the state.

New York continues to make progress in assessing ambient ground water quality across the state through the establishment of a basin approach to ground water sampling. As with the surface water program, ground water sampling is planned for each of NY's 8-digit Hydrologic Unit Code (HUC) basins over a five year period. The studies are being conducted jointly with USGS. As of the start of 2008, New York has conducted ambient ground water quality monitoring in 36 of the state's 51 8-digit HUCs representing 77% of the state. A summary of individual studies for the 2003-2005 sampling efforts is included at the end of this chapter. Final reports for the 2006 studies are expected in the near future with 2007 study reports due out next year.



⁹ Estimated Use of Water in the United States in 2000; USGS CIR 1268; 2004

Figure C-1



Overview of Ground Water Contamination Sources

Table C-1 Major Sources of Ground Water Contamination

Contaminant Source	Ten Highest-Priority Sources (√) ⁽¹⁾	Factors Considered in Selecting a Contaminant Source ⁽²⁾	Contaminants ⁽³⁾
Agricultural Activities			
Agricultural chemical facilities			
Animal feedlots			
Drainage wells			
Fertilizer applications			
Irrigation practices			
Pesticide applications	√	A, B, E, H	A, B
On-farm agricultural mixing and			
Land application of manure			
Storage and Treatment Activities			
Land appl. (Regulated/ Permitted)			
Material stockpiles			
Storage tanks (above ground)			
Storage tanks (underground)	√	A, H	A, B, C, D
Surface impoundments			
Waste piles/ Waste tailings			
Disposal Activities			
Deep injection wells			
Landfills	√	A, E	C, D, H
Septic systems	√	A, B, H	E, J, L, C
Shallow injection wells			
Other			
Hazardous waste generators	√	A, H	C, D, H
Hazardous waste sites	√	A, E	C, D, H
Large industrial facilities			
Material transfer operations			
Mining and mine drainage			
Pipelines and sewer lines			
Salt storage and road salting			
Salt water intrusion			
Spills	√	A, H	A, B, C, D
Transportation of materials			
Urban runoff			
Small-scale manuf. / repair shops	√	A, H	C, D, H
Other sources (state added)			
Abandoned Oil & Gas Wells	√	A, E	D
Radon	√	A, B, F	I

Notes for Table C-1

1. A check (✓) indicates up to ten contaminant sources identified as highest priority in New York State. Ranking is not indicated.
2. Factor(s) used to select each of the contaminant sources, denoted by corresponding letter (A through I) and listed in order of importance. Additional or special factors of importance within New York State are described in accompanying narrative.

- | | |
|---|--|
| A. Human health / environmental risk (toxicity) | E. Hydrogeologic sensitivity |
| B. Size of the population at risk | F. State findings, other findings |
| C. Location of the sources relative to drinking water sources | G. Documented from mandatory reporting |
| D. Number / size of contaminant sources | H. Geographic distribution / occurrence |
| | I. Other criteria (Described in the narrative) |

3. Contaminants/classes of contaminants considered associated with each of the sources checked. Contaminants/contaminant classes are selected based on data indicating that certain chemicals or classes of chemicals may be originating from an identified source. Contaminants/classes of contaminants denoted by corresponding letter below (A through M).

- | | |
|-------------------------|-----------------------------------|
| A. Inorganic pesticides | H. Metals |
| B. Organic pesticides | I. Radio-nuclides |
| C. Halogenated solvents | J. Bacteria |
| D. Petroleum compounds | K. Protozoa |
| E. Nitrate | L. Viruses |
| F. Fluoride | M. Other (Described in narrative) |
| G. Salinity/brine | |

Discussion of Ground Water Contamination Sources

AGRICULTURAL ACTIVITIES

AGRICULTURAL CHEMICAL FACILITIES -

- EPA defines agricultural chemical facilities as those having a Standard Industrial Classification (SIC) code of 3253 under the new North American Industrial Classification System (NAICS). This code refers to the manufacturing and production of fertilizers, pesticides and other miscellaneous agricultural chemicals. The latest Economic Census (2002) from the U.S. Census Bureau (www.census.gov/econ/census02) shows 26 facilities in New York. This is further broken down to: two fertilizer manufacturing facilities, 18 fertilizer mixing only facilities, and six pesticide & other agricultural chemical manufacturing facilities.
- Level of Concern – Low
- Scope of Concern - Regional

ANIMAL FEEDLOTS -

- CONCENTRATED ANIMAL FEEDING OPERATION (CAFO) – Since 1999, NYS law has required Animal Feeding Operations (AFO) with animal numbers above designated values (e.g. 200 mature dairy cows, 300 beef cattle or heifers) to apply for a pollution discharge general permit from DEC. Each permit requires a Comprehensive Nutrient Management Plan (CNMP) prepared by a NRCS certified planner. Those AFOs not required to obtain a discharge permit are encouraged to participate in a voluntary assessment program and also implement a voluntary CNMP. This activity remains a concern due to the number of facilities exempt from CAFO requirements.
- Level of Concern – Intermediate
- Scope of Concern - Regional

DRAINAGE WELLS –

- A drainage well is one example of a Class V injection well as designated by EPA’s Underground Injection Control (UIC) program. Drainage wells include agricultural, storm water, or other special types of drainage wells. These wells are typically used to inject (dispose of) excess untreated surface and subsurface water. Such waters often contain contaminants that exceed New York State’s water quality discharge standards. Primacy for the UIC program in NYS remains with USEPA. Storm water drainage wells are “authorized by rule,” which means they may be operated without an individual permit so long as the injection does not endanger an aquifer.
- Level of Concern – Intermediate
- Scope of Concern – Regional

FERTILIZER APPLICATIONS -

- Much of NYS remains in use for agricultural purposes. Impacts to ground water from the use of agricultural fertilizers remains a concern largely due to their widespread use. Increasingly, there is also concern for residential lawn fertilizing whether by the homeowner or by a lawn care service. Results from DEC’s ambient groundwater monitoring program, beginning in 2002, have found relatively low detectable levels of nitrate in wells sampled (see table below). With one exception, all results were below the current MCL of 10 mg/L. (These results may not exclusively represent contributions from fertilizers).

Study Basin (HUCs)	Study Year	Wells Sampled	Nitrate > 10 mg/L*	Nitrite > 1 mg/L*	Nitrite plus Nitrate > 10 mg/L*	Nitrite plus Nitrate > 1 mg/L
Mohawk R. (02020004)	2002	23	0	0	0	8
Chemung R. (02050105)	2003	37	0	0	0	11
Lake Champlain (02010001, 02010004, 02010006)	2004	22	0	0	0	4
U. Susquehanna R. (02050101, 02050102, 02050103)	2004	33	1	0	1	16
Delaware R. (02040101, 02040102, 02040104)	2005	19	0	0	0	6
St. Lawrence R. (04150301 through 04150307)	2005	25	0	0	0	2
Genesee R. (04130002, 04130003)	2005	22	0	0	0	5

* The MCL for Nitrate is 10 mg/L, for Nitrite is 1 mg/L, for Nitrite plus Nitrate is 10 mg/L

- Level of Concern – Low
- Scope of Concern – Regional

IRRIGATION PRACTICES -

- Concerns for ground water contamination related to irrigation practices potentially involve induced capture of pesticides or nutrients applied to farmlands. A combination of high ground water pumping rates in areas immediately adjacent to farmlands and excessive watering may serve to pull contaminants deeper into aquifers than would otherwise happen. The latest available USGS water use data (2000) ranks NYS 35th in the nation (including several US territories) in terms of groundwater use for irrigation. USGS estimates 23.3 mgd of groundwater is used for irrigation in NYS compared with 11,600 mgd of groundwater for the highest irrigation use state. Overall, this activity is not believed to be a significant concern.
- Level of Concern – Low
- Scope of Concern – Regional

PESTICIDE APPLICATIONS -

- Pesticides, including insecticides, fungicides, herbicides, and other subcategories, remain in widespread use in agricultural, commercial, residential and other parts of society. Results from DEC's ambient groundwater monitoring program, beginning in 2002, have found detectable levels of pesticides or degradates on average in nearly one of every two wells sampled (see table below). Regionally, northern NY is below this average while the Chemung & Upper Susquehanna basins are above. All results were below current state & federal drinking water MCLs however their prevalence is worth noting. There is continuing high concern for the overuse or misuse of pesticides and the potential for groundwater contamination.

Study Basin (HUCs)	Study Year	Wells Sampled	Wells With Detectable Pesticide Levels
Mohawk R. (02020004)	2002	23	12
Chemung R. (02050105)	2003	27	16
Lake Champlain (02010001, 02010004, 02010006)	2004	22	7
U. Susquehanna R. (02050101, 02050102, 02050103)	2004	33	20
Delaware R. (02040101, 02040102, 02040104)	2005	19	10
St. Lawrence R. (04150301 through 04150307)	2005	25	4
Genesee R. (04130002, 04130003)	2005	22	12

- Level of Concern – **High**
- Scope of Concern - Statewide

ON-FARM AGRICULTURAL MIXING AND LOADING PROCEDURES -

- NYS's Agricultural Environmental Management (AEM) Program was enacted through state legislation in August of 2000, under the State Soil and Water Conservation Committee, to assist farmers in identifying and correcting environmental risks associated with farming. As part of the AEM program a guidance worksheet was developed in 2001 specifically dealing with Pesticide Storage, Mixing & Loading. The guidance references and incorporates standards developed by NRCS for agri-chemical mixing facilities. This information is disseminated through 58 County Soil and Water Conservation Districts representing all of NYS. This activity remains of moderate concern.
- Level of Concern – Intermediate
- Scope of Concern – Statewide

LAND APPLICATION OF MANURE (UNREGULATED) -

- Land application facilities for animal manure and associated bedding material are exempt from NYS solid waste regulations. Facilities of sufficient size to be regulated as Concentrated Animal Feeding Operations (CAFOs) would however require an Agricultural Waste Management Plan (AWMP) prepared by an NRCS certified planner.
- Other wastes, not considered manure, which are also exempt from land application regulations include: food processing wastes that are visually recognizable as a part of a plant or vegetable, aquatic plants or a combination of such wastes, and leaves and/or grass. This exemption contains numerous requirements including minimizing impacts to ground water.
- Concern remains for facilities not regulated as CAFO's and possibly non-manure land application of materials containing pesticides or nutrients.
- Level of Concern – Intermediate
- Scope of Concern - Regional

STORAGE AND TREATMENT ACTIVITIES

LAND APPLICATION (REGULATED OR PERMITTED) -

- Land application and associated facilities for disposal of septage, nonrecognizable food processing wastes or fish hatchery waste is regulated by NYS through DEC's solid waste program.
- Level of Concern – Low
- Scope of Concern - Regional

MATERIAL STOCKPILES -

- Salt storage stockpiles are dealt with as a concern elsewhere in this section.
- Mined products stockpiles are regulated by DEC. Each mining permit application requires consideration for the potential of ground water contamination from stockpiles.
- Stockpiles that may be of concern for ground water contamination include treated woods. Although the use of CCA is no longer allowed, continuous stockpiling of other unprotected treated woods may be a concern especially at wood treatment facilities. New York's Inactive Hazardous Waste Registry currently includes a former lumber pressure treatment facility (NY Id 401046) with a hazard classification of 02, which indicates a significant threat.
- Level of Concern – Intermediate
- Scope of Concern – Statewide

STORAGE TANKS (ABOVE GROUND) -

- PETROLEUM TANK REGISTRATION – Since 1986, NYS law has required owners of petroleum tanks with a combined storage capacity of more than 1,100 gallons to register as petroleum storage facilities with DEC. This law applies to both aboveground and underground tanks. Facilities must re-register every five years. Owners are subject to construction, operation, and maintenance requirements. Concern remains for aboveground tanks currently exempt from regulation.
- CHEMICAL TANK REGISTRATION – Since 1989, NYS law has required owners of any underground tank of any size or aboveground stationary storage tanks equal to or greater than 185 gallons capacity, that store a defined hazardous substance, to register each with DEC. Concern remains for aboveground tanks currently exempt from regulation.
- Level of Concern – **High**
- Scope of Concern - Statewide

STORAGE TANKS (UNDERGROUND) -

- PETROLEUM TANK REGISTRATION – See PETROLEUM TANK REGISTRATION under 'STORAGE TANKS (ABOVE GROUND)'. Concern remains for underground tanks currently exempt from regulation.
- CHEMICAL TANK REGISTRATION – See CHEMICAL TANK REGISTRATION under 'STORAGE TANKS (ABOVE GROUND)'. Concern remains for underground tanks currently exempt from regulation.
- Level of Concern – **High**
- Scope of Concern - Statewide

SURFACE IMPOUNDMENTS -

- DEC regulations allow water impoundments to be constructed and used during mining activities however any discharge of water to either surface or subsurface waters must meet NYS water quality standards.
- DEC regulations allow the use of surface impoundments at facilities that treat, store or dispose of hazardous waste provided they are designed, constructed and installed to prevent any migration of wastes.
- DEC regulations allow the use of surface impoundments for treatment of solid waste provided they are located, designed, and operated so as to assure that there will be no migration of any hazardous constituent into ground water or surface water at any future time.
- DEC regulations allow the use of surface impoundments for treatment of municipal wastewater as outlined in Recommended Standards For Wastewater Facilities³. Construction standards include the sealing of cells to prevent seepage loss. Standards also require assessment of industrial wastes for possible pretreatment prior to this method of treatment.

³ Recommended Standards For Wastewater Facilities, Great Lakes - Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers, 1997

- DOH regulations do not allow the use of surface impoundments for individual wastewater treatment systems.

This activity is of low concern due to the amount of regulatory oversight.

- Level of Concern – Low
- Scope of Concern – Statewide

WASTE PILES -

- Regulations require piles of material classified as hazardous waste must be covered and bottom lined to prevent the migration of hazardous constituents.
- WASTE TIRES – Although waste tires do not pose a direct significant threat to ground water, there is increasing concern for waste tire fires and the associated toxic materials released to the environment, including ground water, during such an event. Since 1989 there have been at least 17 major waste tire fires in NYS consuming over 3 million tires. Waste tires have been regulated in NYS, as solid waste, since 1988 however there remains a concern for waste tire stockpiles.
- Level of Concern – Intermediate
- Scope of Concern - Statewide

WASTE TAILINGS -

- Since at least 1991 NYS regulations have required mining applications to include, among other things, the proposed location(s) and size of mineral and spoil storage areas along with existing or proposed drainage and water control features. Each application must also include proposed methods of pollution prevention. Due to the regulatory requirements involved in this activity, concern for ground water contamination is low for newer activities and high for activities that predate 1991.
- Level of Concern – Low / **High**
- Scope of Concern – Regional

DISPOSAL ACTIVITIES

DEEP INJECTION WELLS -

- Currently there are seven brine disposal wells, greater than 500 feet deep, permitted for use in six western or central NY counties (Genesee, Wyoming, Cayuga, Livingston, Steuben, and Allegany). Of those, four are associated with oil & gas production, two with gas storage operations, and the last with cavern construction. Rigorous construction, operation, and closure regulations are in place for brine disposal wells. Wells less than 500 feet are not permitted for use in brine disposal.
- There are no other deep wells in NYS where a permit has been approved for disposal of untreated waste.
- Level of Concern – Low
- Scope of Concern - Regional

LANDFILLS -

- Landfills, including Construction & Demolition (C&D) Debris Landfills, have extensive NYS siting, design, operating and monitoring requirements. The last unlined landfill operating in New York State was closed in 2001. New, unlined landfills have not been issued permits to operate in NYS since 1988. Landfills constructed since then therefore do not pose the same threat to ground water as previous unlined facilities. Numerous older, closed landfills continue however to pose a threat to ground water. Currently, 120 former landfill sites are listed in the State Superfund Program.
- Level of Concern – **High**
- Scope of Concern - Statewide

SEPTIC SYSTEMS -

- Septic systems must be properly sited, designed, constructed, maintained and used in order to prevent ground water contamination. Procedures are in place at state and local levels to address the first three issues. Maintenance and use of Onsite Wastewater Treatment Systems (OWTS) usually falls to the discretion of each owner. Neglect, careless or intentional misuse of an OWTS remains a concern throughout the state.
- Level of Concern – **High**

- Scope of Concern - Statewide

SHALLOW INJECTION WELLS -

- Some geothermal well systems employ an ‘open loop’ design that involves return of water by way of a shallow injection well. This activity is reviewed by DEC to determine if a discharge permit is required. Where it can be demonstrated that the initial water quality meets discharge standards and nothing will be substantially added during use, the system is not required to obtain a discharge permit. The system owner is however advised of and referred to EPA’s Underground Injection Control (UIC) program. All other types of shallow injection wells are likewise referred to EPA’s UIC program.
- Level of Concern – Low
- Scope of Concern - Statewide

OTHER

HAZARDOUS WASTE GENERATORS -

- DEC has established three categories of hazardous waste generators: New York State Conditionally Exempt Small Quantity Generators (NYCESQGs), Small Quantity Generators (SQGs), and Large Quantity Generators (LQGs). Hazardous waste generation is categorized by DEC as either aqueous, or non-aqueous hazardous waste. In 2000 an estimated 72.0 million tons of aqueous hazardous waste was generated in NYS. In the same year, 836.8 thousand tons of non-aqueous hazardous waste was generated in NYS. Although 2% of LQGs accounted for 90% of this total, a significant amount of hazardous waste is generated by the remaining regulated community as well as those not subject to regulations. Concern remains high for this activity due to the widespread occurrence of generators and the human health risks of the wastes generated.
- Level of Concern – **High**
- Scope of Concern - Statewide

HAZARDOUS WASTE SITES -

- New York State currently has (as of March 1, 2008) a list of Inactive Hazardous Waste Sites (IHWS) totaling 852. Sites are ranked from Class 1, (posing imminent danger) to Class 5 (completely remediated). DEC’s website database of inactive hazardous waste sites has a breakdown as follows: Class 1 sites = 0; Class 2 sites = 502; Class 3 sites = 77; Class 4 sites = 257; Class 5 sites = 16. Class 5 sites are eventually delisted from the site registry and noted as a class C. This total includes 86 federal NPL sites.
- MANUFACTURED GAS PLANT (MGP) SITES – Currently approximately 200 sites have been identified as former MGP sites needing action. At this time it is estimated there is a total of roughly 300 former MGP sites in NYS. Manufactured gas plants operated in many cities and towns across New York, primarily during the 1850s to 1950s. The plants converted coal, or a combination of coal, oil and water, into a gas product used for lighting and heating. The potential wastes and substances of concern at former MGP sites may include coal, ash, cinders, coal tars, coal tar-related liquids and sludges, and gas purification wastes. Such materials may contain various organic and/or inorganic chemicals that are classified as hazardous substances or potentially regulated solid waste under State and Federal laws.
- Level of Concern – **High**
- Scope of Concern - Statewide

LARGE INDUSTRIAL FACILITIES -

- Large industrial facilities can pose a threat to ground water in numerous ways. Often however they involve activities for which they are regulated in some manner whether it be storage, treatment, disposal, or generation of materials and wastes. For this reason these facilities are not a high concern.
- Level of Concern – Intermediate
- Scope of Concern - Statewide

MATERIAL TRANSFER OPERATIONS -

- Concerns associated with this activity center on spills, see section on *SPILLS* for discussion of concerns.
- Level of Concern – **High**
- Scope of Concern - Statewide

MINING AND MINE DRAINAGE -

- NYS regulations require discharges from mining operations must meet established water quality requirements including ground water. Due to existing regulatory programs, this activity is of lower concern for ground water contamination.
- Level of Concern – Low
- Scope of Concern - Statewide

PIPELINES AND SEWER LINES –

- PIPELINES - Individual product pipelines that traverse large portions of NYS generally carry natural, propane or similar gas products. One major petroleum pipeline serves the NYC/NY-NJ Harbor area (details are no longer publicly available). Due to the types of products handled or the low occurrence of petroleum pipelines traversing the state, this activity is not a significant ground water contamination concern.
- SEWER LINES – Sewer lines are found in NYS communities of all sizes. Systems are commonly operated by gravity feed or at relatively low pressure. Forced mains are also used in some areas or from collection points to treatment plants. The frequency of ground water contamination from sewer lines is believed to be low in NYS however this is difficult to confirm. The potential for contamination is higher for forced mains however any such occurrence is usually detected and corrected quickly. Generally, sewer areas are also served by public water. This greatly reduces the potential of private well contamination.
- Level of Concern – Low
- Scope of Concern - Statewide

SALT STORAGE AND ROAD SALTING –

- A 1991 report from the National Research Council⁴ suggests NYS may lead the nation in the total amount of salt used for roadway deicing with 450,000 tons used annually. A comparison of usage per road mile was not provided. To lessen the impacts of road salt the State Department of Transportation (DOT) has established recommended storage and handling procedures for its facilities including covered storage structures and, when needed, the use of temporary covering measures. Some concern remains for this activity due to the amount used and its continuing impact on aquifers and at times, drinking water supplies.
- Level of Concern – Intermediate
- Scope of Concern – Statewide

SALT WATER INTRUSION -

- Salt water intrusion has long been recognized as an important issue in the coastal New York counties of Nassau, Suffolk, Kings (Brooklyn) and Queens which are heavily dependent on ground water. Some additional concerns exist in isolated areas of the state where ground water encounters salt deposits at relatively shallow depths.
- Level of Concern – Intermediate
- Scope of Concern - Regional

SPILLS

- There were 15,085 spills reported to DEC during 2007. This compares to 16,784; 16,084, 15,713; 15,522; 14,915; 14,564; and 16,522 for the years 2006 - 2000 respectively. These totals reflect a wide range of volumes and materials spilled as well as the manner of spills and the resulting response. Although many spills were small, contained, or quickly cleaned up, the overall number, volume, materials involved, and their possible effect on ground water, remain a high concern.
- Level of Concern – **High**
- Scope of Concern - Statewide

TRANSPORTATION OF MATERIALS -

- Risks to ground water associated with the transportation of materials are discussed in several other sections. See

⁴ Special Report 235; Highway Deicing, Comparing Salt and Calcium Magnesium Acetate; Transportation Research Board, National Research Council; 1991

sections regarding *SPILLS, PIPELINES AND SEWER LINES*, and *MATERIAL TRANSFER OPERATIONS*.

- Level of Concern – **High**
- Scope of Concern - Statewide

URBAN RUNOFF -

- Urban runoff is generated from nonporous surfaces like roads, bridges, parking lots, and buildings. Examples of urban runoff contaminants of concern include: oil; grease; toxic chemicals; nutrients; pesticides; pathogens; road salts; and heavy metals. This activity is already recognized as a significant concern to surface water quality. With increasing use of designed infiltration areas, storm water collection basins, or constructed wetlands there is concern that these vegetated areas will not be able to sufficiently treat or store runoff contaminants allowing their passage to ground water. There is additional concern for ground water contamination where natural or constructed infiltration areas are not vegetated, properly maintained, or the vegetation has been degraded from excessive pollutant loads.
- Level of Concern – Intermediate
- Scope of Concern - Statewide

SMALL-SCALE MANUFACTURING AND REPAIR SHOPS –

- Small-scale manufacturing and repair shops, like large industrial facilities, can pose a threat to ground water in numerous ways. Small-scale facilities however may not be subject to the same level of regulatory oversight. They are also less likely to have dedicated staff, programs, or advanced methods and training in the prevention of ground water pollution. There is a higher concern for this activity for these reasons as well as their higher geographic occurrence throughout the state.
- Level of Concern – **High**
- Scope of Concern - Statewide

OTHER SOURCES

ABANDONED OIL & GAS WELLS –

- Drilling for oil & gas in NYS has occurred since the early periods of exploration in the U.S. During much of that time proper well abandonment was not performed once wells were no longer in use. This has resulted in the improper abandonment of potentially tens of thousands of oil & gas wells from the western most regions of NYS to the eastern areas of Lake Ontario. Concern for ground water contamination involves the uncontrolled vertical migration of hydrocarbons & other associated contaminants by way of the abandoned bore hole.
- Level of Concern – **High**
- Scope of Concern - Regional

Overview of State Ground Water Protection Programs

Table C-2 Summary of State Ground Water Protection Programs

Programs or Activities	Check (✓) ⁽¹⁾	Implementation Status ⁽²⁾	Responsible State Agency ⁽³⁾
Active SARA Title III Program	✓	Fully established	NYSEMO*, NYSDEC
Ambient ground water monitoring system	✓	Continuing efforts	NYSDEC, USGS
Aquifer vulnerability assessment	✓	Continuing efforts	NYSDEC
Aquifer mapping	✓	Continuing efforts	USGS, NYSDEC
Aquifer characterization	✓	Continuing efforts	USGS, NYSDEC
Comprehensive data management system	✓	Continuing efforts	NYSDEC
Ground water discharge permits	✓	Fully established	NYSDEC
Ground water Best Management Practices	✓	Continuing efforts	NYSDEC
Ground water legislation	✓	Continuing efforts	Various agencies
Ground water classification	✓	Fully established	NYSDEC
Ground water quality standards	✓	Fully established	NYSDEC

Interagency coordination for ground water protection initiatives	✓	Continuing efforts	NYSDEC
Nonpoint source controls	✓	Continuing efforts	NYSDEC* NYSAGMKT
Pesticide State Management Program	✓	Fully established	NYSDEC
Pollution Prevention Program	✓	Fully established	NYSDEC
Resource Conservation and Recovery Act(RCRA) Primacy	✓	Fully established	NYSDEC
Source Water Assessment Program	✓	Fully established	NYSDOH*, NYSDEC
State Superfund	✓	Fully established	NYSDEC
State RCRA Program incorporating more stringent requirements than RCRA Primacy	✓	Fully established	NYSDEC
State septic system regulations	✓	Fully established	NYSDOH*, NYSDEC
Underground storage tank installation Requirements	✓	Fully established	NYSDEC
Underground Storage Tank Remediation Fund	✓	Fully established	NYSOSC*, NYSDEC NYSOAG
Underground Storage Tank Permit Program	✓	Fully established	NYSDEC
Underground Injection Control Program	✓	Fully established	USEPA
Vulnerability assessment for drinking water/wellhead protection	✓	Continuing efforts	NYSDOH*, NYSDEC
Well abandonment regulations	✓	Continuing efforts	NYSDOH*, NYSDEC
Wellhead Protection Program (EPA- approved)	✓	Fully established	NYSDOH*, NYSDEC
Well installation regulations	✓	Fully established	NYSDOH
OTHER NYS PROGRAMS OR ACTIVITIES			
Freshwater Wetlands Program	✓	Fully established	NYSDEC, USACE
Drinking Water State Revolving Fund (SRF)	✓	Continuing efforts	NYSEFC*, NYSDOH
Clean Water State Revolving Fund (SRF)	✓	Continuing efforts	NYSEFC*, NYSDEC
Clean Water/Clean Air Bond Act	✓	Continuing efforts	NYSDEC

NYSDEC - New York State Department of Environmental Conservation

NYSEFC - New York State Environmental Facilities Corporation

NYSDOH – New York State Department of Health

NYSTAX – New York State Department of Taxation and Finance

NYSAGMKT - New York State Department of Agricultural & Markets

NYSGOSC - New York State Governor's Office for Small Cities

NYSEMO - New York State Emergency Management Office

USACE - United States Army Corp of Engineers

NYSOSC – New York State Office of the State Comptroller

USEPA – United States Environmental Protection Agency

NYSOAG – New York State Office of Attorney General

USGS - United States Geological Survey

Notes for Table C-2

1. A check (✓) after a program or activity in Table C-2 indicates existing applicable State program or activity.

2. Implementation status for each of the programs. Terms used to describe implementation status include "not applicable", "under development", "under revision", "fully established", "pending", or "continuing efforts". Implementation status of special programs or activities and the terms used are discussed in the accompanying narrative.
3. State agency, bureau, or department responsible for implementation and enforcement of the program or activity. The lead agency is indicated by an asterisk (*) where multiple agencies are involved in the implementation and enforcement of a program or activity.

Discussion of State Ground Water Protection Programs

ACTIVE SARA TITLE III PROGRAM – SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) was passed as part of the 1986 federal Superfund Amendments and Reauthorization Act (SARA). This act has four major provisions: Emergency planning; Emergency release notification; Hazardous chemical storage reporting requirements; and Toxic chemical release inventory. The NYS Emergency Management Office is the lead agency for New York's EPCRA program. One portion of SARA Title III, the TRI program, is handled by DEC. The state EPCRA requirements are fully established and active. [For further information, go to: www.semo.state.ny.us/programs/serc/ , www.dec.ny.gov/chemical/8434.html]

AMBIENT GROUND WATER MONITORING SYSTEM – In 2001 DEC's Division of Water initiated a pilot ambient ground water monitoring program with the goal of establishing a continuing yearly sampling program based on the Division's Rotating Intensive Basin Study (RIBS) surface water monitoring program schedule. The pilot focused on the Mohawk River basin and was conducted as a cooperative effort with the U.S. Geological Survey (USGS). Sampling by USGS personnel occurred in 2002. The following year, a similar effort was conducted in the Chemung River basin. In 2004, a more extensive effort was conducted in the Lake Champlain and Upper Susquehanna River basins. In 2005, groundwater studies were conducted in the St. Lawrence, Delaware, and Genesee River basins. Analytical results for each of these studies is available online through the USGS National Water Information System (NWIS). Data reports are also available from USGS for these study efforts. For 2006 & 2007, studies were conducted in the Allegheny River, Lake Erie, Western Lake Ontario, Mohawk River; Finger Lakes and Upper Hudson River basins. Analytical results and data reports are expected to be available through USGS approximately 1-2 years following completion of respective studies. The Division of Water expects to continue its ambient ground water monitoring program with plans to conduct ground water sampling efforts in two or three major basins each year with the goal of fully assessing the state every five years. [For further information, go to: www.dec.ny.gov/lands/36117.html , nwis.waterdata.usgs.gov/ny/nwis/qwdata]

AQUIFER VULNERABILITY ASSESSMENT - Aquifer vulnerability assessment is required as part of New York's State Environmental Quality Review Act (SEQR) which became effective in November of 1978. This law requires all state and local government agencies to consider environmental impacts whenever they must approve or fund a privately or publicly sponsored action. It also applies whenever an agency directly undertakes an action. [For further information, go to: www.dec.state.ny.us/website/dcs/seqr]

AQUIFER MAPPING – DEC's aquifer mapping and ground water resource evaluation cooperative effort with USGS dates back to the Department's predecessor, the NYS Water Resources Commission. This effort is expected to continue with approximately one mapping effort undertaken every two years. Consideration is given to population served, resource magnitude, and growth pressures when choosing subsequent mapping efforts. [For further information, go to: www.dec.ny.gov/lands/36118.html]

AQUIFER CHARACTERIZATION – Aquifer characterization is accomplished in conjunction with DEC's cooperative aquifer mapping effort with USGS (see AQUIFER MAPPING section above). Typical information includes material type (i.e. sand & gravel, lacustrine, etc), potential yields, aquifer thickness, and cross sections. Aquifer characterization is expected to continue with mapping efforts of approximately one every two years.

COMPREHENSIVE DATA MANAGEMENT SYSTEM – Ground water data management is a challenging issue due to the numerous programs involved in groundwater data collection and use. DEC has been working both internally and with outside agencies to create a dedicated data system incorporating remedial program data, public water supply and water well reporting data along with other appropriate data. One example of this effort is the current or planned establishment of network nodes at DEC and DOH.

GROUND WATER DISCHARGE PERMITS – DEC has had an approved NPDES pollutant discharge permit program since 1975 and an approved General Permit program since 1992. Although the NPDES program does not require NPDES permits for discharges to ground water, DEC maintains stringent requirements as part of its permitting process for discharges greater than 1,000 gpd to ground water. Discharges to ground water less than 1,000 gpd are generally residential systems, which are handled through state & local health departments. [For further information, go to: www.dec.ny.gov/permits/6054.html , cfpub.epa.gov/npdes/]

GROUND WATER BEST MANAGEMENT PRACTICES (BMPs) – Ground Water Best Management Practices include methods, measures or practices suggested or selected for use in protecting ground water. They include structural and nonstructural controls, operation, or maintenance procedures. DEC has developed a catalog of management practices as part of its Nonpoint Source Management Program. The catalog includes a separate review of management practices in nine separate activities relating to:

Urban/Stormwater Runoff Agriculture Silviculture	Construction Hydrologic/Habitat Modification Road/Right-of-Way Maintenance	Leaks, Spills, Accidents Resource Extraction On-Site Waste Disposal
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Each subject, while considering more than just impacts to ground water, specifically reviews ground water concerns. Other state programs including the Agricultural Environmental Management (AEM) Program, under NYS Agriculture and Markets, have also developed worksheets which, in part, consider ground water protection. In another example NYSDOT has developed an Environmental Handbook for Transportation Operations which is intended to provide general awareness and guidance related to state DOT operations. [For further information, go to: www.dec.ny.gov/about/859.html , www.agmkt.state.ny.us/SoilWater/aem/ , www.nysdot.gov]

GROUND WATER RELATED LEGISLATION –

- SMALL BUSINESS POLLUTION PREVENTION AND ENVIRONMENTAL COMPLIANCE ASSISTANCE PROGRAM – This law took effect September 16, 2005 establishing a new Article 28 under Environmental Conservation Law titled Pollution Prevention. Among other things this law specifically cites protection of groundwater.
- MTBE - As of January 1, 2004, NYS law prohibits gasoline products containing MTBE as an additive from being imported, sold, dispensed or offered for sale in New York State.
- BROWNFIELD / GROUNDWATER GIS – In October of 2003, the NYS Brownfield Cleanup Program (BCP) was signed into law. This legislation sets forth requirements and criteria for participation and clean-up efforts as well as tax and grant incentives plus liability limitation once a Certificate of Completion is issued.

GROUND WATER CLASSIFICATION – Classification of ground water has been established through state environmental regulations since 1985. All fresh ground water in NYS is classified as GA. Class GA waters are assigned a best usage as a source of potable water supply. [For further information, go to: www.dec.ny.gov/chemical/23853.html]

GROUND WATER QUALITY STANDARDS – Regulations establishing ground water quality standards in NYS were first promulgated in 1967. These regulations continue under authority of NYS Environmental Conservation Law and are enforced by DEC. Under NYS law DEC maintains these standards as part of its charge to protect the waters of the state. These standards closely parallel but should not be confused with NYS drinking water standards maintained by NYS DOH for public water supplies. [For further information, go to: www.dec.ny.gov/chemical/23853.html]

INTERAGENCY COORDINATION FOR GROUND WATER PROTECTION INITIATIVES – Interagency coordination of ground water protection issues occurs on various levels of federal, state and local governments from staff level on up through the bureau and director levels including both short and long term committees such as the NYS Nonpoint Source

Coordinating Committee, Water Quality Coordinating Committees, the NYS Soil and Water Conservation Committee, and the Source Water Protection Coordinating Committee (SWPCC). Most recently coordination between DEC, NYSDOH, and USGS has been underway concerning the development of a groundwater related data system. (See section on COMPREHENSIVE DATA MANAGEMENT SYSTEM for additional details.)

NONPOINT SOURCE CONTROLS – New York’s strategy for dealing with nonpoint source pollution is based on the following source control mechanisms: planning, monitoring, direct implementation, regulatory programs, financial incentives, demonstration projects, technical assistance, technical training, and outreach. This strategy is pursued at the state level through the New York Nonpoint Source Coordinating Committee (NPSCC) representing 18 federal, state, and local agencies. It is also pursued at the local level by County Water Quality Coordinating Committees (WQCCs) established through the efforts of the NYS Soil and Water Conservation Committee (NYSSWCC) and DEC. [For further information, go to: www.dec.ny.gov/docs/water_pdf/npsmgt.pdf , www.agmkt.state.ny.us/soilwater/aem]

PESTICIDE STATE MANAGEMENT PROGRAM – DEC is responsible for the regulation of pesticides and pesticide application reporting, providing compliance assistance, water quality monitoring for pesticides, public outreach activities and enforcement of State pesticide laws. Registration of pesticides in New York State predates DEC’s creation in 1970. Products that constitute a major change in use or contain a new active ingredient undergo a through review prior to approved registration. Commercial application businesses are required to register with DEC with certification required for each individual who performs pesticide application. NYS has also adopted a Neighbor Notification Law that requires the posting of visual notification markers when 100 square feet or more of residential lawn application occurs. This law is in effect only when adopted at the county level. January 1, 2008, the following have "opted in": Albany, Erie, Monroe, Nassau, Rockland, Suffolk, Tompkins, Ulster, and Westchester Counties, and New York City. Lastly, a permit is required for the sale of restricted use pesticides in New York State. Pesticides are also a component of New York States’ Department of Agriculture and Markets Agricultural Environmental Management (AEM) program. The voluntary, incentive-based program has developed two pesticide management worksheets dealing with use, storage, mixing, and loading. AEM operates at state and local levels providing financial, educational and technical assistance to farmers to deal with environmental concerns. [For further information, go to: www.dec.ny.gov/chemical/298.html , www.agmkt.state.ny.us/soilwater/aem]

POLLUTION PREVENTION PROGRAM – The Pollution Prevention Unit of DEC works to "Reduce or eliminate the use of toxic substances and the generation of pollutants at the source." This is done through technical assistance outreach and targeted prevention planning development with small & large businesses, local governments, state agencies, and the public. [For further information, go to: www.dec.ny.gov/about/817.html]

RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) PRIMACY - New York State initially received EPA interim base authorization to implement and enforce the federal RCRA-C program in July of 1982, with final base authorization granted in May of 1986. Currently, NYS has adopted 100+ percent of the federal program, including some optional rules. [For further information, go to: www.dec.ny.gov/chemical/8477.html]

SOURCE WATER ASSESSMENT PROGRAM - In NYS, the Source Water Assessment Program (SWAP) was developed and implemented by the New York State Department of Health (DOH) with input from other government agencies and private and public interest groups⁶. New York’s SWAP was approved by EPA in November 1999. Over 9,000 public water systems maintain a total of approximately 14,000 sources of water in NYS. There are roughly 1,700 additional systems that purchase their water and were excluded from SWAP requirements. To accomplish the assessments, DOH awarded a contract to URS Corporation for upstate New York including 8,400 public water systems with 12,300 wells. An additional contract was awarded to Camp, Dresser and McKee to complete assessments for Nassau and Suffolk counties including over 500 public water systems with more than 1,500 wells. The source water assessments for the approximately 350 public supply surface water sources and springs in New York State were completed by NYSDOH. [For further information, go to: www.health.state.ny.us/nysdoh/water/swap.htm]

STATE SUPERFUND – In NYS the Superfund program is known as the Inactive Hazardous Waste Disposal Site

⁶ Source Water Assessment Program Plan, NYS Dept. of Health, November 1999.

Remedial Program. The program seeks to identify and characterize suspected inactive hazardous waste sites and remediate those that have consequential amounts of hazardous waste which pose a significant threat to public health and the environment⁷. As part of the program a registry of sites is maintained with each assigned a classification based on its current stage of investigation or remediation. For a breakdown of the current list see section titled Summary of Ground Water Contamination Sources. [For further information, go to: www.dec.ny.gov/chemical/8439.html]

STATE RCRA PROGRAM INCORPORATING MORE STRINGENT REQUIREMENTS THAN RCRA

PRIMACY – New York State has adopted the full federal RCRA program including some optional rules making the state program more stringent than RCRA primacy requirements, see *RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) PRIMACY* above. [For further information, go to: www.dec.ny.gov/chemical/8477.html]

STATE SEPTIC SYSTEM REGULATIONS – Statewide minimum regulations for septic systems with a design capacity of 1,000 gallons per day (gpd) or less have been in place since 1967 under NYS Public Health Law regulations (NYCRR Title 10, Volume A-1a, Part 75 including Appendix 75-A). Septic systems with a design capacity of 1,000 gpd or more must be designed or approved by a licensed professional, and require a wastewater discharge permit from NYSDEC. [For further information, go to: www.health.state.ny.us/nysdoh/water/appendix_75a.htm]

UNDERGROUND STORAGE TANK INSTALLATION REQUIREMENTS – Since 1994 DEC regulations have contained standards for the installation of new or replacement underground hazardous substance storage tanks dealing with: tank construction specifications; secondary containment; leak monitoring; installation; piping; spill/overflow prevention; vents, gauges and alarms; and tank labeling. Similar regulations have been in effect for new or replacement underground petroleum storage tanks since 1985 for facilities with a combined capacity of 1,100 gallons or more. [For further information, go to: www.dec.ny.gov/chemical/287.html]

UNDERGROUND STORAGE TANK REMEDIATION FUND – This fund was established by the New York State Legislature in 1977 and is officially known as the New York Environmental Protection and Spill Compensation Fund. It is more commonly known as the (NYS) Oil Spill Fund and other times as the Leaking Underground Storage Tank Fund. The fund is used where the responsible party is unknown or unable to pay for a cleanup that is considered necessary to prevent risking public health or the environment. The fund is administered by the State Comptroller's Office. Technical guidance is provided by NYSDEC while the NYS Attorney General's Office pursues fund compensation and criminal charges as appropriate. [For further information, go to: www.osc.state.ny.us/oilspill/index.htm , www.oag.state.ny.us/press/reports/oil_spills/oil_spill.html , www.dec.ny.gov/chemical/8638.html]

UNDERGROUND STORAGE TANK PERMIT PROGRAM – New York State has had a tank registration program since 1986. See section on *STORAGE TANKS (ABOVE GROUND)* for discussion of this item.

UNDERGROUND INJECTION CONTROL PROGRAM – Currently NYS has not requested program primacy for the federal UIC program. As indicated above, NYS does maintain stringent requirements through its SPDES permitting process for discharges to ground water greater than 1,000 gpd. While this may exclude smaller facilities of concern, larger municipal & industrial ground water discharges are regulated. [For further information, go to: www.epa.gov/safewater/uic/index.html]

VULNERABILITY ASSESSMENT FOR DRINKING WATER/WELLHEAD PROTECTION – Vulnerability assessments have been undertaken for each public drinking water supply as part of the Source Water Assessment Program implemented by NYSDOH. See *SOURCE WATER ASSESSMENT PROGRAM* for additional details.

WELL ABANDONMENT REGULATIONS – Abandonment of mineral resource related wells is regulated by DEC. Types of wells include oil, gas, solution mining, geothermal, and exploration. To insure proper closure of wells, DEC requires each applicant to post appropriate financial bonding. NYS DOH has established regulations for abandonment of public and private water supply wells. [For further information, go to: www.health.state.ny.us/environmental/water/

⁷ Remedial Programs Annual Report for State Fiscal Year 2004-05, NYSDEC, Div. of Environmental Remediation, 625 Broadway, Albany, New York 12233-7010

drinking/part5/appendix5b.htm , www.health.state.ny.us/environmental/water/drinking/part5/appendix5d.htm ,
www.dec.ny.gov/lands/5000.html]

WELLHEAD PROTECTION PROGRAM (EPA-APPROVED) – New York State’s approved wellhead protection plan was transferred from DEC to DOH at the start of the Source Water Protection Program. DEC’s program was approved by EPA in 1990. Wellhead protection is handled jointly by DOH and DEC for each new public water supply well as it goes through the water supply permitting process. [For further information, go to: www.health.state.ny.us/environmental/water/drinking/wellhead/wellfact.htm]

WELL INSTALLATION REGULATIONS – In 1999 the NYS Well Driller Registration Law was enacted and became effective in January of 2000. One aspect of this law called for the NYS Department of Health (DOH) to establish water well construction regulations. Separate regulations have been established for both private and public water supply wells. Important aspects of the regulations include: minimum casing, grouting, and separation distances from contamination sources. [For further information, go to: www.health.state.ny.us/environmental/water/drinking/part5/appendix5b.htm , and www.health.state.ny.us/environmental/water/drinking/part5/appendix5d.htm]

OTHER NYS PROGRAMS OR ACTIVITIES

FRESHWATER WETLANDS PROGRAMS – Freshwater wetlands are an important component of ground water protection. Wetlands help break down, use and immobilize pollutants. This is particularly important where involved in recharging groundwater. New York’s Freshwater Wetlands Program was established after state passage of the State Freshwater Wetlands Act in 1975. The state regulates wetlands larger than 12.4 acres including an adjacent area of 100 feet. The U.S. Army Corps of Engineers also regulates activities in wetlands of any size. [For further information, go to: www.dec.ny.gov/lands/4937.html]

DRINKING WATER STATE REVOLVING FUND (DWSRF) – The Drinking Water State Revolving Fund (DWSRF) was created in 1996 as a means to provide a significant financial incentive for municipally and privately owned drinking water systems to finance needed drinking water infrastructure improvements. The DWSRF is administered jointly by the New York State Department of Health (DOH) and the New York State Environmental Facilities Corporation (EFC). [For further information, go to: www.nysefc.org , and www.nyhealth.gov/environmental/water/drinking/water.htm]

CLEAN WATER STATE REVOLVING FUND (CWSRF) – The NYS Clean Water State Revolving Fund was established in 1990 to provide low-interest financing to preserve, protect, or improve water quality. Eligible projects may involve point or nonpoint sources of pollution. [For further information, go to: www.nysefc.org]

CLEAN WATER/CLEAN AIR BOND ACT – New York's Clean Water/ Clean Air Bond Act was approved by NYS voters in November 1996 for funding of investigations and cleanup of Environmental Restoration Projects. Enhancements to the program were enacted on October 7, 2003. Projects are evaluated on, among other things, the potential for public or recreational use after the site is cleaned up. [For further information, go to: www.dec.ny.gov/chemical/8444.html]

Summary of Ground Water Contamination Sources

New York State Superfund Program

New York's Superfund Program maintains a Registry of Inactive Hazardous Waste Disposal Sites where a disposal of a consequential quantity of hazardous waste has occurred. The program also maintains a list of non-registry site (i. e., Brownfield Cleanup Program, Environmental Restoration Program, and Voluntary Cleanup Program sites) where remedial program work is underway. The breakdown of sites as of March 1, 2008 is shown in Table #.

Table C-3 - Status of Sites Currently Listed on the Registry as of March 1, 2008		
Registry Class	Class Description	No. of Sites
Class 1	Causing or presenting an imminent danger of causing irreversible or irreparable damage to public health or environment - immediate action required	0
Class 2	Significant threat to the public health or environment - action required	502
Class 3	Does not present a significant threat to the public health or environment -action may be deferred	77
Class 4	Site properly closed - requires continued management	257
Class 5	Site properly closed - no further action required	16
	Sites on Registry	852
Class A	The classification assigned to a non-registry site in any remedial program where work is underway and not yet complete.	713
Class C	The classification used for sites where the Department has determined that remediation has been satisfactorily completed under a remedial program.	432
	Total	1,997

Federal Superfund Program

Some of the inactive hazardous waste disposal sites listed on New York's Registry are also listed on the National Priorities List (NPL). EPA is the lead agency responsible for remediating NPL sites in New York. The Department provides oversight of EPA's remedial program at NPL sites in New York. As of March 1, 2008, 109 sites in New York have been listed on the NPL, and 23 of these sites have been deleted from the NPL.

Summary of Ground Water Monitoring Data

Below are abstracts from groundwater studies conducted in basins as described. The full report, for each respective basin can be found online at the USGS publications warehouse (pubs.usgs.gov). Analytical data is also available online at the USGS National Water Information System (NWIS) web portal (waterdata.usgs.gov).

Table C-4-a, Ambient GW Monitoring Studies

Hydrogeologic Setting: [HUC 02050105](#)
Spatial Description: [Chemung River Basin](#)
Percent of NYS area: [2.1%](#)
Data Reporting Period: [2003](#)

Ground-Water Quality in the Chemung River Basin, New York, 2003

by Kari K. Hetcher-Aguila
U.S. GEOLOGICAL SURVEY
Open-File Report 2004-1329

Abstract

Water samples were collected from 24 public-supply wells and 13 private residential wells during the summer of 2003 and analyzed to describe the chemical quality of ground water throughout the Chemung River basin, upgradient from Waverly, N.Y., on the Pennsylvania border. Wells were selected to represent areas of heaviest ground-water use and greatest vulnerability to contamination, and to obtain a geographical distribution across the 1,130 square-mile basin. Samples were analyzed for physical properties, inorganic constituents, nutrients, metals and radionuclides, pesticides, volatile organic compounds, and bacteria.

The cations that were detected in the highest concentrations were calcium and sodium; the anions that were detected in the greatest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrient was nitrate. Nitrate concentrations in samples from wells finished in sand and gravel were greater than in those from wells finished in bedrock, except for one bedrock well, which had the highest nitrate concentration of any sample in this study. The most commonly detected metals were aluminum, barium, iron, manganese, and strontium. The range of tritium concentrations (0.6 to 12.5 tritium units) indicates that the water ages ranged from less than 10 years old to more than 50 years old. All but one of the 15 pesticides detected were herbicides; those detected most frequently were atrazine, deethylatrazine, and two degradation products of metolachlor (metachlor ESA and metachlor

OA), which were the pesticides detected at the highest concentrations. Not every sample collected was analyzed for pesticides, and pesticides were detected only in wells finished in sand and gravel. Volatile organic compounds were detected in 15 samples, and the concentrations were at or near the analytical detection limits. Total coliform were detected in 12 samples; fecal coliform were detected in 7 samples; and *Escherichia coli* was detected in 6 samples. These bacteria were detected in water from bedrock as well as sand-and-gravel aquifers.

Federal and State water-quality standards were exceeded in several samples. Two samples exceeded the chloride U.S. Environmental Protection Agency Secondary Maximum Contaminant Level of 250 milligrams per liter. The U.S. Environmental Protection Agency Drinking Water Advisory for sodium (30 to 60 milligrams per liter) was exceeded in 11 samples. The upper limit of the Secondary Maximum Contaminant Level range for aluminum (200 micrograms per liter) was exceeded in one sample. The Maximum Contaminant Level for barium (2,000 micrograms per liter) was exceeded in one sample. The Secondary Maximum Contaminant Level for iron (300 micrograms per liter) was exceeded in 11 samples. The Secondary Maximum Contaminant Level for manganese (50 micrograms per liter) was exceeded in 20 samples. The proposed Maximum Contaminant Level for radon (300 picocuries per liter) was exceeded in 34 samples.

Table C-4-b, Ambient GW Monitoring Studies

Hydrogeologic Setting: HUC 02010001, 02010004, 02010006
Spatial Description: Lake Champlain Basin (portion within New York State)
Percent of NYS area: 6.1%
Data Reporting Period: 2004

Ground-Water Quality in the Lake Champlain Basin, New York, 2004

by Elizabeth A. Nystrom
U.S. GEOLOGICAL SURVEY
Open-File Report 2006-1088

Abstract

Water samples were collected from 11 public-supply wells and 11 private domestic wells in the Lake Champlain basin in New York during the fall of 2004 to characterize the chemical quality of ground water. Wells were selected for sampling based on location and focused on areas of greatest ground-water use. Samples were analyzed for 219 physical properties and constituents, including inorganic compounds, nutrients, metals, radionuclides, pesticides and pesticide degradates, volatile organic compounds, and bacteria.

Sixty-eight constituents were detected at concentrations above laboratory reporting levels. The cation and anion with the highest median concentration were calcium (34.8 mg/L) bicarbonate (134 mg/L), respectively. The predominant nutrient was nitrate, which was detected in 14 (64 percent) of the 22 samples. The two

metals with the highest median concentrations were iron (175 µg/L) and strontium (124 µg/L); concentrations of iron, manganese, aluminum, and zinc exceeded U.S. Environmental Protection Agency secondary drinking-water standards in one or more samples. Radon concentrations were less than 1,000 picocuries per liter (pCi/L) in most samples, but concentrations as high as 6,900 pCi/L were detected and, in eight samples, exceeded the U.S. Environmental Protection Agency proposed maximum contaminant level (300 pCi/L) for radon. The most frequently detected pesticides were degradates of the broadleaf herbicides metolachlor, alachlor, and atrazine. Volatile organic compounds were detected in only three samples; those that were detected typically were fuel oxygenates, such as methyl tert-butyl ether. Coliform bacteria were detected in four samples, two of which also tested positive for *E. coli*.

Table C-4-c, Ambient GW Monitoring Studies

Hydrogeologic Setting: HUC 02050101, 02050102, 02050103
Spatial Description: Upper Susquehanna River Basin (portion within New York State)
Percent of NYS area: 9.4%
Data Reporting Period: 2004

Ground-water quality in the upper Susquehanna River Basin, New York, 2004-05

by Kari K. Hetcher-Aguila and David A.V. Eckhardt
U.S. GEOLOGICAL SURVEY
Open-File Report 2006-1161

Abstract

Water samples were collected from 20 public-supply wells and 13 private residential wells throughout the upper Susquehanna River Basin (upstream from the Pennsylvania border) during the fall of 2004 and the spring of 2005 and analyzed to describe the chemical quality of ground water in the upper basin. Wells were selected to represent areas of greatest ground-water use and highest vulnerability to contamination, and to provide a representative sampling from the entire (4,516 square-mile) upper basin. Samples were analyzed for physical properties, nutrients, inorganic constituents, metals,

radionuclides, pesticides, volatile organic compounds, and bacteria.

The cations that were detected in the highest concentrations were calcium, magnesium, and sodium; the anions that were detected in the greatest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrient was nitrate, the concentrations of which were greater in samples from sand and gravel aquifers than in samples from bedrock. The metals barium, boron, cobalt, copper, and nickel were detected in every sample; the metals with the highest concentrations were barium, boron, iron, manganese, strontium, and lithium. The

pesticide compounds detected most frequently were atrazine, deethylatrazine, alachlor ESA, and two degradation products of metolachlor (metolachlor ESA and metolachlor OA); the compounds detected in highest concentration were metolachlor ESA and OA. Volatile organic compounds were detected in 11 samples, and concentrations of 3 of these compounds exceeded 1 microgram per liter ($\mu\text{g/L}$).

Several analytes were found in concentrations that exceeded Federal and New York State water-quality standards, which are typically identical. Chloride concentrations exceeded the U.S. Environmental Protection Agency (USEPA) Secondary Maximum Contaminant Level (SMCL) of 250 milligrams per liter (mg/L) in two samples, and sulfate concentrations exceeded the SMCL of 250 mg/L in one sample. Sodium concentrations exceeded the USEPA Drinking Water Advisory of 60 mg/L in six

samples. Nitrate concentrations exceeded the USEPA Maximum Contaminant Level (MCL) of 10 mg/L in one sample and approached this limit (at 9.84 mg/L) in another sample. Barium concentrations exceeded the MCL of 2,000 $\mu\text{g/L}$ in one sample. Iron concentrations exceeded the SMCL of 300 $\mu\text{g/L}$ in five samples, and manganese concentrations exceeded the SMCL of 50 $\mu\text{g/L}$ in 14 samples. Arsenic was detected in seven samples, and the MCL for arsenic (10 $\mu\text{g/L}$) was exceeded in two samples. Radon-222 exceeded the proposed MCL of 300 picocuries per liter in 24 samples. Any detection of total coliform or fecal coliform bacteria is considered a violation of New York State health regulations; in this study, total coliform was detected in six samples; fecal coliform was detected in one sample, and *Escherichia coli* was not detected in any sample.

Table C-4-d, Ambient GW Monitoring Studies

Hydrogeologic Setting: [HUC 04150301 through 04150307](#)
Spatial Description: [St. Lawrence River Basin \(portion within New York State\)](#)
Percent of NYS area: [11.5 %](#)
Data Reporting Period: [2005](#)

Ground-Water Quality in the St. Lawrence River Basin, New York, 2005-06 by Elizabeth A. Nystrom U.S. GEOLOGICAL SURVEY Open-File Report 2007-1066

Abstract

The Federal Clean Water Act requires that States monitor and report on the quality of ground water and surface water. To satisfy part of these requirements, the U.S. Geological Survey and New York State Department of Environmental Conservation have developed a program in which ground-water quality is assessed in 2 to 3 of New York State's 14 major river basins each year. To characterize the quality of ground water in the St. Lawrence River Basin in northern New York, water samples were collected from 14 domestic and 11 production wells between August 2005 and January 2006. Eight of the wells were finished in sand and gravel and 17 wells were finished in bedrock. Ground-water samples were collected and processed using standard U.S. Geological Survey procedures and were analyzed for 229 constituents and physical properties, including inorganic constituents, nutrients, trace elements, radon-222, pesticides and pesticide degradates, volatile organic compounds, and bacteria. Sixty-six constituents were detected above laboratory reporting levels. Concentrations of most compounds at most sites were within drinking water standards established by the U.S. Environmental Protection Agency and New York State Department of Health, but a few compounds exceeded drinking water standards at some sites. Water in the basin is generally hard to very hard (hardness equal to 121 mg/L as CaCO_3 or greater); hardness and alkalinity were generally higher in the St. Lawrence Valley than in the Adirondack Mountains. The cation with the highest median

concentration was calcium; the anion with the highest median concentration was bicarbonate. The concentration of chloride in one sample exceeded the 250 milligrams per liter U.S. Environmental Protection Agency Secondary Drinking Water Standard; the concentration of sulfate in one sample also exceeded the 250 milligrams per liter U.S. Environmental Protection Agency Secondary Drinking Water Standard. Nitrate was the predominant nutrient detected but no sample exceeded the 10 mg/L U.S. Environmental Protection Agency Maximum Contaminant Level. The trace elements detected with the highest median concentrations were strontium, barium, and iron. Concentration of trace elements in several samples exceeded U.S. Environmental Protection Agency Secondary Drinking Water Standards, including aluminum (50 micrograms per liter, 4 samples), iron (300 micrograms per liter, 5 samples), and manganese (50 micrograms per liter, 4 samples). The concentration of uranium in one sample from a domestic well finished in crystalline bedrock was three times the U.S. Environmental Protection Agency Maximum Contaminant Level of 30 micrograms per liter. The median concentration of radon-222 was 600 picoCuries per liter, but concentrations as high as 18,800 picoCuries per liter were detected; two wells with high radon concentrations also had high uranium concentrations. Radon-222 is not currently regulated, but the U.S. Environmental Protection Agency has proposed a Maximum Contaminant Level of 300 picoCuries per liter along with an Alternative Maximum Contaminant Level of 4,000 picoCuries per liter, to be in effect in

states that have programs to address radon in indoor air. Concentrations of radon-222 exceeded the proposed Maximum Contaminant Level in 60 percent of samples and exceeded the proposed Alternative Maximum Contaminant Level in 8 percent of samples. Six pesticides and pesticide degradates were detected; all were amide or triazine herbicides or degradates. Five volatile organic compounds were detected, including disinfection

byproducts such as trichloromethane and gasoline components or additives such as methyl tert-butyl ether. No pesticides, pesticide degradates, or volatile organic compounds were detected above established limits. Coliform bacteria, including *Escherichia coli*, were detected in three wells finished in carbonate bedrock.

Table C-4-e, Ambient GW Monitoring Studies

Hydrogeologic Setting: HUC 04130002 & 04130002
Spatial Description: Genesee River Basin (portion within New York State)
Percent of NYS area: 5.0 %
Data Reporting Period: 2005

Ground-Water Quality in the Genesee River Basin, New York, 2005-2006 by David A.V. Eckhardt, J.E. Reddy, and Kathryn L. Tamulonis U.S. GEOLOGICAL SURVEY Open-File Report 2007-1093

Abstract

Water samples were collected from 7 community water system wells and 15 private domestic wells throughout the Genesee River Basin in New York State (downstream from the Pennsylvania border) from October 2005 through March 2006 and analyzed to characterize the chemical quality of ground water in the basin. The wells were selected to represent areas of greatest ground-water use and to provide a representative sampling from the 2,439 square-mile basin area in New York. Samples were analyzed for five physical properties and 226 constituents that included nutrients, major inorganic ions, trace elements, radionuclides, pesticides, volatile organic compounds, and bacteria.

The results show that ground water used for drinking water is generally of good quality in the Genesee River Basin, although concentrations of seven constituents exceeded drinking water standards. The cations that were detected in the highest concentrations were calcium, magnesium, and sodium; the anions that were detected in the greatest concentrations were bicarbonate, chloride, and sulfate. The predominant nutrient was nitrate, and nitrate concentrations were greater in samples from sand and gravel aquifers than in samples from bedrock aquifers. The trace elements barium, boron, cobalt, copper, and nickel were detected in every sample; the highest concentrations were barium, boron, chromium, iron, manganese, strontium, and lithium. Fourteen

pesticides including seven pesticide degradates were detected in water from 12 of the 22 wells, but none of the concentrations exceeded Maximum Contaminant Levels (MCLs). Eight volatile organic compounds (VOCs) were detected in six samples, but none of the concentrations exceeded MCLs.

Seven chemical analytes and three types of bacteria were present in concentrations that exceeded Federal and New York State water-quality standards, which are typically identical. Sulfate concentrations exceeded the U.S. Environmental Protection Agency (USEPA) Secondary Maximum Contaminant Level (SMCL) of 250 milligrams per liter (mg/L) in three samples; the chloride SMCL (250 mg/L) was exceeded in one sample. Sodium concentrations exceeded the USEPA Drinking Water Health Advisory of 60 mg/L in five samples. The SMCL for iron (300 µg/L) was exceeded in 11 filtered samples; the USEPA SMCL for manganese (50 µg/L) was exceeded in 10 filtered samples, and the New York State MCL (300 µg/L) was exceeded in 1 filtered sample. The MCL for aluminum (200 µg/L) was exceeded in 1 sample, and the MCL for arsenic (10 µg/L) was exceeded in 1 sample. Radon-222 exceeded the proposed USEPA MCL of 300 picocuries per liter in 16 samples. Any detection of total coliform or fecal coliform bacteria is considered a violation of New York State health regulations; in this study, total coliform was detected in eight samples; fecal coliform was detected in two samples, and *Escherichia coli* was detected in one sample.

Table C-4-e, Ambient GW Monitoring Studies

Hydrogeologic Setting: HUC 02040101, 02040102, & 02040104
Spatial Description: Delaware River Basin (portion within New York State)
Percent of NYS area: 4.9 %
Data Reporting Period: 2005

Ground-Water Quality in the Delaware River Basin, New York, 2001 and 2005-2006
by Elizabeth A. Nystrom
U.S. GEOLOGICAL SURVEY
Open-File Report 2007-1098

Abstract

The Federal Clean Water Act Amendments of 1977 require that States monitor and report on the quality of ground water and surface water. To satisfy part of these requirements, the U.S. Geological Survey and New York State Department of Environmental Conservation have developed a program in which ground-water quality is assessed in 2 to 3 of New York State's 14 major basins each year. To characterize the quality of ground water in the Delaware River Basin in New York, water samples were collected from December 2005 to February 2006 from 10 wells finished in bedrock. Data from 9 samples collected from wells finished in sand and gravel in July and August 2001 for the National Water Quality Assessment Program also are included. Ground-water samples were collected and processed using standard U.S. Geological Survey procedures. Samples were analyzed for more than 230 properties and compounds, including physical properties, major ions, nutrients, trace elements, radon-222, pesticides and pesticide degradates, volatile organic compounds, and bacteria. Concentrations of most compounds were less than drinking-water standards established by the U.S. Environmental Protection Agency and New York State Department of Health; many of the organic analytes were not detected in any sample. Drinking-water standards that were exceeded at some sites include those for color, turbidity, pH, aluminum, arsenic, iron, manganese, radon-222, and bacteria. pH ranged from 5.6 to 8.3; the pH of nine samples was less than the U.S. Environmental Protection Agency secondary drinking-water standard range of 6.5 to 8.5. Water in the basin is generally soft to moderately hard (hardness 120 milligrams per liter as CaCO₃ or less). The cation with the highest median concentration was

calcium; the anion with the highest median concentrations was bicarbonate. Nitrate was the predominant nutrient detected but no sample exceeded the 10 mg/L U.S. Environmental Protection Agency maximum contaminant level. The trace elements detected with the highest median concentrations were strontium and iron in unfiltered water and strontium and barium in filtered water. Concentrations of trace elements in several samples exceeded U.S. Environmental Protection Agency secondary drinking-water standards, including aluminum (50-200 micrograms per liter, three wells), arsenic (10 micrograms per liter, one well), iron (300 micrograms per liter, three wells), and manganese (50 micrograms per liter, four wells). The median concentration of radon-222 was 1,580 picoCuries per liter. Radon-222 is not currently regulated, but the U.S. Environmental Protection Agency has proposed a maximum contaminant level of 300 picoCuries per liter along with an alternative maximum contaminant level of 4,000 picoCuries per liter, to be in effect in states that have programs to address radon in indoor air. Concentrations of radon-222 exceeded the proposed maximum contaminant level in all 19 of the samples and exceeded the proposed alternative maximum contaminant level in 1 sample. Eleven pesticides and pesticide degradates were detected in samples from ten wells; all were herbicides or herbicide degradates. Three volatile organic compounds were detected, including disinfection byproducts such as trichloromethane and gasoline components or additives such as methyl tert-butyl ether. No pesticides, pesticide degradates, or volatile organic compounds were detected above established limits. Coliform bacteria were detected in samples from five wells, four of which were finished in sand and gravel; *Escherichia coli* was not detected in any sample.

New York State Water Quality Assessment

Wetlands Assessment

As stated in New York State freshwater and tidal wetlands laws (Articles 24 and 25 of the Environmental Conservation Law), it is the policy of the state to preserve, protect and conserve wetlands and the benefits derived therefrom, to prevent the despoliation and destruction of wetlands, and to regulate use and development to secure the natural benefits of wetlands, consistent with the general welfare and beneficial economic, social and agricultural development of the state. Protection of wetlands is a priority in the state.

Wetlands provide a suite of functions and benefits to the environment and the people of the state, including: flood and storm water control; erosion and sedimentation control; water quality maintenance; primary food production, fish and wildlife habitat; recreation, open space, and educational opportunities (see Table 24).

Extent of Wetlands Resources

New York has an estimated 2.5 million acres of freshwater wetlands and 25,000 acres of tidal wetlands. They encompass about nine percent of the land mass of New York. Wetlands types include marshes; hardwood, coniferous and shrub swamps; wet meadows; bogs; fens; and coastal marshes.

There are three main wetland inventories for New York State. Two are regulatory inventories prepared under state statutes. The tidal wetlands inventory shows tidally influenced wetlands on Long Island, in New York City, and in certain counties along the southern reaches of the Hudson River. Tidal wetlands currently are being mapped in the Hudson River up to the Troy Dam. The freshwater wetlands inventory shows all freshwater wetlands protected under Article 24, which outside the Adirondack Park includes those wetlands greater than 12.4 acres in size, and certain smaller wetlands of unusual local importance. Inside the Park, wetlands are protected down to one acre, or smaller if they are connected to an open water body. The National Wetlands Inventory maps, produced by the U.S. Fish and Wildlife Service, show all wetlands and deepwater habitats, to the extent they can be detected in aerial photography. New York recently worked with the FWS to update the maps for the lake plains, and to complete mapping in the Capital district.

The U.S. Fish and Wildlife Service estimates that over half of New York's wetlands have been lost since colonization. In order to evaluate the effectiveness of the state's tidal wetlands program in protecting wetlands under the Tidal Wetlands Act (Article 25 of the Environmental Conservation Law), a tidal wetlands trends analysis is being conducted by the New York State Department of Environmental Conservation. To date, the tidal wetlands trends analysis has shown the regulatory program to protect tidal wetlands from the historic "fill and build" damage is extremely successful. In many areas (e.g. Shinnecock and Moriches Bay on Long Island) there is no detectable loss due to those activities. In fact, the wetlands have increased over 250 acres in Shinnecock and Moriches Bay due to the landward migration of wetlands.

However, NYSDEC has observed significant losses of vegetated tidal wetlands, principally saltmarsh cordgrass (*Spartina alterniflora*) (Intertidal Marsh), in marsh islands of Jamaica Bay, New York City and

in Nassau and Suffolk Counties. Over 1000 acres of vegetated tidal wetlands have been lost since 1974.

Strategies are being discussed to identify causes and solutions. Initial observations indicate that relative sea level rise and sediment budget disruption play a significant role.

A status and trends report of freshwater wetlands was also completed, showing that New York had a net gain of approximately 15,000 acres of wetlands between 1985 and 1995. The report compared mid-1980 and mid-1990 aerial photographs of a sample of sites in five ecological zones of the state. Gains, losses, and changes in cover type were identified, and the causes of those changes noted.

Table D-1 Functions and Values of Wetlands	
Function	Value
Flood / Storm Water Control	During heavy rains and spring snow melt, wetlands serve as natural reservoirs for excess water, slowing the movement of water and reducing flooding.
Erosion/ Sedimentation Control	By decreasing water velocity, wetland vegetation filters sediment and prevents suspended particles from entering navigational channels, lakes and reservoirs. Similarly, wetlands also reduce shoreline erosion by buffering adjacent lands from wave or stream current effects.
Pollution Treatment/Reduction	Microorganisms in wetlands break down and use nutrients, reducing loads to surface water. Wetlands also lock up other pollutants, rendering them inaccessible. Wetlands are occasionally used in tertiary wastewater treatment.
Fish and Wildlife Habitat	Wetlands provide important habitats for many migratory and resident bird species and wildlife, including species identified as endangered, threatened or of special concern. Wetlands also provide spawning grounds for numerous fish species. Tidal wetlands, in particular, are critically important for marine species and the support of a significant commercial and recreational fishery. Wetlands are important components of the state's biological diversity.
Primary Productivity	The products of vegetative photosynthesis are transported to adjacent waters for use in aquatic and estuarine food chains
Nutrient Cycling	Wetlands filter and recycle sediment and organic and chemical nutrients, an important link in the food web.
Recreational Opportunities	Wetlands provide numerous recreational uses including hunting, fishing, boating, hiking, bird watching, photography and camping. Countless New Yorkers (and out-of-state tourists) participate in these activities, generating millions of dollars in revenue annually.
Open Space	Wetlands are often the only undeveloped areas in otherwise heavily developed areas, thereby providing open, green areas for quality of life of local residents.
Education/Research Opportunities	Wetlands provide readily accessible outdoor biophysical laboratories, living classrooms and vast training and educational resources.

Approximately 22,000 acres of wetlands were lost to causes primarily associated with development and agriculture. Approximately 37,000 acres of wetlands were gained, primarily from abandoned agricultural land reverting back to wetland, and from increased runoff flooding previously dry areas. The majority of gains were in the Lake Plains ecological zone. In the Appalachian highlands (southern tier), Adirondacks, and coastal plains (Long Island) gains and losses balanced each other. Net losses occurred in the Hudson valley.

While a net gain of acreage is good news for the state, it must be celebrated cautiously. New York State lost 11,000 acres of wetlands to development, resulting in a loss of wetlands benefits in urbanized areas. Gains were from abandoned agricultural land, resulting in gains in rural areas. Gains also occurred mostly in the lake plains, and net losses occurred in the Hudson Valley. Consequently the state has seen a shift in where wetlands are located. Furthermore, most of the gains occurred from causes not attributable to wetlands conservation programs, but from changes in land use. When no more previously-drained farmland is abandoned, and reversion of wetlands declines, New York State may again see a net loss of wetlands. New York anticipates continuing the status and trends study by evaluating the period from the mid-1990s to the mid-2000s. NYSDEC will be scoping the study during 2008 and in necessary will be seeking funding to conduct the work.

Wetlands Protection Strategies

NYSDEC administers a broad array of regulatory and non-regulatory programs, undertaken in partnership with other federal, state and local governmental agencies and with the non-governmental sector, to preserve, protect, and conserve wetlands. Through efforts such as restoration, acquisition, regulation, and management, NYSDEC strives to achieve a no overall net loss of wetlands acreage and function, and net gain in wetlands where feasible and desirable.

Planning

Planning is the means for providing a vision and context for wetlands conservation. It is integral to effectively implementing any wetlands conservation program because it establishes the context for implementation. The State Wetlands Conservation Plan was drafted to provide a broad context for wetlands conservation programs and activities in the state. However, at this time most planning that encompasses wetlands is occurring at the regional, watershed, and local levels. Planning can occur at any level of government or by the non-governmental sector but is often most effective when it is done through partnerships and when integrated with other land use and resource planning efforts. NYSDEC is including wetlands protection and restoration as components of landscape-level planning efforts, such as the DFWMR's Comprehensive Wildlife Conservation Strategy of 2005. NYSDEC's freshwater wetlands inventory and the National Wetlands Inventory are now available digitally, which increases the utility of the data in local planning efforts.

Acquisition

Acquisition is an important component of a long-term wetland conservation strategy, and New York has a rich history of acquiring wetlands. In the past, the wetlands acquisition program was funded by Environmental Quality Bond Acts, and through various federal funding sources. Today, wetlands acquisition is coordinated through the State Open Space Conservation Plan. Acquisition, however, is expensive and other options are being sought, such as cooperative easements and agreements with landowners. There is also an increasing effort to coordinate acquisition efforts, pool resources, and emphasize a partnership approach.

Regulation

Regulation is often viewed as the primary wetlands conservation tool, and is often equated with government's overall wetlands conservation program, despite the full array of effective, positive efforts ongoing and available. Wetlands regulation at the state level began in the 1970s with the adoption of the Tidal Wetlands Act (Article 25 of the Environmental Conservation Law) in 1973. Certain freshwater wetlands are protected under the 1975 Freshwater Wetlands Act (Article 24 of the ECL). Both statutes require mapping of jurisdictional wetlands. Outside of the Adirondack Park, Article 24 only protects wetlands over 12.4 acres (5 hectares) in size or smaller wetlands of unusual local importance. This accounts for about 80 percent of the wetland acreage outside the Adirondack Park. Inside the Park, wetlands are protected down to one acre, or smaller if there is an open water connection with a permanent water body. A 100 foot adjacent area is also protected as a buffer to the wetland. Permits are required to conduct regulated activities, such as draining, filling, polluting, and dredging. Certain activities are exempt from regulation, including most normal agricultural activities (except filling). Wetlands also are regulated under Article 15, Protection of Waters Act, if they are adjacent to protected streams or state navigable waters. The vast majority of wetlands protection efforts are funded by the state's Conservation Fund (hunting and fishing license revenues), excise tax fees, and a limited amount of General Fund dollars. There is no EPA Performance Partnership Program funding provided for the wetlands protection program.

Wetlands also are regulated under Section 404 of the federal Clean Water Act and Section 10 of the River and Harbors Act.

Federal statutes have no size thresholds, and regulate any dredging, filling, or mechanized land clearing activities that impair the nation's waters, or if under Section 10, any navigability of the nation's water.

Finally, local governments can regulate wetlands either pursuant to Article 24, or independently under Home Rule Authority. Three municipalities implement Article 24, and a few dozen have local ordinances affecting wetlands. In these areas, three permits may be required to conduct a regulated activity in certain wetlands.

Restoration, Creation and Management

These options include actual on-the-ground manipulation conducted to maintain, improve, or bring back degraded or altered wetlands. There is a broad variety of restoration and management efforts underway in the state, most of which are done in partnership between agencies and other stakeholders. Until recently, most of the restoration and management was for fish and wildlife habitat, and was focused through the North American Waterfowl Management Plan and other similar efforts. However, restoration of aquatic habitat, water quality, and broad ecosystem function is becoming increasingly of interest in the state. Wetland restoration actions will be included in landscape-level planning efforts.

Incentive and Disincentives

These options generally receive unanimous support from all sectors, yet it is a very infrequently used approach to wetlands conservation, most likely because it usually includes financial motivation. Disincentive programs are often linked to denying economic benefits if a wetland is negatively impacted. While not regulatory, it still is viewed as punitive by those affected. Incentive programs try to make wetland ownership profitable, or at least less costly (e.g. tax breaks for landowners). Sometimes technical assistance or recognition may be sufficient incentive for landowners to take positive steps for conservation.

Research - Knowledge about wetlands has increased dramatically in the past ten years. Research on wetlands continues and interest by academic institutions appears to be growing as well. Gathering data through inventories, mapping, and monitoring is increasing, but gaps still remain. Use of Geographic Information Systems has drastically improved our ability to manage and track information about wetlands systems. All NYSDEC's regulatory freshwater wetlands maps are available digitally, as are some of Adirondack Park Agency's (APA) maps. Most of the National Wetlands Inventory maps are also digitized.

Education, Outreach and Technical Assistance - These programs provide the building blocks of sound conservation programs: information. They provide the delivery mechanism for information gathered through research, inventories and monitoring and provide information to decision makers to develop or modify programs. These programs deliver maps and inventory information to people who need it to make land purchases or to conduct site planning. Thus information is translated into reality, as when agency staff work with a landowner to restore a wetland on an abandoned farm field. Education, outreach and technical assistance are universally supported, but rarely adequately funded. In the past, USEPA Region II Office funded a number of education and outreach initiatives to improve the public's understanding of wetlands functions and programs to protect wetlands. NYSDEC and other agencies have been partners to these programs. Education through schools and not-for profit groups has also increased in recent years.

Further Integration of Wetlands Assessments

Development of wetland water quality standards is an important step in better integrating wetlands protection into other aspects of implementation of the Clean Water Act. According to USEPA guidance: "Development of wetland water quality standards provides a regulatory basis for a variety of water quality management activities including, but not limited to, monitoring and assessment under Section 305(b), permitting under Sections 402 and 404, water quality certification under Section 401, and control of nonpoint source pollution under Section 319."

New York State has not yet integrated wetlands into existing surface water monitoring programs nor undertaken efforts to monitor the biological, physical, and chemical integrity of wetlands. Because it is unlikely that additional funding will be available for wetlands monitoring in the near future, the DFW&MR is no longer pursuing efforts to develop a wetlands monitoring program. Staff are maintaining awareness of progress in the science, but are not undertaking any further new initiatives.

Because no formal, coordinated monitoring of wetlands exists within NYSDEC, it is not possible to report on attainment of designated uses or to identify causes or stressors and sources of impairment. The Priority Waterbodies List effort includes wetland and other natural resources in determining impairments, and wetlands will be factored into future work. Both DFW&MR and the Division of Water recognize the need to work together to integrate wetlands into all appropriate aspects of the NYSDEC overall program to protect the chemical, physical and biological integrity of New York State waters.

Appendix E

NYSDEC Water Pollution Control Programs

Nonpoint Source Pollution Control Program

The State Nonpoint Source Management Program (**Nonpoint Program**) focuses on integrating federal, state, local and individual landowner activities in a comprehensive program with both regulatory and non-regulatory elements. The principal focus of the Nonpoint Program is on non-regulatory approaches, particularly outreach, education and special assistance projects for implementing best management practices (BMPs) for a wide range of activities.

However, regulatory elements can play a large role. Program staff coordinate with representatives of Federal and State-level regulatory programs to protect or restore waters from nonpoint sources of pollution. For example, Nonpoint Program staff promote consistency with program requirements of general permits for medium and large Concentrated Animal Facility Operations (CAFOs), Stormwater Phase II Construction Sites and Municipal Separate Sewer Systems (MS4s), and certain Onsite Wastewater Treatment Systems. Other State and Federal regulatory programs with which the Nonpoint Program is involved would include: watershed rules and regulations; pesticides and spills prevention; the protection of waters, wetlands and in-stream flows; the emergency response during major floods, and dams safety. These latter programs focus on the protection of life and property, but impact the health of stream and rivers and thus water quality as well. Through the Nonpoint Program's coordinative functions with a wide range of stakeholders, staff work together with stakeholders to better control nonpoint sources of pollution and improve and protect water quality.

The Nonpoint Program had its origin in Section 319 of the federal Water Quality Act of 1987, which called for states to prepare two documents to address nonpoint sources of pollution: *The Nonpoint Source Assessment Report* (February 1989) and *The Nonpoint Source Management Program* (January 1990; revised October 2000). The Assessment Report identified waters that are impacted or threatened by nonpoint sources of pollution and categories of nonpoint sources that pollute certain waters. The Nonpoint Program identified BMPs to be used to reduce nonpoint sources of pollution and programs to implement them. Since its inception, the Nonpoint Program has highlighted the continuing need to rely on partnerships with other federal, state and local government agencies and, more recently, to emphasize watershed planning that addresses both nonpoint and point sources in an integrated approach across entire watersheds.

The management and control of nonpoint pollution can be viewed as four parts of an overall Statewide approach, each involving different partners in the public and private sectors. First, source categories of nonpoint pollution such as contaminated sediments, atmospheric deposition, bulk storage and inactive hazardous waste sites are addressed by other Federal and State government programs. Second, county and municipal governments have lead responsibility for regulating onsite septic systems, stormwater management, and watershed protection. Third, business and agricultural communities are responsible for using best management practices

(BMPs) in their operations to reduce nonpoint pollution. Finally, property owners are responsible for residential sources, such as onsite septic system maintenance, lawn care practices and disposal of household hazardous materials. The methods to promote responsible action differ within each part of the overall Statewide approach.

The NYSDEC Division of Water provides overall leadership for the State Nonpoint Program including responsibility for state and federal government interactions, administration of committees and workgroups, and a principal role in funding local nonpoint source control projects and others to assist local governments. Nonpoint Source and General Permits Section staff coordinate with partners through a multi-level communications approach:

1. A Statewide Nonpoint Program coordination committee and steering committee
2. County water quality coordinating committees, which can set priorities for local water quality improvement projects
3. Subordinate workgroups for each of the prominent nonpoint pollution source categories - workgroups report on recommendations and findings to the Statewide committee
4. Each workgroup can elect to establish additional working groups to work on a special issue or need.

First, a Statewide Nonpoint Program committee, i.e., **the New York State Nonpoint Source Coordinating Committee (NPSCC)** - was established as the statewide body to coordinate the activities of state and federal agencies, and institutions as they relate to local and regional agencies. Principal state agency partners include the NYS Soil and Water Conservation Committee, Cornell University's Cooperative Extension Service and Water Resources Institute, the NYS Departments of Agriculture and Markets, Health, State, and Transportation, and the NYS Soil and Water Conservation Committee. Federal agencies include the United States Environmental Protection Agency (EPA) and Department of Agriculture - Natural Resource Conservation Service (NRCS). In addition, **the Steering Committee of the NPSCC** can be called together to enhance interagency coordination of key members and resolve issues. The NPSCC Steering Committee membership is limited to partners with regulatory, outreach, incentive-based, or funding programs that impact sources of nonpoint pollution.

Second, many of New York's counties have established a **county Water Quality Coordinating Committee (WQCC)** to communicate and coordinate with county agencies, municipal and town governments, and citizen groups or associations on water quality issues. The membership of a WQCC typically includes staff from its local Soil and Water Conservation District, Cornell Cooperative Extension, county health agencies, citizen or lake associations, farm groups, and local representatives of federal agencies, such as the NRCS, and the NYSDEC regional offices. A WQCC can include municipal officials and staff from regional and local planning agencies within the county as well. A WQCC can be proactive, e.g., in stormwater activities. For example, the Albany County WQCC, which meets monthly, has brought attention to the need to create better funding mechanisms to implement MS4 programs, and has its own website - <http://www.albanywater.org/> .

Third, the NPSCC, after reviewing water quality data, established 4 interagency workgroups and

two subcommittees in 2000 to work with partners to protect and improve water quality from source categories of nonpoint water pollution. The Division of Water's Statewide Waters Monitoring Program reports to EPA, every 2-years, on 19 source categories of nonpoint pollution (and 5 point pollution sources). In 2000, the NPSCC grouped 10 nonpoint sources into 4 program areas to form the NYS Nonpoint Program (it determined the other EPA nonpoint categories were already addressed by existing regulatory programs):

1. "Urban, Construction and Roadway (Stormwater) Runoff"
2. "Hydrologic and Habitat Modification (HHM)" involves 3 EPA categories: other-stream bank erosion, hydrologic modification, and habitat modification;
3. "Onsite Wastewater Treatment Systems (OWTS)"
4. "Agriculture"

The NPSCC established the 1) Urban Runoff Workgroup, which has evolved into the Phase II Stormwater (SW) Program; 2) Onsite Wastewater Treatment Systems (OWTS) Workgroup; 3) Hydrologic and Habitat Modification (HHM) Workgroup; 4) Agricultural Workgroup; 5) Information and Education Subcommittee, and 6) Community-based Environmental Management Subcommittee.

HHM and agricultural nonpoint pollution has greater impacts on river miles than stormwater, stormwater runoff significantly impacts downstream lake acres and estuary waters. Also, the State has emphasized stormwater as compared to other nonpoint sources because stormwater contains levels of toxic pollutants.

The Urban Runoff Workgroup was established to address 5 EPA nonpoint categories: urban runoff, storm sewers, construction, highway maintenance/runoff (salt), and other-roadbank erosion. In 2003, the Urban Runoff Workgroup was combined with the Information and Education Subcommittee to form the Stormwater Workgroup, which shouldered the development of the Phase II Stormwater Program. This program is discussed in greater detail later in this chapter, but basically it controls stormwater runoff from disturbed sites, generally one acre or more in size, through general permits at construction sites and through municipal programs and partnerships (go to <http://www.dec.ny.gov/chemical/8468.html> for on-line information).

The Nonpoint Program coordinates with Phase II staff to make stormwater training available to local officials, planners, engineers, contractors and land developers across the State through a network of regional stormwater coalitions, DEC staff and the College of Environment Science and Forestry at the State University of New York (SUNY) at Syracuse. Training outlets are needed to cover the majority of the State, which is not covered by municipal Phase II programs.

Similar to the Urban Runoff Workgroup, **the Agricultural Workgroup** has evolved since 2000 into a separate program. The Agricultural Environmental Management Program (AEM) is a voluntary, incentive-based program, administered through the NYS Department of Agriculture and Markets and the NYS Soil and Water Conservation Committee, of which NYSDEC is a member. To date, nearly 10,000 farms across the State are participating in AEM. Through AEM, farmers learn to make common-sense, cost-effective and science-based decisions to help

meet business objectives while protecting and conserving the State's natural resources. Farmers work with local AEM resource professionals to develop comprehensive farm plans in a tiered approach to assessing, planning, and, ultimately, implementing measures to improve water quality on their farms. For more information, go on-line to <http://www.nys-soilandwater.org/> .

The focus of **the OWTS Workgroup** has been to address nonpoint pollution from failing septic systems. Much of its progress has dealt with improving the design, installation and management of onsite systems discharging to groundwater. The NY Onsite Wastewater Treatment Training Network, Inc. - or OTN - originated as an ad hoc interest group and is now a corporation registered with the New York Charities Board with Federal 501.c.3 tax-exempt status. The OTN's initial development took place at SUNY-Morrisville, and now in its 7th year, OTN Inc. - with a Training Coordinator and website - <http://www.delhi.edu/corporateservices/> - is located with SUNY -Delhi. Training curriculum has been developed and OTN qualified trainers are recruited. The Statewide training is for engineers, local officials, Code Enforcement Officials, home inspectors, wastewater treatment plant operators, contractors, installers and service providers. Curriculum teaches the proper understanding of the science, site and soil criteria, operation, installation & inspection of treatment systems.

In a related activity, the OWTS Workgroup is involved in updating the 1988 Design Standards for Wastewater Treatment Works - Intermediate-sized Sewage Facilities. The standards apply to treatment works for institutional and commercial establishments, as well as cluster housing and other multi-home developments. The standards are applicable to facilities covered by GP-0-05-001, but may also be used for facilities applying for individual SPDES permits.

The work of **the Hydrologic and Habitat Modification Workgroup** has been slowed in order to pool NYSDEC staff resources for Phase II Stormwater program management, outreach, training and guidance development, but progress has continued on several fronts. Over 15 members of the Workgroup have met 2-3 times per year to identify needs and review progress in addressing impacts from nonpoint pollution in streams and rivers. The HHM Workgroup *Plan to Protect and Restore NY Rivers and Streams* was completed in 2005. Also, Greene County Soil and Water Conservation District took the lead on providing training for stream professionals.

In 2006, the HHM Workgroup established the NYS Barrier Mitigation Forum. This special group met numerous times and challenged a smaller group to prepare a preliminary applicant's guide for dam owners, which will be released in 2008. Concurrently, the USFWS had the lead to prepare a strategy for stream professionals on identifying candidate sites for dam removal. The report and companion CD will be released in 2008 as well.

Also, the HHM Workgroup has formed groups to identify thresholds for qualified professionals working in streams, and for responding to flood emergencies. Representatives of the Hudson River Estuary Program, American Rivers, NY Rivers United, The Nature Conservancy, Trout Unlimited and other agency stakeholders are actively involved in the HHM Workgroup.

Finally, **the Community-based Environmental Management Subcommittee** was suspended in 2005 due to NYSDEC resource needs to implement the Phase II Stormwater program.

Point Source Regulation

Control of pollution from point source discharges (i.e., discharges that come through a pipe or other conveyance to a receiving water) is accomplished through the State Pollution Discharge Elimination System (SPDES) permit program. Any individual wishing to discharge a wastewater effluent to the surface or ground waters of New York State must have a permit for that discharge. Currently, just under 10,000 SPDES permits have been issued.

A facility-specific SPDES permit lists parameter-specific limits (for concentration and flow/loadings) for facility discharges. When developing initial permit limits, Division Of Water staff first consider technology-based effluent limits. These limits reflect wastewater treatment technology standards that require:

- i. Secondary treatment of municipal waste;
 - Best Conventional Control Technology (BCT) for conventional pollutants; and
 - Best Available-economically-achievable Technology (BAT) or Best Professional Judgement (BPJ) for toxics.

These standards have been set by USEPA based on a national average for effectiveness and affordability. The term "best" as used above refers to that average rather than a definitive, unqualified best possible treatment.

After establishing technology-based limits, staff then conduct water quality assessments for substances proposed to be discharged to determine if the limits are sufficient to protect the receiving water's quality. This assessment includes a review of the classification and associated water quality standards of the receiving stream and the waste assimilative capacity of the water for biodegradable pollutants (how much of a particular substance can a water receive and self-cleanse without lasting adverse effects). The cumulative effect on the waterbody of all other discharges within the watershed are also evaluated.

Technology-based limits are compared with water quality limits. For each substance, the more stringent of the two limits are reflected in the *draft* permit. Water quality limits are reviewed for reasonableness. Factors considered in determining reasonableness include level of detection, background levels,

Whole Effluent Toxicity Testing

Whole Effluent Toxicity Testing (WETT) requires dischargers to evaluate toxicity of effluent on test organisms. Such testing is required of permittees when:

- the discharge contains numerous compounds, and additive effects are possible;
- the limits for one or more compounds toxic to aquatic life cannot be established; and/or
- toxicity to aquatic life in the waterbody persists after the discharge.

WETT requires permittees to perform both Tier I tests, which measures acute responses of aquatic organisms to effluent, and Tier II tests, to measure chronic effects. Toxicity reduction evaluations (TREs) identify the source and nature of toxicity as indicated by acute or chronic effects. This evaluation determines the appropriate long-term monitoring parameter for toxicity control, sets a permit limit, and suggests a plan to reduce the toxicity permanently.

stream assimilative capacity and waste treatment options. Permits may also require *that Whole Effluent Toxicity Testing* (WETT) be conducted to determine a treated effluent's toxicity to sensitive aquatic organisms (see box). WETT requirements are useful when numerous compounds are discharged and their additive effects are of concern, and/or when limits for specific compounds cannot be established. Once developed, draft facility specific permits are announced publicly in the *Environmental Notice Bulletin* for public review and input before NYSDEC makes them final and issues them.

Permits must be renewed every five years. Until recently, when facility-specific SPDES permits were renewed, each had to go through the same technical review as a new permit, regardless of whether it had any deficiencies or if those deficiencies were environmentally significant. This lengthy process resulted in backlogs of permits waiting for renewal, facilities operating under expired permits, and major permits in the same queue as minor permits, waiting for review.

To make management of facility-specific SPDES permits more responsive to environmental benefit, an Environmental Benefit Permit Strategy (EBPS) was designed. The EBPS is a means of prioritizing permit review to focus staff time and attention where it will do the most good. Under EBPS, each facility-specific permit is administratively renewed before it expires (every 5 years). At renewal time, a permit goes through technical review to identify potential permit deficiencies and the priority of the permit. A permit might need to be modified due to changes in regulation, problems with compliance, or requests from the discharger or the public. A priority ranking of each permit is then developed according to a numerical score based on various considerations (13 environmental program factors and 3 environmental benefit multipliers). The permits with the highest scores get priority attention for detailed technical review and prompt modification to correct deficiencies.

In addition to facility-specific SPDES permits, NYSDEC also issues *general* permits for five specific activities. These are: Municipal Separate Storm Sewer Systems (MS4s), Construction Stormwater Runoff, Stormwater Runoff associated with Industrial Activity, Sanitary Discharges to Groundwater (1,000 to 10,000 gallons/day), and Concentrated Animal Feeding Operations (CAFOs). In each of these instances, discharges must meet requirements in the appropriate general permit rather than in individual discharge-specific permits.

Another component of the division's point source control effort is the Pretreatment Program. Many industries discharge their wastewater to municipal wastewater treatment plants, rather than directly to a receiving water. These industries are called *indirect dischargers* and those industries that receive the most regulatory attention are *significant industrial users*. USEPA regulations require larger municipal treatment authorities that receive industrial waste from significant industrial users to have pretreatment programs to control indirect discharges.

Fifty-seven municipal treatment authorities in New York State have developed and are implementing local pretreatment programs, in accordance with USEPA pretreatment regulations. These local authorities manage significant indirect discharges through permit programs similar to the state SPDES permit program. The objectives of these programs are to prevent pollutants that are incompatible with municipal sewage treatment plants from:

- interfering with municipal treatment plant operation, including the use/disposal of sludge;

- passing through municipal treatment plants; and
- limiting municipal sludge recycling and reclamation.

Local pretreatment programs have been very successful in reducing incompatible pollutants in municipal sewage treatment plants in New York State. NYSDEC presently shares oversight of local pretreatment programs with USEPA. However, the lack of combined USEPA/NYSDEC resources for oversight has kept local pretreatment programs in New York State from reaching their full potential. NYSDEC hopes someday to provide adequate resources to assume primary oversight authority.

Seventy-six municipal treatment authorities in New York State have combined sewer systems that convey both sanitary sewage and storm water through a single pipe. These combined systems are prone to combined sewer overflow (CSO) during wet weather events. When this occurs, the system is designed to overflow directly to surface water bodies. These overflows can be a major source of water pollution in communities served by combined systems. In response NYSDEC and USEPA have developed a statewide permitting strategy designed to reduce, eliminate or control CSOs. The strategy will: ensure that if CSOs occur, they are only as a result of wet weather; bring all wet weather CSO discharge points in New York State into compliance with the technology and water quality based requirements of the Clean Water Act, and minimize the impacts of CSOs on water quality, aquatic biota and human health. NYSDEC will modify the SPDES permit for each CSO community to require implementation of USEPA's Nine Minimum Control Measures, through best management practices and Long-Term Control Planning, wherever Water Quality Standards (WQS) are not achieved. CSO communities throughout the state are in various stages of planning and implementing CSO control measures to achieve WQS. The overall planning approach consists of three major steps: system characterization, development and evaluation of alternatives, and selection and implementation of the CSO controls.

Stormwater and Concentrated Animal Feeding Operations (CAFO) Programs

In 1990, the USEPA established Phase I of the National Pollutant Discharge Elimination System (NPDES) stormwater program. This regulation established requirements for a stormwater permit application process. Under Phase I, USEPA required permit coverage for 11 categories of industrial activities, one of which is construction that disturbs five or more acres of land. Phase I also required permits for stormwater discharges from "large" municipal separate storm sewer systems. In New York State, regulated stormwater activities are covered by a State Pollutant Discharge Elimination System (SPDES) permit. The major component of the general SPDES permits for stormwater discharges is the requirement to implement pollution prevention plans which use management practices and measures aimed at controlling pollutants. On January 8, 2003, NYSDEC issued the new Stormwater Phase II permits required by the Phase II rule promulgated by USEPA in December 1999.

After extensive outreach, NYSDEC made draft renewal permits available for 60 day public review on October 10, 2007. The draft permits build on the successes of the first five years of phase II permitting by providing for more protective requirements for watersheds with reasonable potential for exceedences of water quality standards. 125 sets of comments were received and are being reviewed.

Farms in New York State include a large number of Concentrated Animal Feeding Operations (CAFOs).

To address agricultural runoff from such operations, NYSDEC developed a statewide general discharge permit for CAFOs. The general permit requires the development and implementation of a site-specific Comprehensive Nutrient Management Plan (CNMP).

The Comprehensive Nutrient Management Plan must be developed by a Certified Planner in accordance with the, "Natural Resources Conservation Service - Conservation Practice Standard NY312 - Waste Management Systems", to properly manage liquid and solid waste, including runoff from concentrated areas. Certified planners are reviewed every other year by CNMP specialists to assure quality CNMP development and update.

Currently, there are 144 large and 461 medium CAFO operations in New York State with coverage under the CAFO General Permit. All large and all but sixteen medium CAFO operations required to complete Comprehensive Nutrient Management Plans (CNMPs) have completed their plans. CAFO compliance includes a very high rate of compliance (~ 99 %) submittal of Annual Compliance reports, as well as a greater than 95% rate of compliance with CNMP development requirements. Outreach activities to the regulated agricultural community and to professional service providers include: periodic CAFO Workgroup meetings; AEM Steering Committee and Certification Subcommittee meetings; annual CAFO inspector training (and monthly Farm Team conference calls to discuss emerging issues); statewide farmer outreach meetings; CNMP planner training on the requirements of the CAFO General Permit; soil and water conservation district training at the annual Water Quality Symposium, and Certified Crop Advisor (CCA) training. NYSDEC is currently implementing new inspection procedures, including a new inspection format. NYSDEC is also evaluating compliance with the final deadline for CNMP implementation for Large CAFOs.

DOW Training Programs

The Comprehensive Five Year Strategic Training Plan for Wastewater Treatment Plant Inspectors and Wastewater Treatment Plant Operators was developed to identify and deliver priority wastewater training needs over a five-year period. This training is delivered to DOW wastewater treatment plant inspectors to enhance their surveillance and compliance monitoring activities. Training is provided for wastewater treatment plant operators to partially meet their 6NYCRR Part 650 operator recertification requirements and to maintain a competent operations workforce. This workforce is responsible for operating and maintaining the treatment facilities New York has invested more than \$11 Billion to construct.

In calendar year 2007, NYSDEC's Facility Operations Assistance Section (FOAS) coordinated and delivered 22 training programs on wastewater treatment throughout New York. These programs were provided to 840 wastewater professionals. Topics covered ranged from Solids Handling and Troubleshooting Operation and Maintenance Problems at Activated Sludge Facilities to training of wastewater boards and elected officials on maintaining their wastewater infrastructure. Programs were delivered by FOAS staff and several programs were coordinated with the New York Water Environment Association (NYWEA) and New England Interstate Water Pollution Control Commission (NEIWPC). Staff effort to deliver these programs was 500 days (2.24 man years). Cost to deliver the programs (staff salary, travel, supplies) was approximately \$250,000.

Projections for 2008 are for FOAS to coordinate and deliver 16 programs requiring approximately 343 days of effort and \$180,000 for staff salary, travel, and supplies. Numbers are lower for 2008/2009 because of a reduction in FOAS staff. Information on future programs can be found on FOAS's website at www.dec.ny.gov/chemical/8464.html.

Relevant Program Websites

- **NYSDEC Division of Water:**

- <http://www.dec.ny.gov/chemical/290.html>

- Waterbody Inventory/Priority Waterbodies List (includes full basin reports):
 - <http://www.dec.ny.gov/chemical/23846.html>
 - Water Quality Standards and Analytical Support
 - <http://www.dec.ny.gov/chemical/23842.html>
 - Water Quality Management
 - <http://www.dec.ny.gov/chemical/23844.html>
 - New York State Total Maximum Daily Loads:
 - <http://www.dec.ny.gov/chemical/23835.html>
 - Water Quality Research and Special Projects
 - <http://www.dec.ny.gov/chemical/23843.html>
 - NYS Routine Statewide Monitoring Program
 - <http://www.dec.ny.gov/chemical/23848.html>
 - Lakes, Rivers, Watersheds & Groundwater
 - <http://www.dec.ny.gov/lands/26561.html>
 - Shellfishing
 - <http://www.dec.ny.gov/outdoor/345.html>

- **NYSDOH Fish Consumption Advisories**

- <http://www.health.state.ny.us/environmental/outdoors/fish/fish.htm>

- **Great Lakes Programs:**

Remedial Action Plans (RAPs) – Five Areas of Concern (AOCs) in New York State

Buffalo River: <http://www.epa.gov/glnpo/aoc/buffalo.html>

Eighteenmile Creek: <http://www.epa.gov/glnpo/aoc/eighteenmile.html>

Niagara River: <http://www.epa.gov/glnpo/aoc/niagara.html>

Rochester Embayment: <http://epa.gov/greatlakes/aoc/rochester.html>

St. Lawrence River (at Massena): <http://www.epa.gov/glnpo/aoc/stlawrence.html>

Oswego River – Stage 3 Delisting: <http://www.dec.ny.gov/lands/25587.html>

Lakewide Management Plans (LaMP)

Lake Ontario LaMP: <http://www.epa.gov/glnpo/ontario.html>

Lake Erie LaMP: <http://epa.gov/lakeerie/lamp2000/>

Niagara River Toxics Management Plan:

<http://www.epa.gov/glnpo/lakeont/nrtmp/pr&wp99/>

Watershed Program Websites:

- New York/New Jersey Harbor Estuary Program: <http://www.seagrant.sunysb.edu/hep/>
- Long Island Sound Study: <http://www.longislandsoundstudy.net/>
- New York City Watershed:
http://www.nyc.gov/html/dep/html/watershed_protection/home.html
- South Shore Estuary Reserve Council: <http://www.estuary.cog.ny.us/>
- Peconic Estuary Program: <http://www.peconicestuary.org/>
- Lake Champlain Basin Program: <http://www.lcbp.org/>
- Onondaga Lake Partnership: <http://www.onlakepartners.org/>
- Delaware River Basin Commission: <http://www.nj.gov/drbc/>
- Chesapeake Bay Program: <http://www.chesapeakebay.net/>
- Susquehanna River Basin Commission: <http://www.srbc.net/>
- Hudson River Estuary Program: <http://www.dec.ny.gov/lands/4920.html>
- Ohio River Valley Water Sanitation Commission: www.orsanco.org