New York City Department of Environmental Protection
Bureau of Water Supply

Waterfowl Management Program

July 31, 2011

Prepared in accordance with the Final 2007 (Waterfowl Management Program-Section 4.1) of the United States Environmental Protection Filtration Avoidance Determination

A Waterfowl Management Program was developed to evaluate and mitigate pollutant impacts (fecal coliform bacteria) from migratory and resident waterbirds (waterfowl, gulls and cormorants). The purpose of the study reported here, for the period April 1, 2010 to March 31, 2011, is to evaluate further the trends observed in bird numbers and their effect on fecal coliform bacteria levels as a consequence of DEP's Waterfowl Management Program.

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Division of Watershed Water Quality Operations

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The author, Mr. Christopher A. Nadareski, is DEP's Section Chief of Wildlife Studies and is responsible for the Waterfowl Management Program oversight including data management, field data collection, and contract administration.

INTRODUCTION

The management of waterbird populations at key reservoirs throughout the New York City Water Supply is essential to meet stringent water quality regulations as stated in the Environmental Protection Agency's (EPA) Surface Water Treatment Rule (SWTR) of 1991. As a result, DEP developed and implemented a comprehensive Watershed Protection-Filtration Avoidance Program to protect its water supply. A component of the Watershed Protection Plan is DEP's Waterfowl Management Program (WMP) which was established to research the relationship between wildlife, particularly waterbirds (geese, gulls, cormorants, swans, ducks and other duck-like birds) that inhabit the reservoirs, and fecal coliform bacteria (FCOLI) elevations in the untreated surface water. The Waterfowl Management Program, originally developed for the NYC's Kensico Reservoir in 1992, has been expanded to include five additional reservoirs for waterbird management under the November 2002 Filtration Avoidance Determination (FAD) (Section 4.1 – Waterfowl Management Program). The most recent FAD update (2007 FAD) includes bird management at Hillview Reservoir in Yonkers, New York.

The WMP was designed to study the relationship between seasonal trends in bird populations on the reservoirs as well as trends in fecal coliform concentrations both within the reservoir and at the keypoint water sampling locations. Following several years of waterbird population monitoring, DEP's scientific staff consisting of wildlife biologists and microbiologists identified birds as a significant source of fecal coliform at the Kensico Reservoir. In response, DEP developed and implemented a Waterfowl Management Program using standard bird management techniques (approved by the United States Department of Agriculture, Wildlife Services (USDA) and the New York State Department of Environmental Conservation (DEC)) to reduce or eliminate the waterbird populations inhabiting the reservoir system (DEP 2002). DEP has also acquired depredation permits from the United States Fish & Wildlife Service and DEC to implement some management techniques. Since the initial implementation of DEP's bird dispersal and deterrent techniques in 1993 there has been a dramatic reduction in both bird populations and fecal coliform levels, thus maintaining high quality water in compliance with the SWTR.

Migratory populations of waterbirds utilize NYC reservoirs as temporary staging areas and wintering grounds and therefore can significantly contribute to increases in fecal coliform loadings during the autumn and winter primarily from direct fecal deposition in the reservoirs. These migrant waterbirds generally roost nocturnally and occasionally forage and loaf diurnally on the reservoirs, however, it has been determined that most of the feeding activity occurs away from the reservoir. Fecal samples collected and analyzed for fecal coliform bacteria concentrations from both Canada geese (*Branta canadensis*) and Ring-billed Gulls (*Larus delawarensis*) revealed that fecal coliform concentrations are high per gram of feces (Alderisio and DeLuca 1999). Water samples collected near waterbird roosting locations have shown fecal coliform increases concurrent with waterbird populations at several NYC reservoirs in previous

DEP reports (DEP 1993 - 2009). Thus, DEP has determined that waterbirds contributed the most important fecal coliform bacteria load seasonally to Kensico Reservoir and to other terminal reservoirs (West Branch, Rondout, Ashokan) and potential source reservoirs to the Catskill-Delaware System (Croton Falls, and Cross River). Since waterbirds have been associated with elevated fecal coliform bacteria levels found in various reservoirs and lakes (DEP 1994 and 1995), a program to discourage waterbird activity was developed for Kensico Reservoir in the fall of 1993 and is expected to continue indefinitely. The bird dispersal program was more recently expanded to Rondout Reservoir during the winters of 2001 through 2007, West Branch Reservoir in 2007 and 2010/2011 and at Croton Falls Reservoir during the winter of 2001/2002 on an "as needed" basis. To assure DEP's program activities remained in compliance with all federal, State, and Local laws including effects on local environmental conditions including endangered species an Environmental Impact Statement was completed for Kensico in 1996 and another one in the spring of 2004 for five additional reservoirs (Rondout, West Branch, Ashokan, Croton Falls, and Cross River). A Final Environmental Impact Statement including a "findings statement" can be found on the DEP website identifying program impacts and required mitigation to meeting implementation standards for the expanded WMP. This report is a requirement of the 2007 FAD.

The purpose of this report is to evaluate further the down-trend observed in waterbird populations and its impact on FCOLI concentrations as a consequence of DEP's Waterfowl Management Program for the period April 1, 2010 through March 31, 2011.

METHODS

Under the DEP's Final 2007 Filtration Avoidance Determination Section (FAD), Waterfowl Management Program Section 4.1, it specifically states the following:

4.1 Waterfowl Management Program

The Waterfowl Management Program was initiated in 1993 by the City for the Kensico Reservoir in response to elevated coliform bacteria levels contained in the Reservoir. The 2002 FAD required that the City continue this program for the Kensico Reservoir on a routine basis and expand the program on an "as needed" basis for five additional reservoirs. Three of these five reservoirs (West Branch, Rondout and Ashokan) routinely serve Kensico with its source water. The remaining two (Cross River and Croton Falls), while in the Croton system, may serve Kensico with source water under special circumstances. The objective of the program is to minimize the fecal coliform loading to the reservoirs that result from roosting birds during the migratory season. The program includes three activities: avian population monitoring, avian harassment activities (motorboats, air boats, and pyrotechnics) and avian deterrence (depredation of nests and eggs, bird exclusion wires, and netting at critical intake chambers.) All avian harassment techniques and deterrence activities have been approved by the United States

Department of Agriculture Wildlife Services and DEC.

The City's 2006 Long-Term Watershed Protection Program expanded the Waterfowl Management Program on an "as needed" basis to include avian harassment activities for the Hillview Reservoir as well as avian deterrent measures for Hillview and other City reservoirs. The term "as needed" refers to implementation of avian management measures based on the following criteria:

- Current bird populations, including roosting or staging locations relative to water intakes;
- Fecal coliform bacteria concentrations approaching or exceeding 20 colony-forming units at reservoir effluent structures coincident with elevated bird populations;
- Recent weather events;
- Operational flow conditions within the reservoir (i.e. elevations and flow patterns and amounts);
- Reservoir ice coverage and watershed snow cover; and
- Determination that active bird management measures would be effective in reducing bird populations and fecal coliform bacteria levels.

The 2007 FAD (Table 1) requires that NYCDEP continue implementation of its Waterfowl Management Program in accordance with Section 2.3.1 of the City's 2006 Long-Term Watershed Protection Program and the milestones therein with the following clarification:

- NYCDEP will perform avian population monitoring in accordance with the frequencies specified in the City's 2001 Watershed Protection Program Summary, Assessment and Long-term Plan.

Table 1. Final 2007 FAD Requirements

Requirement	Due Date
Active Bird Harassment – Kensico Reservoir	8/1 to 3/31; Annually
"As needed" Bird Harassment – West Branch, Rondout, Ashokan, Cross River, Croton Falls, and Hillview Reservoirs	8/1 to 4/15; Annually
Avian Deterrent Measures – Kensico, West Branch, Rondout, Ashokan, Cross River, Croton Falls, Hillview Reservoirs and other City reservoirs as needed	Year-round; Annually
Submit annual summary of Waterfowl Management Program activities including contract status, and implementation and analysis of all program elements (including special studies)	7/31; Annually

Waterbird Census

The relationship between elevated waterbird counts and increased levels of fecal coliform bacteria identified from raw water samples is well established. New York City Reservoirs, situated in southeastern New York State, lie in the Atlantic Flyway, an important migratory pathway for many groups of birds including waterbirds. Although limited in feeding opportunities, the NYC reservoirs offer important areas of open water used for night roosting and winter stop-overs. Since it has been well documented that the primary bacterial contribution of the water supply is from night-roosting and migratory birds, night census data is presented throughout this report. Defecation rates of birds are known to be somewhat lower nocturnally than diurnally.

Daily waterbird observations were conducted at predawn hours (between 4:30am and 8:00am E.S.T.) and post dusk hours (between 5:00pm to 10:00pm E.S.T.) to determine overnight waterbird roosting populations and to evaluate the success of the hazing activities from the previous day (where applicable) at all reservoirs. Survey times vary seasonally reflecting available daylight hours. Since it has been determined that most birds roost nocturnally, and generally fly off the reservoir during extended periods of the day, all population monitoring data reflect overnight roosting (NYCDEP 1993). For successful data collection, ideal weather and atmospheric conditions were necessary. Otherwise precipitation events and fog prohibited data collection resulted in short gaps of "no data". Reservoir maps with Bird Zones can be found in Appendix A.

The July 2007 FAD, Section 4.1 specifies the frequency of reservoir surveys and is listed in Table 2. Actual surveys conducted from April 1, 2010 to March 31, 2011 are also listed in Table 2.

Table 2. Frequency of bird observation surveys by reservoir 2010/2011 (as listed under the November 2002 FAD, Section 6.4.1).

Reservoir	Bird Surveys Scheduled	Proposed/Actual Surveys
Kensico	Pre-dawn to Post-dusk Daily August 1 to March 31; Pre-dawn and Post-dusk Weekly April 1 to July 31	260/253*
West Branch	Pre-dawn, Midday, and Post-dusk Weekly all year; Increased to daily "as needed"	26/66**
Rondout	Pre-dawn, Midday, and Post-dusk Weekly all year; Increased to daily "as needed"	52/55
Ashokan	Pre-dawn, Midday, and Post-dusk Weekly all year; Increased to daily "as needed"	52/52
Croton Falls	Pre-dawn, Midday, and Post-dusk Bi-weekly all year; Increased to daily "as needed"	26/25
Cross River	Pre-dawn, Midday, and Post-dusk Bi-weekly all year; Increased to daily "as needed"	26/25
Hillview	Pre-dawn, Midday, and Post-dusk Weekly all year; Increased to daily "as needed"	52/247 (night) 52/360 (day)

*A total of three surveys were cancelled due to holidays and four surveys were cancelled due to inclement weather.
** As needed program activated in 2010/2011.

Reservoir-wide observational surveys for waterbirds were conducted year-round at all six reservoirs listed (Table 2). Additional "as needed" surveys were conducted at Hillview, West Branch and Croton Falls Reservoirs as a measure to determine if bird harassment actions were necessary. Each survey records species evenness (number per species), species richness (species diversity), roosting and foraging locations, band/collar identifications, and general behavior during the overnight roosting period. Waterbird data is collected from shoreline locations and/or watercraft (motorboat, airboat, or canoe) by a wildlife biologist, ornithologist, or wildlife technician using binoculars and spotting scopes. DEP developed field data sheets to record observation locations with times for each reservoir. Data is entered in an Excel spreadsheet and is checked twice for Quality Assurance/Quality Control. Each survey data point can consist of a minimum of one or two site visits per datum reported (i.e. night before and morning after the nightly roost), and is dependent on the field conditions (i.e. weather, fog), reservoir physical characteristics (i.e. drought), and time of year (leaf-cover or not). Data collected during reservoir-wide surveys that were incomplete due to inclement weather were not recorded. Only high counts for each category of waterbirds are used for data recording. For example, if there was a count of 20 Canada geese at a bird observation location and zero for the rest of the reservoir for the night before count and a count of 20 ducks at another location on the morning after survey, a combination of 20 geese and 20 ducks would give a reservoir-wide total of 40 birds. The purpose of using two surveys for data collection is ascertaining species highest

concentrations over a specific time period. Some species at certain times of the year are easier to count at night when birds are flying into roost areas (or open water) in the evening whereas others are easier to count when flying out of the reservoir in the early morning.

Waterbird population zones were delineated at all reservoirs to identify local impacts on water quality and have been described in previous DEP reports for Kensico and West Branch (DEP 1994, 1995, 1997a).

Data reported on fecal coliform bacteria concentrations for both keypoint raw water outflow samples (aqueduct and outflows) and reservoir samples have been reviewed by DEP laboratory personnel. The following conditions apply to the water quality data reported:

- Only high concentration duplicate samples are reported (for example if two keypoint samples were collected in a single day, or if more than one sample is collected at different depths at a single limnology sampling location, the highest bacteria count has been used for charting)
- All special investigation samples are reported
- Reanalysis samples are reported
- There were no samples with confluent growth reported

Fecal Coliform Bacteria Data

Water quality data presented in this report were collected by DEP's Watershed Water Quality Operations personnel and analyzed and reported by four DEP New York State Department of Health Environmental Laboratory Approval Program certified Laboratories in Valhalla, Kingston, Grahamsville, and Queens, New York. Watershed DEP Laboratory personnel utilize the Membrane Filtration Technique for fecal coliform analyses while the Distribution Laboratory personnel utilize the Colilert18 with Quantitray for E.coli analysis (Hillview samples). Reservoir-wide waterbird survey results are presented with fecal coliform bacterial levels at keypoint (outflow) and reservoir sampling areas. Detailed descriptions are listed below by reservoir (Table 3).

Waterbird Dispersal Techniques

The list of bird dispersal activities conducted since 2002 is listed in Table 3. Waterbird dispersal techniques were employed at Kensico Reservoir from August 1, 2010 through March 31, 2011 using motorboats, Husky Airboats, noisemakers (pyrotechnics), and bird distress tapes. Pyrotechnics and propane cannons were used on a daily basis year-around at Hillview Reservoir during this reporting period. Dispersal techniques were conducted under a DEP Waterfowl Management Program contract (WMP-08) by HDR (Henningson, Durham, and Richardson, P.C. of Pearl River, New York). The Kensico and Hillview programs will remain permanently-based conducted between August 1 and March 31 annually. Beginning daily at 8am and continuing until approximately 1.5 hours past sunset, bird hazing activities were conducted reservoir-wide, targeting all species except those with a federal or NYS endangered or threatened status (e.g. N.Y.S. Threatened Pied-billed Grebe).

The Husky Airboats were again used for bird harassment in 2010/2011 at Kensico. Airboats have the ability to ride over ice and water interfaces with ease. The airboats also have heated cabins which provide longer time periods of bird hazing opportunities (physical chasing and pyrotechnic use) during reservoir freezing periods throughout the winter.

The other five reservoirs included in this report are covered under the "as needed" section for the expanded reservoirs. During this reporting period an "as needed" bird management response was necessary at West Branch Reservoir. Detailed descriptions are listed below by reservoir.

Table 3. Reservoir Bird Mitigation (1993 – 2011)

Reservoir	Dates of Bird Harassment/Deterrence	Bird Harassment/Deterrence Measures Used
Kensico	August 1,– March 31 1993 to 2011	Bird Harassment (Motorboats, Husky Airboats, Pyrotechnics, and Bird Distress Tapes), Waterbird Reproductive Depredation, Shoreline Meadow Management and Fencing, and Alewife Collections
West Branch*	January 11 to March 28, 2007 December 15, 2010 to January 6, 2011	Bird Harassment (Motorboats and Pyrotechnics) and Waterbird Reproduction Depredation
Rondout*	December 2002 – January 2003 December 2003 – January 2004 December 2005 – March 2006 None required during this reporting period	Bird Harassment (Pyrotechnics, Red-beam Lasers, and Bird Distress Tapes) and Waterbird Reproduction Depredation
Ashokan*	None required during this reporting period	Waterbird Reproductive Depredation
Croton Falls*	January – February 2002 None required during this reporting period	Bird Harassment (Motorboats, Pyrotechnics, Red-beam Lasers, and Bird Distress Tapes) and Waterbird Reproductive Depredation
Cross River*	None required during this reporting period	Waterbird Reproductive Depredation
Hillview	Year-around-continuous or "as needed" (July 1993 to March 31, 2011)	Bird Deterrent Wire System and Bird Harassment (Pyrotechnics)

*Indicates reservoir mitigation only occurs "as needed" under the Final 2007 FAD, Section 4.1.

In response to entrainment of Alewives (*Alosa pseudoharengus*), a baitfish, into the water intake structures at Ashokan Reservoir and their subsequent outflow at Kensico Reservoir, the DEP Waterfowl Management contractor installed a temporary collection boom around the Catskill Influent structure (CATIC) to remove the dead fish that collected at the boom. Alewives are an

attractive food source for gulls and some species of ducks and when large numbers of fish are flushing into the reservoir, the gulls become very difficult to manage.

Waterbird Reproductive Management
Canada Geese and Mute Swan egg and nest depredation were conducted during the spring and summer periods of 2010 to help reduce fecundity at all NYC reservoirs. Mitigative actions included Canada goose reproductive management and maintenance of meadow vegetation (Kensico, Rondout) and shoreline fences (Kensico), where applicable. Egg and nest-depredation involved locating all Canada Geese and Mute Swan (*Cygnus olor*) nests within NYC reservoir property, numbering each nest and egg, and puncturing each egg with a probe to break the membranes thereby destroying the embryo. Eggs were then replaced in the nest to allow incubation to continue. A small number of goose nests were often destroyed late in the breeding season to encourage the birds to relocate off reservoir property during the annual post-nuptial molt when the birds are rendered flightless for a few weeks.

A total of 75 Canada goose nests containing 392 eggs were depredated (punctured) at 7 New York City Reservoirs (Table 4) during the spring of 2010 compared to 60 nests and 243 eggs in the previous year. All depredation activity was conducted under the terms of Federal Permit (#RG-01040A) from the United States Department of the Interior, United States Fish & Wildlife Service for Canada Geese (*Branta Canadensis*) and a DEC permit (#3-11-100) for Mute Swans.

Additionally, DEP in conjunction with DEC continued an annual Canada goose banding project in Westchester, Putnam, and Ulster, Counties to track local movements throughout the NYC watersheds. Band identifications provide a means to identify local breeding, feeding, and loafing areas which may aide in implementing best management practices (i.e. elimination of feeding areas may eliminate presence on reservoirs).

Table 4. 2010 Canada Geese and Mute Swan Nest Census and Egg-Depredation

Reservoir	Number of Surveys	Canada Geese/Mute Swan Nests	Canada Geese/Mute Swan Eggs depredated	Canada Geese/Mute Swan Depredation Success Rate
Kensico	5	36/1	170/9	98% (4 goslings/100% (0 cygnets)
West Branch	4	12/0	42/0	100% (0 gosling)/NA
Rondout	1	2/0	11/0	34% (21 goslings)/NA
Ashokan	4	4/0	19/0	37% (32 goslings)/NA
Croton Falls	5	6/0	24/0	83% (5 goslings) /NA
Cross River	4	7/0	33/0	100%/NA
Hillview	91	0/0	0/0	NA/NA

RESULTS and DISCUSSION

1. Kensico Reservoir

Kensico Reservoir receives water from Rondout and West Branch Reservoirs via the Delaware Aqueduct and from the Ashokan Reservoir via the Catskill Aqueduct. Water leaving Kensico is disinfected with chlorine and delivered via aqueduct to Hillview Reservoir. Kensico Reservoir has been divided into eight Bird Zones to compare bird counts with water samples collected at limnological sampling locations. Waterbird numbers at Kensico Reservoir remained consistently low throughout the reporting period as a result of continued implementation of the Waterfowl Management Program (Figures 1 and 2). The geographic configuration of Kensico includes two main open water areas; one in Bird Zone 4 and one in Bird Zone 6 (Figure 29). These open water areas tend to attract large numbers of gulls roosting overnight.

Prior to implementing bird harassment, DEP began collecting bird census data in August of 1992. Bird counts reached several thousand during the migratory/wintering period (Figure 1) with high bird roosting counts recorded in the water intake coves at Kensico. Figure 3 shows a dramatic decline in bird counts from several thousand in 1994 to a few hundred during the same migratory period in recent years with bird harassment techniques employed. Fecal coliform bacteria show a dramatic decline simultaneous with the inception of the bird harassment efforts, and this observation (or effect) continues through the present day (Figure 2).

Figure 1. Kensico Reservoir Waterbird Totals

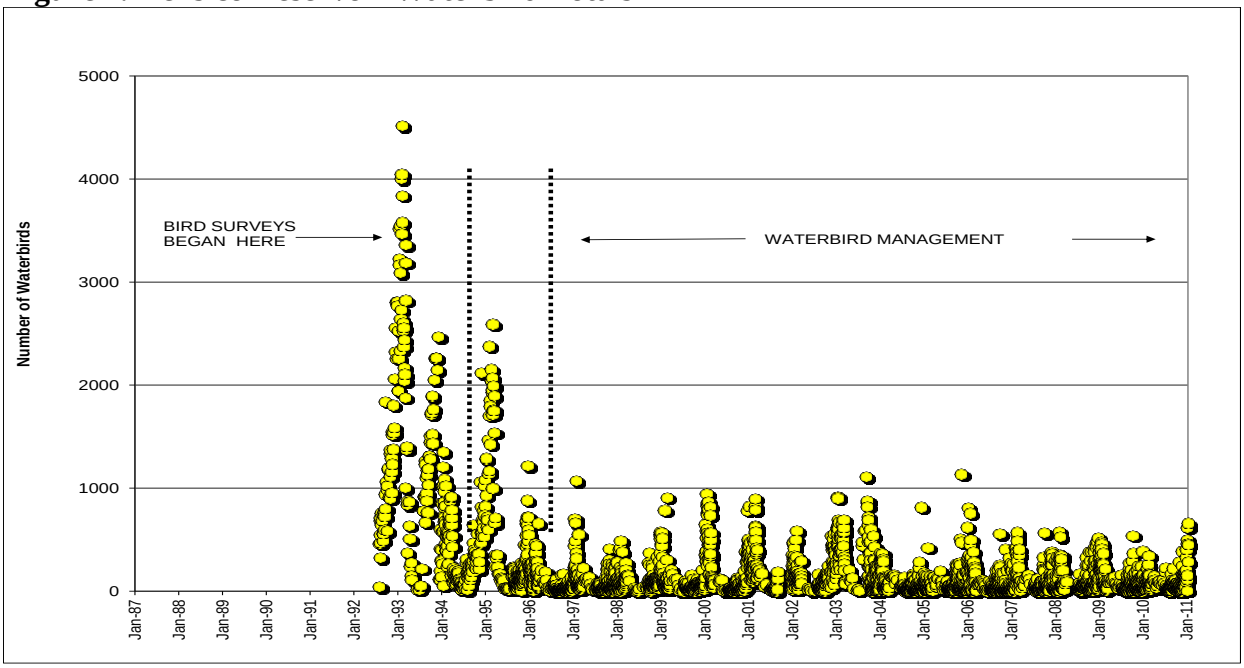
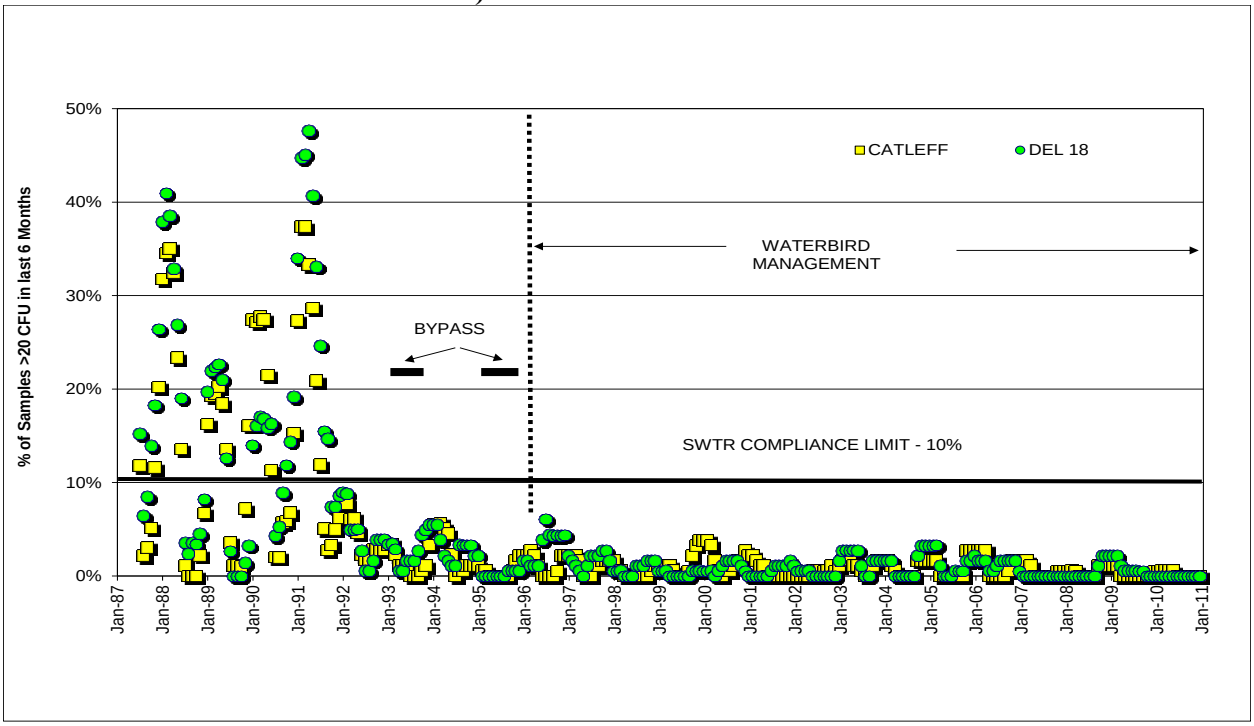


Figure 2. Kensico Reservoir Surface Water Treatment Rule Compliance (Fecal Coliform Bacteria at DEL18 and CATLEFF)



Reservoir-wide waterbird counts remained relatively low throughout the waterbird harassment period (August 1 to March 31) averaging about 93 birds per night survey and spiking at 661 on 1/29/11 compared to an average of 68 birds/night in 2009/2010 (Figures 3 and 4). In Bird Zone 2, closest to Delaware Shaft 18 (DEL18), birds were observed during the harassment period on 36 morning surveys (15/36 days birds observed consisted of a count of 1 bird) compared to 7 days in the previous year (Figure 5). A high count of 73 birds of which 72 were geese was observed in Bird Zone 2 on 3/3/2011, probably as a result of a new migratory flock heading north. In Bird Zone 3, closest to the Catskill Effluent (CATLEFF), birds were observed on 6 surveys during the active harassment period with two spikes of 37 and 43 geese observed on 12/9/10 and 12/17/10, respectively (Figure 6). There were no observations of birds over 200 in Bird Zone 4 closest to the NYC outflows (DEL 18 and CATLEFF), but this was higher than the two observed in 2009/2010 and 10 in 2008/2009 (Figure 7). The high count of 110 birds in Zone 4 occurred on 12/13/ 2010 and was concurrent with a precipitation event of 1.76 inches. There was a slight increase in fecal coliform bacteria to 16 CFU/100mL at CATLEFF. This compares to a high count of 335 birds in Zone 4 in the previous year.

Figure 3. Kensico Reservoir Total Annual Waterbirds (4/1/2009 to 3/31/2010)

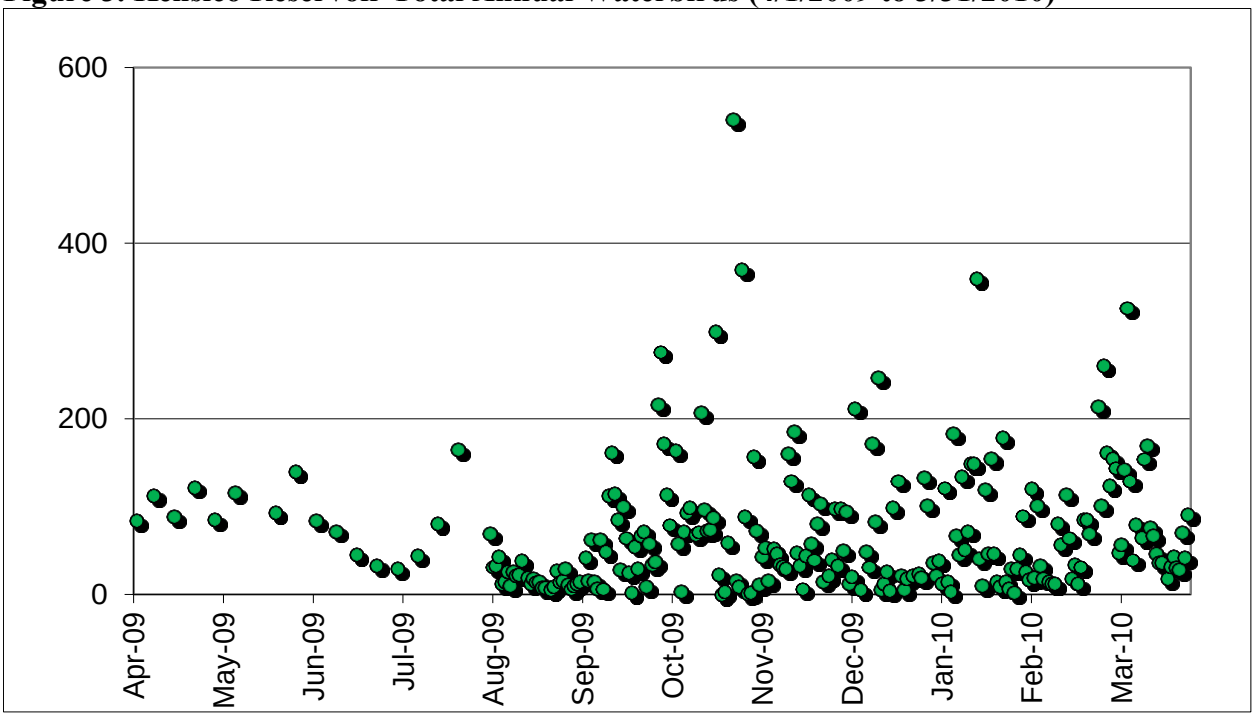


Figure 4. Kensico Reservoir Total Annual Waterbirds (4/1/2010 to 3/31/2011)

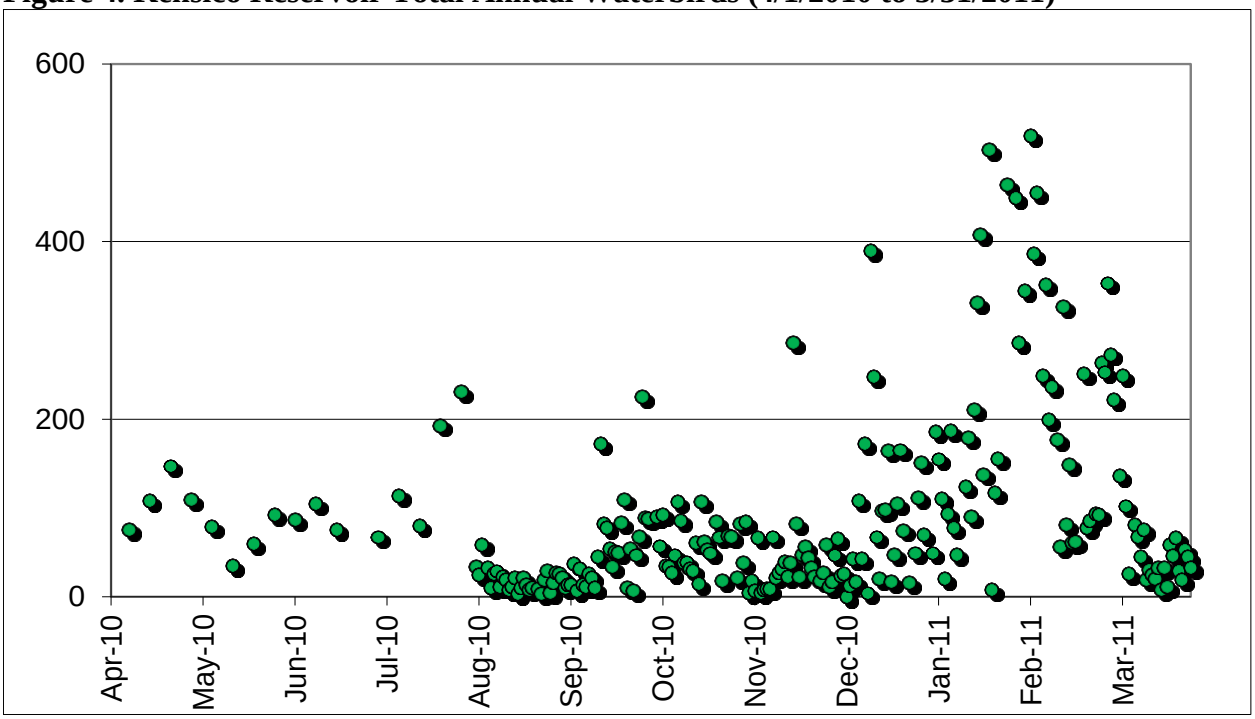


Figure 5 Kensico Reservoir Bird Zone 2 Waterbirds (4/1/2010 to 3/31/2011)

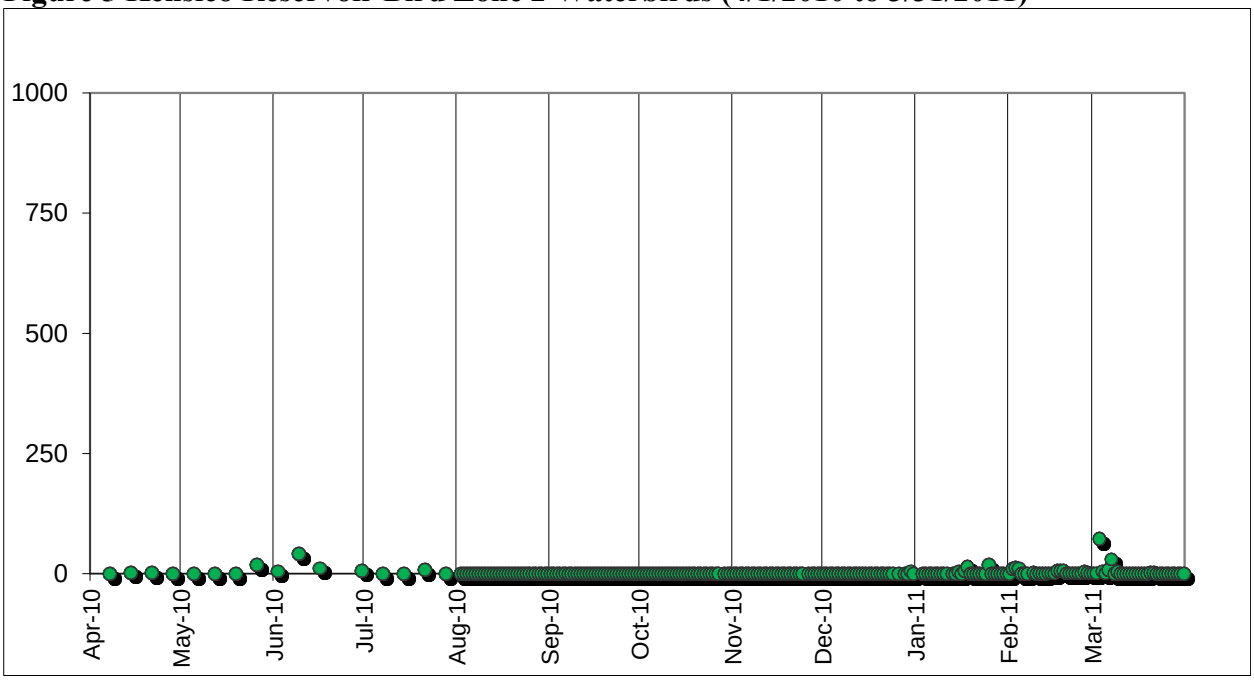


Figure 6. Kensico Reservoir Bird Zone 3 Waterbirds (4/1/2010 to 3/31/2011)

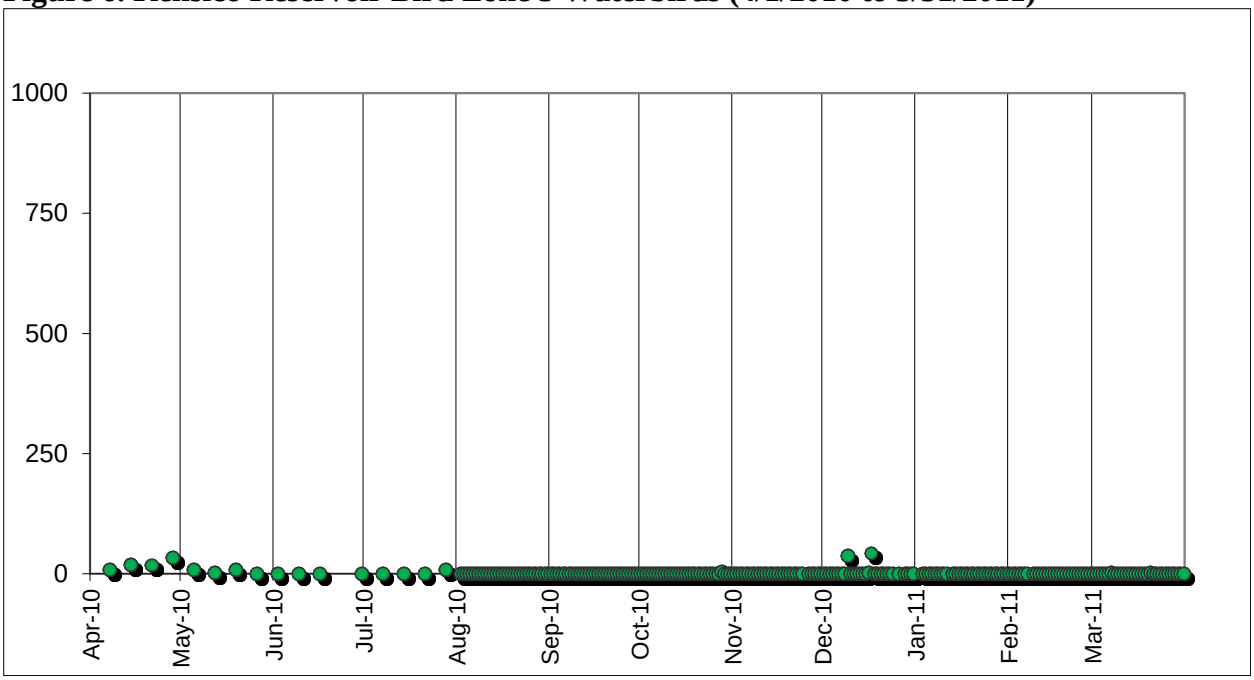
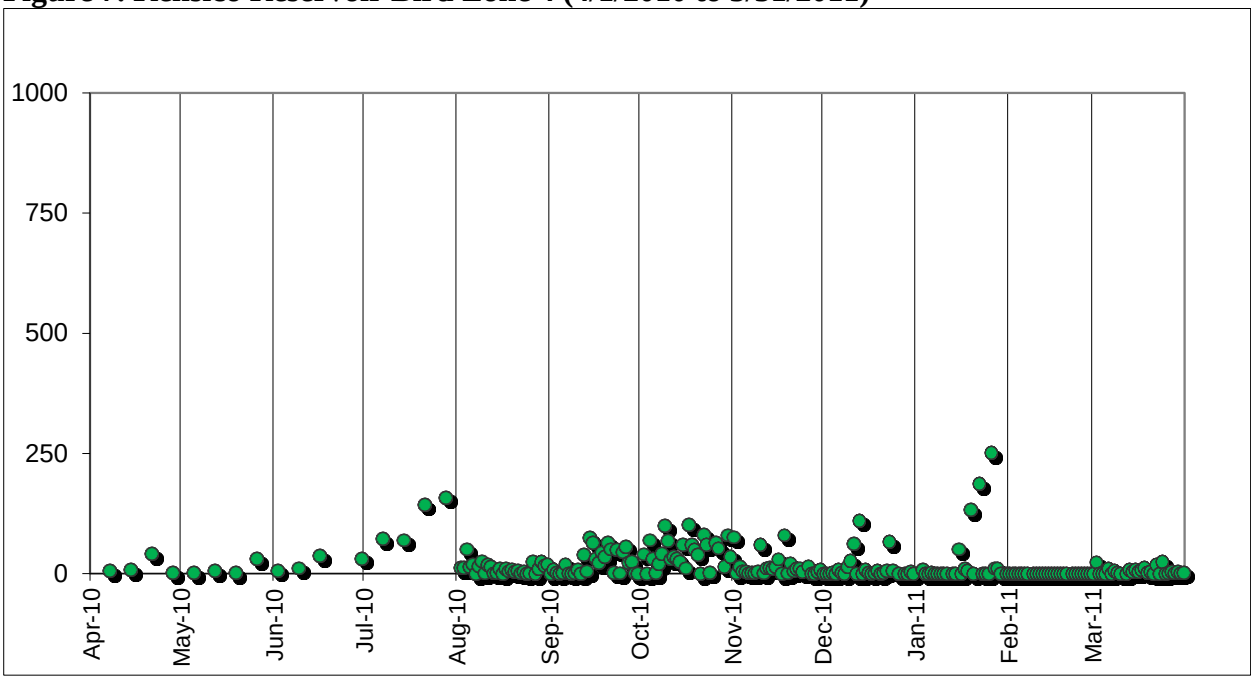


Figure 7. Kensico Reservoir Bird Zone 4 (4/1/2010 to 3/31/2011)



Reservoir ice-cover was first observed during late December 2010 and persisted into the second week in March 2011. The highest counts of gulls were recorded from late September through mid-December 2010 peaking at 360 for the overnight count on December 13, 2010. The reservoir-wide high waterbird count was recorded on 1/29/ 2010 at 661 birds (610 ducks and 51 geese) compared to a high count of 541 birds in the previous report (Figures 8 and 9).

The Westchester County Airport, located immediately east of the Rye Lake area (Bird Zone 6 in Figure 29) continued to manage birds for air-traffic safety. As part of the airport's Wildlife Hazard Management Plan, they have contracted with the United States Department of Agriculture Wildlife Services (USDA) to remove all Canada Geese within a five-mile radius around the airport property which includes all of the Kensico Reservoir. Culling of the geese occurs primarily during the goose molting period during the early summer. The DEP is actively cooperating with the USDA and Westchester County Airport to allow access to NYC-owned property to remove the geese. During this reporting period there were no geese removed from the Kensico Reservoir property as the geese naturally relocated to adjacent properties prior to the molt period.

Figure 8. Kensico Reservoir Total Waterbird Groups (4/1/2009 to 3/31/2010)

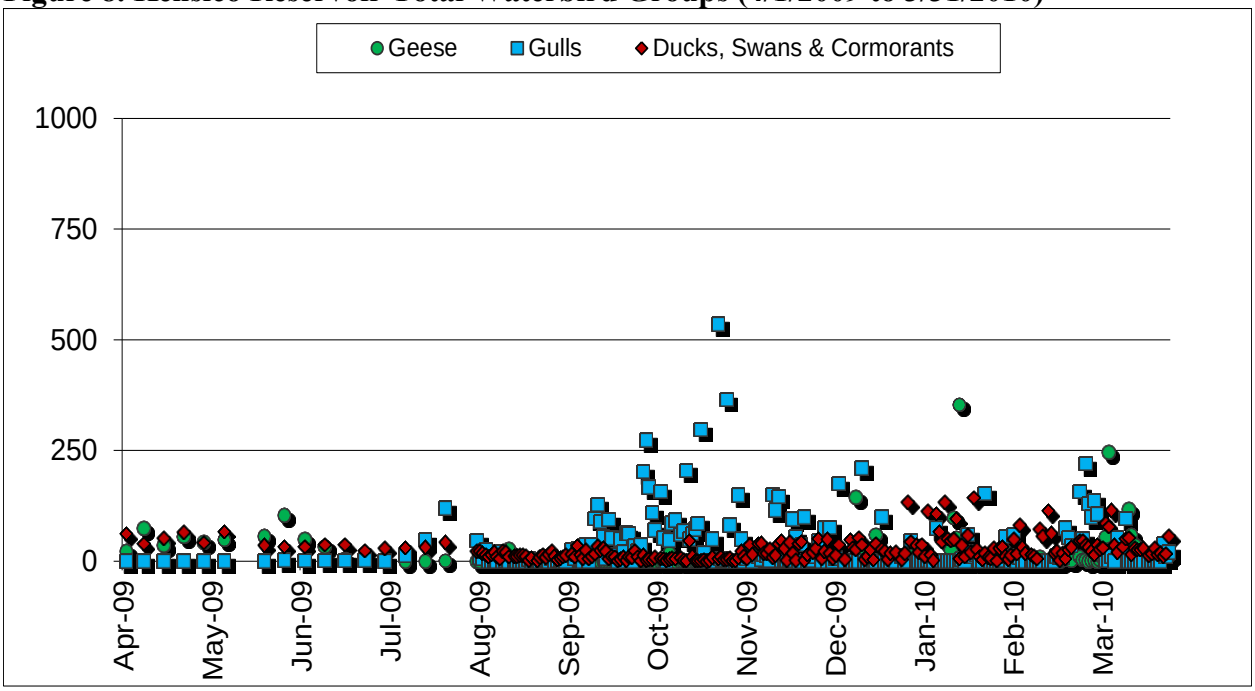
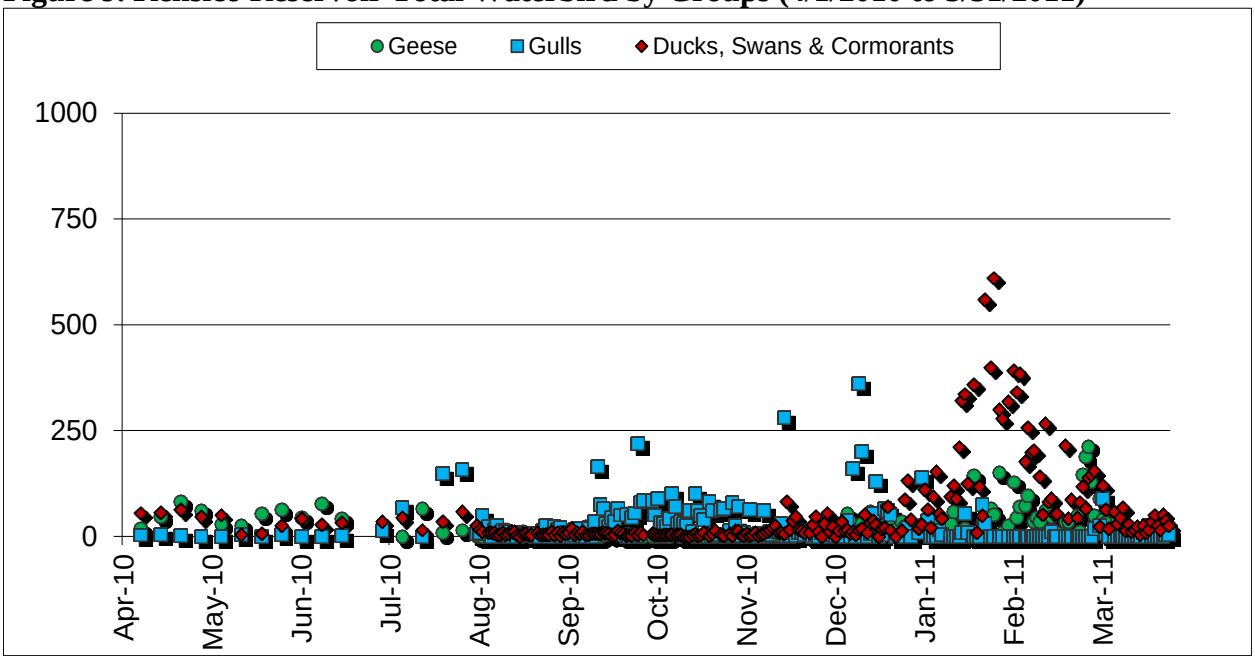


Figure 9. Kensico Reservoir Total Waterbird by Groups (4/1/2010 to 3/31/2011)



It is suspected that the increased spatial separation between birds and the water intake continue to reduce the threat for an increase in fecal coliform bacteria at the DEL18 and CATLEFF

facilities. As a result, bird harassment activities are concentrated in the vicinity of the two main water intake facilities. Overall, waterbird numbers continue to be lower throughout Kensico; a direct result of the ongoing bird harassment work.

Fecal coliform bacteria levels at the keypoint water sampling locations (DEL18 and CATLEFF) were consistently low and remained in compliance with the Surface Water Treatment Rule (SWTR) through the reporting period (Figures 10 - 13). There were no water samples collected at the DEL18 or CATLEFF water intakes that exceeded the SWTR limit of 20 CFU/100mL (colony forming units) in the 2010/2011 reporting period (Figures 11 and 13).

Bird counts remained relatively low during Kensico's double-digit FCOLI events. Of the 15 days of double-digit FCOLI reported between DEL18 and CATLEFF, only one day (10/19/2010) did not have an associated precipitation event within the previous 3-days (Table 5). Waterbird counts rose to 390 on 12/13/2010 of which 129 were observed overnight in bird zones 2, 3, and 4 coincidental with a precipitation event of 1.76 inches and a fecal coliform bacteria level of 16 CFU/100mL at the CATLEFF water intake. All other double-digit fecal coliform water samples may be linked to precipitation events (Table 5).

Figure 10. Kensico Reservoir Fecal Coliform Bacteria at DEL18 vs. Total Waterbirds (4/1/2009 to 3/31/2010)

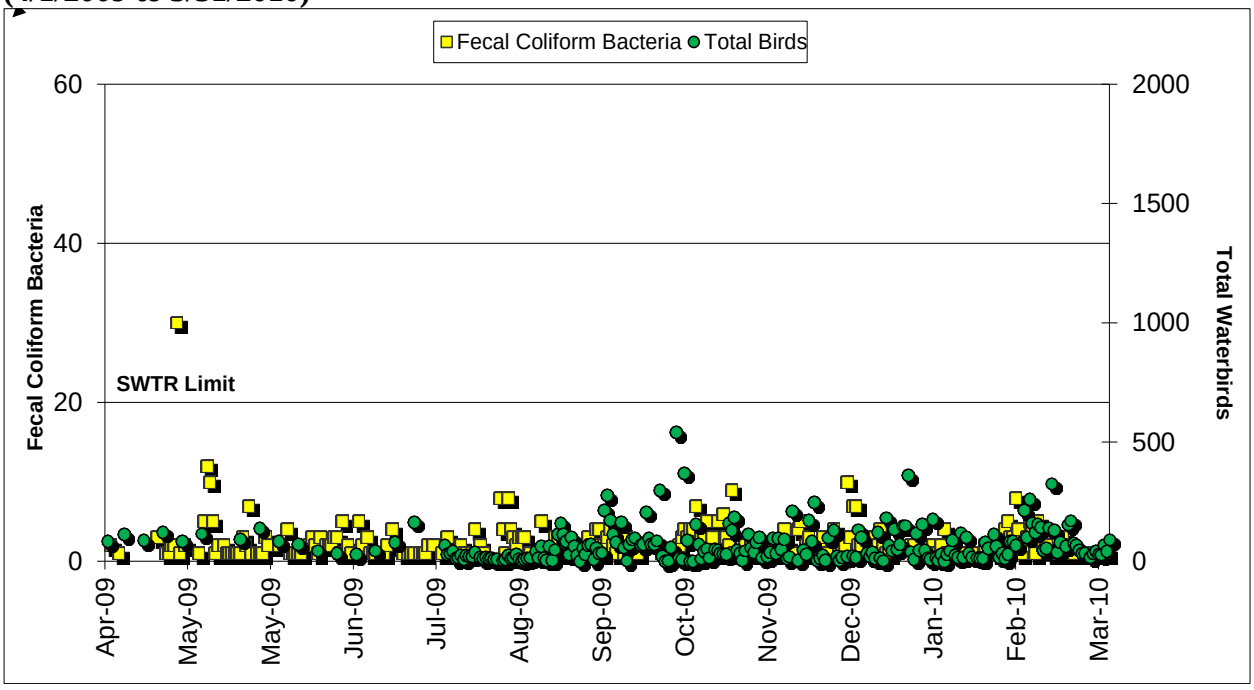


Figure 11. Kensico Reservoir Fecal Coliform Bacteria at DEL18 vs. Total Waterbirds (4/1/2010 to 3/31/2011)

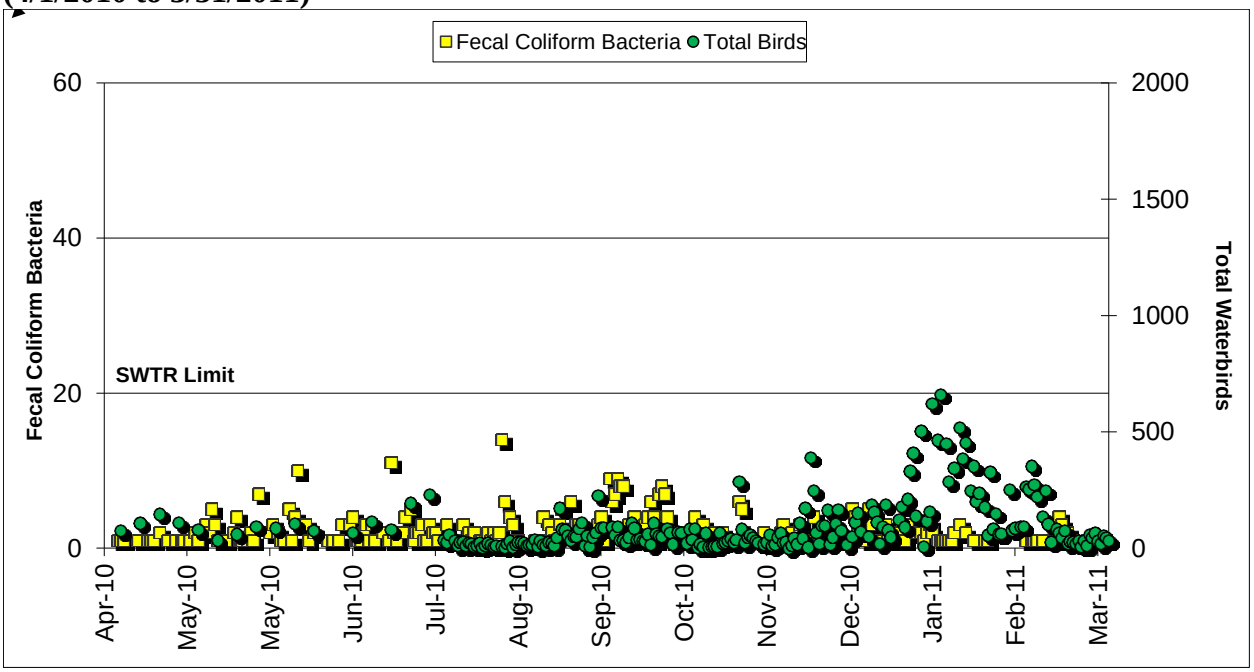


Figure 12. Kensico Reservoir Fecal Coliform Bacteria at CATLEFF vs. Total Waterbirds (4/1/2009 to 3/31/2010)

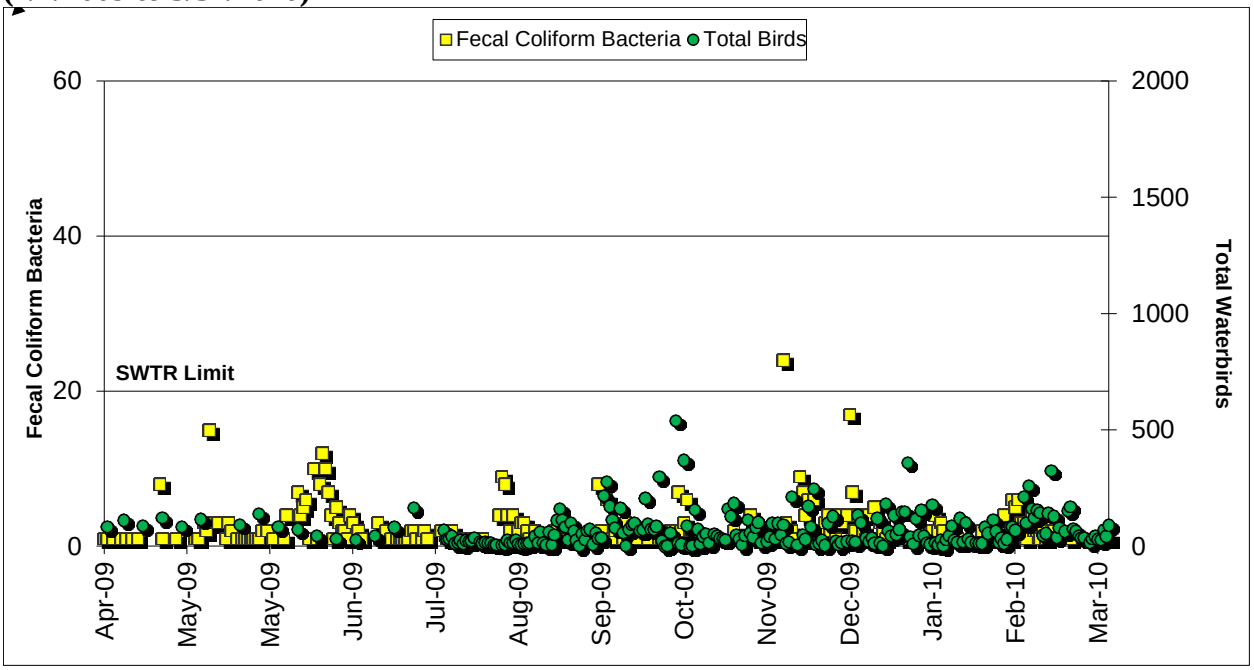


Figure 13. Kensico Reservoir Fecal Coliform Bacteria at CATLEFF vs. Total Waterbirds (4/1/2010 to 3/31/2011)

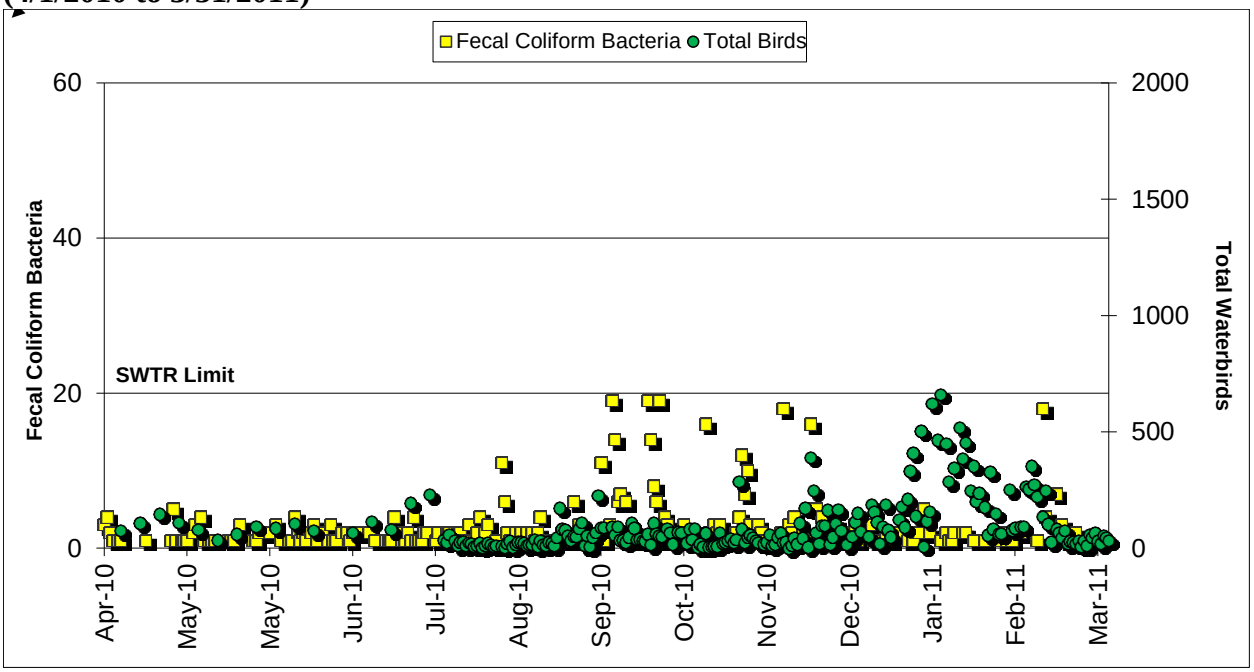


Table 5. Double-digit (>=10) FCOLI results, precipitation events, and bird counts at Kensico Reservoir keypoint water sampling locations

Date	DEL18 CFU/mL	CATLEFF CFU/mL	Precipitation within 3 days of event	Bird Counts on or before sample date	
				Total	Zones 2,3,4
06/10/10	10	-	0.53	105 on 6/9/10	78 on 6/9/10
07/14/10	11	-	3.00	80 on 7/14/10	74 on 7/14/10
08/23/10	14	11	3.31	9 on 8/23/10	6 on 8/23/10
9/28/10	-	11	0.58	89 on 9/28/10	29 on 9/28/10
10/02/10	-	19	0.80	90 on 10/2/10	41 on 10/2/10
10/03/10	-	14	0.82	57 on 10/3/10	8 on 10/3/10
10/15/10	-	19	1.59	61 on 10/15/10	61 on 10/15/10
10/16/10	-	14	1.59	15 on 10/16/10	12 on 10/16/10
10/19/10	-	19	0.00	53 on 10/19/10	53 on 10/19/10
11/05/10	-	16	1.17	66 on 11/5/10	6 on 11/5/10
11/18/10	-	12	0.93	82 on 11/18/10	82 on 11/18/10
11/20/10	-	10	0.00	48 on 11/20/10	27 on 11/20/10
12/03/10	-	18	1.99	24 on 12/3/10	12 on 12/3/10
12/13/10	-	16	1.76	390 on 12/13/10	129 on 12/13/10
03/07/11	-	18	4.00	136 on 3/7/11	50 on 3/7/11

Alewives (baitfish) flushing through upstate aqueducts to Kensico was unremarkable once again during the fall/winter period of 2010/2011. The dead and dying alewives typically attract foraging gulls and ducks. DEP has determined additional measures to deter baitfish from becoming entrained into the aqueducts may not be effective at reservoirs that are a source to Kensico. DEP and its contractor will continue monitor fish concentrations and collect dead/dying baitfish as they enter Kensico Reservoir. The volume of fish observed, collected and disposed of at the Kensico water intakes dramatically decreased in 2010/2011 compared to 2009/2010. There was no collection of dead fish from the Catskill Influent Chamber (CATIC) at Kensico reported during this period compared to 200 pounds collected during the previous reporting period.

In the spring of 2010 a total of 36 Canada Geese nests were identified along the reservoir shoreline and on islands. Among the 36 nests, 170 eggs were punctured and replaced back to the nest to allow the nesting geese to continue to incubate (Table 4). The average number of eggs per nest was 4.8 compared to 5.1 in the previous year. A total of 4 young goslings were observed rendering the egg depredation success at 98% in 2010 compared to a 99% success rate in 2009. Normally, the adult breeding geese or failed breeders disperse from the reservoir prior to the post-breeding season molt which begins in June however the one brood of 2 goslings attracted many of these adults to remain at the reservoir during the molt. Usually, the geese molt off-reservoir and generally remain flightless for approximately three weeks to a month before attempting to fly back to the reservoir.

2. West Branch Reservoir

The 2007 FAD lists West Branch Reservoir as one of five reservoirs covered under the "as needed" criteria for Waterfowl Management. West Branch Reservoir is divided into four bird survey zones associated with reservoir water quality sampling locations (Figure 30). Migratory and wintering waterbird populations at West Branch are sampled weekly to record annual trends which aid in identifying sources of elevated fecal coliform bacteria levels. In 2010, similar to previous years gull counts started increasing by mid-summer (Figure 14). Gull counts peaked to a level of 1,200 on 11/23/2010 with a reservoir-wide total bird spike of 6,289 recorded on 12/11/10. During this reporting period the birds (mostly waterfowl) increased to a peak of 5,564 on 12/11/2010. This was much higher than the peak of 3,890 observed on 12/15/2009 (Figures 14 and 15).

DEP determined it was necessary to conduct the bird harassment during this reporting period at West Branch based on the criteria established for "as needed" actions (i.e. bird counts, fecal coliform bacteria levels, reservoir operations). The program was implemented from 12/15/10 through 1/5/11 due to elevated fecal coliform bacteria detected in water samples collected at Shaft 17 probably a result of an operational shutdown of the Rondout Reservoir which decreased water elevations at West Branch and during the onset of the winter waterbird migration (Figure 16). The bird harassment program consisted of daily shoreline harassment and occasional use of

motorboats combined with pyrotechnics in the afternoon/evening period. Gull numbers dropped from a count of 984 on 12/14/10 to zero on 12/15/10 following the inception. Overnight gull counts were only detected on 3 occasions through the end of March 2011.

There was one fecal coliform count (43 CFU/100mL) above the SWTR regulation (20 CFU/100mL) recorded at the Delaware Shaft 10 (DEL10) water intake on 12/21/10 (Figure 17). The elevated bacteria count was recorded 10 days following the onset of the bird harassment activities and does not appear to be associated with any significant precipitation event.

Figure 14. West Branch Reservoir Total Waterbirds (4/1/2009 to 3/31/2010)

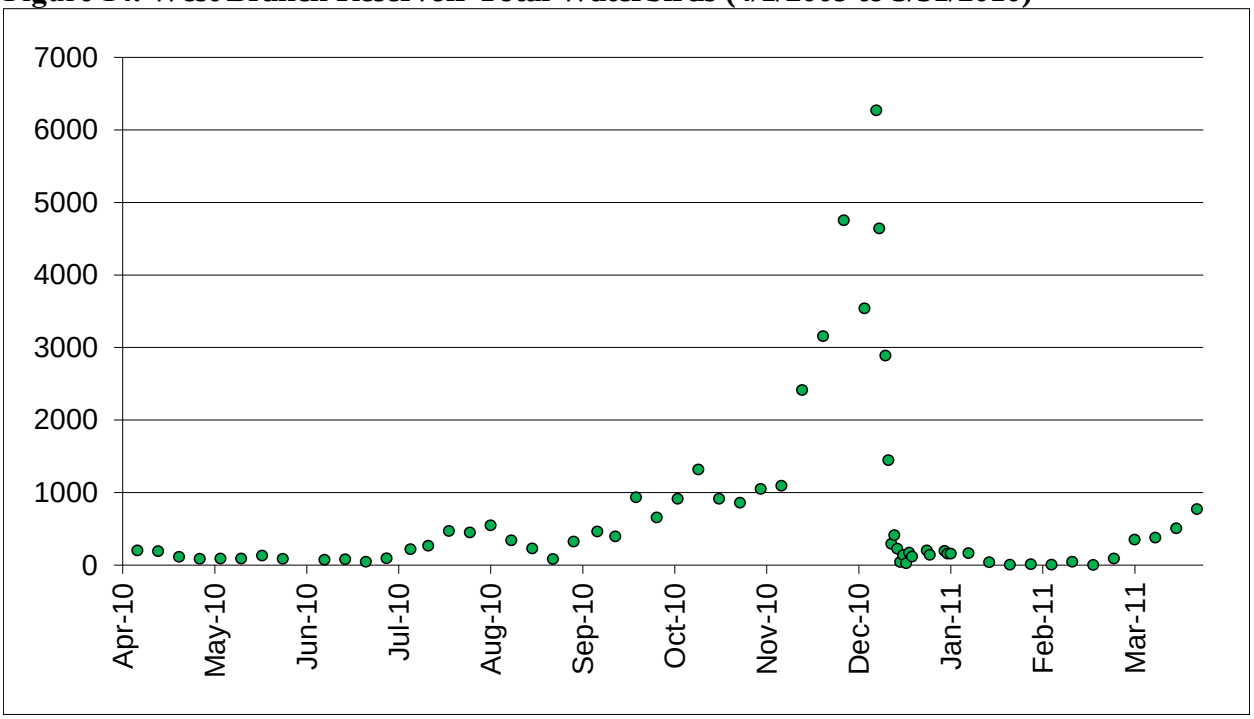


Figure 15. West Branch Reservoir Total Waterbirds (4/1/2010 to 3/31/2011)

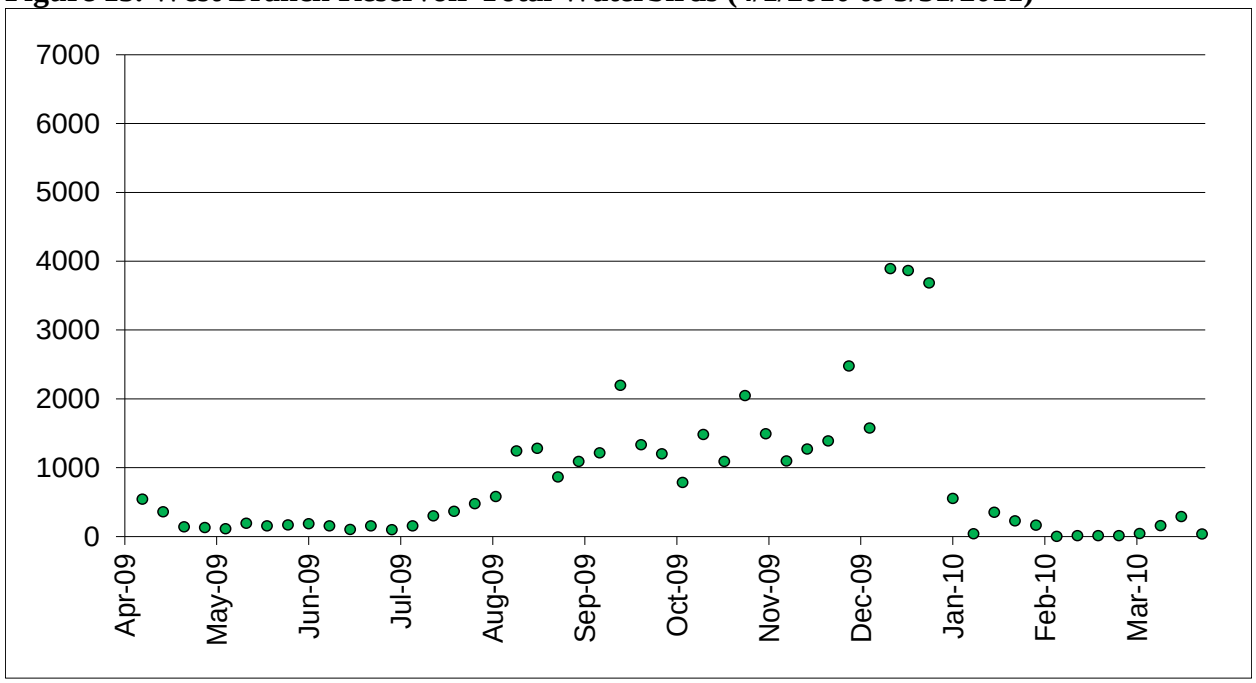


Figure 16. West Branch Reservoir As Needed Bird Harassment Program (12/15/2010 to 1/5/2011)

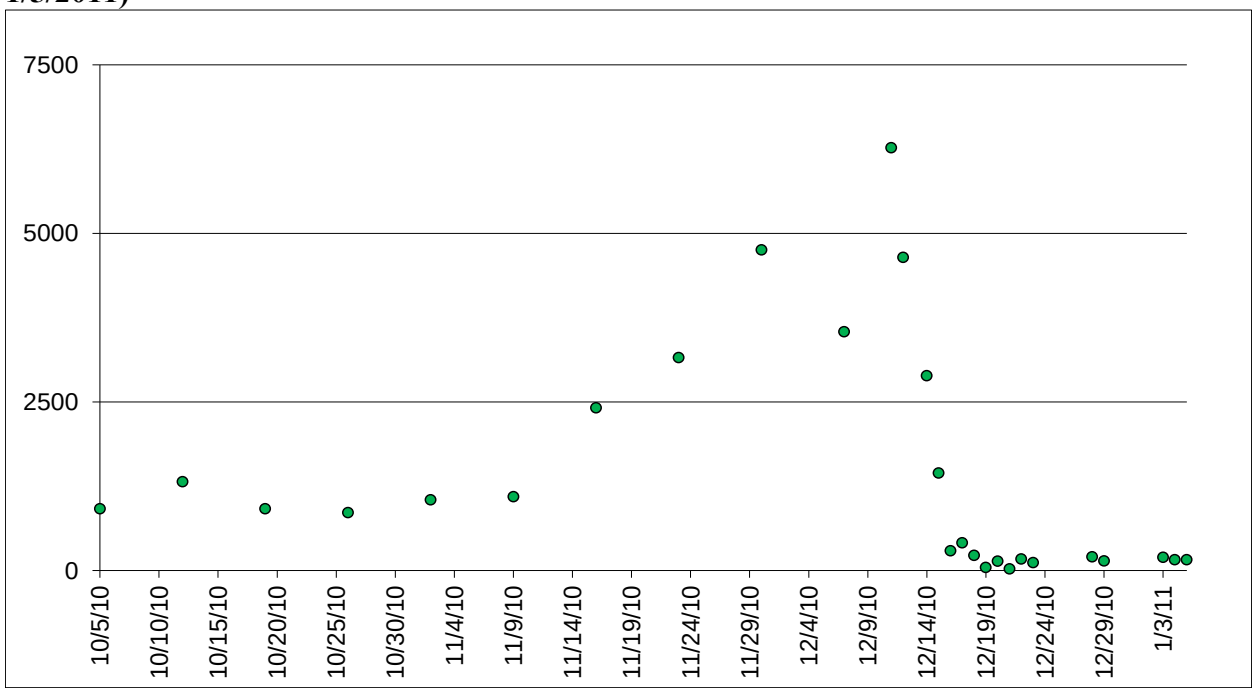
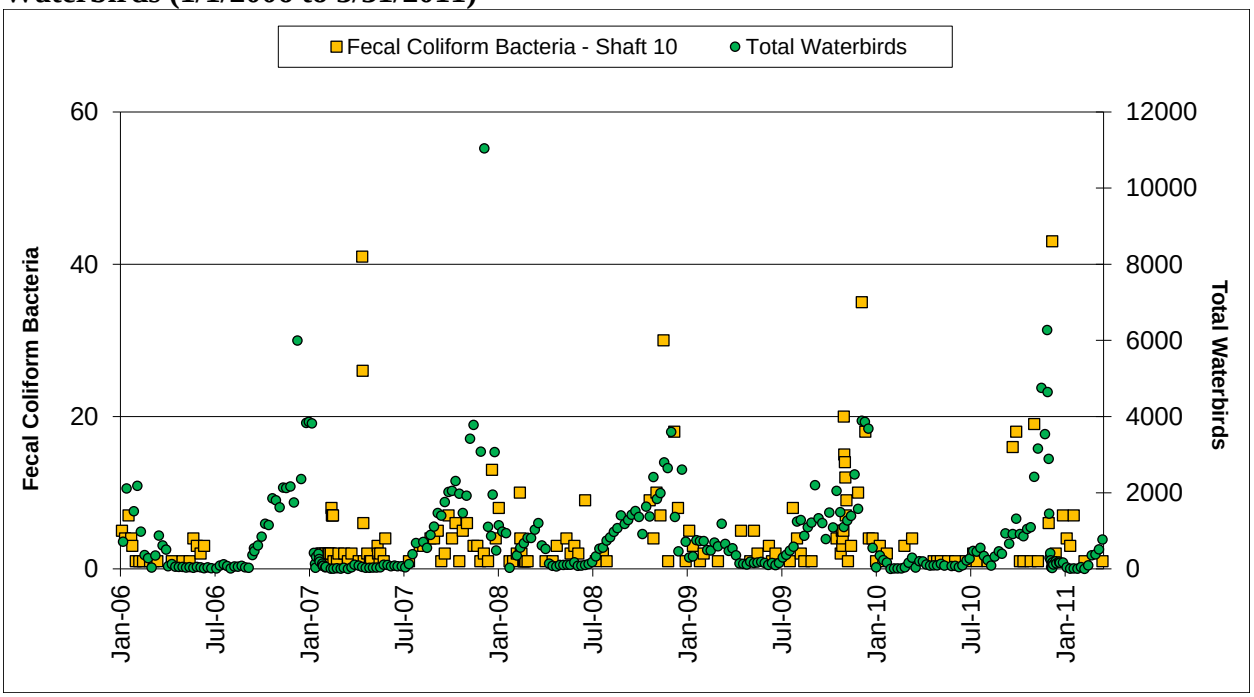


Figure 17. West Branch Reservoir Fecal Coliform Bacteria at Shaft 10 vs. Total Waterbirds (1/1/2006 to 3/31/2011)



DEP conducted reproductive control on Canada Geese from April 1 through May 31 to reduce productivity at West Branch Reservoir. In 2010, 12 nests and 42 eggs were depredated which was down from the previous year at 13 nests and 55 eggs (Table 4). The egg-depredation was deemed 100% successful. There were no Mute Swans nesting at West Branch in 2010. A small colony of Double-crested Cormorants attempted to nest in the spring of 2009 but subsequently failed as the nests were flooded during the incubation period. The colony has since developed a new nesting location along the eastern shoreline in Bird Zone 3.

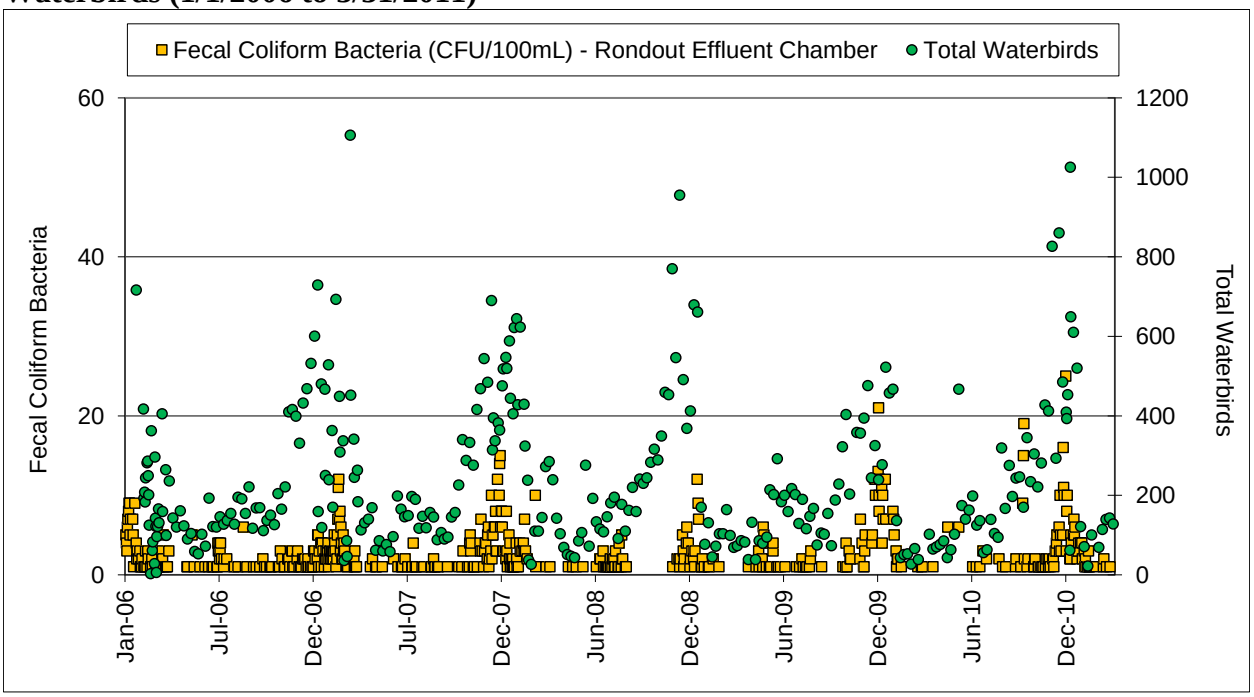
3. Rondout Reservoir

The Rondout Reservoir is a terminal or source reservoir to both Kensico and West Branch. Located west of the Hudson River, it is part of the Delaware System of reservoirs. The 2007 FAD lists Rondout as one of five reservoirs covered under the "as needed" criteria for Waterfowl Management. Survey frequency is listed as biweekly in the 2002 FAD, however, DEP increases these surveys to weekly with additional surveys added during the early winter period when bird numbers increase and bacteria results start to rise. The Rondout Reservoir is divided into nine bird sampling geographic zones associated with reservoir water quality sampling locations (Figure 41).

Seasonally elevated bird counts and the associated rise in fecal coliform levels reported in Figure

22 continue to suggest a relationship that will need to be closely monitored. During this reporting period, there were eight double-digit fecal coliform raw water samples collected at Rondout and only one that exceeded the SWTR of 20 CFU/100mL on 12/26/2010 (21 CFU/100ml) compared to no samples above the 20 level during the previous year (Figure 18). This peak of 21 CFU/100/ml was preceded by three previous samples in double digits (10 CFU/100mL on 12/23/10; 11 CFU/100/mL on 12/22/10; and 16 CFU/100/mL on 12/20/10) and may correspond to the change in the gull roosting location from mid-reservoir to Bird Zone 1 in front of the Rondout water intake from late November 2010 through early January 2011.

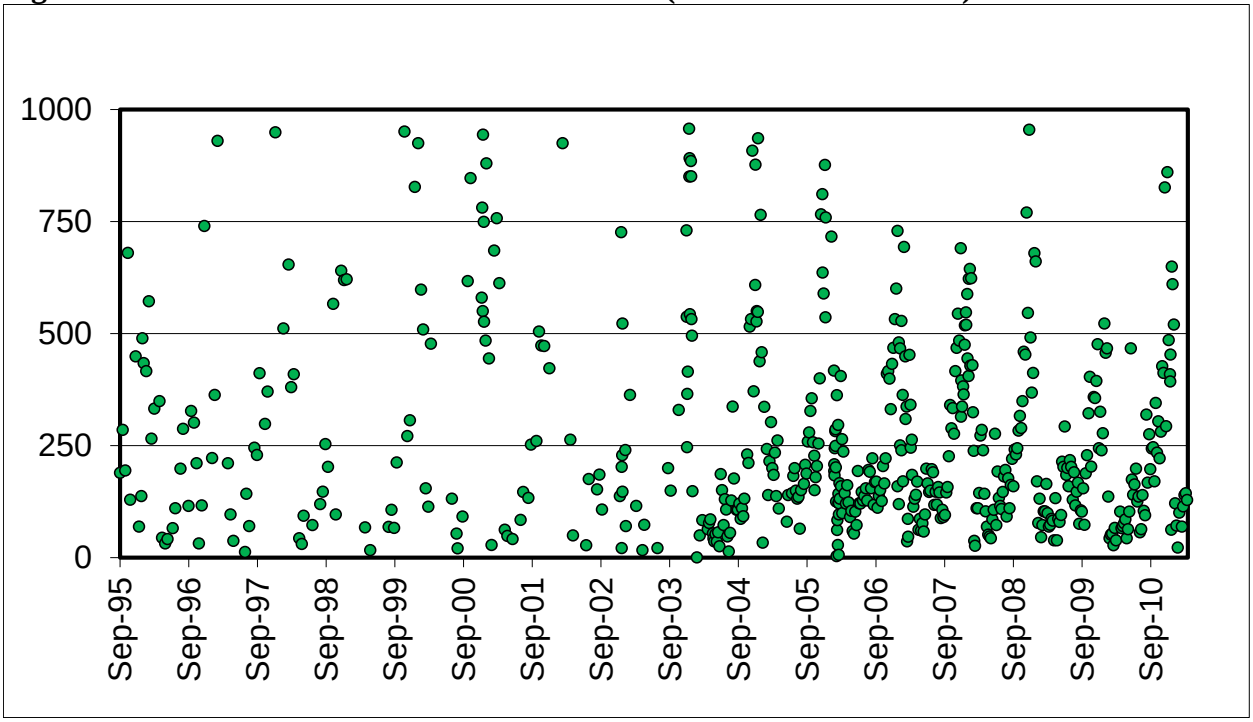
Figure 18. Rondout Reservoir Fecal Coliform Bacteria at Rondout Effluent vs. Total Waterbirds (1/1/2006 to 3/31/2011)



Ducks and duck-like species were present year-around and gradually increased from late summer through the autumn and winter period spiking at 697 on January 4, 2011. A flock of Brant Geese (*Branta bernicla*) was observed stopping-over on their northerly migration back to Canada on 6/2/2010 and just prior to the annual post-nuptial molt of local Canada Geese where they are rendered flightless for approximately 4 weeks. Canada geese were mostly absent during the winter period at Rondout but increased slightly in mid-March 2011. Each year seasonal elevations of waterbirds (mostly gulls and ducks) are recorded at Rondout (Figure 19).

Reservoir icing was first observed in the first week in January 2011 and persisted through the third week in March at which time breeding populations of Canada geese were recorded establishing territories.

Figure 19. Rondout Reservoir Total Waterbirds (9/1/1995 to 3/31/2011)



DEP closely monitors the spatial distribution of the gull populations at Rondout particularly during the December through January period. Gulls typically roost at Bird Zone 1; zone closest to the Rondout Effluent Chamber. There does not, however, appear to be a foraging attraction by the birds nor is it due to ice cover restrictions on other parts of the reservoir forcing the birds to roost at the Zone 1 location this time of year. Occasionally, it is necessary to increase the number of waterbird surveys each December and January and monitor changes in both bird numbers and roost location. No additional surveys, however, were necessary in response to the gull roost shift to Bird Zone 1 as this is part of the criteria to activate the "as needed" bird harassment actions. DEP did not have to activate its bird harassment program in the 2010/2011 reporting period. The seasonal increase in waterbird populations was similar to the previous year (Figures 20 and 21).

DEP also conducted routine monitoring and full compliance with a protection plan for Bald Eagles (*Haliaeetus leucocephalus*) as required by the DEC and United States Fish and Wildlife Service in preparation for any "as needed" bird harassment activity as stated in the Findings Statement of the Environmental Impact Statement on file.

Figure 20. Rondout Reservoir Total Waterbirds (4/1/2009 to 3/31/2010)

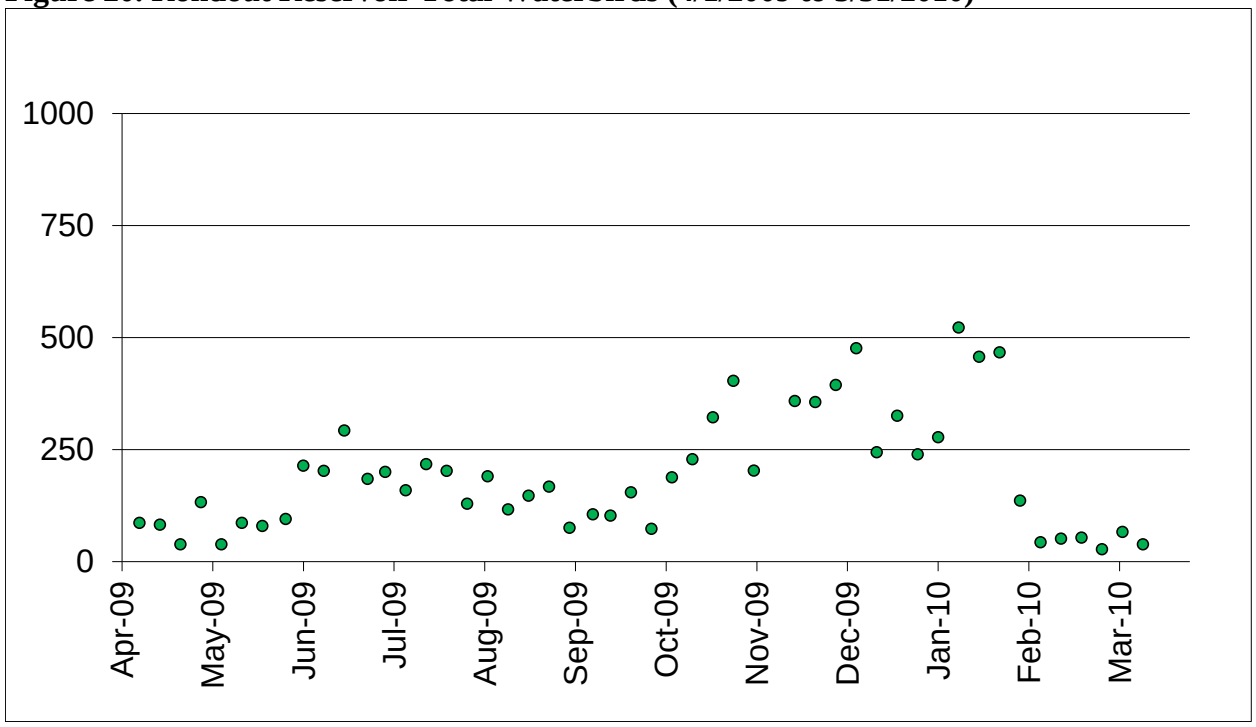
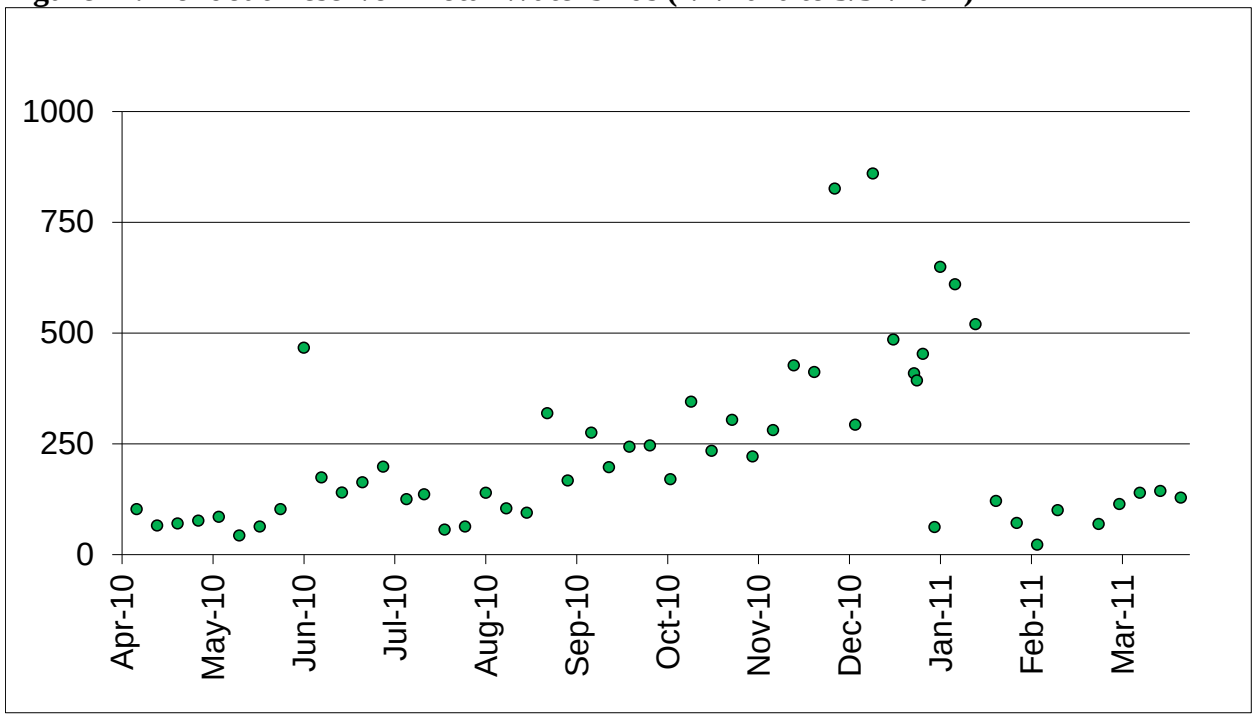


Figure 21. Rondout Reservoir Total Waterbirds (4/1/2010 to 3/31/2011)

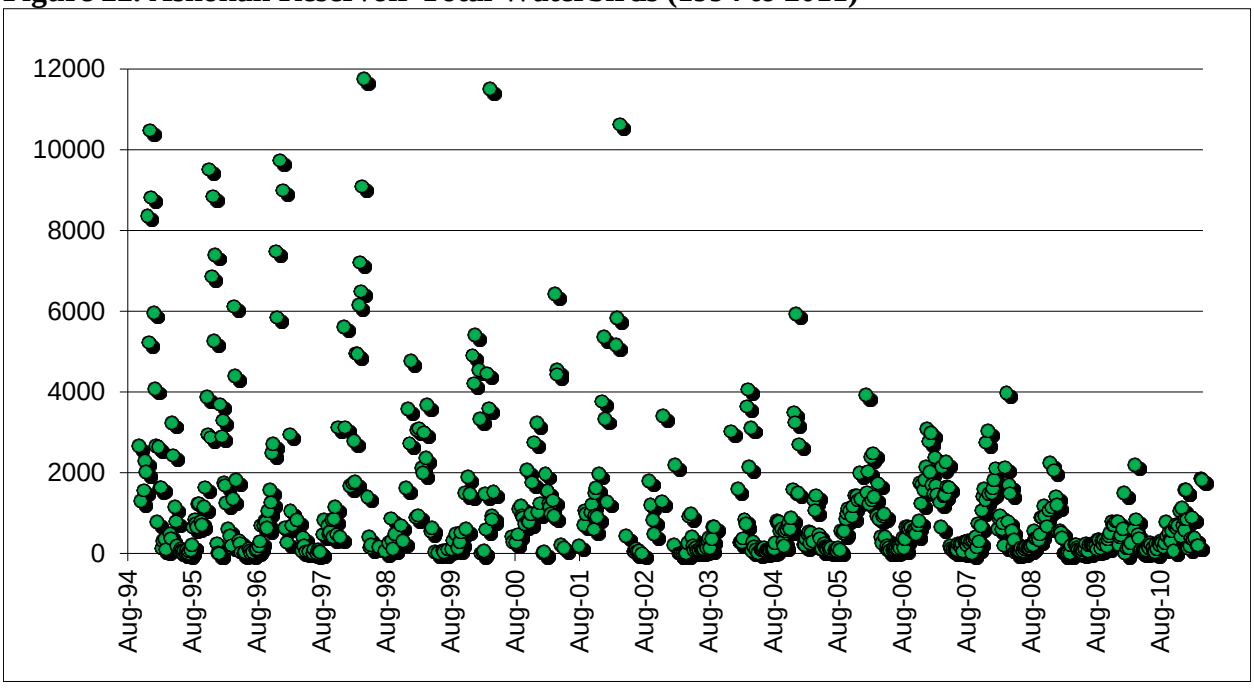


DEP conducted reproductive control on Canada Geese at Rondout in 2010. Due to the close proximity of some Canada goose nests to established Bald Eagle nests DEP abstained from some depredation work to maintain compliance with the New York State Endangered Species Protection Laws. A total of 2 nests and 11 eggs were depredated while 21 goslings hatched in 2010 compared to 8 goslings observed in 2009 (Table 4). There were no Mute Swan nests identified at Rondout in 2010.

4. Ashokan Reservoir

The 2007 FAD lists Ashokan Reservoir as one of five reservoirs covered under the "as needed" criteria for Waterfowl Management. The Ashokan Reservoir is divided into two main basins each with a water intake chamber located at the Dividing Weir (Figure 32). There are six bird sampling geographic zones, three within each basin and associated with reservoir water quality sampling locations (Figure 32). Overall, bird numbers (particularly gulls) continue to decrease in abundance during the migration and over-wintering period at the Ashokan over the past years (Figure 22). The East Basin of the Ashokan is the primary waterbird roosting area where high numbers of gulls, ducks, and geese have been recorded seasonally relative to the West Basin (Figures 23 and 24).

Figure 22. Ashokan Reservoir Total Waterbirds (1994 to 2011)



Gull counts spiked at a count of 720 in mid-November 2010 and again in mid-March 2011 at 1,237. Gulls were largely absent from early January 2011 through mid-March 2011. Canada

Geese numbers rose to a high count of 366 on 9/3/2010 and dropped to zero from mid-December through early February 2011. There appears to be three slightly elevated counts of geese during this reporting period: one in the late spring/early summer as breeding populations from surrounding private lands congregate for safety and food at the Ashokan during the post-nuptial molt; another that coincides with fall migration and winter stop-over in September and October; and a final elevation with an early onset of migratory geese flying north back to the breeding grounds. The Ashokan West Basin generally has very low bird counts annually compared to the East Basin (Figures 23 and 24).

Full reservoir ice-cover was observed by early January 2010 at the Ashokan Reservoir. Ice-cover typically reduces gull roosting as the numbers typically drop to zero under such conditions. Duck species, present year-around, reached a peak on 3/25/ 2011 at 1,032 compared to a high count of 1,017 recorded on 3/12/2010 in the previous report.

Figure 23. Ashokan Reservoir West Basin Total Waterbirds in Bird Zones 1, 2, and 3 (1994 to 2011)

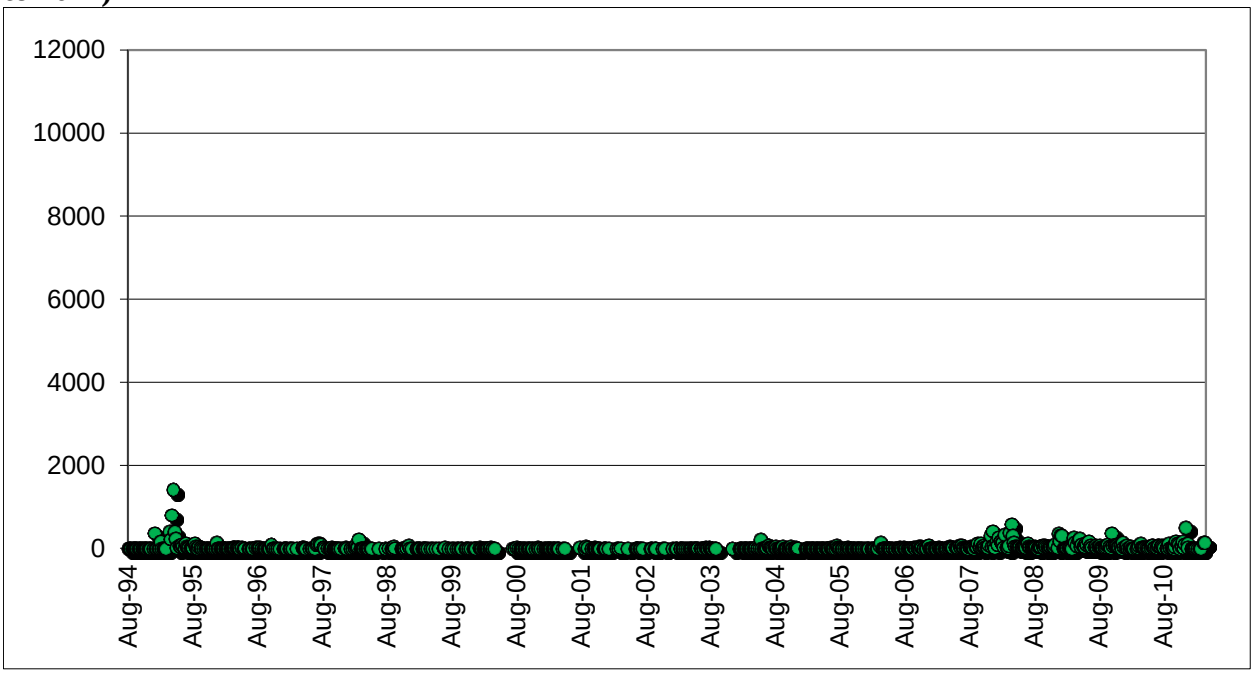
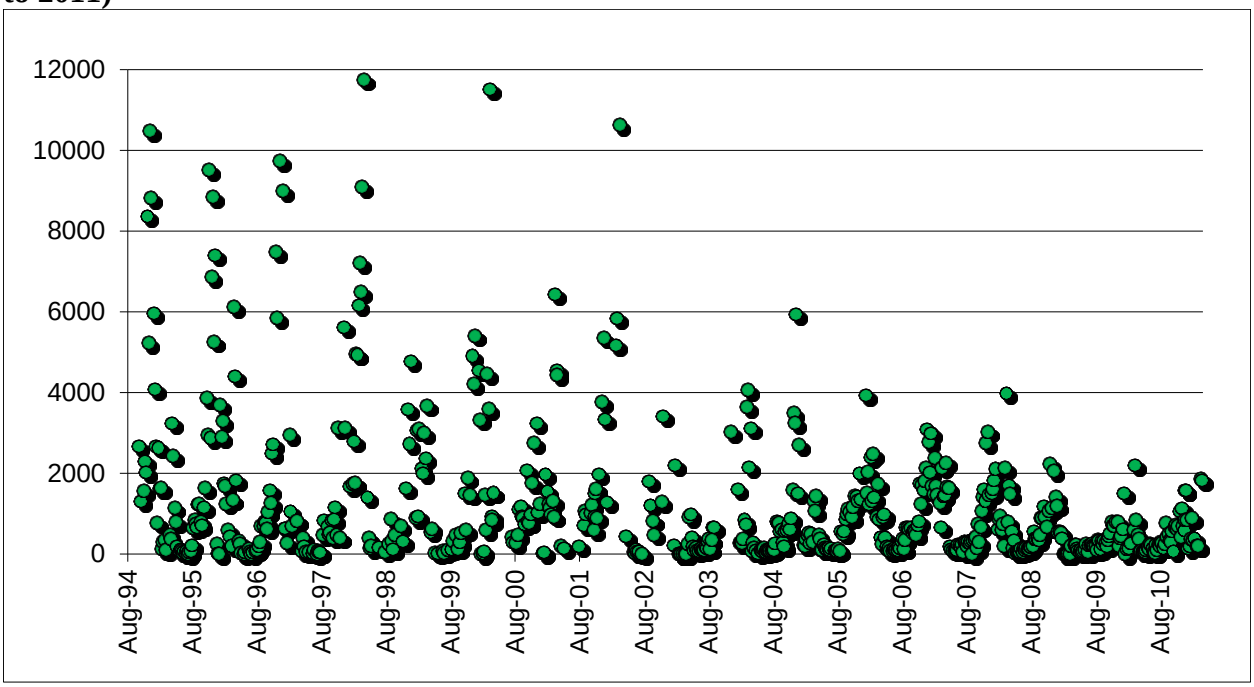


Figure 24. Ashokan Reservoir East Basin Total Waterbirds in Bird Zones 4, 5, and 6 (1994 to 2011)

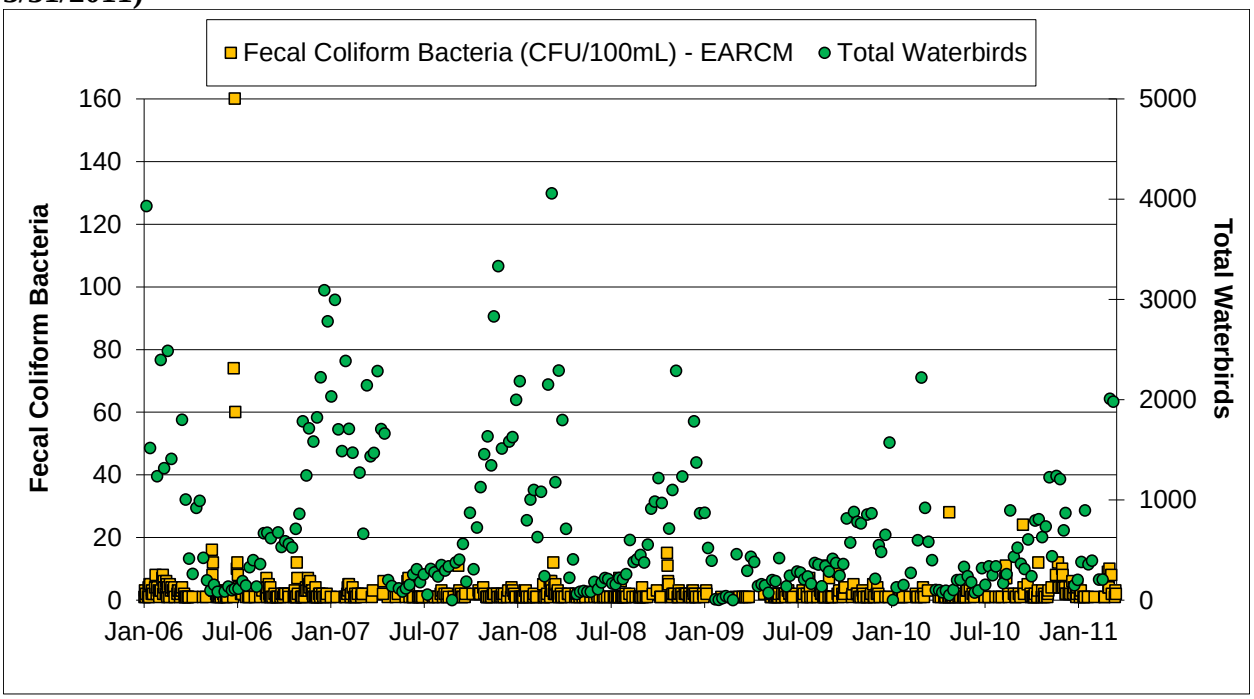


Fecal coliform samples collected at the water intake sampling location at Ashokan (EARCM) did not exceed the 20 CFU/100mL SWTR in 2010/2011, and this result was similar to that observed during the same 2009/2010 reporting (Figure 25). There were seven double-digit FCOLI bacteria samples of which only two were above the SWTR limit both samples do not appear to be caused by birds roosting. The spike in reservoir-wide bird activity on 3/18/2011 of 2,006 birds compared to the 2009/2010 of 2,218 birds on 3/12/2010 did not appear to have an important influence on FCOLI levels as the March 2011 bacteria counts for EARCM remained in the single digits except for a sample of 10 CFU/100mL recorded on 3/17/2011.

The relatively low fecal coliform bacteria levels did not necessitate the activation of the "as needed" bird management options as required under the Final 2007 FAD, Section 4.1 during this reporting period.

DEP conducted reproductive control on Canada Geese from April 1 through June 30 to reduce productivity at Ashokan. In 2010, four Canada goose nests were identified and 19 eggs addled compared to 7 nests and 30 eggs 2009 (Table 4). The egg-depredation success rate at the Ashokan Reservoir in 2010 was 37% compared to a 58% success in 2009. A total of 32 goslings were observed in late spring 2010 some of which are known to have hatched in wetlands off DEP property. There were no Mute Swans found nesting in 2010 similar to 2009.

Figure 25. Ashokan Reservoir Fecal Coliform Bacteria vs. Waterbirds – (1/1/2006 to 3/31/2011)



5. Croton Falls Reservoir

The 2007 FAD lists Croton Falls Reservoir as one of five reservoirs covered under the "as needed" criteria for Waterfowl Management. The Croton Falls Reservoir is divided into five bird sampling geographic zones associated with reservoir water quality sampling locations (Figure 33). Similar to the previous year gulls and waterfowl (ducks) continue to represent the primary bird groups counted throughout Croton Falls Reservoir from the late July 2010 through the spring of 2011 except for most of January and February 2011 during extensive ice-cover (Figures 26 and 27). Geese were present from April 2010 through early December and again in mid-March 2011. Geese numbers spiked in July 2010 at 103 compared to a high count of 103 in October 2009 in the previous reporting period. Waterbird species (mostly Common Mergansers and Mallards) were present throughout the year; increasing in numbers in late July resulting from successful local breeding and spike at 1,028 on 12/172010 and again on 3/11/2011 at 1,131; a similar roosting pattern 2009/2010 (Figures 26 and 27). Gull counts also started increasing in in late July and spiked at 900 on 12/17/2010 then dropping to zero during ice cover from late December though late February 2011.

Figure 26. Croton Falls Reservoir Total Waterbirds - (4/1/2009 to 3/31/2010)

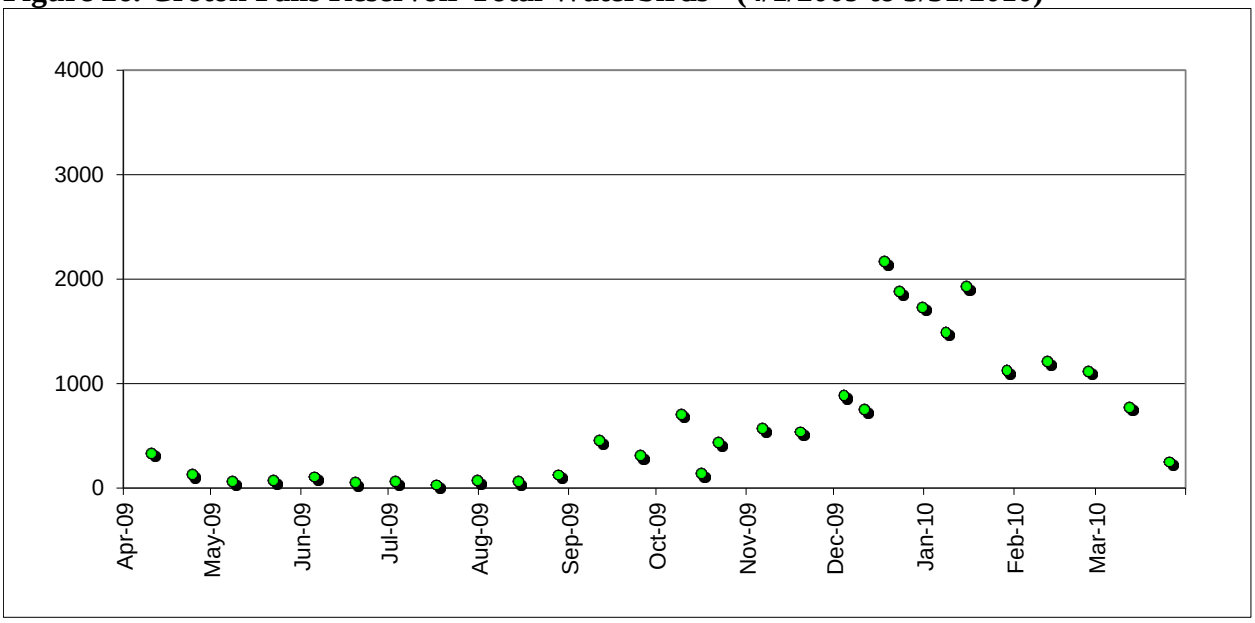
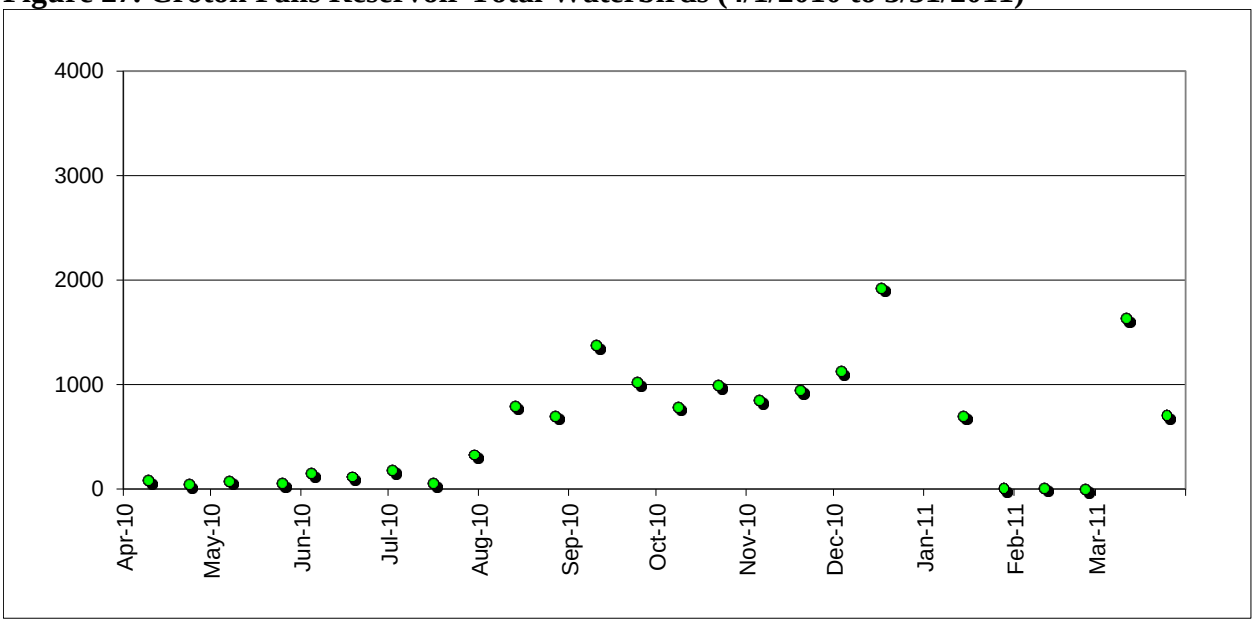


Figure 27. Croton Falls Reservoir Total Waterbirds (4/1/2010 to 3/31/2011)

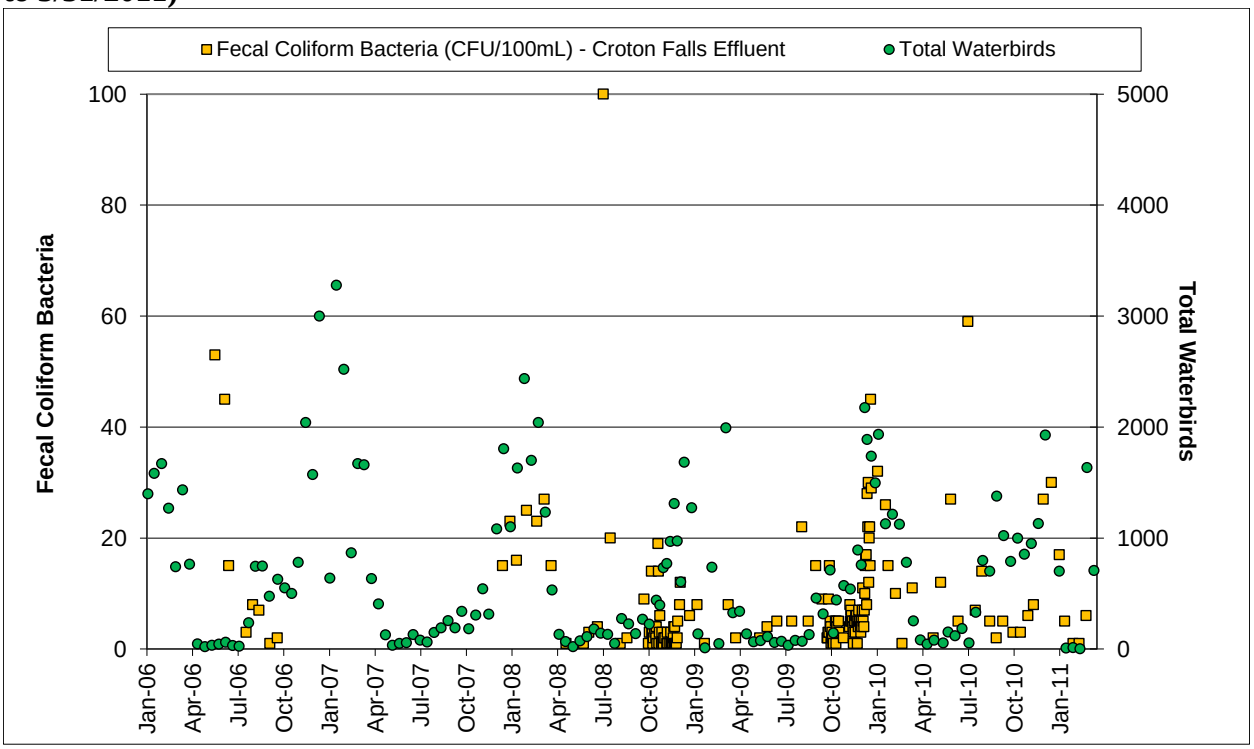


There were a total of 9 double-digit fecal coliform bacteria samples measured at the Croton Falls effluent chamber in 2010/2011 of which 4 were above the 20 CFU/100mL limit compared to 21 double-digit samples of which only 1 was above 20 CFU/100mL recorded in 2009/2010. There does appear to be a relationship between the seasonal increases in bird activity and elevated

FCOLI levels (Figure 28). A spike of 1,634 in total birds occurred on 3/11/2011 with a corresponding fecal coliform level of 27 CFU/100mL. DEP determined that activation of the "as needed" waterbird dispersal program was unnecessary during this reporting period.

DEP conducted reproductive control on Canada Geese from April 1 through May 31 to reduce productivity at Croton Falls. In 2010, 6 Canada goose nests were identified and 24 eggs were depredated compared to 5 nests and 38 eggs 2009 (Table 4). The egg-depredation success rate at Croton Falls for 2010 was 83% with a total of 5 goslings that hatched. There were no Mute Swans found nesting in 2010.

Figure 28. Croton Falls Reservoir Fecal Coliform Bacteria vs. Total Waterbirds – (1/1/2006 to 3/31/2011)

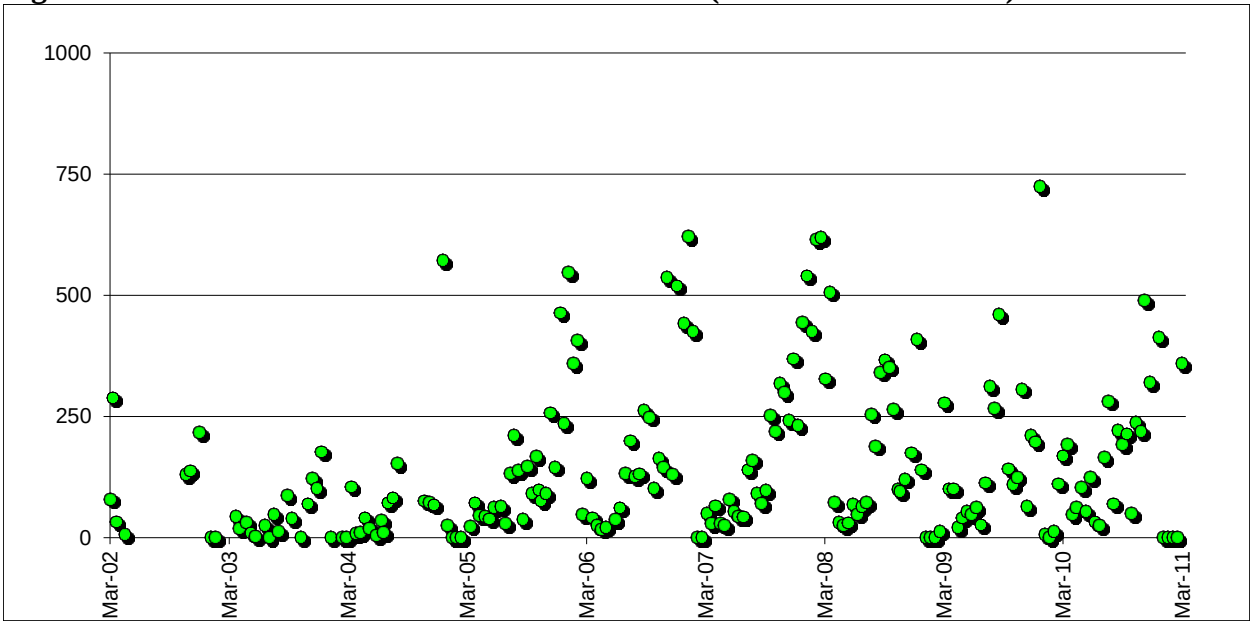


6. Cross River Reservoir

The 2007 FAD lists Cross River Reservoir as one of five reservoirs covered under the "as needed" criteria for Waterfowl Management. The Cross River Reservoir is divided into three bird sampling geographic zones associated with reservoir water quality sampling locations (Figure 34). Bird numbers at Cross River were similar with those reported in previous years peaking with the high total count of 489 recorded on 11/24/2010 compared to a high of 725 recorded in January 2010 (Figure 29). Canada Geese numbers rose from late July through late September 2010 which represents the return of the birds after the post-breeding season molt and

including the onset of winter migration. The duck population rose from early September through early January 2011, until the reservoir iced-over. Almost no birds were present from the onset of ice cover until mid-March. Gulls were only observed on five surveys at Cross River with a high count 56 on 3/18/2011.

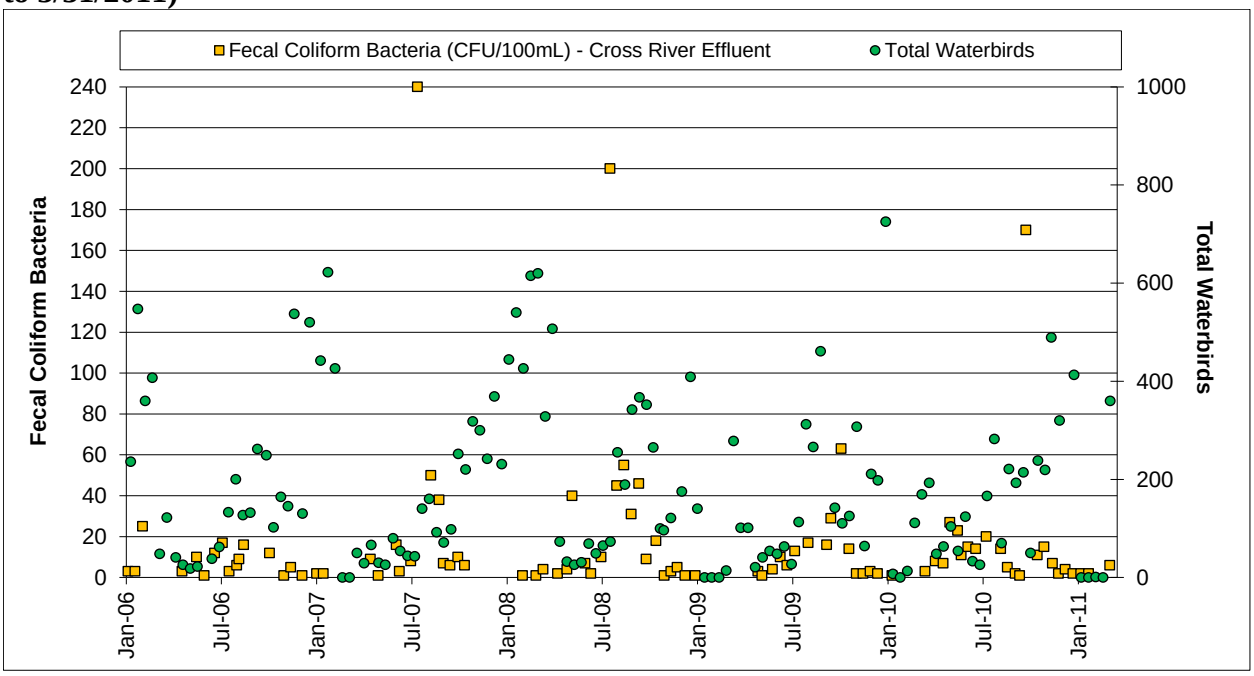
Figure 29. Cross River Reservoir Total Waterbirds (3/1/2002 to 3/31/2011)



Fecal coliform bacteria concentrations identified in water samples at Cross River Reservoir exceeded the 20 CFU/100mL limit four times compared to three times in the previous reporting period (Figure 30). The increase in goose numbers beginning in late July doesn't appear to correspond to the elevations in fecal coliform bacteria levels at the Cross River Effluent Chamber. DEP determined that activation of the "as needed" waterbird dispersal program was unnecessary during this reporting period.

DEP conducted reproductive control on Canada Geese from April 1 through May 31 to reduce productivity at Cross River. In 2010, 7 nests were identified and 33 eggs addled compared to 5 nests and 38 eggs 2008 (Table 4). The egg-depredation success rate for Cross River in 2010 was 100%. There were no Mute Swans nesting in 2010.

Figure 30. Cross River Reservoir Fecal Coliform Bacteria vs. Total Waterbirds – (1/1/2006 to 3/31/2011)



7. Hillview Reservoir

The City's Long-Term Watershed Protection Program (July 2007 FAD) expanded the Waterfowl Management Program to include Hillview Reservoir on an "as needed" basis similar to the 2002 FAD expansion for five additional reservoirs listed above. DEP initiated an in-depth program starting in 1993 which continues through the present day. The Hillview Reservoir is divided into two bird sampling geographic zones associated with the reservoirs two distinct basins and water quality sampling stations (Figure 35). Waterbird population survey frequencies have varied through the years but generally have been conducted at a minimum on a weekly basis and most often on a daily basis. Bird deterrent and harassment activities have also been employed since 1993 with a high level of success reducing and in most cases eliminating the presence of roosting waterbirds, particularly geese, cormorants, and gulls.

Prior to 1993, DEP Operations staff infrequently employed a variety of noisemakers to eliminate birds roosting diurnally and nocturnally at Hillview. During the summer of 1993, DEP's Wildlife Studies initiated a formal bird management program to monitor birds throughout the year and develop a bird deterrence/harassment program. Pyrotechnics and propane operated cannons were initially used to chase the birds off the water and adjacent shaft buildings. In July 1994, a bird deterrent wire system was partially installed which formed an aerial grid above the surface water to prevent birds such as swans, cormorants, geese, gulls and ducks from landing and defecating in the water. The wire grid, which was mostly completed by the spring of 1995,

consisted of a combination of high-test monofilament, Kevlar wire, and twine. The grid was strung along the shoreline fences spanning a distance of nearly 1,200 feet. From 1994 to 2006, this wire grid system was maintained by DEP staff until a contract was let in 2006 to install an upgraded version of the wire deterrent system using 15' stanchions with reel tensioning devices at the base. DEP and its contractor continue to use pyrotechnics to supplement the wire system to actively keep birds off the reservoir. In the early winter of 2008, DEP installed remote-operated propane cannons along the reservoir's dividing wall to keep gulls and other birds from roosting on the dividing wall railings. The cannons were supplemented by installation of Daddi-long-legs (bird deterrent wires) placed on the tops of the 15' stanchions to prevent birds from roosting. The program enhancements were funded in association with an EPA Administrative Order.

A new EPA Administrative Order on Consent governing the covering of Hillview Reservoir (Docket No. SDWA-02-2010-8027 Catskill Delaware System) was signed on 5/24/2010. Under this order and beginning on 8/1/2011 DEP will be implementing an enhanced wildlife management program at Hillview to further protect the water supply. New best management practices will include increased bird census and harassment, mammal population monitoring and removal, alewife (baitfish) monitoring and removal, facility and grounds inspections and clean-up of animal feces and monthly reporting on wildlife management activities at Hillview Reservoir.

Overnight waterbird counts have been conducted since 1993 whereas daytime counts were initiated in the summer of 2004 with infrequent data collected from 1993 through 2004 (Figures 31 and 32). During the period from summer 2004 through early 2007 the overhead bird deterrent wire system was in disrepair and in preparation for replacement. Prior to bird wire mitigation in 1994, gulls comprised more than 70% of the night-roosting species on the reservoir. This compares to 22.9% for gulls, 0.9% for geese, and 76.2% for ducks in this reporting period. Except for a low number of diving ducks (Ruddy Ducks) all waterbirds observed and reported on both nocturnal and diurnal surveys were harassed off the reservoir using pyrotechnics, cannons, and physical chasing from 0800 until post-dusk times. DEP contractor crews were largely successful in dispersing the gulls and geese once observed. Throughout 2009/2010 ducks comprised 98.9% of the overnight roosting birds at Hillview compared to 100% in 2008/2009. The ducks have generally remained unaffected by a variety of bird deterrent and harassment measures employed by DEP to date. As a result, DEP developed and is currently implementing additional bird management techniques that include new lethal actions to remove the few resident ducks that remain on the reservoir. The lethal program was started after the reporting period for this document.

Water quality results for Hillview are presented as number of positive *E. coli* for each month of the reporting period at four water quality sampling locations (Figures 33-36). There does not appear to be an association between bird counts and positive *E.coli* samples. Three of four reservoir water sampling locations had results of 0 for *E.coli*. Overnight and daytime waterbird

Figure 31. Hillview Reservoir Total Waterbirds Nocturnal Counts (1993 to 2011)

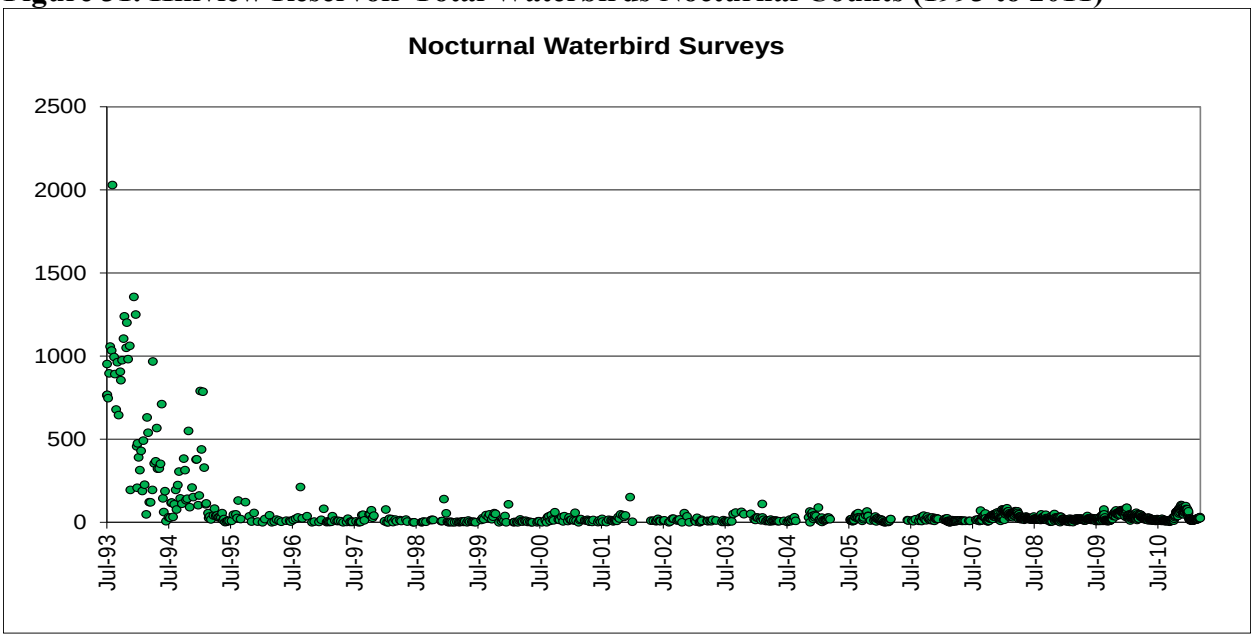
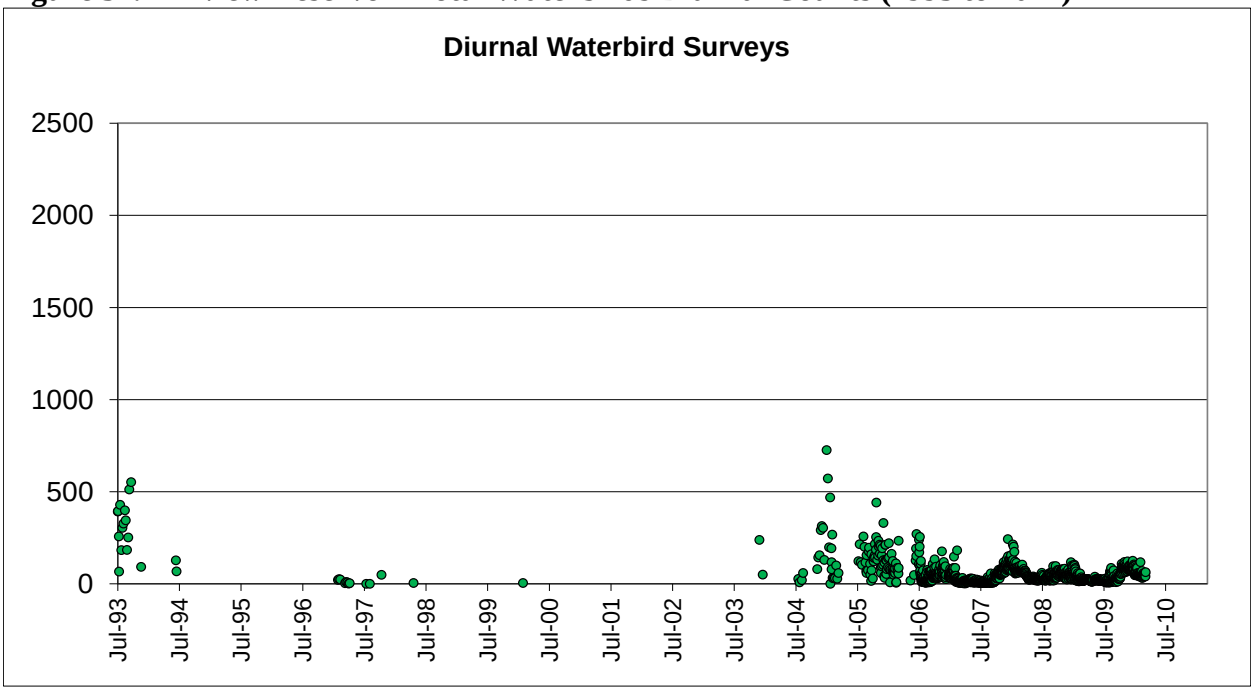


Figure 32. Hillview Reservoir Total Waterbirds Diurnal Counts (1993 to 2011)



counts on both basins remained very low. Overnight waterbird counts peaked at 104 on 12/9/2010. Bird counts were generally lowest during the *E.coli* elevation recorded at sampling

site 3 from mid-May through early September 2010. The average number of ducks recorded roosting overnight during the elevated *E. coli* sampling period was 13. Gulls were only recorded on 8 occasions out of 247 overnight observations and although gulls are recorded during the diurnal surveys they are immediately harassed off the reservoir using pyrotechnics and propane cannons.

The behavior patterns of the waterbirds utilizing Hillview Reservoir are different from the other upstate reservoirs reported in the document as Hillview is situated in a highly urbanized area and surrounded by large populations of breeding gulls throughout the NYC metropolitan area. This partially explains why gull activity is a year-around challenge at Hillview. Since the installation of the bird deterrent wire system in 1994, small numbers of gulls and two species of ducks remain the target of active harassment activity.

Figure 33. Hillview Reservoir Number of Positive *E. coli* at water sampling site 1 (4/1/2010 to 3/31/2011)

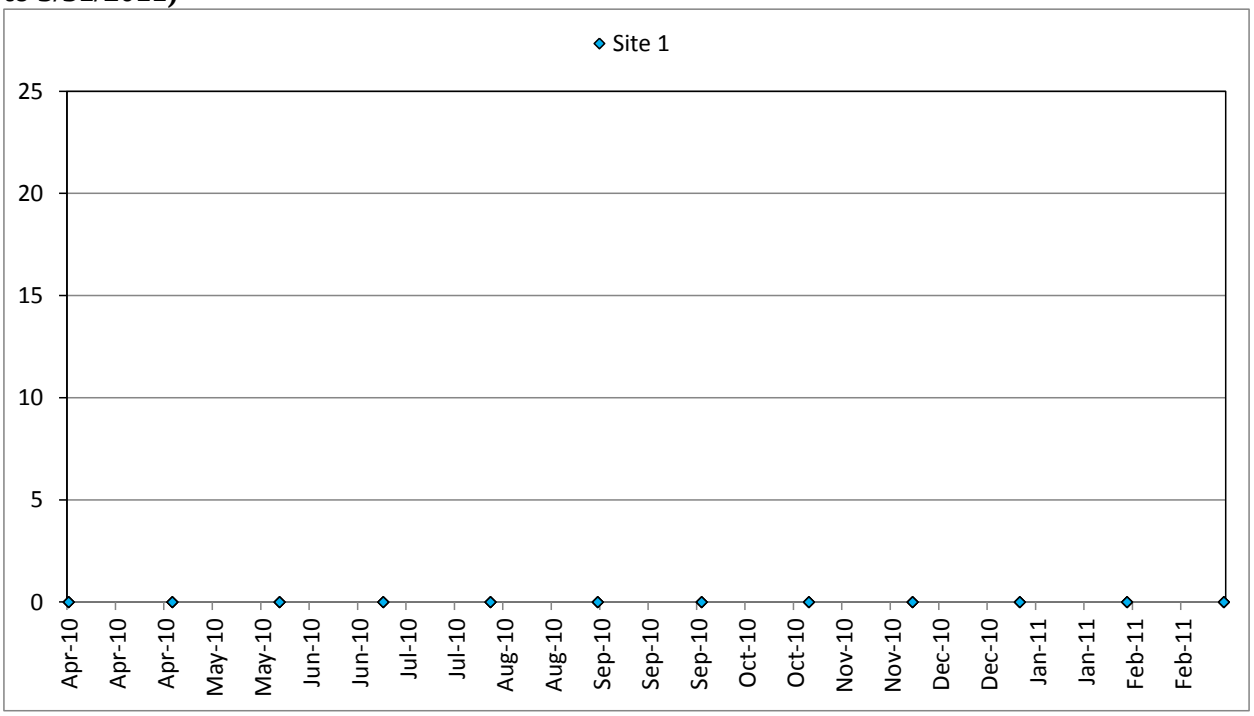


Figure 34. Hillview Reservoir Number of Positive *E. coli* at water sampling site 2 (4/1/2010 to 3/31/2011)

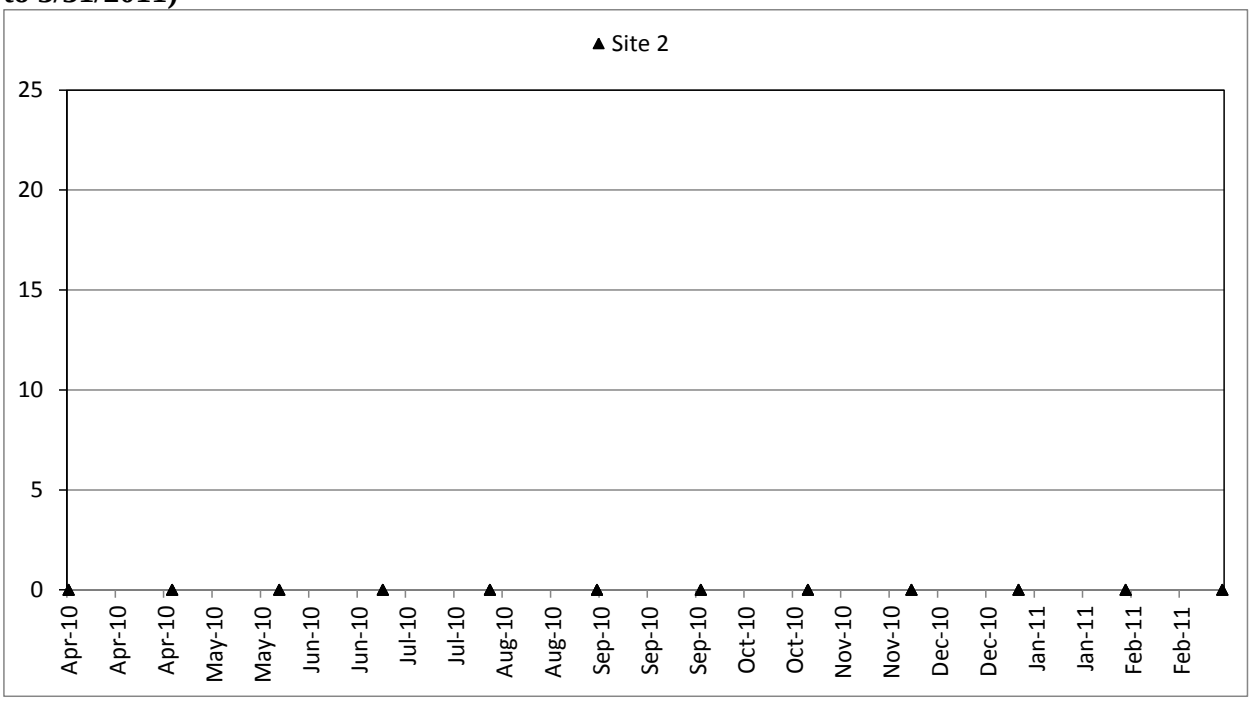


Figure 35. Hillview Reservoir Number of Positive *E. coli* at water sampling site 3 (4/1/2010 to 3/31/2011)

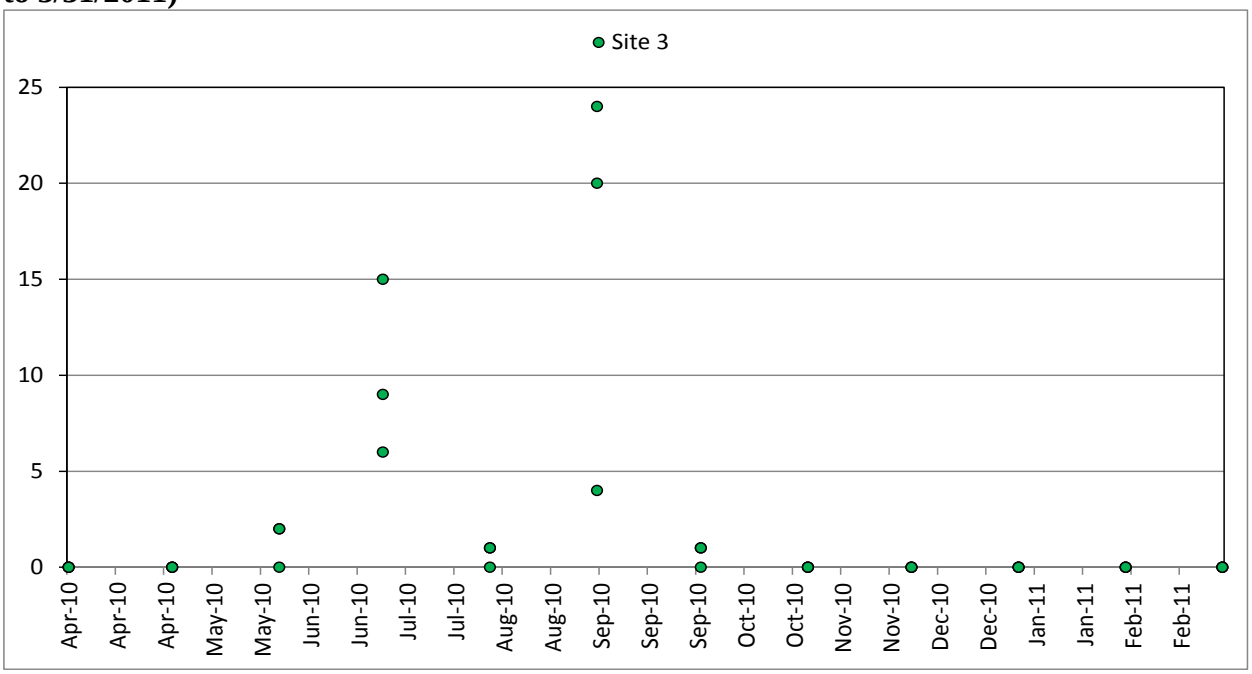
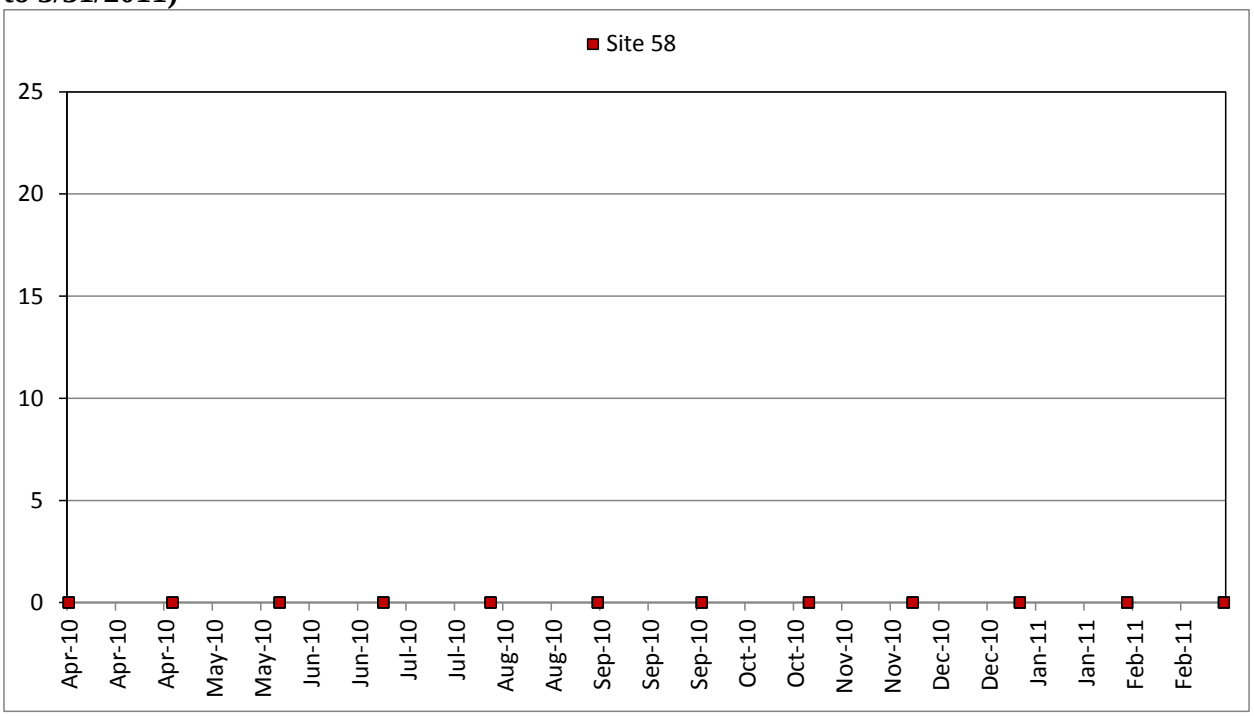


Figure 36. Hillview Reservoir Number of Positive *E. coli* at water sampling site 58 (4/1/2010 to 3/31/2011)



DEP attempted to trap and relocate the small flock of Ruddy Ducks in 2010/2011 using, nets, running remote control motor boats, harassment, and attempted capture by boat largely without success except for the capture and removal of one Ruddy Duck by net. Several Ruddy Ducks once again perished at Hillview and appear to have starved to death. Some collected specimens revealed wing and tail feather deformities which appeared to have developed among the resident population. Since Ruddy Ducks are not typically found as breeding species in this region, it is believed that the resident ducks with deformities perished due to dietary changes. DEP continued to submit the Ruddy duck specimens to the New York State Department of Environmental Conservation Wildlife Pathology Unit for stomach content analysis and cause of death. To date, many of the specimens appear to have been affected by starvation and stomach contents were generally empty. The Hillview basins are concrete and may not provide proper nutrition of aquatic invertebrates for the ducks to survive. Additional actions employed by DEP working in conjunction with assistance of DEC and USDA Wildlife Services included the following:

- September 2008 and February 2009 – Present: Use of remote control motor boat for harassment
- December 2008 – Present: Use of canoes, kayaks, and electric motored Jon-boats for harassment
- September 2009 – Present: Deployment of gill nets and use of electric motored Jon-boats

to attempt to capture ducks
- April 2010 – Present: Experimental lethal shooting employed by the USDA Wildlife Services
- April 2010 – Present: Nighttime spotlighting using electric motored Jon-boats for capturing ducks
- July 2010 – Present: Bird wiring installed on reservoir shaft buildings intake openings to preclude roosting and breeding swallow spp.

DEP will continue to assess the feasibility of trapping efforts using the nighttime spotlighting technique as well as gill net deployment in the late summer when the ducks undergo a molt and are temporarily rendered flightless. If live-trapping efforts are successful the small flock of Ruddy Ducks will be relocated to a northern New York location that has been predetermined by the DEC. Daily monitoring and bird harassment activities will continue by DEP contract to supplement the new bird wire grid system which was completed in late 2007. DEP has also developed an Intergovernmental Cooperative Agreement (contract) for services to lethally remove the Ruddy Ducks with the USDA Wildlife Services which was implemented during the spring of 2011.

CONCLUSION

DEP's Waterfowl Management Program is a key component to the City's continuance of Filtration Avoidance as outlined under the Final 2007 FAD document. The program has allowed DEP to retain flexibility in choosing the highest quality water for distribution. The Waterfowl Management Program has been in continuous operation since 1993 and continues to effectively reduce waterbird populations and keep fecal coliform bacteria levels in compliance with the Environmental Protection Agency's Surface Water Drinking Rule (SWTR) of 1991 as part of the Safe Drinking Water Act regulations.

It is well established that waterbird elevations and their spatial distributions relative to NYC watershed reservoirs' water intake facilities can affect fecal coliform bacteria levels in water samples collected. It will remain important for DEP to continue indefinitely with year-around monitoring and bird reduction measures where necessary.

The reduced waterbird and fecal coliform bacteria counts at Kensico Reservoir and other reservoirs as covered under the "as needed" section can be attributed directly to the seasonal bird the variety of bird dispersal and deterrence techniques. When dispersal tools (motorboats, Husky Airboats, and pyrotechnics) are used together they result in the most effective means to bird reduction over large open areas of drinking water. To date, it remains inconclusive whether a tolerable number of waterbirds can be considered acceptable at Kensico or other reservoirs listed at terminal reservoirs in the NYC water supply before water quality is compromised; therefore, the objective of the Waterfowl Management Program will be to continue with the elimination of all roosting birds during the bird migratory seasons for Kensico and Hillview Reservoirs and on as "as needed" basis for reservoirs that are a direct source to Kensico. Operational changes in the Delaware Aqueduct system occurred during the migratory/overwintering period for several waterbird species resulting in the need to activate the "as needed" management program for West Branch Reservoir during this reporting period. In anticipation of elevated fecal coliform bacteria levels entering Kensico Reservoir from West Branch and as a preventive measure to comply with the Surface Water Treatment Rule the bird management activities proved successful eliminating birds and decreasing fecal coliform bacteria levels.

The establishment of bird-free zones (spatial distributions) around water intake structures at reservoirs source to Kensico (i.e., Rondout and Ashokan Reservoirs), whether program-initiated through harassment or by the natural process of the birds selecting roosting locations, continues to be a key influence on lower fecal coliform bacteria levels. The spatial distributions of the birds in relation to the flow dynamics of the reservoir appear to have the greatest influence in the transport of bacteria to the water intakes. It is evident that when DEP properly manages its waterbird populations, fecal coliform bacteria concentrations remain low and in compliance with EPA regulations.

Bird deterrence measures which include waterbird reproductive management, shoreline fencing, and meadow management continued to reduce local breeding opportunities around water intake

structures and eliminate fecundity during this reporting period. Future options for Canada Geese and Mute Swan management should consider incorporation of measures to reduce local breeding populations by means of "take" under federal permit. The "take" option, although not employed by DEP or by the Westchester County Airport depredation order during this reporting period, is expected to be used in the summer of 2011 and thereafter.

Additional bird deterrent equipment is proposed to be installed during the 2011/2012 reporting period. These measures included bird netting to cover additional water intake chambers to the reservoir influent and effluent facilities Hillview, and West Branch Reservoirs. At the Hillview Reservoir, DEP continued to employ the use of pyrotechnics, physical chasing, remote-operated propane cannons, Daddi-long-leg, bird deterrent wires and netting, and lethal control measures to prevent ducks, gulls and other non-waterbird species from landing on the reservoir dividing wall. Remote-operated propane cannons have improved bird deterrence during times of inclement weather when contractor staff is not permitted on the reservoir dividing wall and pyrotechnics are rendered ineffective from the reservoir shoreline.

Waterbird populations continue to demonstrate seasonal elevations primarily during the autumn and winter periods in all reservoirs listed in this report. Climate alterations can affect behaviors and migratory activity changes of "local" or resident birds such as Canada Geese. Gull populations are migratory and utilize the New York City Reservoir system as a migratory stop-over or wintering area until local conditions (i.e. ice and snow cover) become too intolerable. Ice cover on the reservoirs and snow cover in the associated watershed or daily flight range for food often determine whether they will continue in migration. If climate conditions become warmer it could potentially develop an increased demand to use the "as needed" component for bird management at a significant increase in cost.

Although NYC continues to remain in compliance with SWTR regulations, low seasonal elevations of fecal coliform bacteria were recorded annually from late autumn through early winter oftentimes associated with migratory waterbirds stopping over and wintering on the reservoirs and/or precipitation events. Monitoring the effects that bird dispersal measures have on each reservoir can be achieved through continued routine population surveys and expanding research identifying bacteria origins. Survey results provide inferences about the potential effect the bird's fecal matter through the spatial and temporal aspects of the birds but also evaluate the effectiveness of the dispersal measures. DEP will continue with the implementation of the Waterfowl Management Program indefinitely to ensure the highest quality water by managing waterbird populations.

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Appendix A. Reservoir Maps with Bird Zone Designations and Water Sampling Locations

Figure 37. Map of New York City Water Supply System – East of Hudson Region

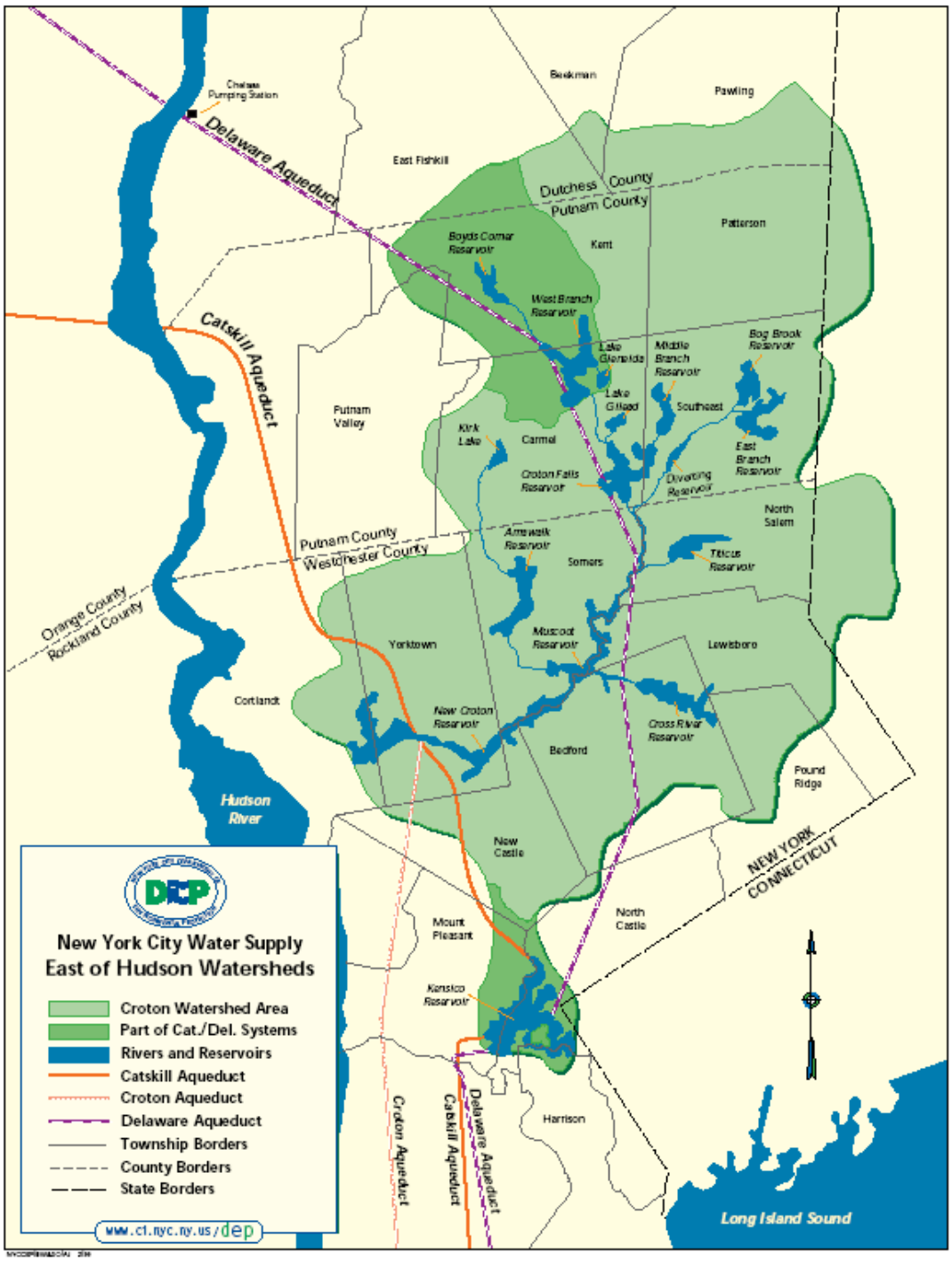
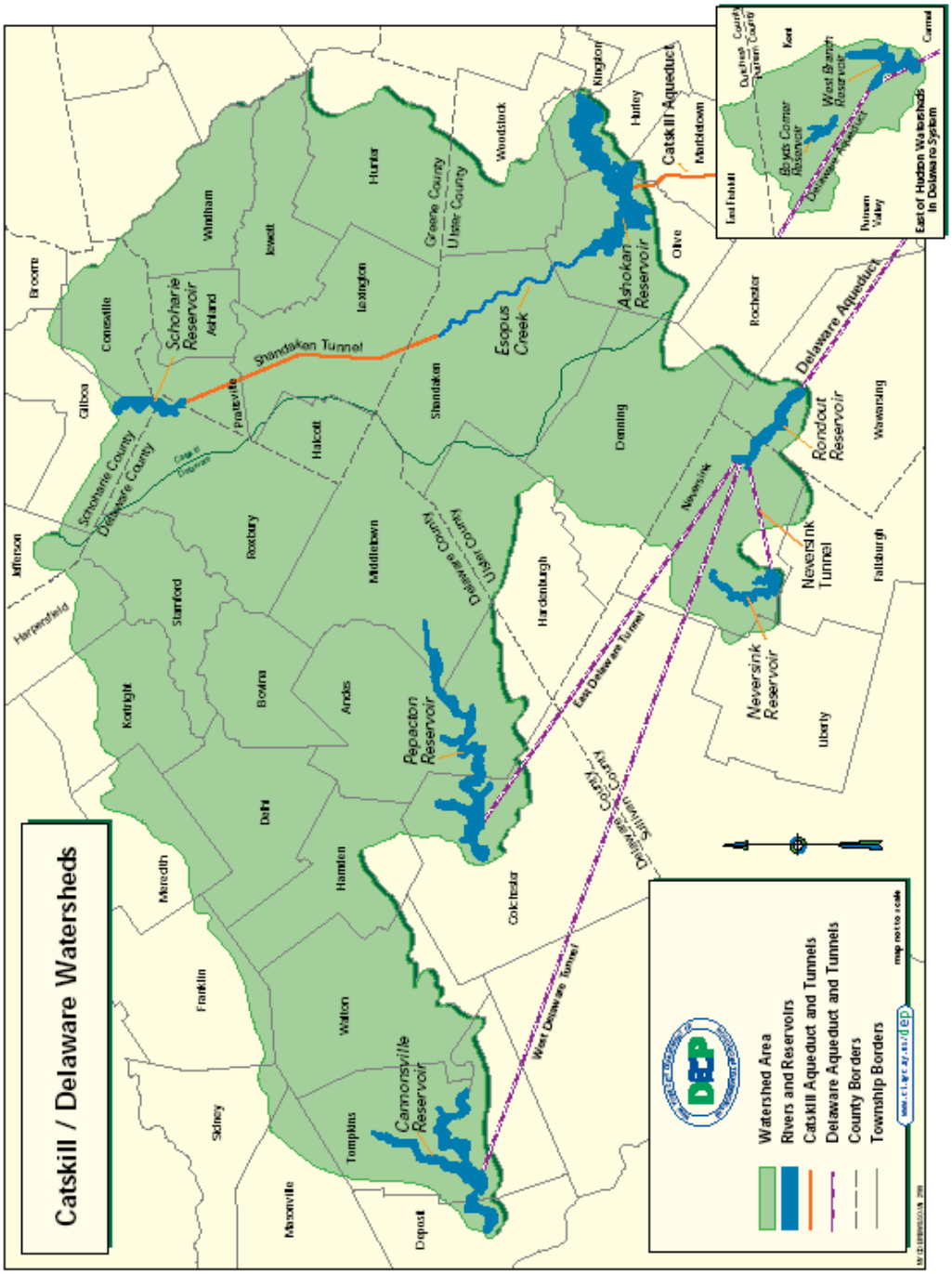


Figure 38. Map of New York City Water Supply – West of Hudson



Region

Figure 39. Map of Kensico Reservoir Bird Zones

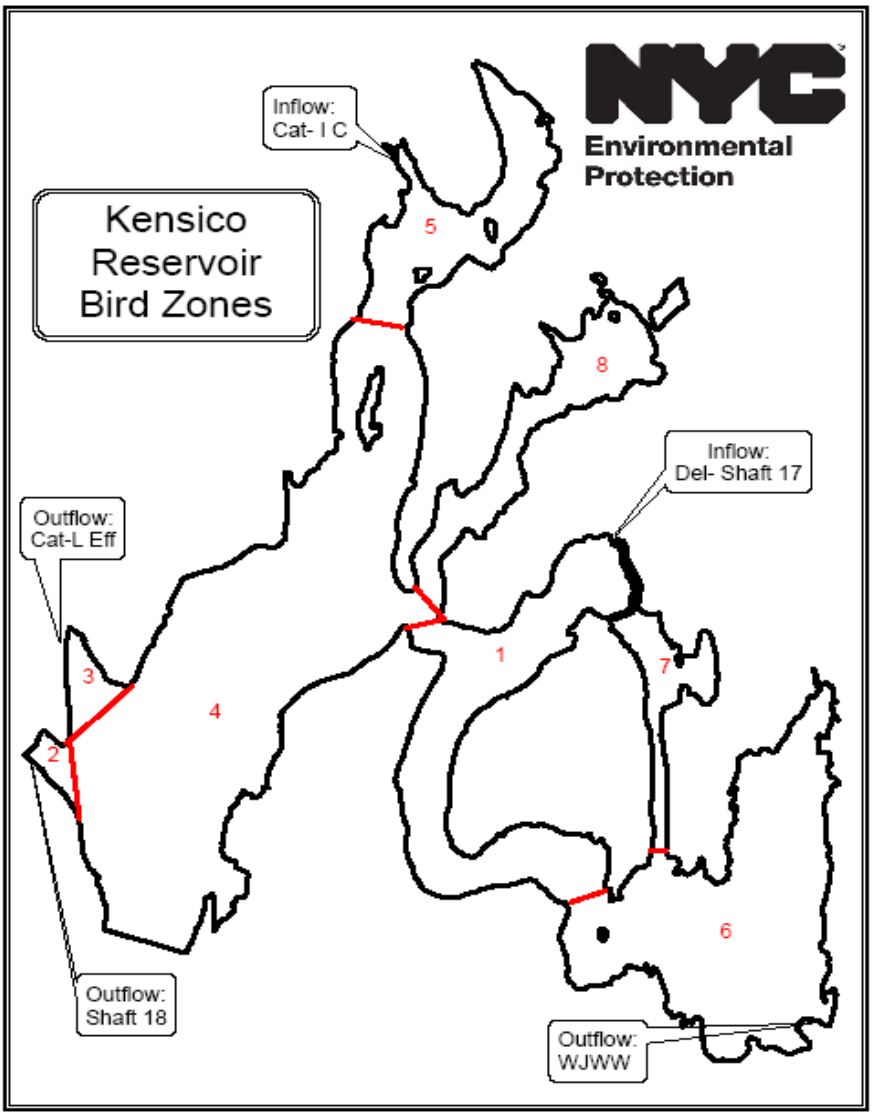


Figure 40. Map of West Branch Reservoir Bird Zones

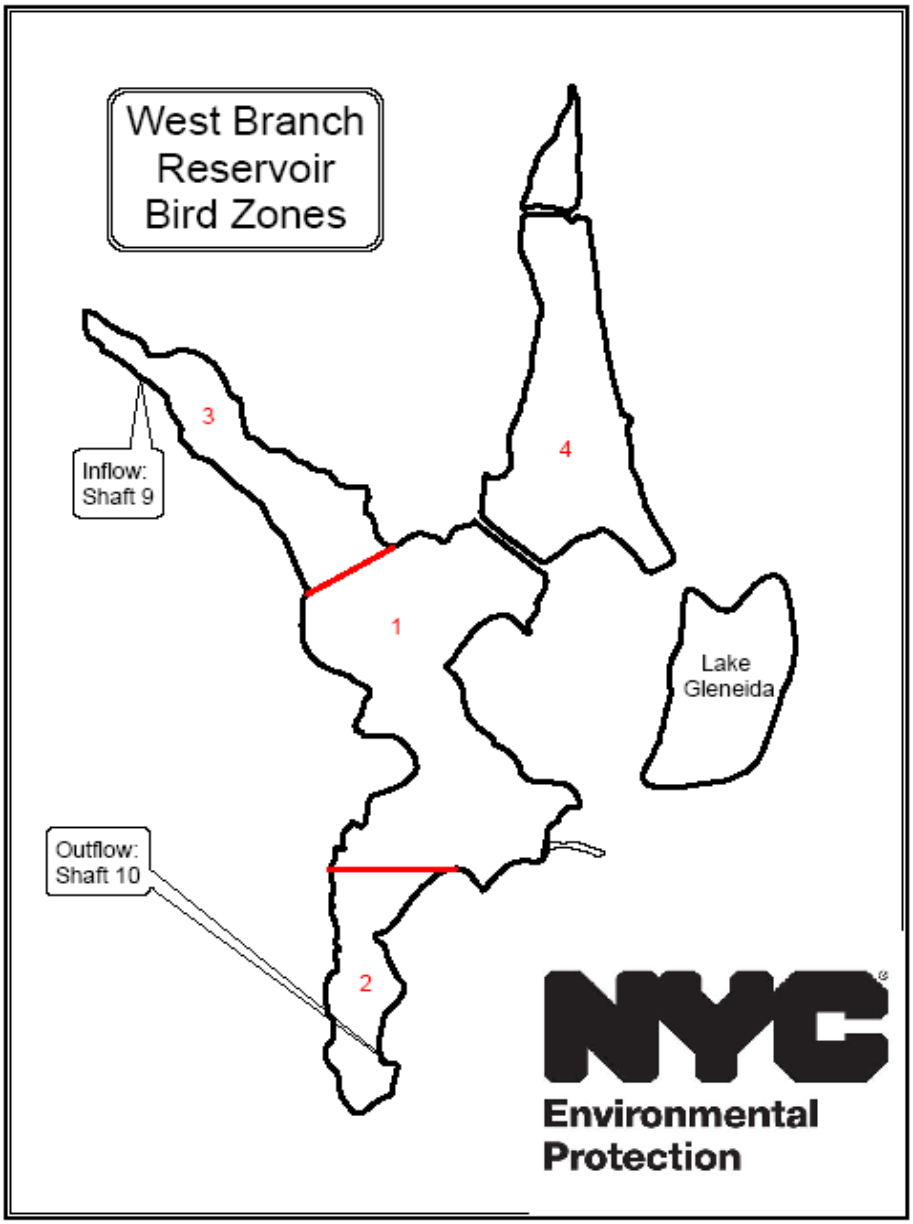


Figure 41. Map of Rondout Reservoir Bird Zones

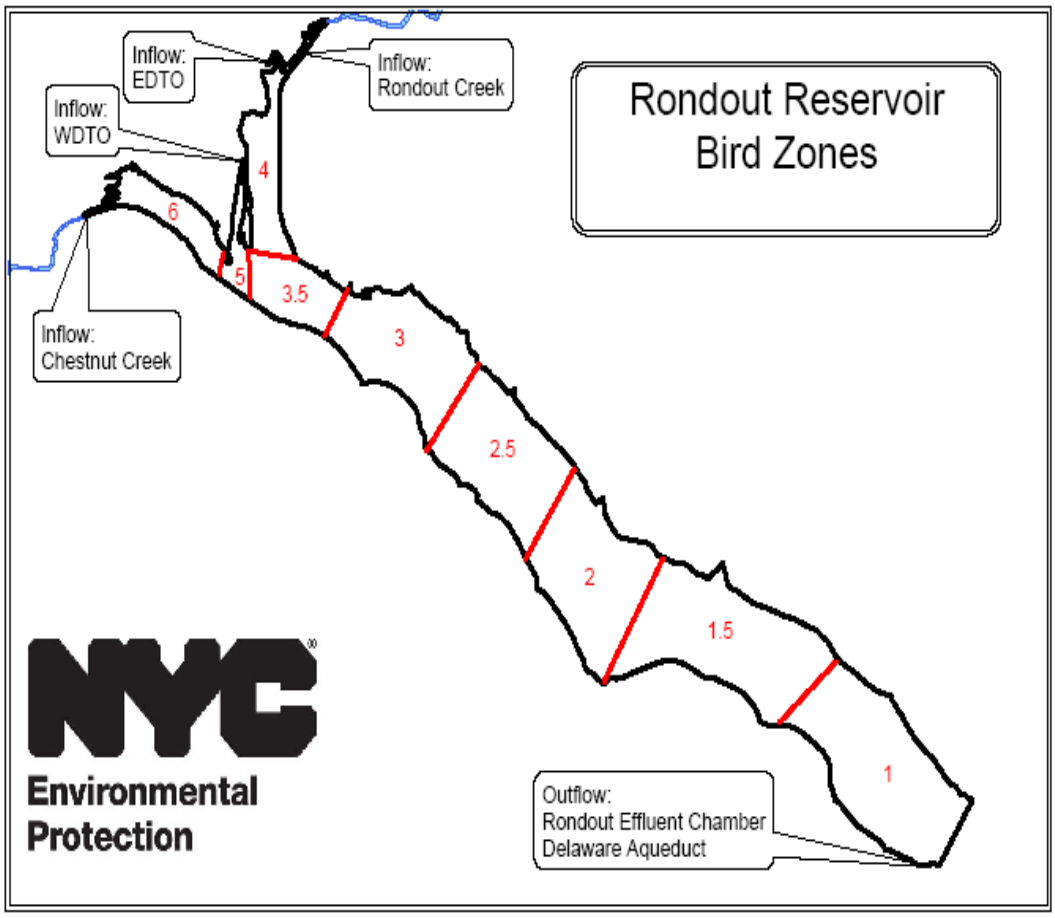


Figure 42. Map of Ashokan Reservoir Bird Zones

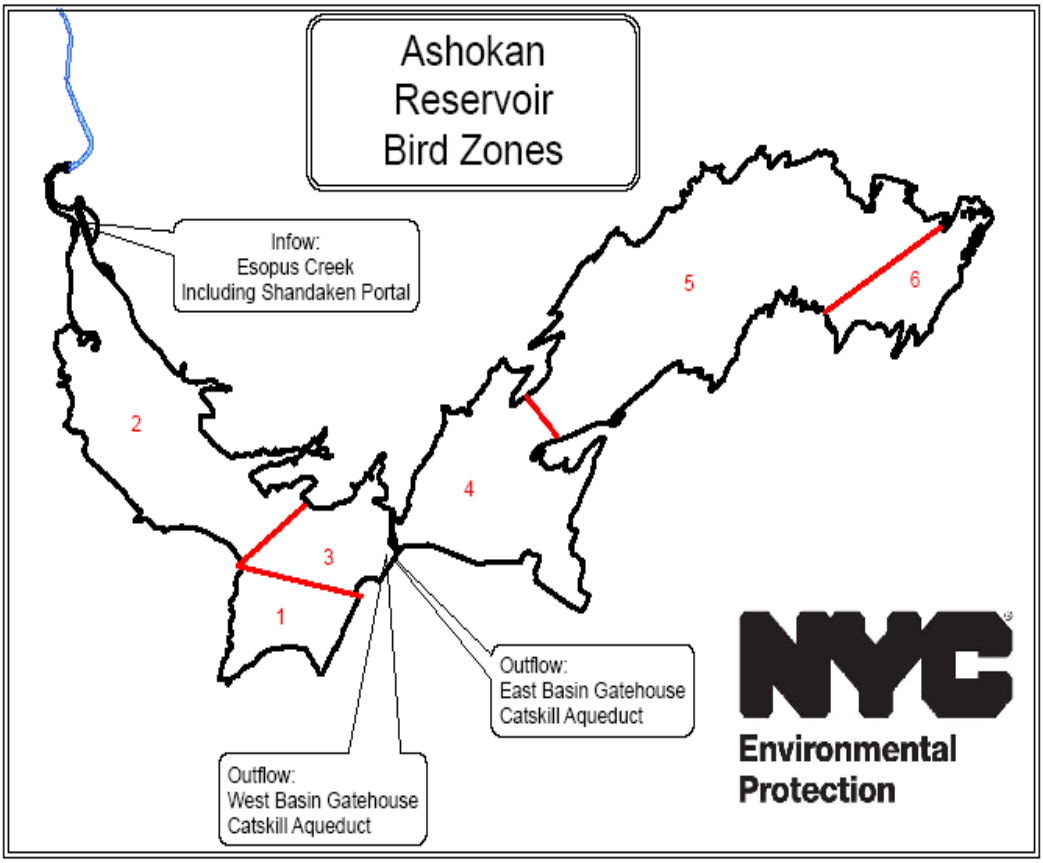


Figure 43. Map of Croton Falls Reservoir Bird Zones

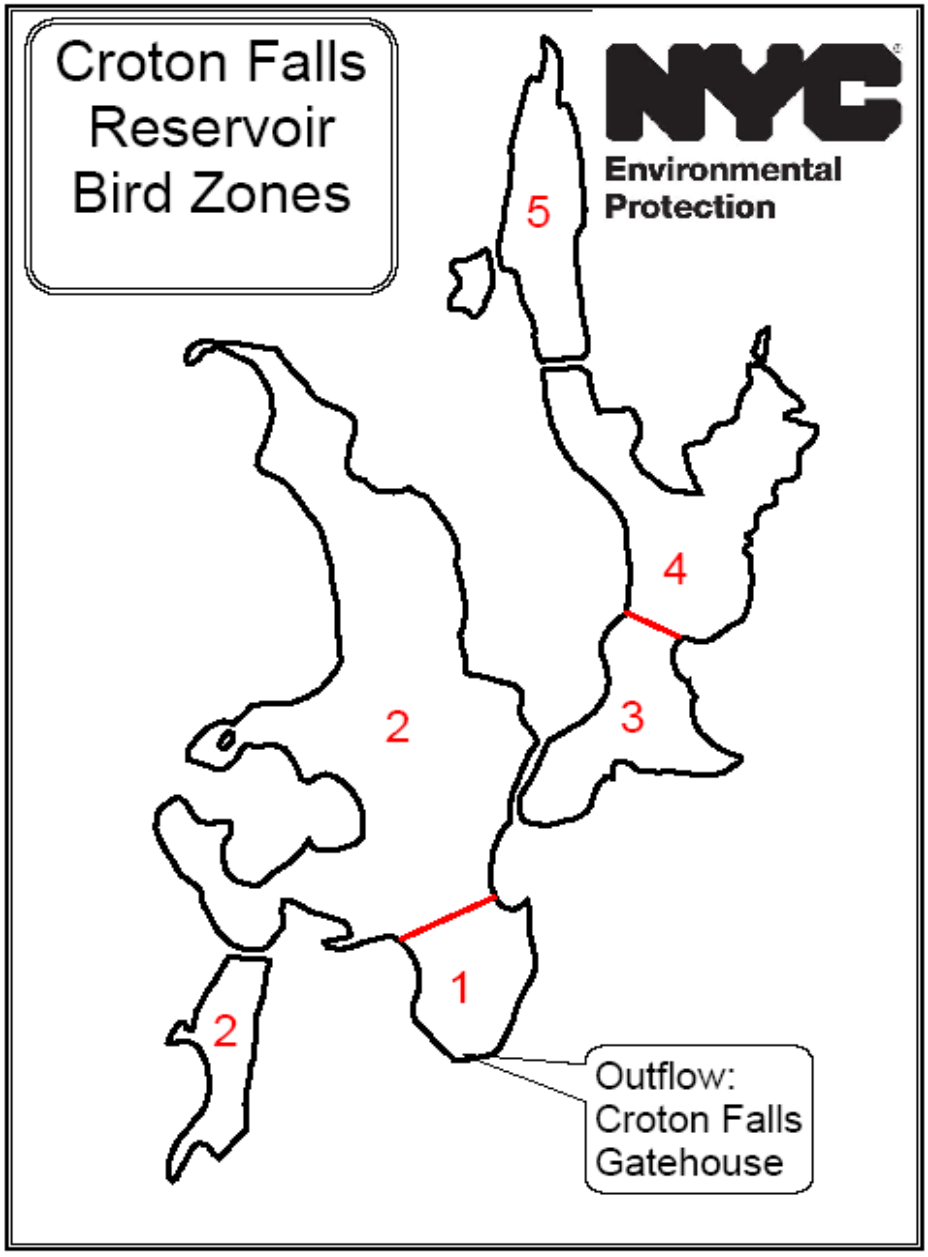


Figure 44. Map of Cross River Reservoir Bird Zones

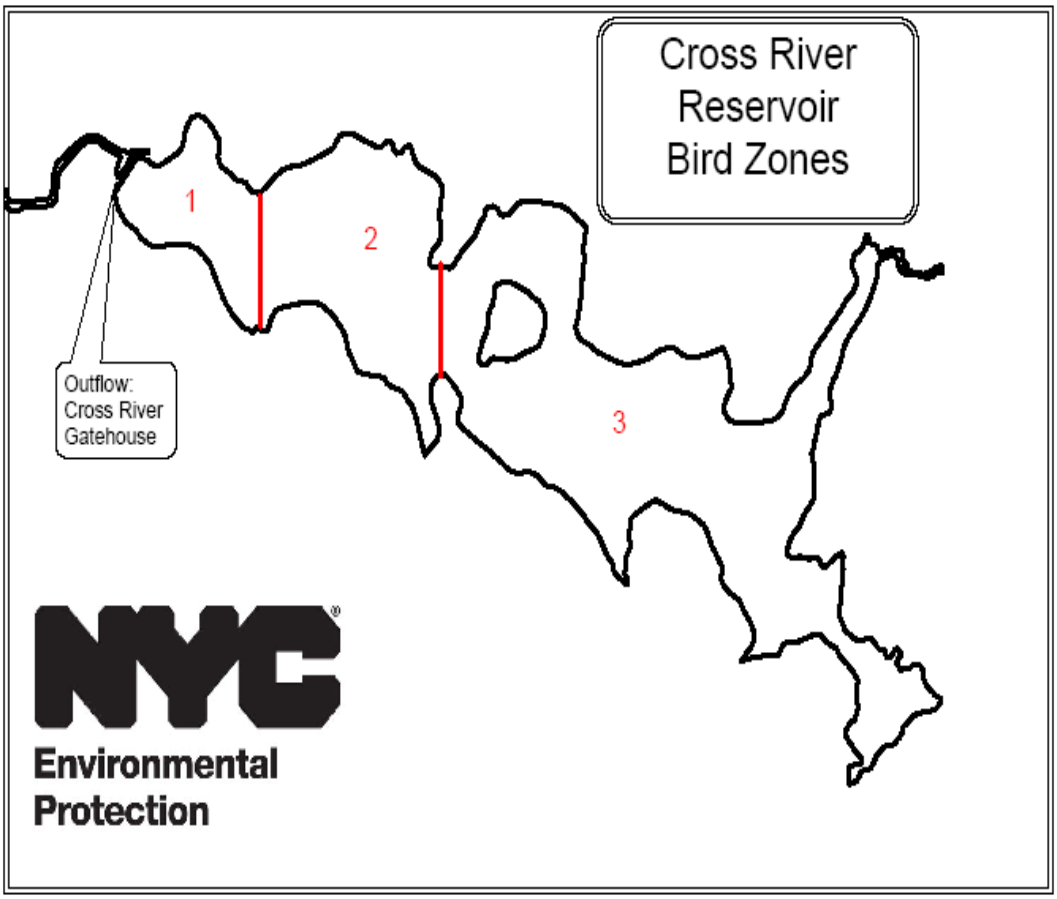


Figure 45. Map of Hillview Reservoir Bird Zones

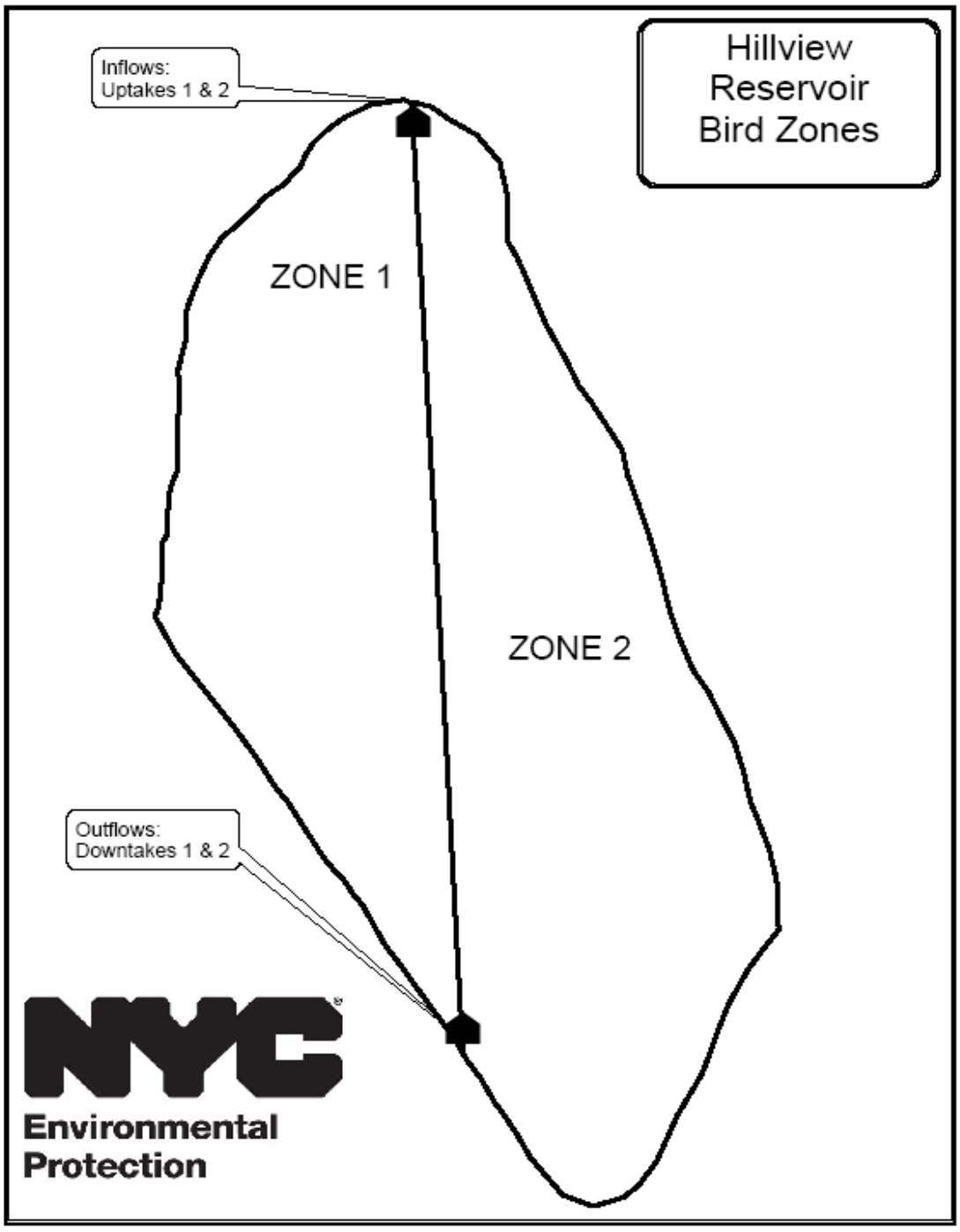


Figure 46. Map of Hillview Reservoir Water Sampling Locations