New York City Department of Environmental Protection
Bureau of Water Supply

Waterfowl Management Program

October 31, 2020

Prepared in accordance with Section 4.1 of the NYSDOH 2017 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, ducks, swans, and cormorants). The purpose of this report is to evaluate the trends in bird numbers and their effect on fecal coliform bacteria levels from August 1, 2019 to July 31, 2020

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1. 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 (USEPA) Surface Water Treatment Rule (SWTR) (USEPA 1989). As a result, New York City Department of Environmental Protection (DEP) developed and implemented a comprehensive Watershed Protection Program to protect its water supply and as a requirement of Filtration Avoidance Determinations (FAD) received from USEPA and New York State Department of Health (NYSDOH). A component of the Watershed Protection Plan is DEP's Waterfowl Management Program (WMP), established to research and manage the relationship between wildlife, particularly waterbirds (geese, gulls, cormorants, swans, ducks, and other duck-like birds) that inhabit the reservoirs and fecal coliform bacteria elevations in the untreated and treated surface water. The Waterfowl Management Program, originally developed for Kensico Reservoir in 1992, was expanded to include five additional reservoirs for waterbird management under the November 2002 Filtration Avoidance Determination (FAD) (Section 4.1 – Waterfowl Management Program). The 2007 FAD (USEPA 2007) further expanded the program to include bird management at Hillview Reservoir in Yonkers, New York. The 2017 FAD was issued to DEP in December 2017, and will remain in effect until a further determination is made (NYSDOH 2017).

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 reservoirs and at the keypoint water sampling locations. Following a year 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 (DEP 1993). In response, DEP developed and implemented a Waterfowl Management Program using standard bird management techniques (approved by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA) and the New York State Department of Environmental Conservation (NYSDEC) to reduce or eliminate the waterbird populations inhabiting the reservoir system (DEP 2002). DEP has also acquired a depredation permit, a federal registration from the United States Fish & Wildlife Service (USFWS), and a License to Collect and Possess from NYSDEC to employ additional wildlife management techniques. Since the initial implementation of DEP's bird dispersal and deterrent techniques in 1993, there has been a significant reduction in both bird populations and fecal coliform bacteria levels, thus maintaining high quality water in compliance with the SWTR.

Migratory populations of waterbirds utilize City reservoirs as temporary staging areas and wintering grounds and therefore can significantly contribute to increases in fecal coliform loadings in the reservoirs during the autumn and winter, primarily from direct fecal deposition. These local and migrant waterbirds generally roost nocturnally and occasionally forage and loaf

diurnally on the reservoirs, however, it has been determined that some of the feeding activity occurs away from the reservoirs. 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) sampled 236 Canada geese and 249 Ring-billed gulls from in and around Kensico Reservoir to determine fecal coliform counts per gram of feces. The results identified average bacteria levels as follows: Canada geese (1.53×10^4 FC/g) and for Ring-billed gulls (3.68×10^8 FC/g). Without a robust bird dispersal effort, large migratory and wintering populations of gulls could deposit significantly high levels of fecal coliform bacteria into the water supply.

Water samples collected near waterbird roosting locations have shown fecal coliform increases concurrent with waterbird populations at several City reservoirs (DEP 1992 - 2019). Waterbirds have been associated with elevated fecal coliform bacteria levels found in several reservoirs and including various reservoirs and lakes (Gould and Fletcher 1978, Hussong et al. 1979, Standridge et al. 1979, Benton, et al. 1983, DEP 1992 and 1993, Levesque et al. 1993, Hatch, 1996). DEP developed a program to discourage waterbird activity for Kensico Reservoir in the autumn of 1993, which is expected to continue indefinitely. The bird dispersal program was expanded in 2004 to allow for "as needed" waterbird management at five additional reservoirs (Rondout, West Branch, Ashokan, Croton Falls, and Cross River). To ensure DEP's program activities remained in compliance with all federal, state, and local laws including effects on local communities and environmental conditions an Environmental Impact Statement was completed for Kensico in 1996 and second one in the spring of 2004, which included the five additional "as needed" reservoirs (DEP 2004).

This report is a requirement of the current 2017 FAD (NYSDOH 2017). Its purpose is to evaluate further the downtrend observed in waterbird populations and its impact on fecal coliform bacteria concentrations resultant of DEP's Waterfowl Management Program for the period August 1, 2019 through July 31, 2020.

2. Methods

Waterfowl Management Program

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 four activities: avian population monitoring, avian dispersal activities (motorboats, airboats, propane cannons, physical chasing, remote control motorboats, and pyrotechnics), avian deterrence (depredation of nests and eggs, bird exclusion wires, and netting at critical intake chambers) and wildlife sanitary surveys. All avian dispersal techniques and deterrence activities have been recommended and fully approved by USFWS, USDA, and NYSDEC.

DEP initiated the Waterfowl Management Program in 1992 for the Kensico Reservoir in response to elevated fecal coliform bacteria levels. DEP determined that the water leaving Kensico had higher levels of bacteria than the water entering Kensico from source reservoirs through aqueducts and as a result focused on identifying and mitigating local inputs of bacterial pollution (DEP 1992). Preliminary waterbird surveys conducted by DEP staff in 1992 demonstrated a seasonal effect of increased numbers of roosting birds and elevated fecal coliform bacteria levels. By December 1993, DEP initiated a daily (24-hour/day) program which was further refined to a pre-dawn to post-dusk bird dispersal effort in 1994. The bird dispersal program evolved into a tri-season effort from August through March annually. DEP subsequently expanded the program to include additional reservoirs.

The 2002 FAD required that the City continue this program for the Kensico Reservoir on an annual basis and expand the program to an “as needed” basis for five additional reservoirs. Three of these five reservoirs (West Branch, Rondout, and Ashokan) routinely supply Kensico as source water (Appendix B, Figures B.1 and B.2). The remaining two reservoirs (Cross River and Croton Falls), while in the Croton System (Appendix B, Figure B.1), may also provide Kensico with source water under certain conditions and with permission from the NYSDOH.

The City’s 2006 Long-Term Watershed Protection Program expanded the Waterfowl Management Program to include “as needed” avian dispersal 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:

- Fecal coliform bacteria concentrations approaching or exceeding 20 colony-forming units per 100 milliliters at reservoir effluent structures coincident with elevated bird populations;
- Current bird populations, including roosting or staging locations relative to water intakes;
- 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
- An assessment that active bird management measures would be effective in reducing bird populations and fecal coliform bacteria levels.

The 2017 FAD Activity and Reporting Requirements for the Waterfowl Management Program are outlined in Table 1.1, below.

Table 1.1 2017 FAD activity and reporting requirements (NYSDOH 2017).

Activity	Due Date
Active Waterbird Dispersal – Kensico Reservoir	Annually, 8/1 to 3/31
Active Waterbird Dispersal – Hillview Reservoir	Year-round
"As needed" Bird Dispersal – West Branch, Rondout, Ashokan, Croton Falls, and Cross River Reservoirs.	Annually, 8/1 to 4/15
"As needed" Bird Deterrent Measures – Kensico, West Branch, Rondout, Ashokan, Croton Falls, Cross River, and Hillview Reservoirs.	Year-round
Report Description	**Due Date**
Summary of Waterfowl Management Program activities at all reservoirs, including wildlife management at Hillview Reservoir (8/1 to 7/31).	Annually, 10/31

Waterfowl Management Program Contract Status

The current Waterfowl Management Program Contract (WMP-16 Renewal) is in a six-month extension of the contract renewal period through January 27, 2021 for services that are provided by DEP contractor Henningson, Durham, and Richardson, P.C. (HDR) of Omaha, Nebraska.

Waterbird Census

New York City reservoirs, situated in southeastern New York State (Appendix B. Figure B.3), lie in the Atlantic Flyway, an important migratory pathway for many guilds of birds including waterbirds. The City reservoirs may offer important areas of open fresh water used for night roosting, foraging, winter stopovers, and breeding habitat for some waterbirds species. Since the primary bacterial contribution to the water supply is from migratory waterbirds that roost and defecate overnight in the reservoirs, night census data is mostly presented throughout

this report. Defecation rates of waterbirds are typically lower nocturnally than diurnally due to reduced foraging and physical activity, however overnight roosting involves longer periods of time during which the birds habituate on the reservoirs (DEP 1993).

Daily waterbird observations were conducted from predawn hours (between 4:30am and 8:00am E.S.T.) to post dusk hours (between 5:00pm and 10:00pm E.S.T.). Results of the overnight population surveys were used to evaluate the success of the bird dispersal activities from the previous day. Survey times (pre-dawn and post-dusk) vary seasonally and reflect available daylight hours. Ideal weather and atmospheric conditions were necessary for successful data collection. Some precipitation events and fog prohibited data collection and resulted in short gaps of "no data". Reservoir maps with geographic bird zones can be found in Appendix B. The waterbird population zones were delineated at all reservoirs to identify local impacts on water quality.

Table 1.2 lists scheduled and actual DEP and contractor waterbird surveys conducted at Kensico, West Branch, Hillview Croton Falls, and Cross River Reservoirs from August 1, 2019 to July 31, 2020.

Table 1.2. Frequency of bird observation surveys by reservoir 2019/2020.

Reservoir	Bird Surveys Scheduled	Scheduled/Conducted Surveys
Kensico	Pre-dawn to post-dusk daily August 1, 2019 to March 31, 2020; Pre-dawn and post-dusk weekly April 1 to July 31, 2020	244/231[1,2] and 34/33[2]
West Branch	Pre-dawn, midday, and post-dusk, biweekly; August 1, 2019 to April 15, 2020	36/36
Hillview	Pre-dawn, midday, and post-dusk daily all year	366/359[2]
Croton Falls	Pre-dawn, midday, and post-dusk As Needed	38/38
Cross River	Pre-dawn, midday, and post-dusk As Needed	14/14

[1] **Three surveys were cancelled due to holiday observances.**
[2] **Surveys were cancelled or overnight data not collected due to severe winter storms, fog, and other weather-related events.**

In 2013, NYSDOH approved DEP's request to reduce the bird monitoring requirements to daytime surveys of birds roosting in close proximity to reservoir water intakes at the West Branch, Rondout, and Ashokan. Surveys are performed by DEP Aqueduct Monitoring staff in the form of un-aided (i.e., without binoculars) observations on a weekly basis.

Reservoir-wide observational surveys for waterbirds were conducted year-round at Kensico and Hillview Reservoirs and for part of the year at West Branch Reservoir. Surveys at West Branch were conducted biweekly from August 1, 2019 through April 15, 2020.

For each survey the following parameters were recorded: species evenness (number per species), species richness (species diversity), roosting and foraging locations, flight patterns into and out of the reservoir, bird band/collar identifications, general behavior during the overnight roosting period, environmental conditions, and ice-cover. Waterbird data was collected from shoreline locations and/or watercraft (motorboat, Jon boat, or airboat) by a trained wildlife biologist, ornithologist, or wildlife technician using binoculars and spotting scopes. Both contractor and DEP personnel conducted the collection of field data using field Tough Pads to record observation locations with times for each reservoir. Data was entered in an Excel spreadsheet and were 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 may be dependent on the field conditions (i.e. weather, fog), reservoir physical characteristics (i.e. drought, ice-cover), and time of year (leaf-cover or not). Data collected during reservoir-wide surveys that were incomplete due to inclement weather were not reported. Only high counts for each category of waterbirds were used for data recording. For example, if there was a count of 20 Canada geese during the post-dusk survey and a count of 20 ducks observed at the pre-dawn survey, the 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 to determine the species' highest concentrations. At certain times of the year, some species are easier to count in the evening when birds are flying into roost areas (or open water) whereas other species are more efficiently counted when flying out of the reservoir in the early morning.

Fecal Coliform Bacteria Data

Water quality data presented in this report were from samples collected, analyzed and reported by DEP's Watershed Water Quality Operations and Distribution Water Quality Operations personnel from four NYSDOH Environmental Laboratory Approval Program (ELAP) certified laboratories in Hawthorne, Kingston, Grahamsville, and Queens, New York. DEP watershed laboratory personnel utilized the Membrane Filtration Technique (SM9222D-2006) for fecal coliform analyses. DEP's Distribution Laboratory personnel utilized the Colilert18 with Quantitray for *E.coli* analyses for samples collected at Hillview Reservoir. Reservoir-wide waterbird survey results are presented with fecal coliform bacteria levels from keypoint (outflow) facilities.

Data reported on fecal coliform bacteria concentrations for both keypoint raw water samples (aqueduct and outflows) and reservoir samples were reviewed by DEP laboratory and field personnel. The following conditions apply to the water quality data included in this report:

- 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 reported)
- All water samples reported below the detection limit of one fecal coliform $100mL^{-1}$ were reported as non-detected
- All special investigation samples are reported
- Reanalysis samples are reported
- One sample with confluent growth was reported for the Ashokan Reservoir

Precipitation Data

Precipitation data used in this report for the Kensico Reservoir were provided by DEP's Bureau of Water Supply Source Water Operations Directorate staff and were recorded at the Westchester County Airport meteorological station, located in White Plains, New York (adjacent to Kensico Reservoir) and at the DEP Meteorological Station near the DEL18DT Effluent.

Waterbird Dispersal and Deterrent Techniques

The list of bird mitigation activities conducted during this reporting period is presented in Table 1.3. Dispersal techniques were conducted under a DEP Waterfowl Management Program contract (WMP-16 Renewal) and by DEP staff. Beginning at 8:00am and continuing until approximately 1.5 hours past sunset, bird dispersal activities were conducted reservoir-wide, targeting all species except those with a federal or NYS endangered or threatened status. Those species include NYS threatened pied-billed grebe (*Podilymbus podiceps*), bald eagle (*Haliaeetus leucocephalus*), NYS endangered peregrine falcon (*Falco peregrinus*), and NYS species of special concern osprey (*Pandion haliaeetus*) and common loon (*Gavia immer*).

Airboats, capable of operating over ice and water interfaces with ease, were available for bird dispersal again in 2019/2020 at Kensico. The airboats have heated cabins that allow contractor personnel to remain on-reservoir for longer periods conducting bird dispersal operations during reservoir freezing periods throughout the winter. In addition, an Intergovernmental Cooperative Service Agreement contract has been continued with USDA to conduct lethal management of ducks at Hillview Reservoir as a last choice option. Details of the contract work are discussed in the Hillview Reservoir section of this report.

Table 1.3. Reservoir bird mitigation (August 1, 2019 to July 31, 2020).

Reservoir	Dates of Bird Dispersal and Deterrence	Bird Dispersal and Deterrence Measures Used
Kensico[1,2]	August 1, 2019 – July 31, 2020	• Bird dispersal (motorboats, airboats, Jon boats, and pyrotechnics) • Shoreline meadow management and fencing • Baitfish containment and collections • Maintenance of bird netting for terrestrial bird management for swallows, starlings, pigeons, sparrows, and other small birds • Wildlife excrement sanitary surveys prior to precipitation events • Egg and nest depredation for geese and swans • Canada goose removals by USDA (as needed)
Hillview[3]	August 1, 2019 - July 31, 2020	• Bird deterrent overhead wire system maintenance and replacement • Bird dispersal actions (pyrotechnics, propane cannons, physical chasing, remote control motorboats) • Mammal management via trapping / euthanasia • Baitfish collections • Maintenance of bird netting for terrestrial bird management for swallows, starlings, pigeon, sparrows, and other small birds • Maintenance of bird deterrent wires on shaft buildings and on dividing wall railings. • Mallard depredation • Duck removals by USDA (as needed) • Egg and nest depredation for Mallards and swallows • Wildlife excrement sanitary surveys as needed.

[1] Bird dispersal actions at Kensico Reservoir were conducted from August 1, 2019 to March 31, 2020
[2] Egg and nest depredation for geese and swans were conducted from April 1 to May 31, 2020
[3] Egg and nest depredation for mallards and swallows were conducted from April 1 to July 31, 2020

All bird deterrent techniques such as bird netting on reservoir shaft buildings were maintained throughout the upstate reservoirs. Ongoing maintenance of bird deterrent equipment at Hillview Reservoir continued to improve the success of diverting waterbirds and terrestrial avian species from inhabiting the surface water. Such measures included routine repairs to the overhead bird deterrent wire system, dividing wall bird exclusion wire system, and bird netting (effluent building intake openings).

In response to the seasonal entrainment of baitfish, mostly alewives (*Alosa pseudoharengus*), into the water intake structures at Ashokan Reservoir and their subsequent outflow at Kensico Reservoir, DEP's Waterfowl Management contractor have the ability to install a temporary collection boom as deemed necessary around the Catskill Influent Chamber structure (CATIC) so that dead fish could be removed. Collection of alewives and other bait-sized fish was conducted as needed from the Hillview Reservoir dividing wall using landing nets to retrieve all dead floating fish to eliminate a potential food source for avian piscivorous species such as gulls and ducks like the common merganser (*Mergus merganser*).

Waterbird Reproductive Management

Egg and nest depredation activities targeted locally breeding Canada geese, mallards (*Anas platyrhynchos*), and mute swans (*Cygnus olor*) on City reservoir property (Appendix A, Table A.1). Each nest was flagged and eggs were numbered and punctured using a probe to break the membrane thereby destroying the embryo. Eggs were then replaced in the nest to allow incubation to continue but without development. A small number of goose nests are 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 several weeks.

3. Results and Discussion

3.1 General Results

Waterbird Monitoring, Dispersal and Deterrent Measures

During the 2019/2020 reporting period DEP maintained full compliance with the 2017 FAD requirements for all reservoirs listed in this report. Results of compliance are listed by reservoir below.

Egg and Nest Depredations

City reservoirs offer ideal breeding habitat for a number of waterfowl species such as Canada geese, mute swans, double-crested cormorants, mallard ducks and others. In response, DEP's surveillance program to document and suppress reproductive success and nest-site fidelity has been highly effective. Table 1 in Appendix A summarizes the 2019/2020 program activities.

DEP conducted 39 field surveys and depredated (punctured) 52 Canada goose nests containing 255 eggs at six New York City Reservoirs (Table 1.4) during the spring of 2020 compared to 62 Canada geese nests containing 282 eggs in 2019. All Canada geese egg and nest depredation activity was conducted under the terms of a Federal Registration (#RG-01040A) from the United States Department of the Interior, United States Fish & Wildlife Service. In addition, a NYSDEC permit (#2395) was acquired to depredate mute swans eggs and nests. DEP did not place identification bands on Canada geese or double-crested cormorant in 2020.

There was no goose or swan breeding activity recorded at Hillview; however, DEP depredated one mallard nest containing seven eggs in 2020 compared to five nests containing 20 eggs in 2019. There were five adult mallards depredated at Hillview in 2020. A USFWS Permit (MB789947-0) covered mallard and swallow depredation work at Hillview. DEP conducted 109 surveys for nesting mallards at Hillview Reservoir in 2020.

3.2. Kensico Reservoir

Kensico Reservoir, a terminal reservoir in the New York City Water Supply System, typically receives water from Rondout and West Branch Reservoirs via the Delaware Aqueduct and from the Ashokan Reservoir via the Catskill Aqueduct (Appendix B, Figures B.1 and B.2). Water from the Delaware Aqueduct can also be delivered through the Catskill Aqueduct by way of an interconnecting shaft (Shaft 4 Interconnection). Croton Falls and Cross River Reservoirs have the capacity to send water to Kensico via the Delaware Aqueduct during times of drought or other operational changes such as aqueduct shutdowns. The Aqueduct System is shown in Appendix B, Figure B.3. Water leaving Kensico is disinfected with chlorine and ultraviolet light prior to being delivered to Hillview Reservoir via the Delaware and Catskill Aqueducts.

Kensico Reservoir has been divided into eight geographic Bird Zones to compare bird counts and water quality in samples collected at limnological sampling locations. The geographic configuration of Kensico includes two main open water areas, one in Bird Zone 4 and one in Bird Zone 6 (Appendix B, Figure B.4). These open water areas tend to attract the highest concentrations of gulls and other waterbirds roosting overnight from late summer through early spring. Waterbird numbers at Kensico Reservoir remained consistently low throughout the reporting period because of continued implementation of the Waterfowl Management Program (Figure 3.1).

Prior to implementing an approved bird dispersal program, DEP began collecting reservoir-wide bird census data in August 1992. Overnight waterbird counts reached several thousand during the autumnal migratory and wintering periods (Figure 3.1) with high bird roosting counts recorded within the water intake coves at Kensico. Figure 3.1 shows a dramatic decline in waterbird counts from several thousand in 1992 and 1993 (prior to formal bird dispersal activities) to hundreds or less during the same migratory period in subsequent years and up through the present day when bird seasonal dispersal techniques were employed.

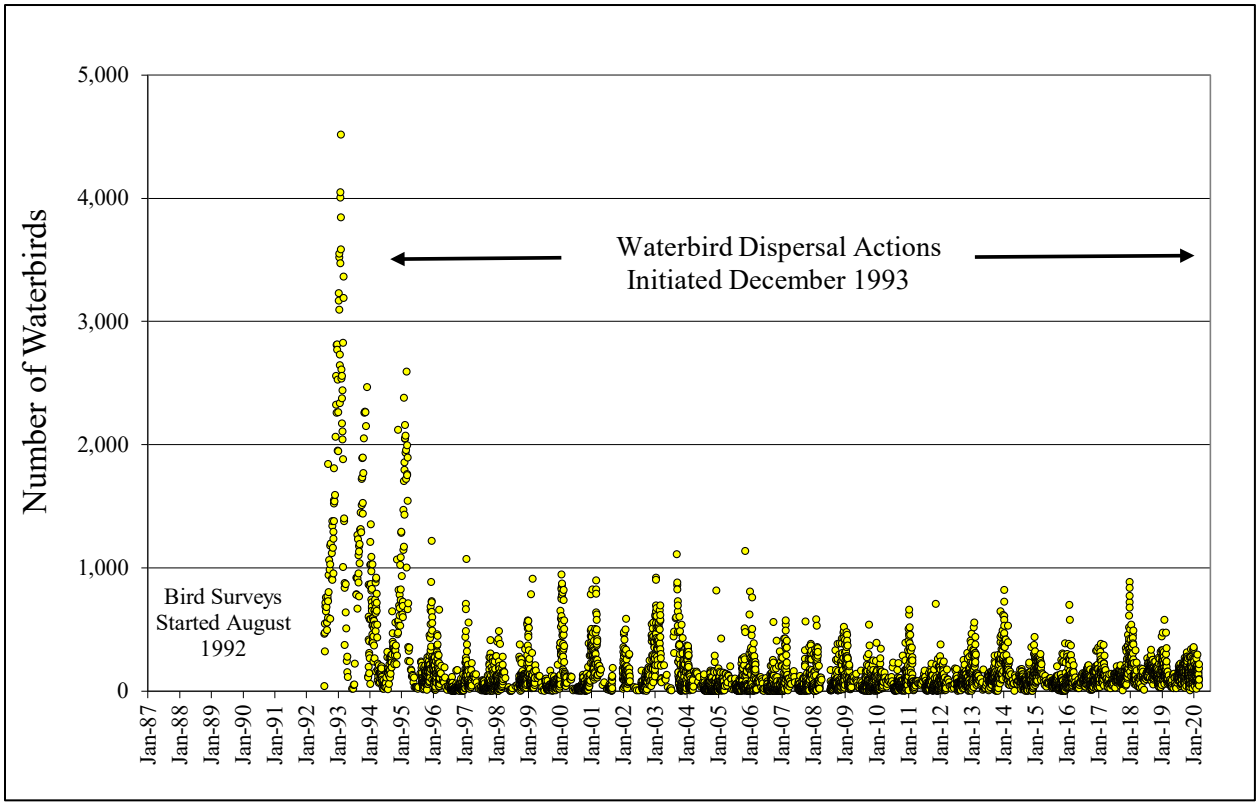

Figure 3.1. Kensico Reservoir waterbird totals.

Waterbird Monitoring

In 2019/2020, the DEP contractor attained 95% reportable data in completing reservoir-wide waterbird surveys. Approximately five percent of the surveys were deemed "no reportable data" due to inadequate bird observations from unsuitable environmental conditions (e.g., fog, snow, or rain). Reservoir-wide waterbird counts from August 1, 2019 to July 31, 2020 found in Figure 3.2 decreased slightly from previous reporting period averaging about 143 birds per survey night compared to 151 in the previous reporting period. Waterbird activity spiked at 355 (184 gulls, and 171 ducks) on January 30, 2020 compared to a high count of 579 in the previous reporting period. The seasonal high count of gulls at 245 was recorded on January 24, 2020.

In Bird Zone 2 (Figure 3.3), closest to Delaware Shaft 18 Effluent (DEL18DT), there were no observations of waterbirds on 229 of 238 reportable survey days (August 1 to March 31) or 96% of the time. The one-day high overnight count of 31 Canada geese observed on February 25, 2020 did not cause a fecal coliform bacteria elevation in Bird Zone 2. During the non-dispersal period from April 1, 2020 to July 31, 2020, waterbirds were observed in Zone 2 on only five of 34 occasions with a high count of six Canada geese and six ducks during the spring nesting season.

All birds observed in the water intake cove (Bird Zone 2) during the pre-dawn period (0500 hours) were immediately dispersed using motorboats or physical chasing from the shoreline. Increased spatial separation between birds and the water intake at Delaware Shaft 18 effluent at Kensico tends to be a factor that reduces fecal coliform bacteria, therefore bird dispersal activities were heavily concentrated in the vicinity of Delaware Shaft 18 and the lower main basin of Kensico (Bird Zones 2, 3, and 4, Appendix B, Figure B.4). DEP contractors demonstrated a greater degree of success deploying a combination of motorboats with pyrotechnics for bird dispersals.

Waterbird surveys in Bird Zone 3 (Figure 3.4), adjacent to the Bird Zone 2 cove revealed five occasions when birds were present out of 238 reportable survey days (2%) during the bird dispersal period from August 1, 2019 to March 31, 2020. A high count of nine ducks was recorded March 5, 2020. Zero bird counts in Bird Zone 3 were identified on 233 of the 238 surveys (98%) during the bird dispersal period.

Waterbirds tend to utilize expansive areas of open water found in Bird Zone 4 for nighttime roosting. Total waterbirds in Bird Zone 4 (Figure 3.5) represent 53% of the total birds on the reservoir including 76% of the gull that are observed. There were no reportable data on seven of the 244 or 3% of surveys conducted in Bird Zone 4 during the bird dispersal period (August 1, 2019 to March 31, 2020). The high count of waterbirds was recorded on October 30, 2019 when 253 waterbirds were observed roosting overnight. The total high count of 46 Canada geese was observed on December 3, 2019 and the high gull count was on December 15, 2019 at 219 gulls, neither of which coincided with elevated bacteria levels.

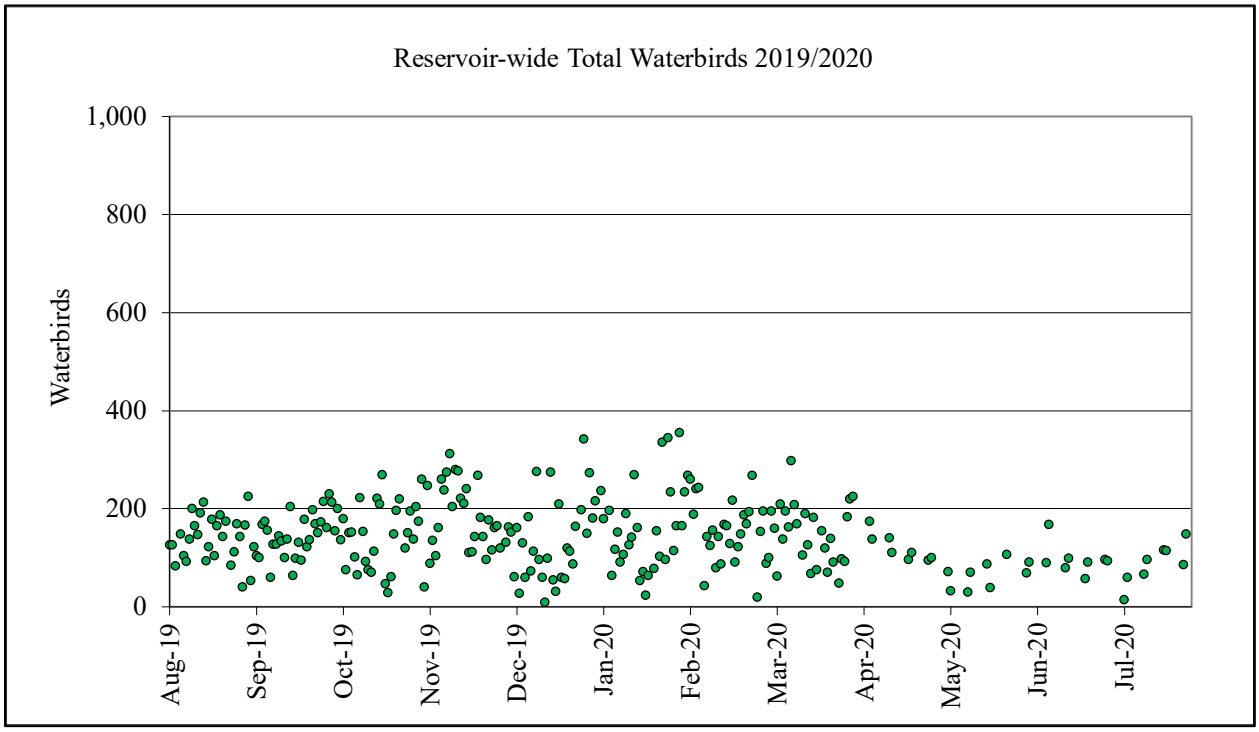

Figure 3.2. Kensico Reservoir total annual waterbirds (August 1, 2019 to July 31, 2020).

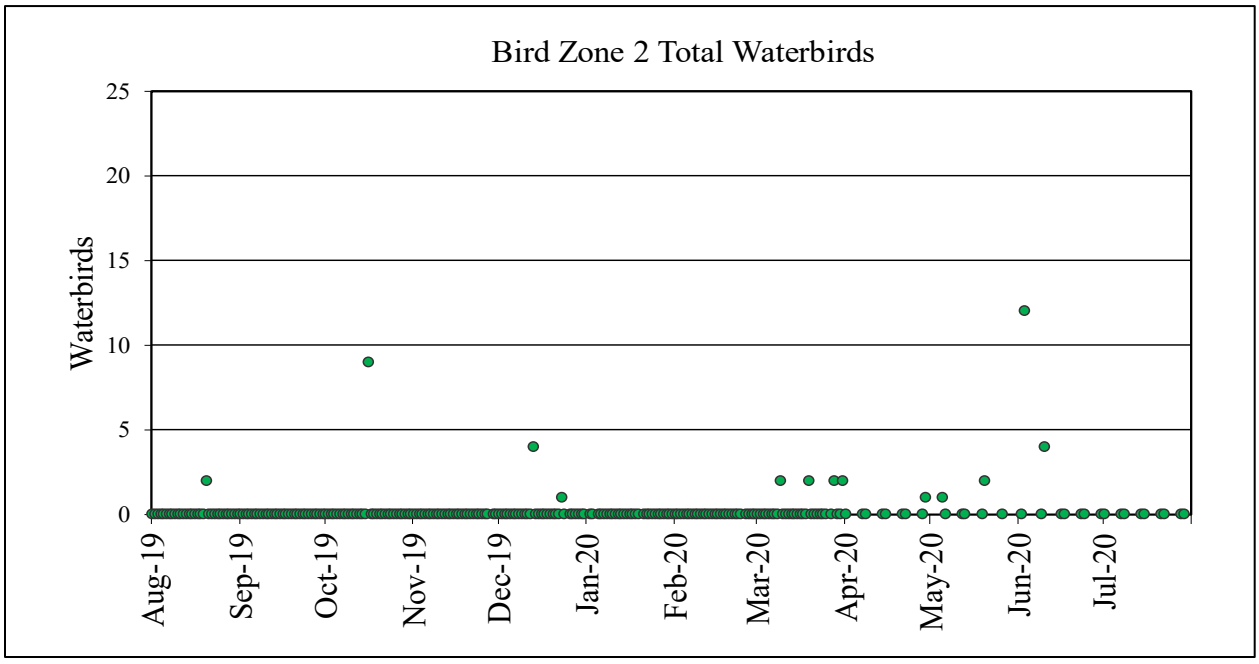

Figure 3.3. Kensico Reservoir bird zone 2 waterbirds (August 1, 2019 to July 31, 2020).

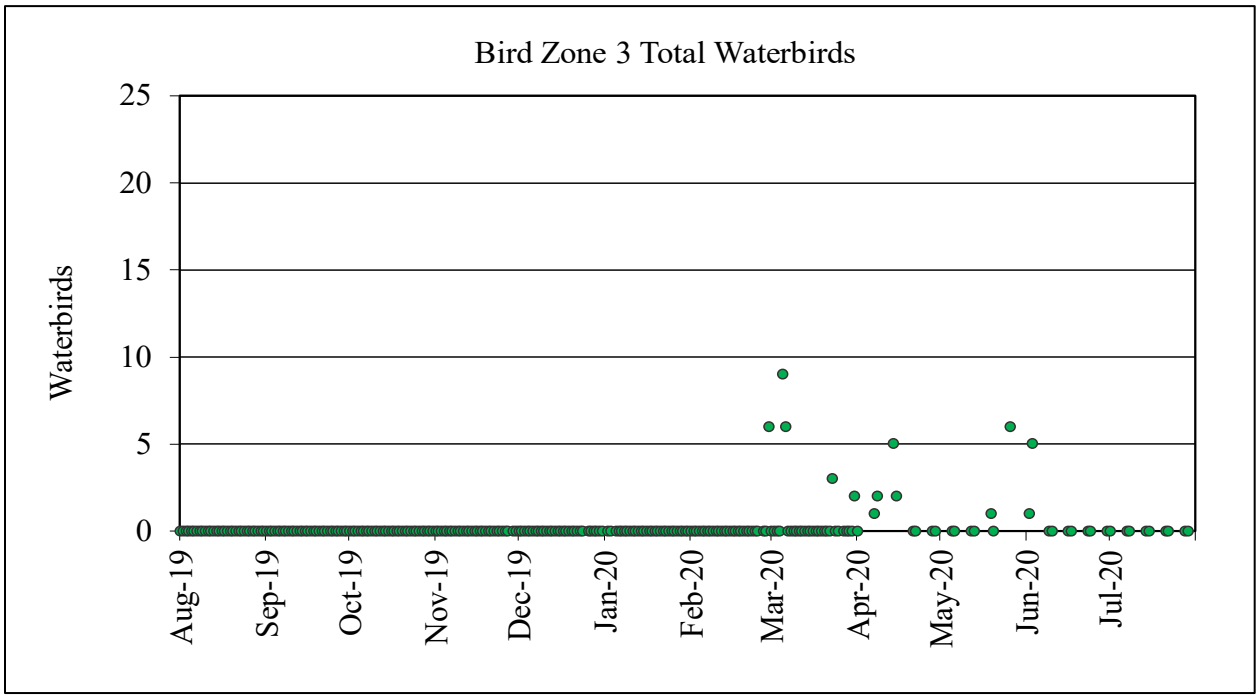

Figure 3.4. Kensico Reservoir bird zone 3 waterbirds (August 1, 2019 to July 31, 2020).

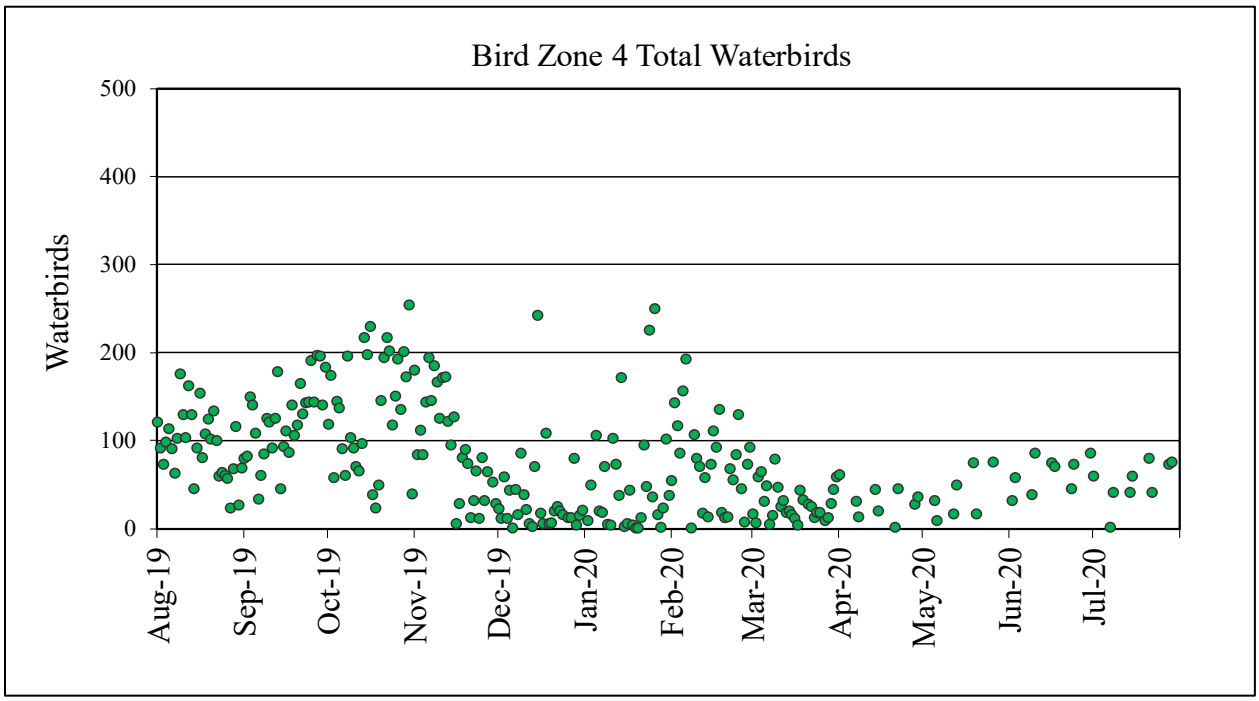

Figure 3.5. Kensico Reservoir bird zone 4 waterbirds (August 1, 2019 to July 31, 2020).

The incidence of specific groups of waterbirds continues to follow trends for annual migration and over-wintering patterns at Kensico (Figure 3.6). Winter waterbird roosting locations are generally determined by extent of ice-cover, however during the winter of 2019/2020, ice-cover was primarily absent. The first detection of ice was observed on December 20, 2019 with minimal periods of partial ice-cover throughout the season. These conditions allowed continuous motorboat operations for bird dispersal activities.

During the bird dispersal period from August 1 to March 31, ducks continued to be the most commonly observed bird group averaging 99 birds per night or 53% of the total counts, comparable to 102 birds per overnight count in 2018/2019. Gulls were the second most common group with an average nightly count of 46 birds (34%) comparable to 45 birds per night in 2018/2019. Geese were not observed on 148 out of 265 valid surveys. Of the 117 surveys when geese were observed, the average was 15, with a high of 84 and low of one. The daily average overnight count of Canada geese decreased to six birds (12%) in 2019/2020 compared to 16 birds/night in 2018/2019.

Throughout the non-dispersal period from April 1 to July 31, 2020, geese averaged 10 birds per night, gulls averaged 10 birds per night and ducks averaged 76 birds per night. Total average bird counts increased in 2019/2020 to 95 compared to 75 birds per night during 2018/2019 representing a 21% increase in bird activity reported at Kensico during the non-dispersal period.

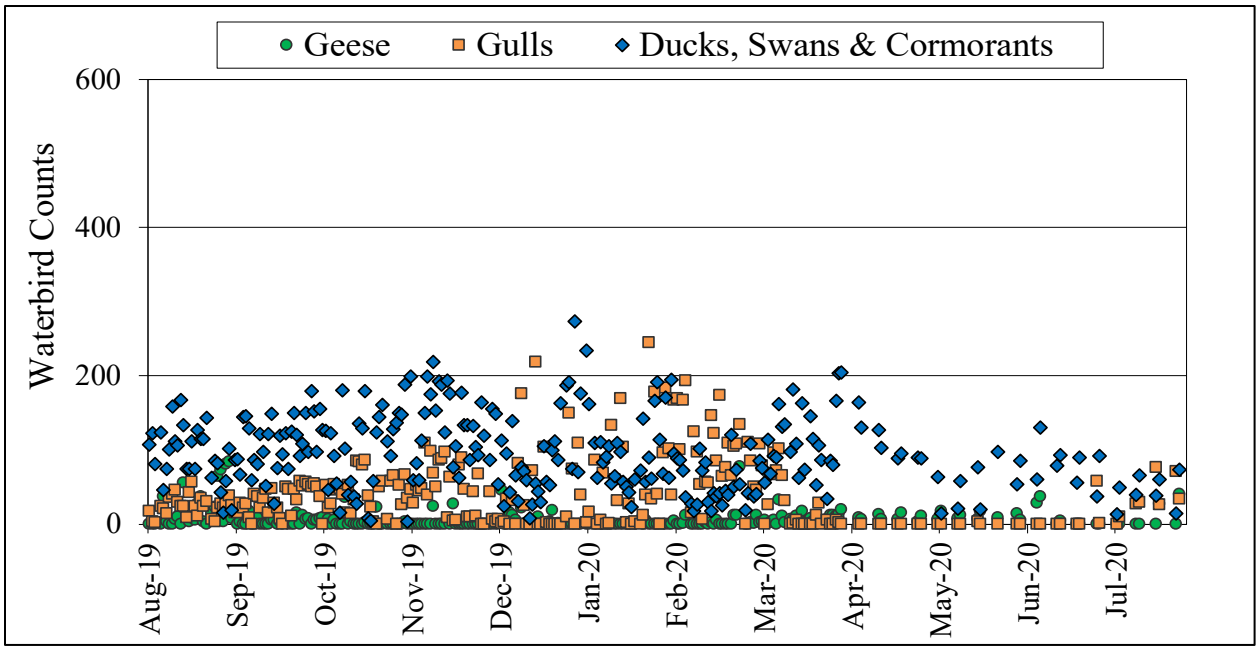

Figure 3.6. Kensico Reservoir bird guilds (August 1, 2019 to July 31, 2020).

The majority of the overnight bird roosting activity was observed at distances far from the effluent at DEL18DT water intake cove most of the reporting year. There was limited need for the operation of the two Biondo Airboats for bird dispersal activities due to a low incidence of ice-cover reported during this period.

Waterbird Dispersal Actions

Continuous waterbird monitoring and dispersal actions using motorboats combined with discharging pyrotechnics were the primary method for reducing waterbird numbers at Kensico in this reporting period Figure 3.7. Figure 3.8 is a view from the Kensico Reservoir Dam where waterbird surveillance and dispersal activities were coordinated on a daily basis by DEP Contractor staff. From the Kensico Dam, staff can monitor waterbird activity in bird zones 2, 3, and 4, closest to the DEL18DT water quality compliance sampling location and redirect watercraft to target rafting birds. Airboat usage was limited in 2019/2020 (Figure 3.9).

From August 1, 2019 through March 31, 2020 there were 18,557 waterbird dispersal action successfully dispersing 140,885 birds from the reservoir. Motorboat mitigation represented 69% of the dispersal actions followed by pyrotechnics at 27%. Of the waterbirds dispersed, 51% were gulls, 46% were ducks, and ~2% were geese. Overall the number of birds dispersed in 2019/2020 was up by approximately 17% when compared to the previous reporting year.

Figure 3.7. DEP contractors using motorboats and pyrotechnics to disperse waterbirds at Kensico. Photo by Chris Nadareski.

Figure 3.8. View from the Kensico Reservoir Dam where DEP contractor staff conduct waterbird surveys and dispersal actions discharging pyrotechnics. Photo by Chris Nadareski.

Figure 3.9. Biondo Airboats for bird dispersal activities at Kensico. Photo by Mike Reid.

Water Quality Summary

The WMP waterbird dispersal actions successfully reduced bird counts to a level that allowed DEP to continue to maintain compliance with the federal SWTR criteria for the fecal coliform bacteria parameter.

Figure 3.10 shows a long-term dramatic decline in fecal coliform bacteria simultaneous with the commencement of the bird dispersal efforts in December 1993, and this observation (or effect) continues through the present day. Prior to the inception of the waterbird dispersal efforts in 1992, DEP conducted intermittent bypass operations for Kensico Reservoir when fecal coliform bacteria elevations occurred. This generally coincided with the onset of waterbird migrations in month of October and remained elevated until reservoir icing occurred sometime in mid-winter. In recent years, there has only been one temporary period of elevated fecal coliform bacteria and that approached the SWTR compliance regulation. It occurred during the late summer and autumn of 2011 when southeastern NYS was impacted with back-to-back high precipitation storms, Tropical Storms Irene and Lee.

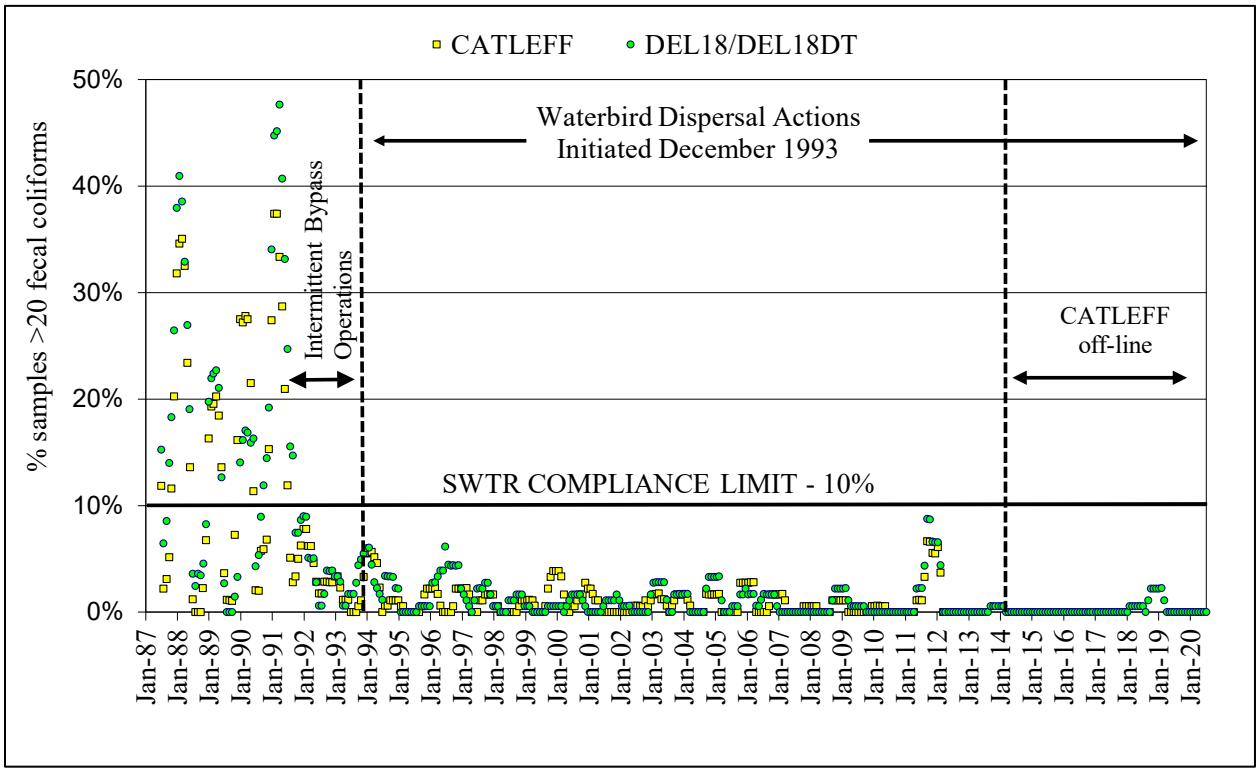

Figure 3.10. Kensico Reservoir Surface Water Treatment Rule compliance (fecal coliforms 100mL^{-1} at DEL18/DEL18DT/DEL18DTD and CATLEFF). Kensico sanitary surveys began in 2012. Non-detect fecal coliform are not presented.

Figure 3.11 graphic shows a basic association with elevated waterbird counts and slight increases in fecal coliform bacteria from August 2019 through mid-March 2020. The period from mid-March through the end of May 2020 fecal coliform counts declined similar to waterbird counts at the time when birds were departing from Kensico to northerly breeding grounds outside the watershed. During this period of reduced bird activity water quality samples were recorded as follows: 59 of 78 were non-detect, 14 of 78 were 1 fecal coliform 100mL^{-1}, four of 78 at 2 fecal coliform 100mL^{-1}, and one of 78 at 3 fecal coliform 100mL^{-1}. Waterbird counts remained very low with an average of 0.3 birds/successful survey at bird zone 2 closest to the water intake during this period.

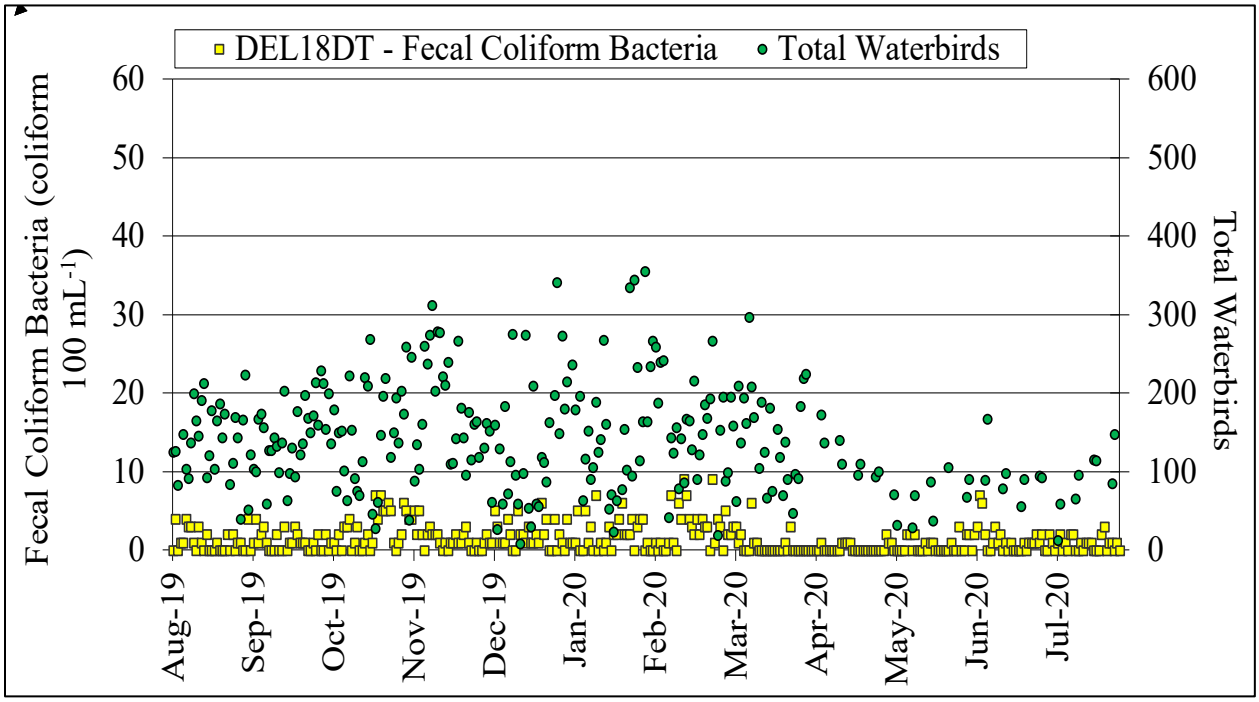

Figure 3.11. Kensico Reservoir fecal coliforms 100mL^{-1} at DEL18DT vs. total waterbirds (August 1, 2019 to July 31, 2020). Non-detect fecal coliform are not presented.

Table 3.1 lists the highest fecal coliform counts 100mL^{-1} recorded at DEL18DT in 2019/2020 in relation to precipitation events and waterbird counts. During this reporting period there were no fecal coliform bacteria elevations that exceeded 20 fecal coliform 100mL^{-1}. In comparison there were four samples above the regulatory limit in 2018/2019 which were likely associated with precipitation events (DEP 2019). In 2019/2020, only two of 366 water quality compliance samples reached an annual high count of nine fecal coliforms 100mL^{-1}. The February 13, 2020 water sample of 9 fecal coliforms 100mL^{-1} was likely associated with a precipitation event ranging from 0.9 to 1.11 inches recorded in the previous three days or longer

and when bird counts remained relatively low in the bird zones closest to the water intake. The two aqueduct discharge facilities (DEL17 and CATALUM), supplying approximately 98 percent of the water entering Kensico, had fecal coliform bacteria samples recorded at seven fecal coliforms 100mL^{-1} from the DEL17 facility and a non-detect recorded at the CATALUM facility on February 13. The second elevation of nine fecal coliforms 100mL^{-1} occurred on February 24, 2020 had no associated precipitation event and waterbird counts in the bird zones closest to the water intake remained relatively low at 83 with no birds reported in the intake cove. The DEL17 water sample was recorded at one fecal coliform 100mL^{-1} and a non-detect sample at the CATALUM facility.

Table 3.1. Highest fecal coliform 100mL^{-1} results at DEL18DT / DEL17, and CATALUM water sampling locations, precipitation events, and bird counts at Kensico Reservoir.

Bacterial Reported Sample Date	DEL18DT / DEL17 / CATALUM fecal coliform 100mL^{-1} (E = estimated count based on non-ideal plate)	Precipitation within 3 days of elevated fecal coliform fecal coliform 100 mL^{-1} (inches rounded to the nearest 100th)		Bird Counts on or before sample bacterial sample date	
		Westchester County[1]	DEP Kensico Reservoir[2]	Reservoir-wide totals	Bird Zones 2, 3, and 4 totals
2/13/20	E9 / E7 / <1	1.11	0.9	142 on 2/13/20	57 on 2/13/20
2/24/20	E9 / E1 / <1	0	0	193 on 2/24/20	83 on 2/24/20

[1] Precipitation data reported from Westchester County Airport, White Plains, New York
[2] Precipitation data reported from DEP Kensico Reservoir (Shaft 18), Valhalla, New York

The five highest precipitation events recorded at the Westchester County Airport and the Kensico Met Station are listed in Table 3.2. Events October 17, 2019 and October 28, 2019 were associated with slight elevations in fecal coliform counts at the DEL17 water Influent facility of 16 and eight fecal coliforms 100mL^{-1}, respectively. Waterbird counts of 200 in bird zone 4 were recorded on October 28, 2019 including 53 gulls and 147 ducks observed distant from the water intake. The remaining three elevated precipitation events in December 2019 and April and July 2020 did not have an associated fecal coliform elevation and bird counts remained relatively low with no waterbirds observed in the DEL18 water intake cove.

One hundred and fifty one out of 366 (41%) fecal coliform samples recorded at DEL18DT were non-detect (below the detection limit of one fecal coliform 100mL^{-1}) compared to 36% of the samples recorded in 2018/2019. In 2019, a coliform-restricted assessment based

on compliance of the SWTR for Kensico Reservoir determined that the basin status was 'non-restricted', as was the case in 2018 (DEP 2019). Non-detect fecal coliform counts during the waterbird dispersal period from August 1, 2019 through March 31, 2020 comprised 34% of the samples compared to 41% non-detect counts throughout the annual reporting period of August 1, 2019 through July 31, 2020. Fecal coliform counts of less than or equal to five fecal coliforms $100mL^{-1}$ represented 96% of the annual samples. Fifteen fecal coliform samples collected at DEL18 ranged from six to nine fecal coliforms $100mL^{-1}$.

Table 3.2. Highest precipitation events, fecal coliform $100mL^{-1}$ results at DEL18DT / DEL17, and CATALUM water sampling locations, and bird counts at Kensico Reservoir.

Bacterial Reported Sample Date	DEL18DT / DEL17 / CATALUM fecal coliform $100mL^{-1}$ (E = estimated count based on non-ideal plate)	Precipitation (inches)		Bird Counts on or before sample bacterial sample date	
		Westchester County[1]	DEP Kensico Reservoir[2]	Reservoir-wide totals	Bird Zones 2, 3, and 4 totals
10/17/2019	E7 / 16 / E1	2.56 on 10/16/2019	3.27 on 10/16/2019	38 on 10/17/2019	46 on 10/17/2019
10/28/2019	E6 / 8 / <1	2.3 on 10/26 – 10/27/2019	1.93 on 10/26 – 10/28/2019	203 on 10/28/2019	200 on 10/28/2019
12/14/2019	E1 / E1 on 12/13/2020 / ND[3]	3.57 on 12/9 – 12/14/2019	3.08 on 12/9 – 12/14/2019	98 on 12/14/2019	70 on 12/14/2019
4/14/2020	E1 / E2 / E1	2.58 on 4/13/2020	2.31 on 4/13 – 4/14/2020	137 on 4/8/2020	44 on 4/14/2020
7/9/2020	E1 / <1 / <1	1.68 on 7/8 – 7/11/2020	2.55 on 7/9 – 7/11/2020	59 on 7/8/2020	40 on 7/8/2020

[1] Precipitation data reported from Westchester County Airport, White Plains, New York
[2] Precipitation data reported from DEP Kensico Reservoir (Shaft 18), Valhalla, New York
[3] ND = No data collected

Figure 3.12 compares the regulatory source water samples collected from Delaware Shaft 18 (DEL18DT) with respect to fecal coliform bacteria and reservoir bird counts for the 2019/2020.

It is expected that fecal coliform bacteria levels could be a magnitude higher without implementation of the daily waterbird dispersal activities. Prior to the start of the waterbird

dispersal program dating back to the early 1990s, waterbird counts in bird zone 2 closest to the DEL18DT sampling site ranged from several hundred to a high of 1,439 on February 19, 1993 causing DEP to bypass Kensico Reservoir for flow-through operations due to high fecal coliform levels. The present day low waterbird counts closest to the water compliance sampling station at DEL18DT are directly attributed to the daily bird dispersal activities and bypass options for fecal coliform management is no longer necessary.

There are approximately 30 perennial and intermittent streams that discharge into Kensico Reservoir representing about 2% of the annual total water volume. Approximately 98% of the source water to Kensico is from the two upstate aqueducts. Figure 3.12 compares the fecal coliform bacteria levels entering the reservoir at the DEL17 water sampling location with those leaving through the DEL18DT sampling location.

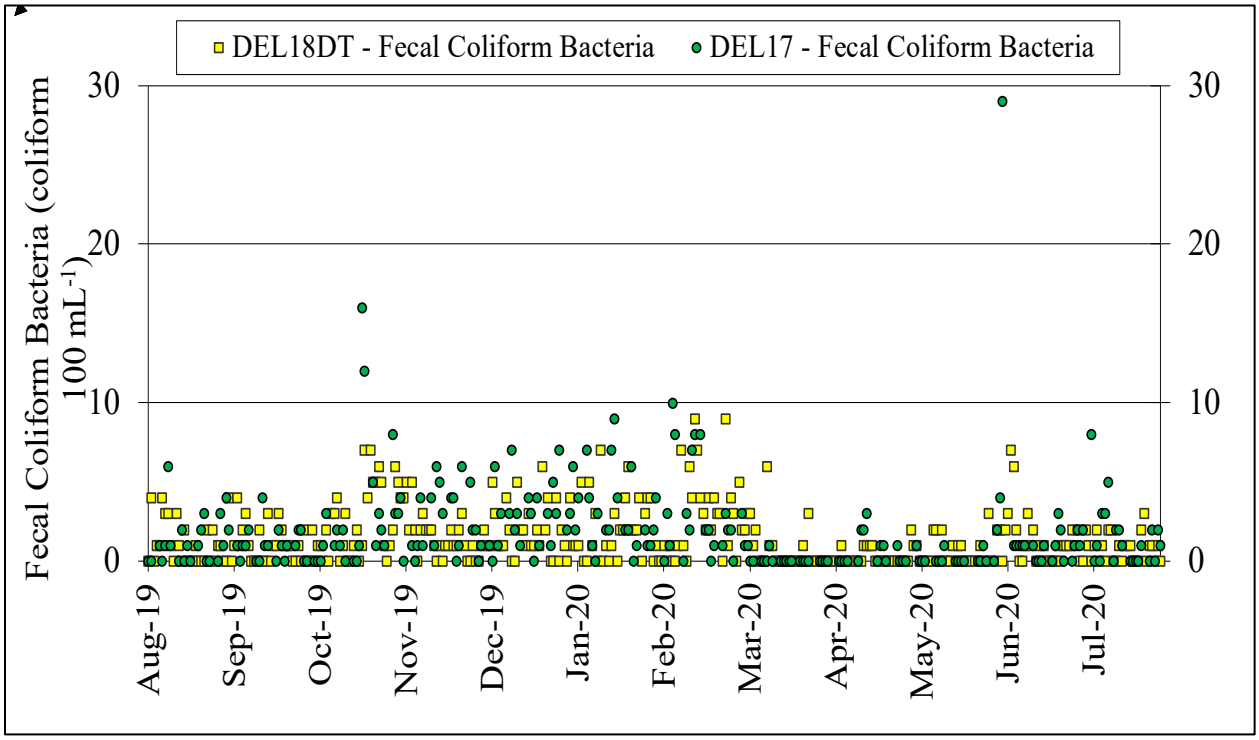

Figure 3.12. Comparison of fecal coliform bacteria 100mL^{-1} levels at the DEL17 Influent entering the reservoir and DEL18DT Effluent leaving the reservoir.

There appears to be a relationship of slightly elevated fecal coliform bacteria entering Kensico from the Delaware Aqueduct (DEL17) with the bacteria levels leaving Kensico at the DEL18DT sampling location. The Delaware Influent at DEL17 receives water from the Rondout Reservoir in Sullivan and Ulster Counties and depending on water flow operations receives water from the West Branch Reservoir in Putnam County.

Figure 3.13 compares the fecal coliform bacteria levels entering the reservoir from the Catskill Aqueduct at the sampling location CATALUM with those leaving through DEL18DT. There are coincidental elevations of fecal coliform bacteria between the Catskill CATALUM sampling location and DEL18DT during the autumn and late spring periods. The Catskill Aqueduct receives water from the Ashokan Reservoir in Ulster County.

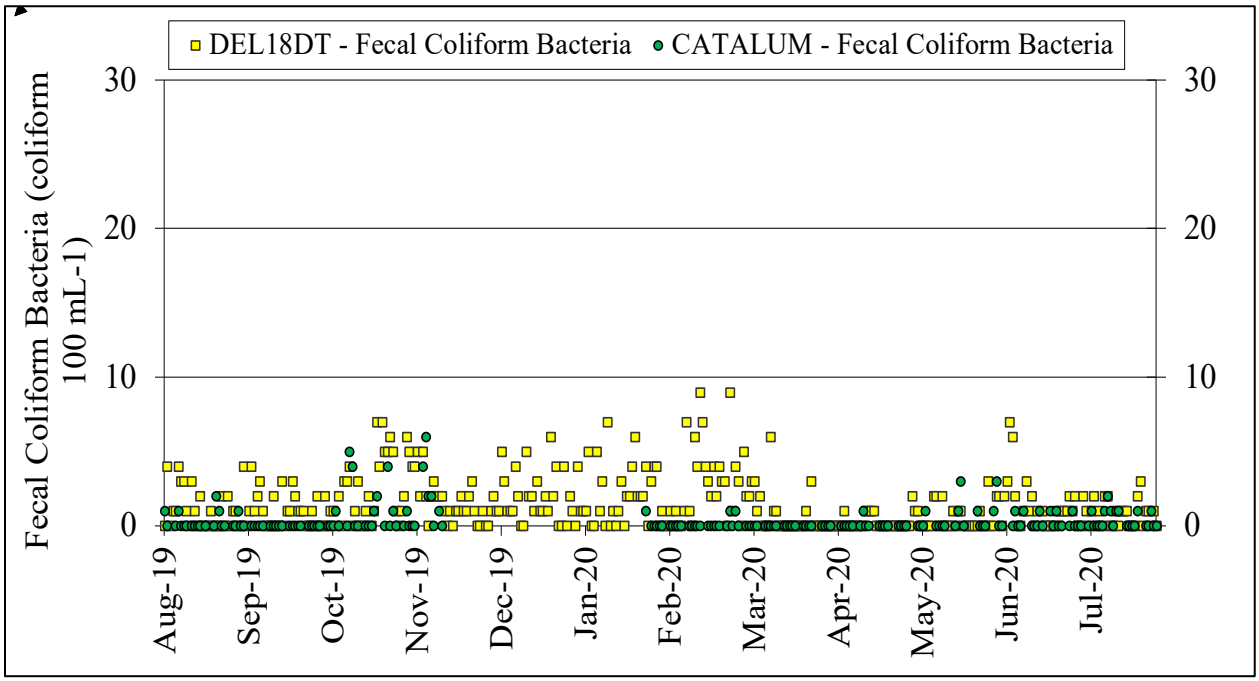

Figure 3.13. Comparison of fecal coliform bacteria 100mL^{-1} levels at the CATALUM Influent entering the reservoir and DEL18DT Effluent leaving the reservoir.

Nest and Egg Depredation

In the spring of 2020, a total of 12 Canada goose nests were found along the reservoir shoreline and on islands compared to 20 in 2019 (Appendix A, Table A1); a 40% decrease in nesting activity. Fifty-three eggs were depredated and placed back in the nests to allow the geese to continue to incubate in comparison to 79 eggs in 2019 (Figure 3.14). The average number of eggs per nest in 2020 was 4.6, as compared to 4.2 in the previous year. Three goslings were observed in 2020 compared to four reported in the previous year, rendering the egg depredation success at 95% in 2020. Adult breeding geese or failed breeders generally disperse from the reservoir prior to the post-breeding season molt, which begins in June (annually). Canada geese that do remain at Kensico during the molt period were subject to removal through depredation by the Westchester County Airport contract for air-traffic safety measures.

One mute swan nest was observed at Kensico in 2020. One of the adult pair was found dead in the nest suspected from coyote predation which reduced the seasonal need to addle eggs after the initial site visit. There were no double-crested cormorant nests observed at Kensico during the 2020-nesting season.

Figure 3.14. Female Canada goose incubating eggs and nest with eggs labeled for depredation on an island nest. Photos by Chris Nadareski.

Waterbird Deterrence

Baitfish including mostly alewives transported through upstate aqueducts to Kensico were not observed during the autumn/winter period of 2019/2020 similar to the 2018/2019 season. When present, the dead and dying Alewives typically attract foraging gulls and diving ducks. A surface retention boom is normally placed around the Catskill Influent Chamber (CATIC) to concentrate the baitfish and allow for easy collection and disposal but in 2019/2020 was not possible due to ongoing construction at the Catskill Influent Chamber.

Figure 3.15 demonstrates a bird deterrent technique DEP with netting installed at the DEL18DT sampling facility intake openings to prevent terrestrial bird species such as swallows, pigeons, starlings, and sparrows from nesting inside the effluent facility. Weekly inspections are conducted to maintain the integrity of the bird deterrent netting.

Figure 3.15. Bird deterrent netting maintained on the waterside of Shaft 18 at Kensico to prevent swallows, pigeons, and sparrows from nesting inside the structure. Photo by Chris Nadareski

Depredation

The Westchester County Airport (HPN), located immediately east of the Rye Lake area at Kensico (Bird Zone 6 in Appendix B, Figure B.4) manages birds and other wildlife for air-traffic safety both on-airport and at off-airport locations. Waterbird activity at the Kensico Reservoir poses high risk to aircraft. DEP continued to maintain routine communication with airport officials and participated with the airport's Wildlife Hazard Bird Strike Task Force to stay apprised of any changes in bird management activities conducted at the reservoir. DEP's bird management activities incorporate safety guidelines for waterbird dispersal activity to prevent birds from crossing the flight paths of arriving and departing aircraft at HPN (Figure A.4). DEP bird dispersal crews abstain from discharging pyrotechnics when aircraft are approaching and departing to avoid potential airstrikes with birds and pilot confusion with the use of aerial low-grade explosives (pyrotechnics).

DEP participated in the annual review of the airport's Wildlife Hazard Management Plan for air-traffic safety. HPN is tasked with the implementation of an Airport Depredation Order for resident Canada goose nest and egg depredation (50 CFR 12.50) and a Control Order for resident Canada geese at airports and military airfields (50 CFR 12.49). HPN has contracted

with USDA, Animal Plant Health Inspection Services, Wildlife Services to manage wildlife species, including the depredation of geese at select off-airport properties within a 7-mile radius that includes all of the Kensico Reservoir. During this reporting period, DEP allowed USDA personnel under contract with the HPN to access City-owned property at Kensico Reservoir to survey and conduct depredation activity for nesting geese. In 2020, early spring survey results generated a request to depredate and remove nesting Canada geese that demonstrate high nest site fidelity. On April 16, 2020, a USDA biologist removed seven adult geese. USDA conducted a follow-up visit on June 22, 2020 during the annual goose molt period and removed an additional five geese on Westchester County property along Kensico Reservoir.

Wildlife Excrement Sanitary Surveys

To prevent wildlife excrement from being washed into the reservoir in close proximity to the water intake, sanitary surveys were conducted when substantial precipitation events were predicted. In 2019/2020 DEP Wildlife Studies and contractor staff conducted 19 wildlife sanitary surveys adjacent to the Delaware Shaft 18 effluent. All wildlife excrement samples were identified to species, and disposed of off reservoir property. White-tailed deer are commonly observed around Kensico Reservoir (Figure 3.16).

Figure 3.16. White-tailed deer were commonly observed at Kensico. Deer scat was collected in advance of precipitation events near the DEL18DT sampling location.

Table 3.3 shows a significant collection of Eastern Cottontail Rabbit excrement samples collected near the DEL18DT sampling location on February 24, 2020. Rabbit feces were prevalent from October through February. Overall, 380 wildlife excrement samples were collected during this reporting period. Eastern cottontail rabbit, Canada goose, passerine birds, and white-tailed deer feces were found in the highest concentrations on the sanitary surveys.

Table 3.3. Wildlife sanitary surveys conducted adjacent to DEL18DT Effluent.

Date of Survey	White-tail Deer	Raccoon	Eastern Cottontail Rabbit	Canada goose	Coyote/ Fox	Striped Skunk	Passerine (birds)	Meadow Vole	Other/Unknown Mammal	Total (all species)
10/7/19	1	1	4	0	0	0	0	0	0	**6**
10/15/19	2	2	0	0	0	0	0	0	1	**5**
10/30/19	3	0	1	0	0	0	5	0	0	**9**
11/22/19	6	0	8	0	0	0	0	0	1	**15**
11/29/19	0	0	6	0	0	0	0	0	0	**6**
12/8/19	6	0	16	0	0	1	0	1	0	**24**
12/13/19	0	0	9	0	0	0	0	0	1	**10**
12/28/19	2	0	24	0	1	0	0	1	0	**28**
1/24/20	0	0	16	0	0	0	0	0	1	**17**
2/11/19	1	0	1	0	1	0	0	0	0	**3**
2/24/20	0	2	132	0	1	0	0	1	0	**137**
3/12/20	3	0	1	0	0	0	1	0	2	**7**
3/27/20	1	0	0	0	0	0	0	0	0	**1**
4/8/20	1	0	0	0	0	0	18	0	1	**20**
4/22/20	0	0	0	0	0	0	3	0	0	**3**
4/29/20	0	0	0	0	1	0	17	0	1	**18**
6/10/20	4	0	0	63	0	0	0	0	1	**68**
7/7/20	2	0	0	0	0	0	0	0	0	**2**
7/21/20	0	0	0	1	0	0	0	0	0	**1**
Total by Species	**32**	**5**	**218**	**64**	**4**	**1**	**44**	**3**	**9**	**380**

Figure 3.17 shows coyote scat identified and subsequently removed from the grounds surrounding the Delaware Effluent facility. Of the 380 excrement samples collected only 9

could not be confirmed to species level.

Figure 3.17. Coyote scat.

Endangered Species Compliance

In the spring of 2020, DEP reconfirmed a nesting pair of bald eagles on the eastern side of Kensico Reservoir within ½ mile of the Westchester County Airport. Under federal (USFWS) and state (NYSDEC) guidance for the protection of nesting bald eagles, DEP maintained protective compliance by means of restrictions on waterbird management activities. This guidance limited work activity within a 660' protection buffer around the eagle's nest. Under federal and state guidelines DEP was required to avoid discharging pyrotechnics within a ½-mile buffer radius of the nest so as not to disturb the eagles from January 1 through September 30. The 660' eagle protective buffer zone does not extend into the reservoir, so all dispersal activities using boating operations were allowed to continue. DEP also maintained direct communication with the NYSDEC and HPN officials and their contractor (USDA Wildlife Services) regarding the status of the nesting eagles.

The ongoing implementation of the WMP has been critical in allowing DEP to maintain compliance with the SWTR criteria for fecal coliform bacteria at Kensico dating back to 1993 and throughout the 2019/2020 reporting period.

3.3. West Branch Reservoir

The 2017 FAD lists West Branch Reservoir as one of five reservoirs covered under the "as needed" criteria for waterbird management. Since the implementation of the WMP program, only two "as needed" actions have been implemented at West Branch.

Waterbird Monitoring

West Branch Reservoir is divided into four bird survey zones that are associated with reservoir water quality sampling locations (Appendix B, Figure B.5). Migratory and wintering waterbird populations at West Branch were surveyed biweekly from August 1, 2019 through April 15, 2020 (Figure 3.18) to record annual trends that aid in identifying sources of elevated fecal coliform bacteria levels. In 2019, overnight surveys from August through early November, waterbird counts ranged from three to 110 birds. During the mid-November through mid-April, migratory and wintering waterbird counts of mostly duck species gradually increased from 324 recorded on November 15, 2019 to a peak of 2,583 on February 18, 2020. Total waterbird counts decreased to 371 on March 6, 2020 and continued to decline into the early spring as many of the birds dispersed to the northerly breeding locations outside the watershed. Gulls peaked at 46 on January 24, 2020 and were only present on four of 18 reportable surveys. Canada geese peaked at 46 on August 9, 2019 and again on January 24, 2020 with a count of 43. Waterfowl, mostly ducks (mallards and common mergansers) were present on all 18 surveys and peaked at 2,560 on February 18, 2020.

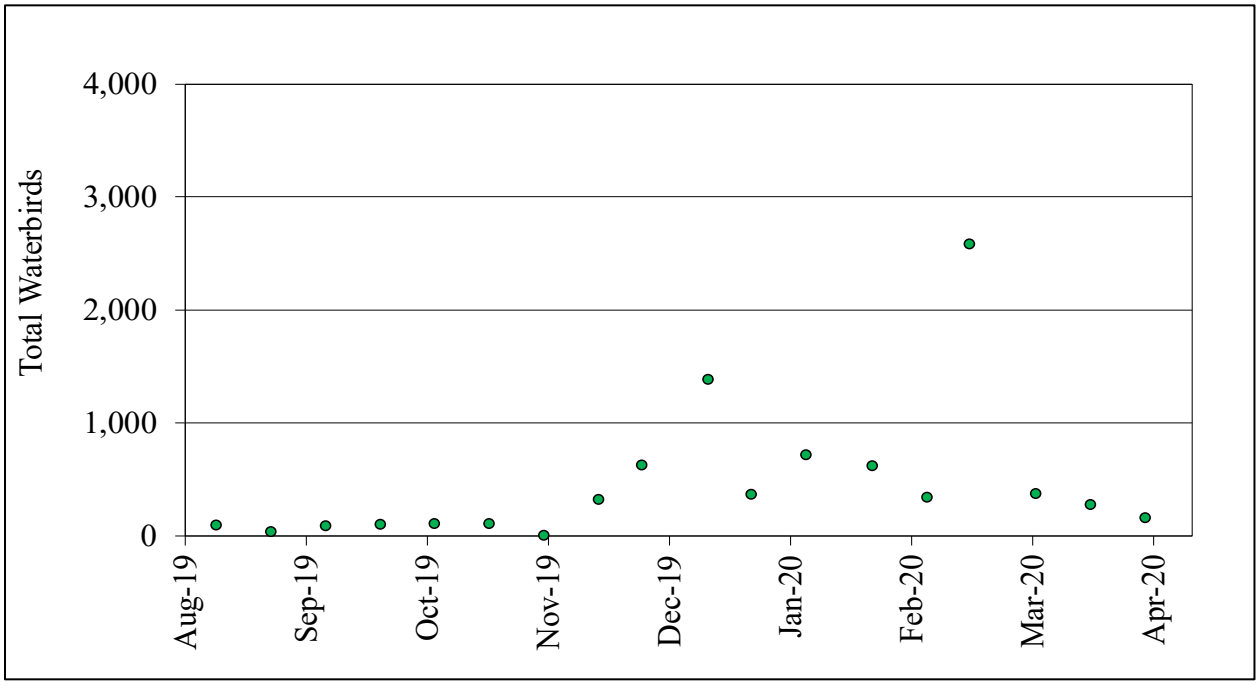

Figure 3.18. West Branch Reservoir total waterbirds (August 1, 2019 to July 31, 2020).

Waterbird Dispersal Actions

Based on the 2017 FAD criteria requirements for West Branch, DEP was not required to conduct waterbird dispersal actions during this reporting period. DEP's requirement under the 2017 FAD uses criteria list in Table 1.1. The primary trigger to implement "as needed" bird dispersal actions are fecal coliform bacteria concentrations, which DEP determined there was no need to take action during the reporting period.

Water Quality Summary

Two fecal coliform bacteria counts were recorded above 20 fecal coliforms 100mL^{-1} in samples collected from the in-reservoir sampling site CWB1.5 from August 1, 2019 through July 31, 2020 (Figure 3.19). Of 252 water samples collected over the period from August 1, 2019 to July 31, 2020, 60% (151) were non-detect for fecal coliform bacteria. For comparison, Figure 3.20 shows fecal coliform bacteria over the previous five years near the Delaware Shaft 10 (CWB1.5 sampling location) intake.

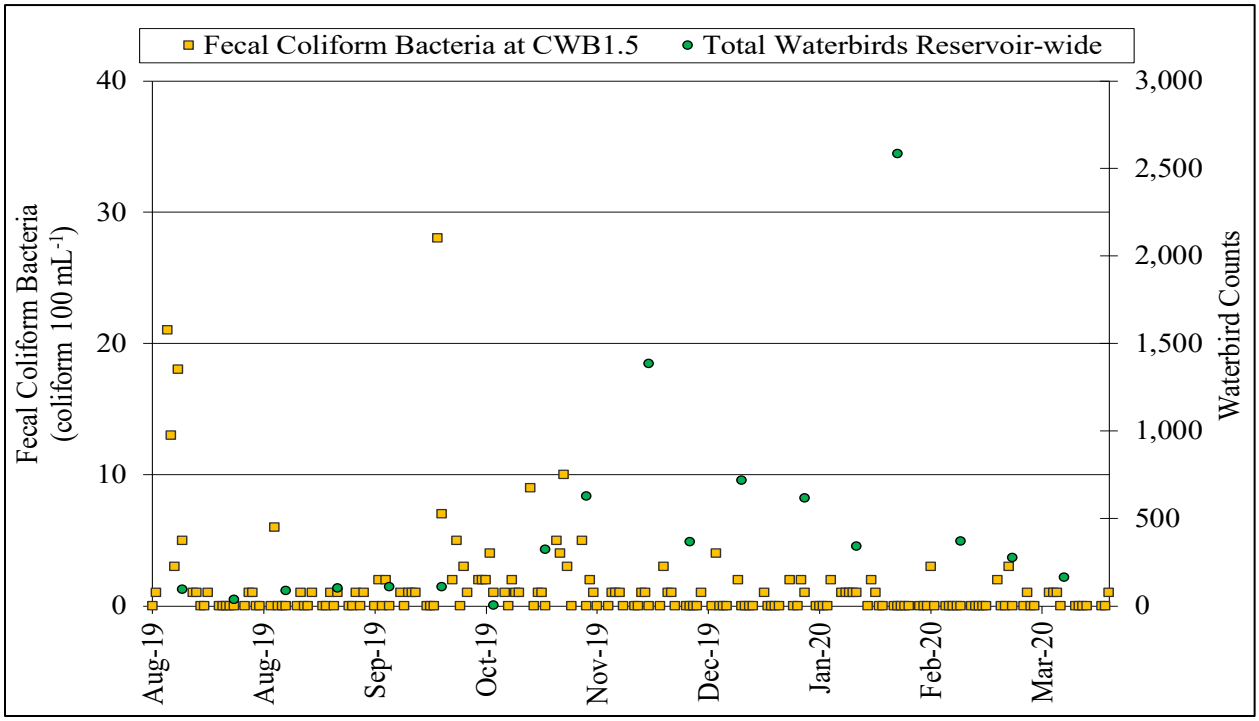

Figure 3.19. West Branch Reservoir fecal coliforms 100mL^{-1} at CWB1.5 vs. total waterbirds (August 1, 2019 to July 31, 2020). Non-detect fecal coliform are not presented.

In 2019, a coliform-restricted assessment based on compliance of the SWTR for West Branch Reservoir determined that the basin status was 'non-restricted'.

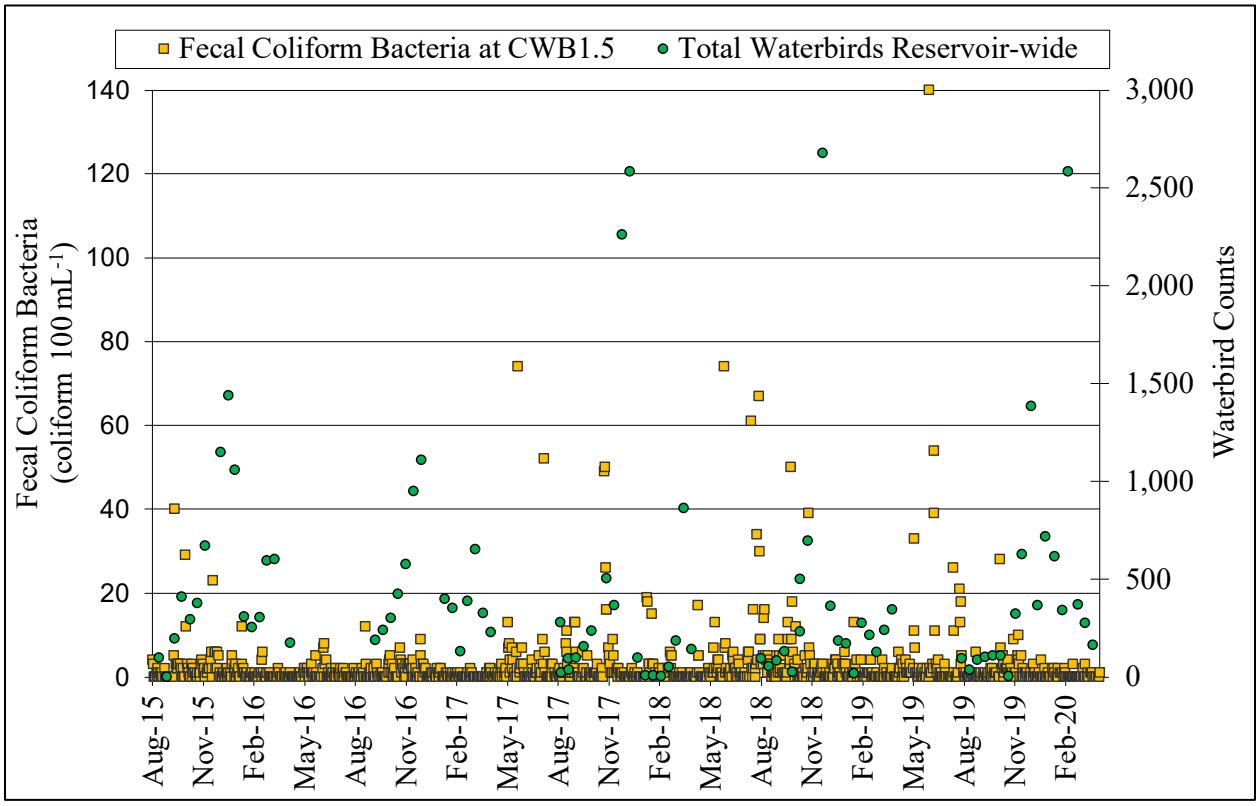

Figure 3.20. West Branch Reservoir fecal coliforms 100mL^{-1} at CWB1.5 vs. total waterbirds August 1, 2015 to July 31, 2020). Non-detect fecal coliform are not presented.

Additional Surveys

Additional daytime bird observations (un-aided eye) were conducted by DEP Water Quality Aqueduct Monitoring staff during routine site visits for water quality sampling. The dates, times and counts when birds were observed at the West Branch Effluent (Delaware Shaft 10, Figure 3.21) are listed in Table 3.4. Thirty-seven out of 52 observations or 71% of the observations were reported as "with birds present during the midday period".

Table 3.4. West Branch Reservoir - daytime bird detections at Delaware Shaft 10 (DEL10).

Date	Time of Observation	Bird Count Range or Actual Bird Counts
08/21/19	09:36	1-50
09/18/19	10:16	1-50
09/25/19	10:38	1-50
10/02/19	10:55	1-50
10/15/19	10:40	1-50
10/16/19	11:31	1-50
12/04/19	11:04	1-50
12/11/19	11:17	1-50
12/25/19	10:42	1-50
01/02/20	11:21	1-50
01/08/20	10:38	1-50
01/22/20	10:20	1-50
01/29/20	09:54	1-50
02/07/20	11:33	1-50
02/12/20	10:32	1-50
03/04/20	11:03	1-50
03/11/20	11:25	1-50
03/18/20	11:05	1-50
04/01/20	10:14	1-50
04/08/20	10:55	1-50
04/22/20	10:38	1-50
04/29/20	10:25	1-50
05/05/20	09:11	1-50
05/06/20	11:09	1-50
05/13/20	09:56	1-50
05/19/20	10:25	1-50
05/20/20	09:54	1-50
06/03/20	10:02	1-50
06/17/20	10:48	1-50
06/24/20	11:11	1-50
07/01/20	10:25	1-50
07/08/20	10:45	1-50
07/14/20	10:18	1-50
07/15/20	10:32	1-50
07/22/20	10:53	1-50
07/28/20	10:42	1-50
07/29/20	10:06	1-50

Figure 3.21. West Branch DEL10 Effluent facility. Photo by Chris Nadareski.

Nest and Egg Depredation

DEP conducted reproductive control on nesting Canada geese from April 1 through May 31, in 2020 to eliminate hatch success at West Branch Reservoir. Springtime searches for nesting geese include the dams and release channels below the dams (Figure 3.22). In 2020, six nests with 26 eggs were depredated compared to eight nests and 35 eggs depredated in 2019 (Appendix A, Table A1). Egg depredation efforts were deemed 96% successful with one gosling that hatched. There were no mute swans or double-crested cormorants observed nesting at West Branch during the spring of 2020.

Deterrence

DEP continued to inspect and maintain netting that was installed on the West Branch shaft building intake openings to deter terrestrial bird nesting and roosting. DEP determined that there was no need for maintenance during this reporting period. The bird exclusionary netting targeted barn swallows, cliff swallows, rock pigeons, house sparrows, and European starlings.

Figure 3.22. Canada goose nest below West Branch Dam. Photo by M. Reid.

Endangered Species Compliance

There was one active bald eagle nest at West Branch during the 2020 nesting season. DEP conducted bald eagle (*Haliaeetus leucocephalus*) nest site monitoring and maintained full compliance with a protection plan as required by the NYSDEC and USFWS in preparation for any "as needed" bird dispersal activity as stated in the Findings Statement of the Environmental Impact Statement (N.Y.S. Environmental Conservation Law, Art. 8 (§8101 et seq.)) on file.

3.4. Rondout Reservoir

Rondout Reservoir is a terminal source water reservoir to both Kensico and West Branch Reservoirs. Located west of the Hudson River, Rondout is part of the Delaware Aqueduct System. The Rondout Reservoir is divided into nine bird zones (Appendix B, Figure B.6). The 2017 FAD lists Rondout as one of five reservoirs covered under the "as needed" criteria for Waterfowl Management. Since the inception of the WMP, only three "as needed" actions have been implemented at Rondout, the last being in 2006.

Waterbird Monitoring

Based on the 2017 FAD criteria requirements for Rondout, DEP did not conduct overnight waterbird surveys during this reporting period.

Waterbird Dispersal Actions

Based on the 2017 FAD criteria requirements for Rondout, DEP did not conduct waterbird dispersal actions during this reporting period. In the event bird dispersal actions were required, DEP would implement a program using contractor personnel to reduce waterbird numbers to eliminate any water quality threat. The Rondout Effluent Chamber (Figure 3.23) would normally be the site where mitigation of waterbirds occur.

Figure 3.23 Rondout Reservoir Effluent Chamber. Photo by Chris Nadareski

Water Quality Summary

In 2019/2020, there were no bacteria counts above 20 fecal coliforms 100mL^{-1} in samples collected from the Rondout Effluent Chamber (Figure 3.24). Of 211 water samples collected over the period from August 1, 2019 to July 30, 2020, no fecal coliform bacteria were detected in 107 (51 percent) of the samples.

Figure 3.24 demonstrates long-term low-level seasonal elevations in fecal coliform bacteria that begin in the autumn and continue through part of the winter when the reservoir remains free of ice, which offers waterbird overnight roosting opportunities.

In 2019, a coliform-restricted assessment determined that the Rondout basin status was 'non-restricted'.

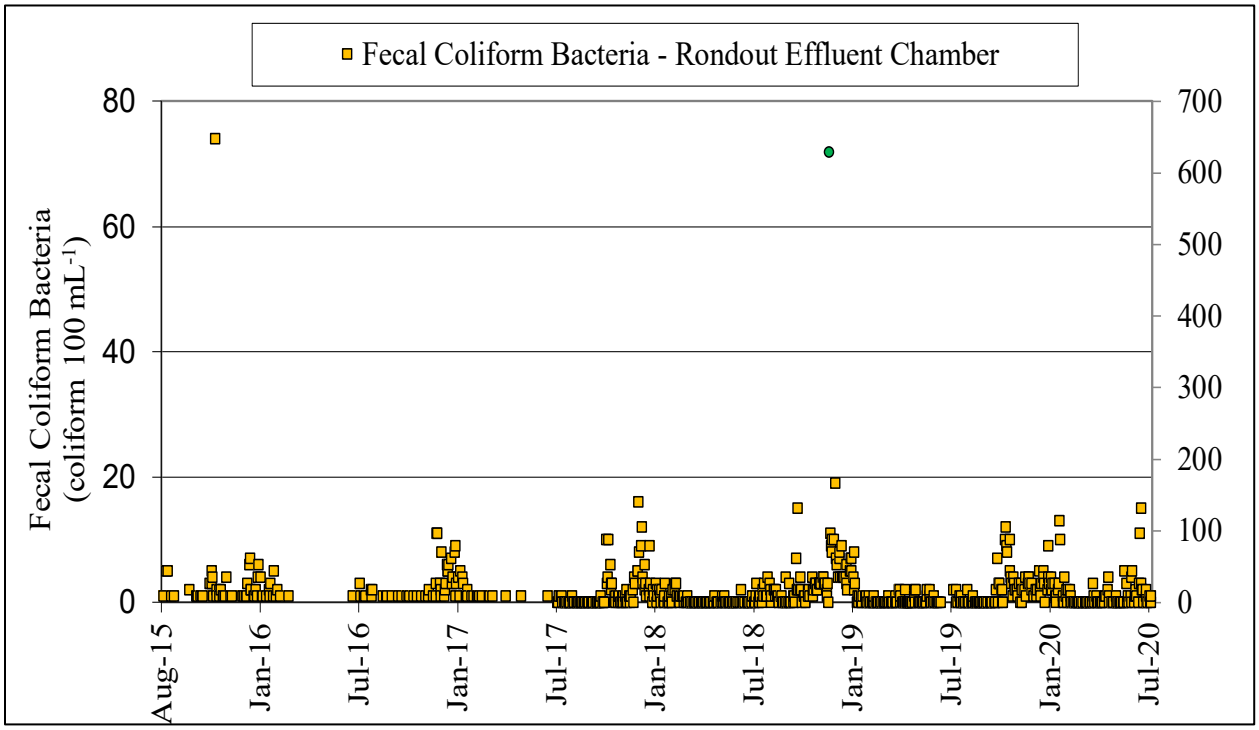

Figure 3.24. Rondout Reservoir fecal coliforms 100mL^{-1} at Rondout Effluent (August 1, 2015 to July 31, 2020). Non-detect fecal coliform are not presented.

Additional Surveys

DEP Aqueduct Monitoring staff conducted 52 daytime bird observations (un-aided eye) during routine site visits. The dates, times, and count-ranges for birds observed at the Rondout Effluent Chamber are listed in Table 3.5. Eighteen of 42 observations (43%) reported birds present.

Table 3.5. Rondout Reservoir – daytime bird detections at Rondout Effluent.

Date	Time of Observation	Bird Count Range or Actual Bird Counts
08/12/19	11:15	1-50
09/09/19	10:35	1-50
09/16/19	11:48	1-50
09/23/19	10:08	1-50
09/30/19	10:31	1-50
10/15/19	12:50	1-50
11/04/19	11:01	1-50
11/14/19	07:27	1-50
11/18/19	10:33	1-50
12/02/19	10:35	1-50
01/13/20	13:04	1-50
02/03/20	08:51	1-50
02/11/20	09:10	1-50
03/09/20	08:07	1-50
03/16/20	09:00	1-50
03/30/20	09:40	1-50
06/29/20	12:19	1-50
07/20/20	10:11	1-50

Nest and Egg Depredation

DEP also conducted reproductive control of nesting Canada geese at Rondout in the spring of 2020. Due to the close proximity of some Canada goose nests to active bald eagle nests, DEP abstained from some goose egg and nest depredation work to maintain compliance with the New York State Endangered Species Protection Laws and USFWS Bald and Golden Eagle Protection Act.

Three Canada goose nests containing 14 eggs were depredated during the spring of 2020 compared to three nests with 15 eggs depredated in 2019 (Appendix A, Table A1). Figure 3.25 shows one of two Canada goose nesting islands on the western end of the reservoir. No goslings were documented in 2020 resulting in a 100% success rate. There were no mute swan or double-crested cormorant nests observed at Rondout Reservoir in 2020.

Figure 3.25. DEP wildlife biologist conduct early spring Canada goose nest searches on islands at Rondout Reservoir. Photo by Chris Nadareski.

Endangered Species Compliance

There were two active bald eagle nests at Rondout during the 2020 season. DEP conducted bald eagle (*Haliaeetus leucocephalus*) nest site monitoring and maintained full compliance with a protection plan as required by the NYSDEC and USFWS in preparation for any "as needed" bird dispersal activity as stated in the Findings Statement of the Environmental Impact Statement (N.Y.S. Environmental Conservation Law, Art. 8 (§8101 et seq.)) on file.

3.5. Ashokan Reservoir

The 2017 FAD lists Ashokan Reservoir as one of five reservoirs covered under the "as needed" criteria for waterbird management. Since the implementation of the WMP, no "as needed" actions have been necessary at Ashokan.

Waterbird Surveys

Ashokan Reservoir is divided into two basins each with a water intake chamber located at the Dividing Weir. There are three bird zones on each of the two basins (Appendix B, Figure B.7). DEP did not conduct overnight waterbird surveys during the 2019/2020.

Waterbird Monitoring

Based on the 2017 FAD criteria requirements for Rondout, DEP did not conduct overnight waterbird surveys during this reporting period.

Waterbird Dispersal Actions

Based on the 2017 FAD criteria requirements for Ashokan, DEP was not required to conduct waterbird dispersal actions during this reporting period. In the event bird dispersal actions were required, DEP would implement a program using contractor personnel to reduce waterbird numbers to eliminate any water quality threat. Since the inception of the WMP Expanded Program at Ashokan Reservoir in March 2002, DEP has not been required to initiate an "as needed" bird dispersal action due to elevated fecal coliform bacteria and/or waterbird counts. In the event bird dispersal actions were required, DEP would implement a program using contractor personnel to reduce waterbird numbers to eliminate a water quality threat.

Water Quality Summary

Figure 3.26 shows the fecal coliform bacteria $100mL^{-1}$ levels recorded since from August 1, 2015 through July 31, 2020 at the EARCM water quality sampling location on the reservoir's east basin. A seasonal low-level elevation of bacteria generally occurs during the autumn/winter period annually which is coincidental with the migration and wintering period of waterbird populations at the Ashokan Reservoir.

In 2019, a coliform-restricted assessment for Ashokan Reservoir determined that the basin status was 'non-restricted' status. Of 149 fecal coliform bacteria samples collected over the period from August 1, 2019 to July 31, 2020, one-hundred and four (70%) had no fecal coliform bacteria present. There were no bacteria samples reported above the 20 fecal coliform bacteria $100mL^{-1}$ level during this reporting period.

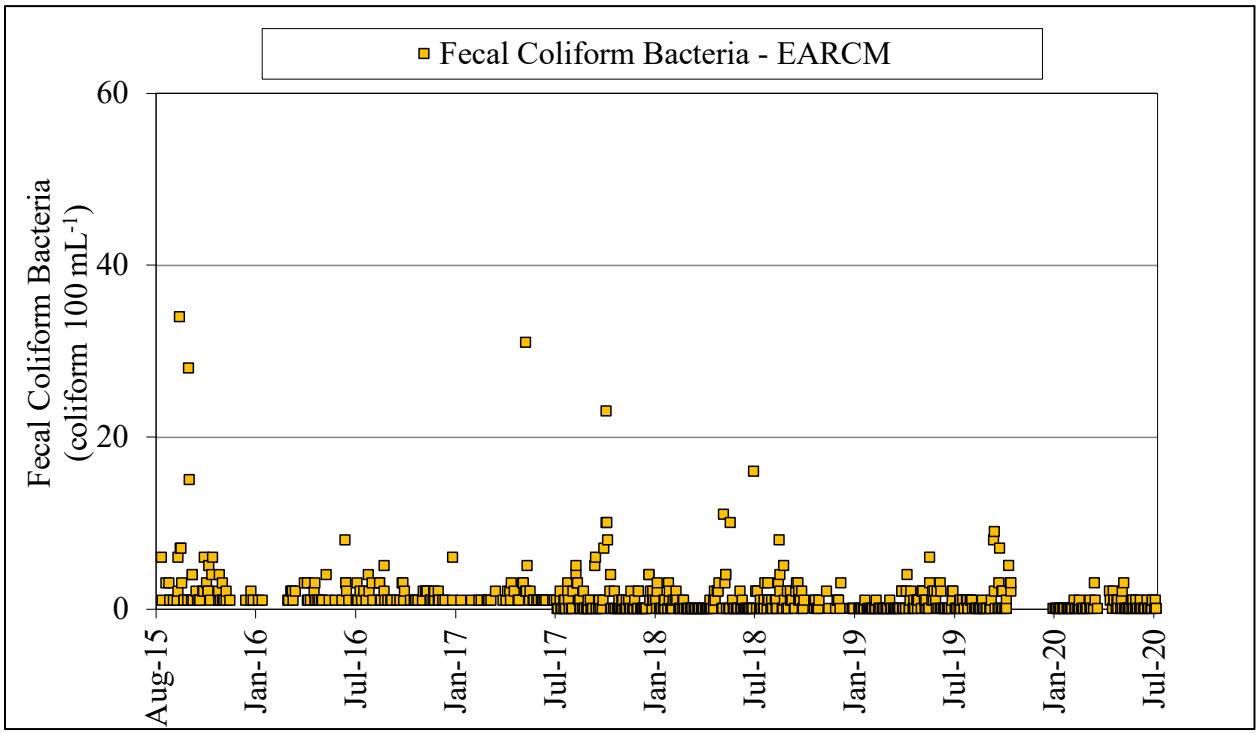

Figure 3.26. Ashokan Reservoir fecal coliforms 100mL^{-1} at Ashokan Effluent (EARCM) August 1, 2015 to July 31, 2020. Non-detect fecal coliform are not presented.

Additional Surveys

DEP Aqueduct Monitoring staff conducted daytime bird observations (un-aided eye) routine site visits. Forty-three bird observations were conducted each at the Ashokan East Basin Effluent and 40 bird observations at the Ashokan West Basin Effluent during this reporting period. Thirteen of 43 surveys had reportable data on the East Basin representing 30% of the observations during the midday period. Nineteen of 40 surveys had reportable data on the West Basin representing 48% of the observations during the midday period. The dates, times and count ranges for birds observed near the Ashokan East Basin Effluent and Ashokan West Basin Effluents are listed in Tables 3.6 and 3.7.

Table 3.6. Ashokan Reservoir – daytime bird observations at Ashokan East Effluent.

Date	Time of Observation	Bird Count Range or Actual Bird Counts
08/05/19	11:00	1-50
09/03/19	11:40	1-50
09/09/19	11:46	1-50
09/23/19	10:45	1-50
10/07/19	09:30	1-50
11/18/19	10:35	1-50
11/22/19	11:45	1-50
02/03/20	12:01	1-50
02/18/20	10:35	1-50
04/01/20	10:35	1-50
04/06/20	11:30	1-50
04/24/20	10:41	1-50
06/01/20	11:50	1-50

Table 3.7. Ashokan Reservoir – daytime bird observations at Ashokan West Effluent.

Date	Time of Observation	Bird Count Range or Actual Bird Counts
08/05/19	11:00	1-50
08/12/19	10:52	1-50
08/19/19	11:30	1-50
08/26/19	10:15	1-50
09/23/19	10:45	1-50
09/30/19	11:01	1-50
12/30/19	12:01	1-50
01/13/20	12:22	1-50
03/02/20	09:12	1-50
03/09/20	11:08	1-50
03/16/20	11:58	1-50
04/01/20	10:35	1-50
04/06/20	11:31	1-50
04/20/20	11:05	1-50
04/24/20	10:41	1-50
04/27/20	10:25	1-50
05/26/20	12:42	1-50
06/01/20	11:52	1-50
06/08/20	13:29	1-50

Nest and Egg Depredation

DEP conducted reproductive control on nesting Canada geese from April 1 through May 31, 2020. In 2020, six Canada goose nests were identified and 33 eggs were depredated (Appendix A, Table A1). In the previous reporting period, seven Canada goose nests were identified with 39 eggs depredated. The egg-depredation success rate at the Ashokan Reservoir was 85% in both 2019 and 2020. Five goslings were observed in late spring 2020 compared to six in 2019. There were no mute swans or double-crested cormorants found nesting in 2020.

Endangered Species Compliance

DEP monitored and recorded two nesting pair of bald eagles at the Ashokan Reservoir in 2020. DEP maintained compliance with the NYSDEC endangered species regulations to protect nesting bald eagles on reservoirs during routine water quality sampling and other reservoir operations activities (Figure 3.27). DEP Wildlife Studies staff conducted seasonal surveys at all bald eagle nest sites for compliance with the DEP Bald Eagle Conservation Plan.

Figure 3.27. Adult bald eagle with hatch-year fledgling. Photo by Michael Reid.

3.6. Croton Falls Reservoir

The 2017 FAD lists Croton Falls Reservoir as one of five reservoirs covered under the "as needed" criteria for waterbird management. Since the inception of the WMP, only one "as needed" waterbird dispersal action was conducted at Croton Falls.

Waterbird Monitoring

The reservoir is divided into five bird zones associated with reservoir water quality sampling sites (Appendix B, Figure B.8). DEP conducted 19 nocturnal and diurnal waterbird as needed waterbird surveys (Figure 3.28) conducted during the reporting period for compliance with DEP's Operational Guidance Plan (Croton Falls Pump Station Operations Monitoring). DEP invoked the action plan for waterbird monitoring from November 7, 2019 to March 20, 2020.

Waterbird Dispersal Actions

Based on the 2017 FAD criteria requirements for Croton Falls, DEP was not required to conduct waterbird dispersal actions during this reporting period. In the event bird dispersal actions were required, DEP would implement a program using contractor personnel to reduce waterbird numbers to eliminate any water quality threat.

Water Quality Summary

Of 116 water quality samples collected over the period from August 1, 2019 to July 31, 2020, six percent were non-detectable and 21% were above the 20 fecal coliform $100mL^{-1}$ limit. Figure 3.29 demonstrates a relationship between elevated waterbird counts and elevated fecal coliform bacteria at the Croton Falls Keypoint water sampling location (CROFALLSVC). Weekly updates containing fecal coliform bacteria sampling results and waterbird counts were provided to regulators for compliance.

Figure 3.28. Croton Falls Reservoir waterbird observation site. Photo by C. Nadareski.

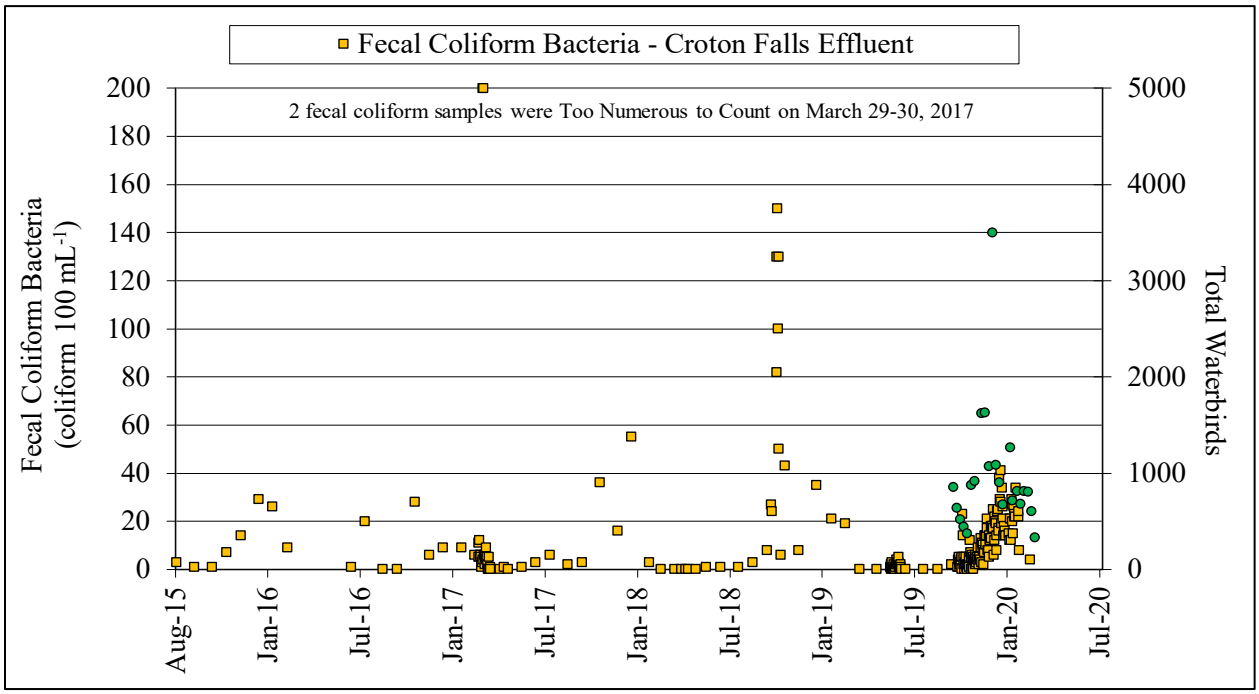

Figure 3.29. Croton Falls Reservoir fecal coliforms 100mL^{-1} at Croton Falls Effluent vs. total waterbirds (August 1, 2015 to July 31, 2020). Non-detect fecal coliform are not presented.

Fecal coliform bacteria elevations and declines were concurrent with waterbird counts during the autumn and early winter periods at Croton Falls Reservoir. DEP determined that the temporary bacterial elevations were not sufficient to authorize waterbird dispersal actions.

Nest and Egg Depredation

DEP conducted reproductive control of Canada geese from April 1 through May 31 in the spring of 2020 for a total of eight site visits to reduce productivity at Croton Falls (Appendix A, Table A1). In 2020, 15 Canada geese nests were identified with 82 eggs depredated compared to 12 nests and 72 eggs in 2019. The Canada goose egg-depredation success rate at Croton Falls for 2019 was 96% as three goslings hatched. Figure 3.30 shows a nesting goose in Bird Zone 5 that was depredation during the 2020 season. There were no mute swan or double-crested cormorant nests observed in 2020.

Figure 3.30. Canada goose nest incubation. Photo by Mike Reid.

3.7. Cross River Reservoir

The 2017 FAD lists Cross River Reservoir as one of five reservoirs covered under the "as needed" criteria for waterbird management.

Waterbird Monitoring

Cross River Reservoir is divided into three (3) bird zones associated with reservoir water quality sampling locations (Appendix B, Figure B.9). There were seven nocturnal waterbird counts conducted during the reporting period for compliance with DEP's Operational Guidance Plan (Cross River Pump Station Operations Monitoring). DEP invoked the plan in October 2019 for waterbird monitoring.

Waterbird Dispersal Actions

Based on the 2017 FAD criteria requirements for Cross River, DEP was not required to conduct waterbird dispersal actions during this reporting period. In the event bird dispersal actions were required, DEP would implement a program using contractor personnel to reduce waterbird numbers to eliminate any water quality threat.

Water Quality Summary

Of the 34 water samples collected and analyzed from August 1 to July 31, 2020 at Cross River Reservoir (CROSSVS) there were no fecal coliform bacteria samples that exceeded the 20 fecal coliforms $100mL^{-1}$ level. Figure 3.31 presents fecal coliform data collected at the Effluent facility for the previous five years with limited waterbird survey data. There are noted increases in fecal coliform and waterbirds during the autumn of 2018 and 2019. DEP determined that the temporary bacterial elevations were not sufficient to authorize waterbird dispersal actions. Weekly updates containing fecal coliform bacteria sampling results and waterbird counts were provided to regulators for compliance.

Of 34 water quality samples collected in this reporting period, 10 (29%) were recorded as non-detect. Only one water sample reached a double-digit level at 14 fecal coliform $100mL^{-1}$ on November 3, 2019. DEP determined it unnecessary to initiate a waterbird dispersal action based on the fecal coliform bacteria levels below the SWTR limit of 20 fecal coliforms $100mL^{-1}$.

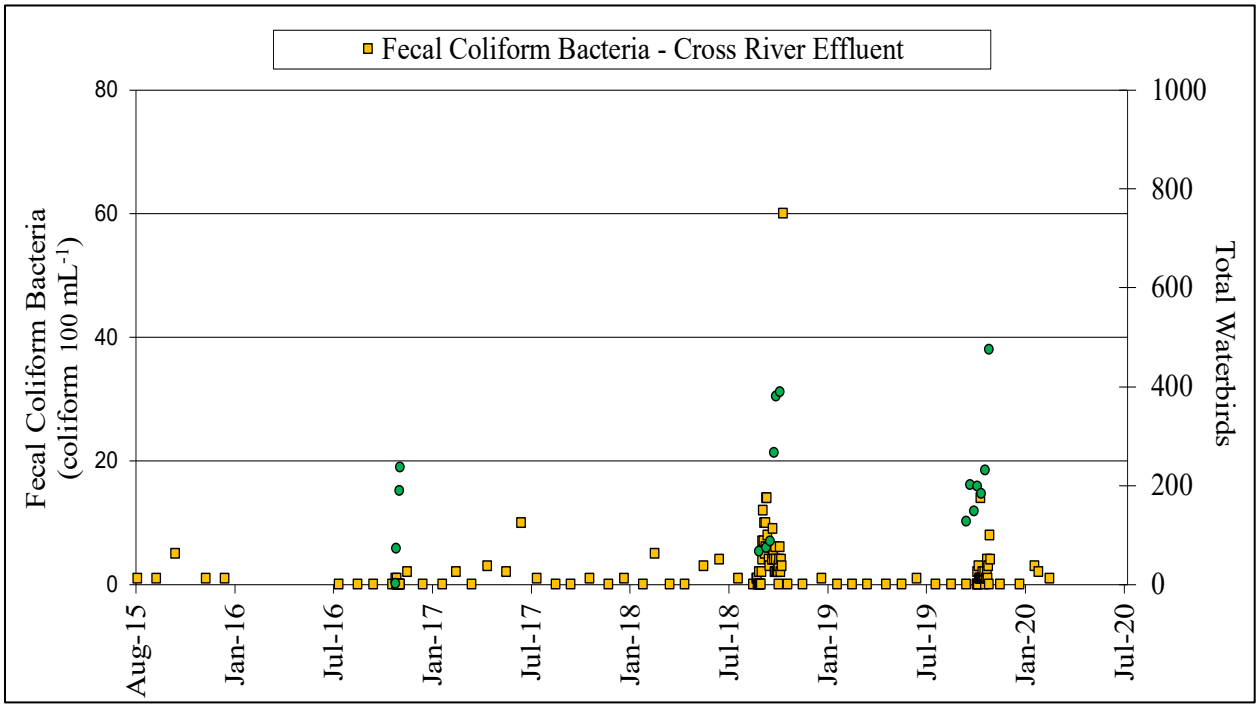

Figure 3.31. Cross River Reservoir fecal coliforms 100mL^{-1} at Cross River Effluent vs. total waterbirds (August 1, 2015 to July 31, 2020). Non-detect fecal coliform were not presented.

Nest and Egg Depredation

DEP conducted reproductive control on nesting Canada geese from April 1 through May 31 in 2020. In 2020, 10 nests were identified and 47 eggs depredated during nine site visits compared to 12 nests and 42 eggs in 2019 (Appendix A, Table A1). The Canada goose egg-depredation success rate for Cross River in 2020 was 87% with observations of seven goslings. Reservoir nesting Canada geese can be difficult to locate and require a thorough inspection of shoreline areas and islands (Figure 3.32). There were no mute swans nesting in 2020. DEP did observe some double-crested cormorants building nests in 2020 but no depredation actions occurred.

Endangered Species Compliance

DEP monitored one nesting pair of bald eagles at the Cross River Reservoir in 2020. DEP maintained compliance with the NYSDEC endangered species regulations to protect nesting bald eagles on reservoirs during routine water quality sampling and other reservoir operations activities. DEP Wildlife Studies staff conducted seasonal surveys at all bald eagle nest sites for compliance with the DEP Bald Eagle Conservation Plan.

Figure 3.32. Reservoir island used by Canada geese for nesting. Photo by Chris Nadareski.

3.8. Hillview Reservoir

DEP maintained full compliance with the USEPA Administrative Order on Consent governing the covering of Hillview Reservoir (Docket No. SDWA-02-2010-8027 Catskill Delaware System) for wildlife management activities during this reporting period. DEP and its contractor continued to use pyrotechnics, propane cannons, remote-control boats, and employed physical chasing techniques to supplement the wire system to actively keep birds off the reservoir, including the influent (Uptake) and the effluent (Downtake) facilities, and the reservoir-dividing wall. Hillview Reservoir is divided into two bird zones (Figure 3.33), one on each site of the reservoir dividing wall (Appendix B, Figures B.10 and B.11). Prior to bird wire installation in 1994, gulls comprised more than 70% of the night-roosting species on the reservoir.

Figure 3.33. Hillview Reservoir aerial view of dividing wall. Photo by DEP Police.

Waterbird Monitoring

In 2019/2020, night-roosting guilds of birds were comprised of the following Canada geese 6% and ducks about 94%. Three hundred and fifty-nine out of 366 (98%) overnight surveys conducted were successful for the collection of data in 2019/2020. There were no gulls observed on the reservoir during the overnight surveys in this reporting period. There were only five observations of Canada geese recorded during the overnight surveys. Overnight waterbird counts peaked at 33 on May 31, 2020. When birds were observed during the early morning surveys, ducks were the most commonly observed waterbirds. There were no birds observed on 46% (165/359 reportable days) of the overnight waterbird surveys.

Figures 3.34 and 3.35 show the overnight and daytime waterbird count data for the last two years. Overnight and daytime waterbird counts on both basins remained very low and were almost exclusively from a relatively small wintering duck population during the autumn and winter and mallards during the spring and summer nesting periods.

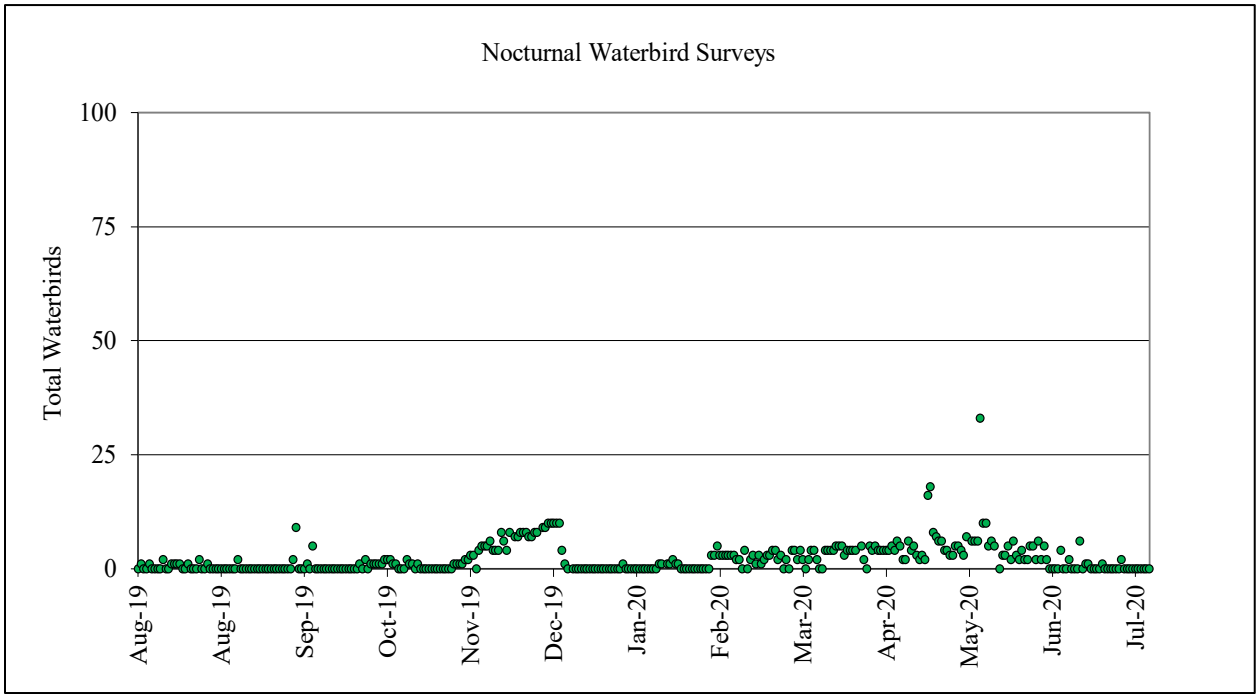

Figure 3.34. Hillview Reservoir total waterbirds nocturnal counts (August 1, 2019 to July 31, 2020).

The behavior patterns of the waterbirds utilizing Hillview Reservoir are different from the patterns of those using other upstate reservoirs as Hillview is situated in a highly urbanized area surrounded by large populations of breeding gulls throughout the New York City metropolitan network of waterways and islands. This partially explains why gulls are often

observed flying over the reservoir and present year-around on properties adjacent to Hillview. Since the installation of the bird deterrent wire system in 1994, small numbers of gulls and ducks remain the target of most active dispersal activity.

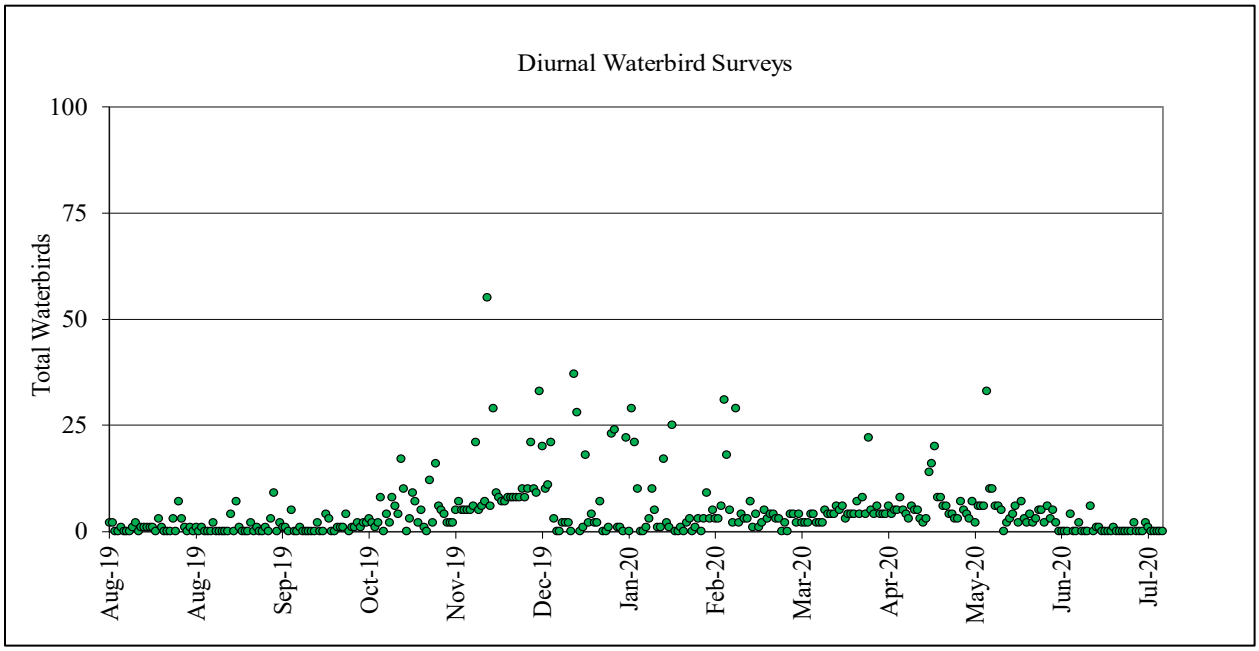

Figure 3.35. Hillview Reservoir total waterbirds diurnal counts (August 1, 2019 to July 31, 2020).

Waterbird Dispersal Actions

During this reporting period, there were 1,852 bird harassment actions that dispersed 6,025 waterbirds including 1,274 Canada geese, 3,897 gulls, and 846 ducks. Dispersal actions included use of propane-operated cannons on one instance, five uses of the remote-control boats, 756 physical chases on the reservoir-dividing wall, and 1,090 bird banger pyrotechnics discharged. Early morning dispersal actions from pre-dawn to 8am were restricted to physical chasing due to noise ordinance compliance with the surrounding residential communities. From 8am until approximately 1.5 hours past sunset noisemakers (pyrotechnics and cannons) and remote control boats were added to disperse the birds.

Except for a low number of diving ducks (ruddy ducks, *Oxyura jamaicensis,* Figure 3.36) that arrive during fall migration, all waterbirds observed and reported on both nocturnal and diurnal surveys were dispersed from the reservoir using pyrotechnics, cannons, and physical chasing from 5:00am until post-dusk times. Ruddy ducks typically do not respond to the aforementioned bird dispersal measures. Additional bird mitigation for ruddy duck management is discussed below in the Depredation section. DEP and its contractor crews were largely

successful in dispersing all other birds including migratory flocks of terrestrial species such as European starlings upon observation.

Figure 3.36. DEP wildlife biologists continue to diving ducks using nets from Jon boats as an alternative to depredations. Photo by Chris Nadareski.

Water Quality Summary

Daily water quality results for Hillview Reservoir are presented in this report as number of positive *E. coli* for each month of the reporting period at two water quality-sampling locations (Figures 3.35 and 3.36). *E. coli* levels remained at zero detections entering Hillview at water quality sampling Site 1 (Appendix B, Figure B.10). There was one positive *E. coli* sample reported at sampling Site 3 as the water leaves Hillview Reservoir for distribution (Appendix B, Figures B.10). There were no *E. coli* elevations recorded during the high count of overnight waterbirds reported on May 31, 2020.

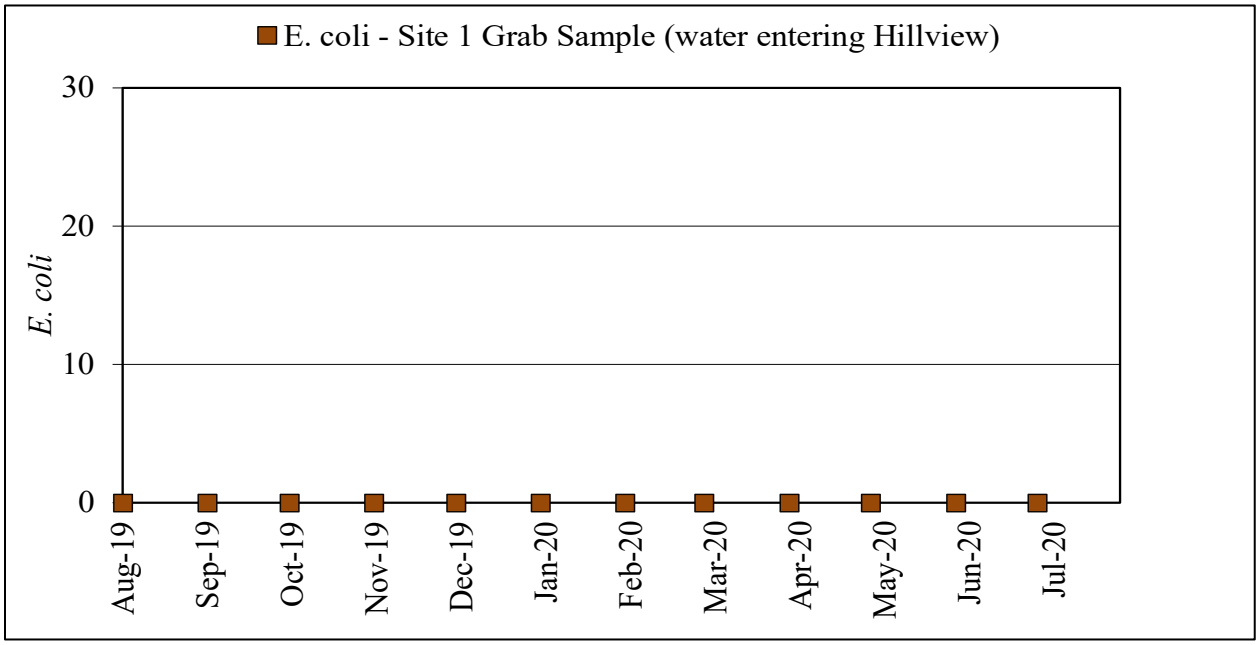

Figure 3.37. Hillview Reservoir number of positive *E. coli* (grab sample) at water sampling site 1 (August 1, 2019 to July 31, 2020).

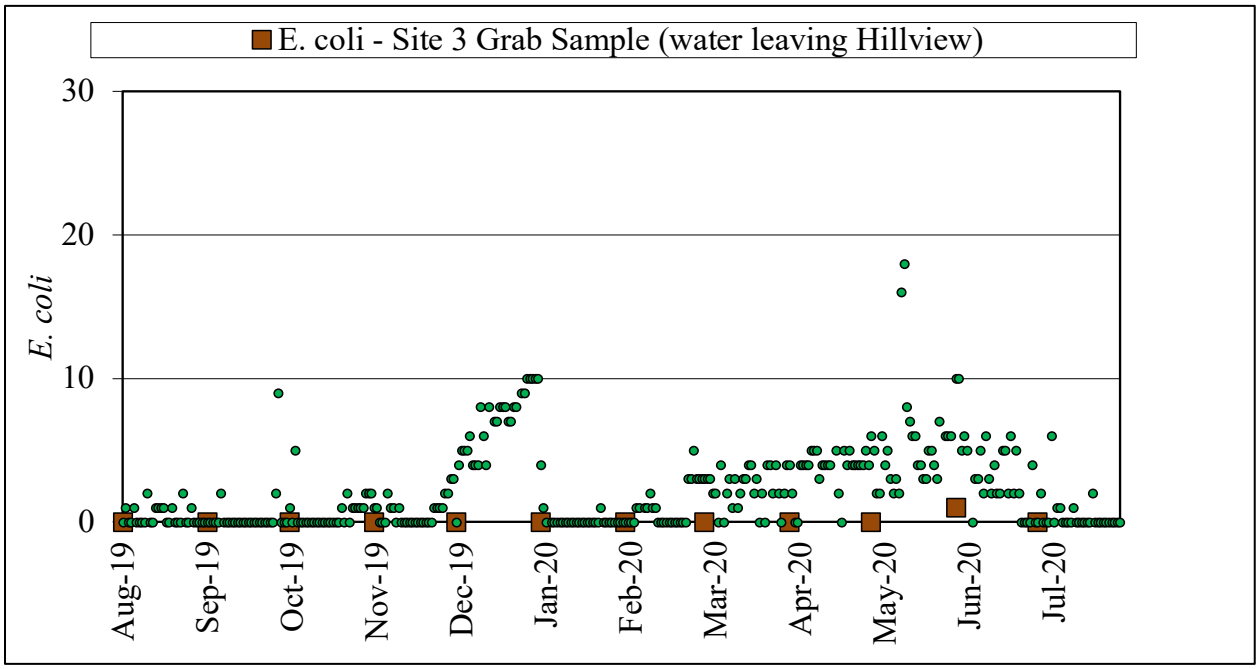

Figure 3.38. Hillview Reservoir number of positive *E. coli* (grab sample) at water sampling site 3 versus total waterbirds (August 1, 2019 to July 31, 2020).

Mammal Trapping

DEP initiated a year-around mammal management program in August 2011 and currently conducts trapping for mammals each week of the year (Table 3.39). Traps were generally set around the Downtake 1 and Uptake 1 (Appendix B, Figure B10) facility catwalks and along the reservoir shoreline as many species of mammals are generally attracted to invertebrates like spiders and moths that are present. A variety of commercial and supermarket-type trapping baits were used by DEP with variable success. Traps have been outfitted with catchment plates to avoid release of fecal material and body fluids into the reservoir from trapped animals. All traps are secured with wires to the shoreline fence to prevent trap rollovers.

DEP uses large, medium and small sized live traps that are inspected during pre-dawn hours five days/week (Figure 3.39). DEP complies with the American Veterinary Medical Association for employing humane euthanasia practices with its trapping program. Trained wildlife professionals use hypoxia in high concentrations of carbon dioxide (CO_2) gas to displace oxygen (O_2).

Figure 3.39. DEP wildlife biologist rebaiting large mammal traps around Hillview Reservoir. Photo by HDR staff.

Mammals trapped and subsequently depredated under NYSDEC approval include raccoons (*Procyon lotor*), mice (*Peromyscus* spp.), striped skunk (*Mephitis mephitis*), meadow vole (*Microtus pennsylvanicus*), eastern gray squirrel (*Sciurus carolinensis*), Norway rat (*Rattus norvegicus*), and northern short-tailed shrew (*Blarina brevicauda*). Live-trapped (non-target) feral cats were transferred to the City of Yonkers Animal Control Unit or released off Hillview Reservoir property. Some species like raccoons have robust populations in urban landscapes like Yonkers where Hillview Reservoir is situated (Figure 3.40).

Figure 3.40. Raccoon observed and subsequently removed by DEP staff. Photo by Sean Camillieri.

DEP conducted four-thousand one-hundred and fifty trap nights setting live and lethal traps from August 1, 2019 to July 31, 2020 (Table 3.8). A single mammal trapping night consists of one trap baited for one night. Forty-two specimens from six species were trapped in the first half of 2020. One non-target terrestrial bird species and six non-target feral cats were also trapped and subsequently released in this reporting period. The success of the trapping program by year is outlined in Table 3.9. Seventy-five animals from nine mammal species and two bird species were trapped during this reporting period. From August 1, 2011 to July 31,

2020 a total of 625 animals have been trapped including 12 feral cats and several species of passerine birds (Tables 3.8 and 3.9).

Table 3.8. Mammal trapping summary August 1, 2019 through July 31, 2020.

Month/Year	Number of live-traps and lethal traps set	Trapping success
Aug-19	399	8 *Peromyscus* spp., 1 raccoon, 2 Norway rats, 1 meadow vole, and 1 feral cat (released)
Sep-19	332	2 opossum, 1 house mouse, and 1 striped skunk
Oct-19	374	3 *Peromyscus* spp., 2 striped skunks, and 1 raccoon
Nov-19	264	1 opossum and 1 feral cat (released)
Dec-19	248	4 *Peromyscus* spp.
Jan-20	396	4 *Peromyscus* spp.
Feb-20	315	1 *Peromyscus* spp., 1 opossum, and 1 feral cat (released)
Mar-20	414	7 *Peromyscus* spp.
Apr-20	352	4 *Peromyscus* spp., 1 gray squirrel, and 1 house mouse
May-20	352	7 *Peromyscus* spp., 1 Eastern gray squirrel, 2 raccoons, and 1 house sparrow
Jun-20	330	1 *Peromyscus* spp. and 1 raccoon
Jul-20	374	10 *Peromyscus* spp., 3 European starlings, and 1 house sparrow
Annual Trapping Totals	**4,150**	**11 Wildlife Species (9 mammals and 2 birds)**

All trapped specimens were euthanized (except for the feral cats and birds) and subsequently composted at the DEP Animal Compost Facility located in Ulster County. For comparison, in 2018/2019, three thousand nine hundred and eighty-five live and lethal traps were set. Since 2011, a total of 29,138 mammal trapping-nights have been conducted.

Table 3.9 Mammal trapping success summary for Hillview Reservoir (August 2011 to July 31, 2020).

Species Trapped	**2011 (8/1 to 12/31)**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020 (1/1/ to 7/31)**	**Totals**
Raccoon	8	5	6	6	5	0	4	6	3	3	**46**
Striped Skunk	0	1	0	7	3	0	1	1	0	0	**13**
Virginia Opossum	0	0	0	4	6	1	6	9	2	1	**29**
Mice (*Peromyscus* Spp.)	7	0	11	7	13	116	165	39	15	34	**407**
Meadow Vole	0	0	4	0	0	6	6	1	0	0	**17**
Short-tailed Shrew	0	0	1	0	0	6	10	2	0	0	**19**
House Mouse	0	0	0	21	2	7	11	2	1	1	**45**
Norway Rat	0	0	0	1	4	1	3	8	0	0	**17**
Gray Squirrel	0	0	0	1	0	1	1	7	7	2	**19**
Feral Cat	0	0	0	4	1	1	0	3	3	**1**	**13**
Annual Totals	**15**	**6**	**22**	**51**	**34**	**139**	**207**	**78**	**31**	**42**	**625**

As part of the ongoing wildlife management initiatives, nighttime remote sensing cameras were used to document the presence or absence of wildlife on the reservoir dividing wall and catwalks surrounding the shaft buildings at Hillview. Figure 3.41 represents the occurrence of nighttime remote camera photographs of animals on nights that traps were set and nights when traps were not set.

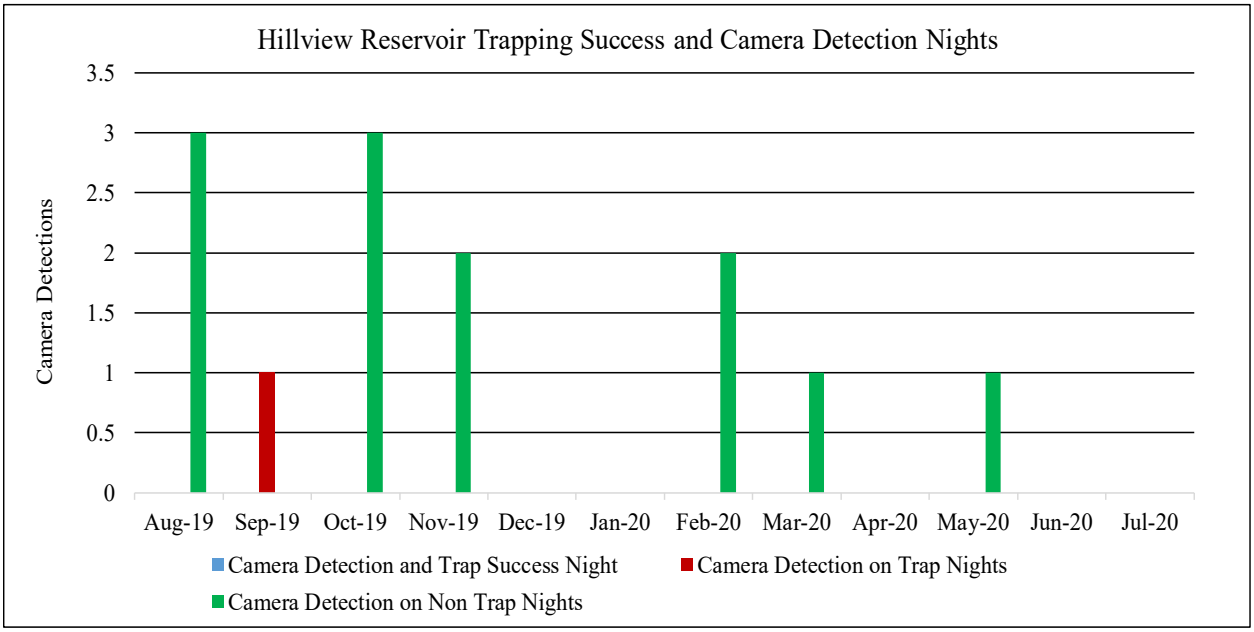

Figure 3.41. Occurrences of remote nighttime photography of animals recorded on the reservoir catwalk and dividing wall versus trapping success (August 1, 2019 to July 31, 2020).

Nest and Egg Depredation

During the spring/summer 2020 waterbird nesting season there were no reported nesting attempts by Canada geese or mute swans. In July 2020, one mallard nest was identified and seven eggs were depredated under a federal permit. A second nest was found destroyed without an egg count. Of the two nests found in 2020, sixteen (16) ducklings were live-captured and delivered to a wildlife rehabilitator for captive raising and subsequent release at locations distant from Hillview Reservoir (Appendix A, Table A1). DEP has observed that the urban nesting mallards continue to adapt to the variety of bird deterrent and dispersal measures making the surveys more difficult each year. DEP expanded the search boundaries for nesting mallards in 2020.

Depredation

The ruddy duck is a diving duck species that often does not respond to conventional bird dispersal measures. In 2019/2020 DEP had limited success in live trapping the ducks by means

of chasing and netting from boats. DEP utilized contract services with USDA for lethal removal of ducks during this reporting period on an as needed basis. The work was conducted mostly during the autumn and winter periods and when the migratory ducks overwinter at Hillview. USDA Wildlife Services conducted several depredation actions from December 2019 through June 2020 to remove 12 ruddy ducks and five mallard ducks that did not respond to the conventional types of bird dispersal methods.

DEP has continued an active swallow depredation program to eliminate the nesting cliff swallows and barn swallows on the reservoir buildings. Swallows typically construct their nest on the eaves of the shaft buildings. DEP conducts nest searches from April through July annually. This work was conducted under a USFWS Depredation Permit. In 2020, no cliff swallow nests or eggs were depredated. There were no barn swallow nests observed during the spring and summer period of 2020 similar to the previous year. A single tree swallow nest was depredated including three eggs when found inside a propane cannon shaft used to disperse waterbirds. This additional species information was reported to the USFWS.

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4. Conclusions

DEP's Waterfowl Management Program is a key component of the City's watershed protection efforts as outlined under the 2017 FAD. The program has helped DEP maximize options for delivering high quality water into distribution. The WMP commenced in the summer of 1992 with year of collecting waterbird population data prior to waterbird dispersal efforts initiated in December 1993. The program continues to effectively reduce waterbird populations and fecal coliform bacteria levels which assists DEP in maintaining compliance with the Environmental Protection Agency's Surface Water Treatment Rule under the Safe Drinking Water Act (42 U.S.C. §300f et seq.).

The reduced waterbird and fecal coliform bacteria counts at Kensico and Hillview Reservoirs can be directly attributed to the variety of wildlife mitigation actions including but not limited to bird dispersal and deterrence techniques, wildlife excrement sanitary surveys, and mammal trapping. The FAD and Hillview Administrative Order on Consent identify additional wildlife management practices employed by DEP. When waterbird dispersal tools (motorboats, airboats, propane cannons, and pyrotechnics) and bird deterrent systems (overhead bird wires and netting, reproductive control, and depredation) are used in a variety of combinations they result in the most effective means of reducing bird populations over large open areas of surface water. The tolerable number of waterbirds at the reservoirs before fecal coliform bacteria levels would exceed the SWTR has not been determined. As a result, the objective of the Waterfowl Management Program is to continue with an active bird dispersal program during the migration and wintering seasons for Kensico, year-around at Hillview, and on an "as needed" basis for reservoirs that are sources to Kensico via aqueducts.

The establishment of bird-free zones in close proximity to water intake structure at Kensico Reservoir from successful program-initiated bird dispersal activities continues to be a key influence on maintaining lower fecal coliform bacteria levels. In 2019, Kensico Reservoir was once again classified as a 'non-restricted' basin for SWTR. Managing waterbird populations adjacent to the water intake facilities is key to reducing the release of wildlife excrement and potential fecal coliform elevations. 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. DEP will continue to monitor waterbird population and fecal coliform bacteria data to determine when mitigation actions are necessary.

Bird deterrence measures used at multiple reservoirs will be continued over the long-term. These measures include waterbird reproductive (nest and egg) management, bird deterrent netting, overhead bird deterrent wires, and shoreline fencing. Deterrence will continue to reduce local breeding opportunities for waterbirds around water intake structures and eliminate fecundity and nest site fidelity of waterbirds in future years.

DEP conducted 39 springtime Canada goose and mute swan nest depredation actions on six reservoirs resulting in 52 goose nest depredations whereby 255 eggs were addled. DEP may employ direct depredation options as deemed necessary for Canada geese to reduce local breeding populations by means of "take" under federal and state depredation permits. The "take" option was utilized by the USDA on the Kensico Reservoir as part of the HPN depredation order to remove local nesting Canada geese during this reporting period. The removal of locally breeding Canada geese helps break the strong nest-site fidelity these birds exhibit particularly with a species that may survive more than 20 years as a local breeder. One hundred and nine surveys for nesting ducks were conducted at Hillview Reservoir to suppress reproductive activity during the spring and summer periods.

At Hillview Reservoir, DEP wildlife biologists continued to employ the use of pyrotechnics, physical chasing, remote-operated propane cannons, remote-control motorboats, Daddi-Long-Legs, bird deterrent wires, and netting to prevent terrestrial and waterbird species from landing on the reservoir and reservoir-dividing wall. DEP will continue to use additional lethal control measures to manage ducks, geese, swallows and sparrows when the need arises and conventional dispersal and deterrence measures fail. Although minimally used in 2019/2020, propane cannons have improved bird deterrence during times of inclement weather when DEP and contractor staff are not permitted on the reservoir-dividing wall and pyrotechnics are rendered ineffective from the reservoir shoreline.

As a part of the USEPA Administrative Order on Consent, DEP conducted small mammal trapping inside the reservoir perimeter fence and on the reservoir-dividing wall at Hillview Reservoir. DEP conducted 4,150 trap-nights during 2019/2020, in an attempt to eliminate small mammal activity inside the reservoir perimeter fence. In 2020, DEP completed another successful year in egg and nest depredation for nesting swallows under a federal depredation permit with a 100% success rate by preventing active nests from developing. DEP's effort to live-capture sixteen mallard ducklings trapped inside the reservoir was successful as the birds were transported to a local wildlife rehabilitator for captive raising and subsequent release. DEP contracted with USDA Wildlife Services to lethally remove 12 ruddy ducks and five adult mallards that didn't respond to conventional bird dispersal actions.

Waterbird populations continue to demonstrate seasonal elevations primarily during the autumn and winter periods in all reservoirs included in this report. Climate alterations can affect migratory and breeding activity changes of "local" or resident birds such as Canada geese and other waterbird species for the reservoir system. DEP will continue to document any behavioral pattern changes through the continued routine monitoring of waterbirds populations at the reservoirs. Gull populations are categorized as both migratory and resident and have been documented to utilize the New York City Reservoir system as temporary stopover or wintering areas until local conditions (i.e. ice and snow cover) become intolerable. The Kensico Reservoir is situated between the Hudson River (west) and the Long Island Sound (east) making it an

attractive fresh water system for many species of waterbirds. Ice-cover on the reservoirs, snow cover, and daily flight range for foraging often determine whether the waterbirds will continue southward in migration or utilize the reservoirs.

DEP continues to remain in compliance with SWTR regulations at Kensico Reservoir and the federal Administrative Order on Consent for Hillview Reservoir with low seasonal elevations of fecal coliform bacteria and E.*coli* recorded annually from late autumn through early winter. DEP has documented a comprehensive wildlife management program for water quality improvement and protection the past 28 years. With continued routine water quality sampling and waterbird population monitoring DEP can evaluate the effects of bird dispersal measures on each reservoir. Waterbird surveys continue to provide information on the spatial and temporal distribution of birds and their potential effects on fecal coliforms. DEPs long-term strategy is to continue with the implementation of the Waterfowl Management Program as part of its Filtration Avoidance Program to protect water quality through managing waterbird and other wildlife populations.

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Appendix A. Egg and Nest Depredation Summary

Table A1. 2020 Canada goose, mute swan, and mallard[2] egg and nest management.

Reservoir	Number of Surveys	Nests Depredated by Species	Eggs Depredated by Species	Species Depredation Success Rate
Kensico	8	Canada geese = 12 Mute swan = 1	Canada geese = 53 Mute swan = 8	95 percent (3 Canada geese goslings) 100 percent (0 Mute swan cygnets)
West Branch	8	Canada geese = 6	Canada geese = 26	96 percent (1 Canada geese gosling)
Rondout[1]	2	Canada geese = 3	Canada geese = 14	100 percent (0 Canada geese goslings)
Ashokan	5	Canada geese = 6	Canada geese = 33	85 percent (5 Canada geese goslings)
Croton Falls	8	Canada geese = 15	Canada geese = 82	96 percent (3 Canada goose goslings)
Cross River	8	Canada geese = 10	Canada geese = 47	87 percent (7 Canada goose goslings)
Hillview[2]	109	Mallard = 2	Mallard = 7	Mallard = 30 percent (16 Mallard ducklings)

[1] Nest depredation for Canada geese was restricted due to nesting Bald eagles.
[2] Mallard nest depredation only conducted at Hillview Reservoir.

Appendix B. Reservoir maps with bird zone designations and water sampling locations

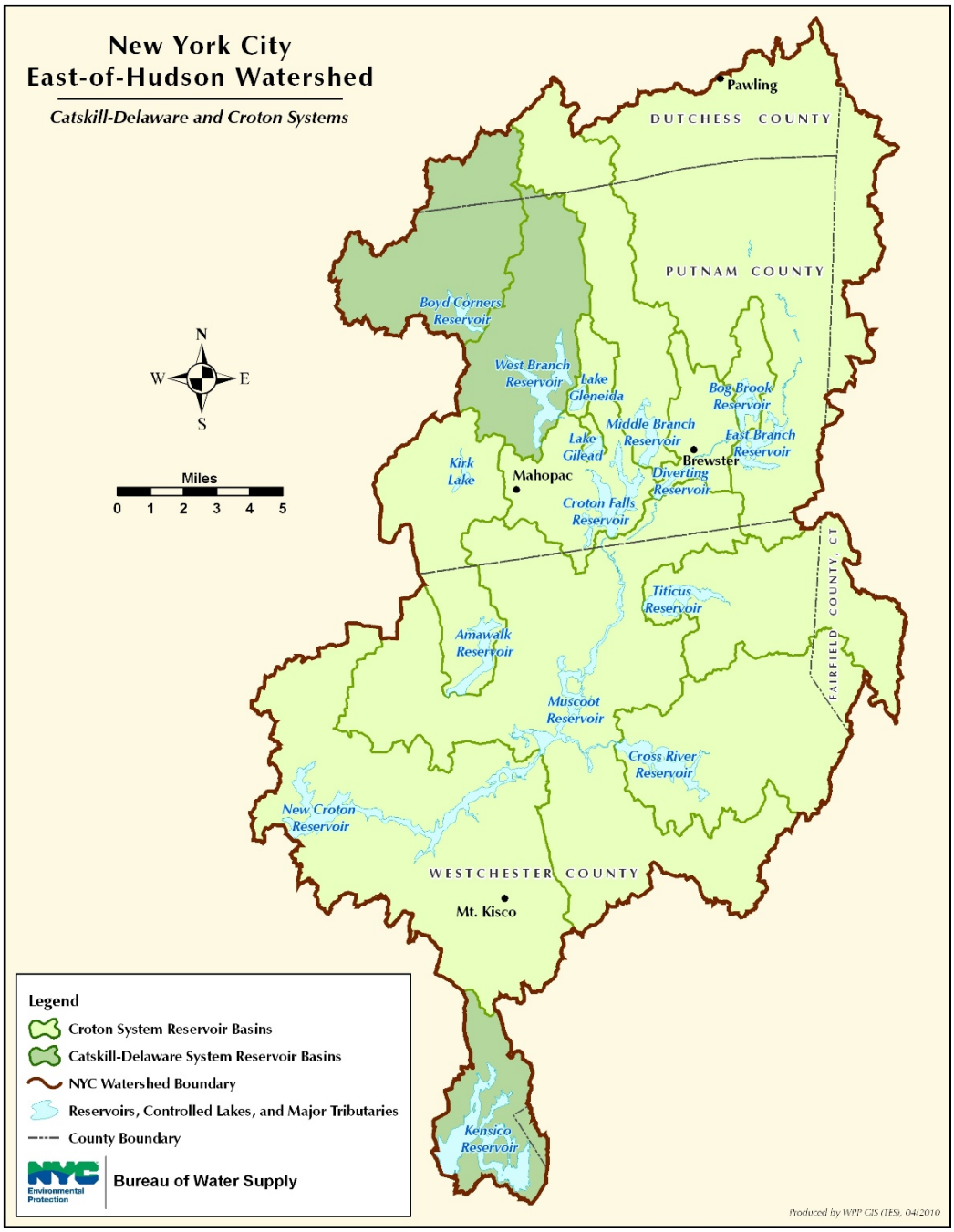

Figure B.1. Map of New York City Water Supply System – East of Hudson Watershed.

Figure B.2. Map of New York City Water Supply – West of Hudson Watershed.

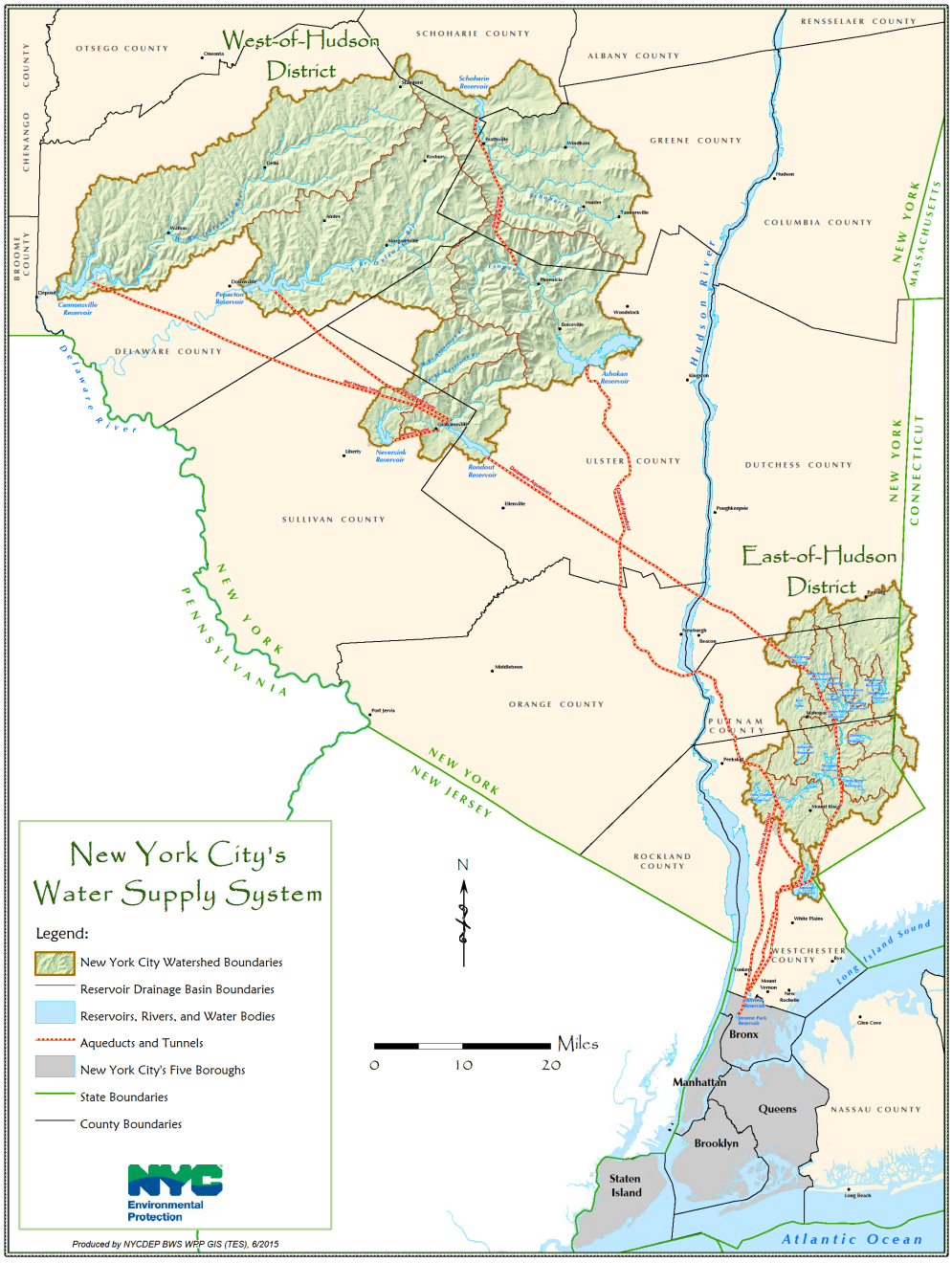

Figure B.3. Catskill, Delaware and Croton Systems.

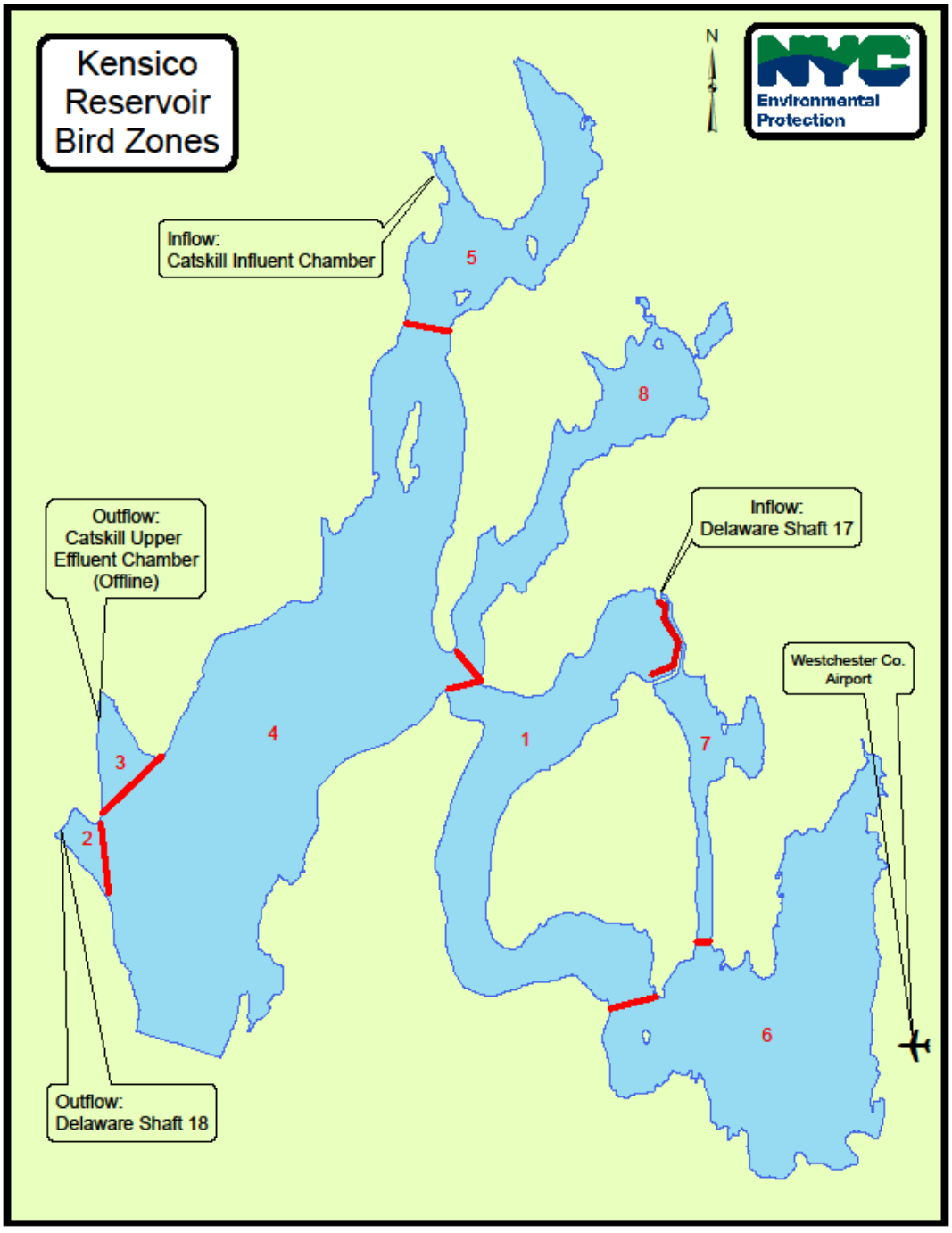

Figure B.4. Map of Kensico Reservoir bird zones.

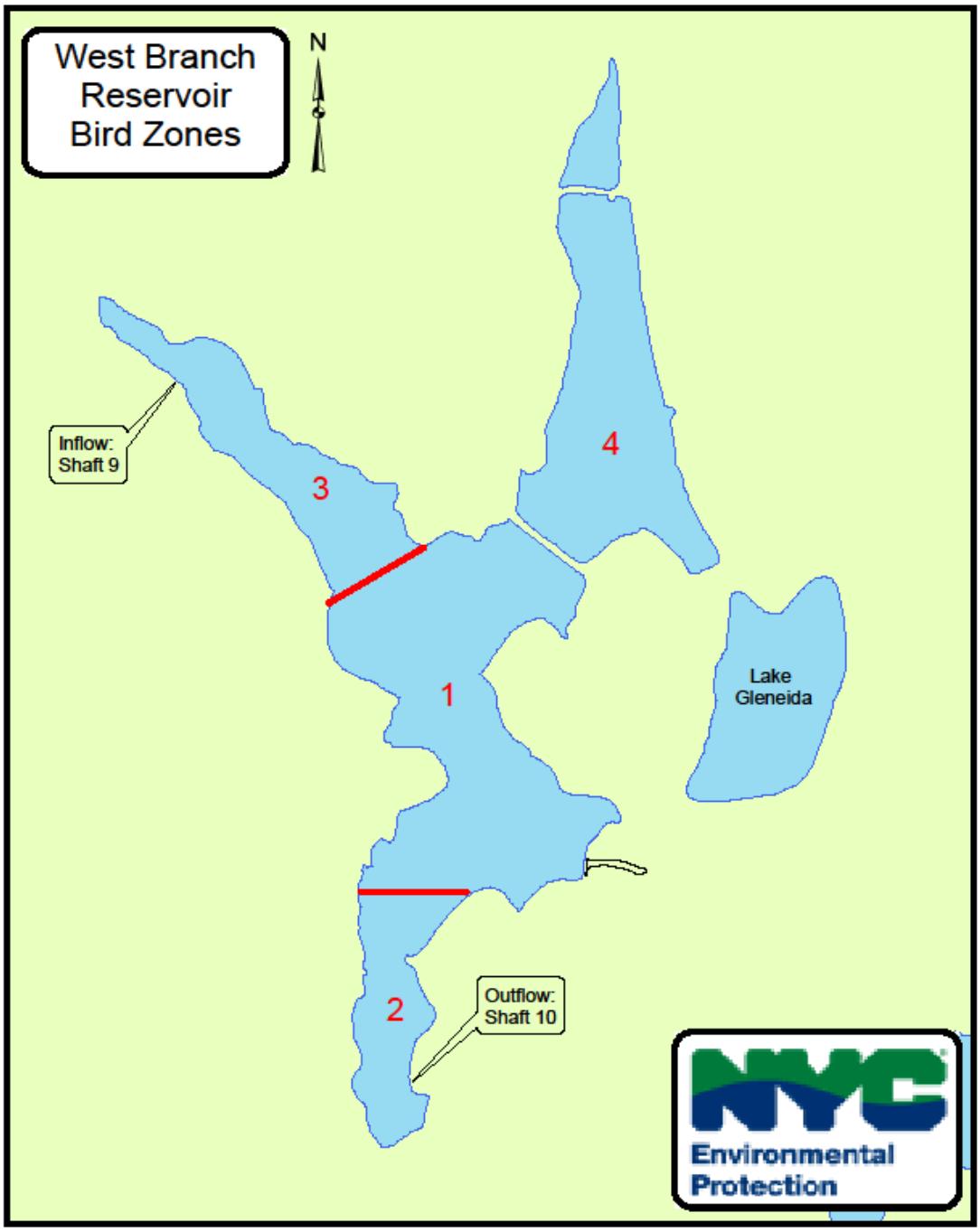

Figure B.5. Map of West Branch Reservoir bird zones.

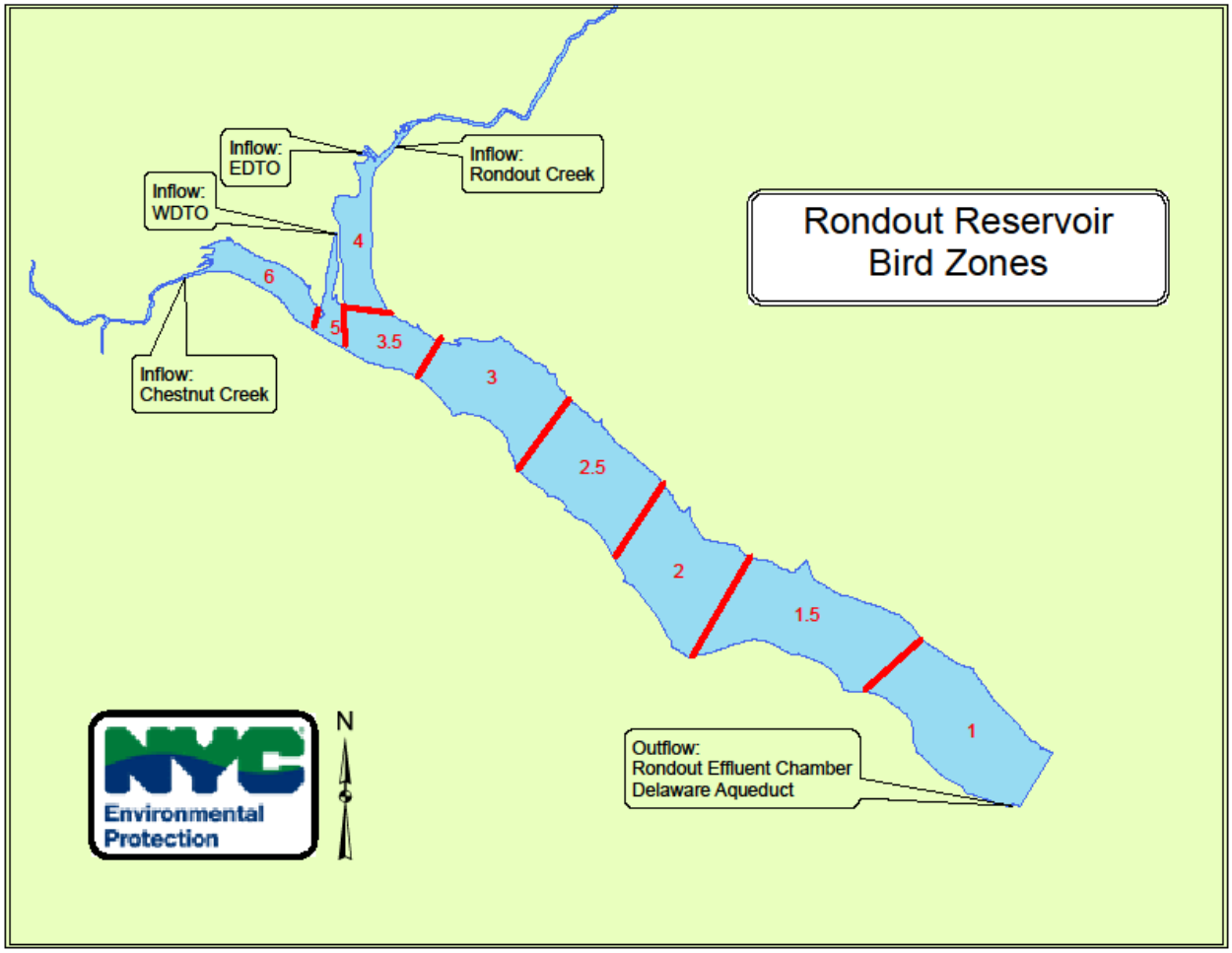

Figure B.6. Map of Rondout Reservoir bird zones.

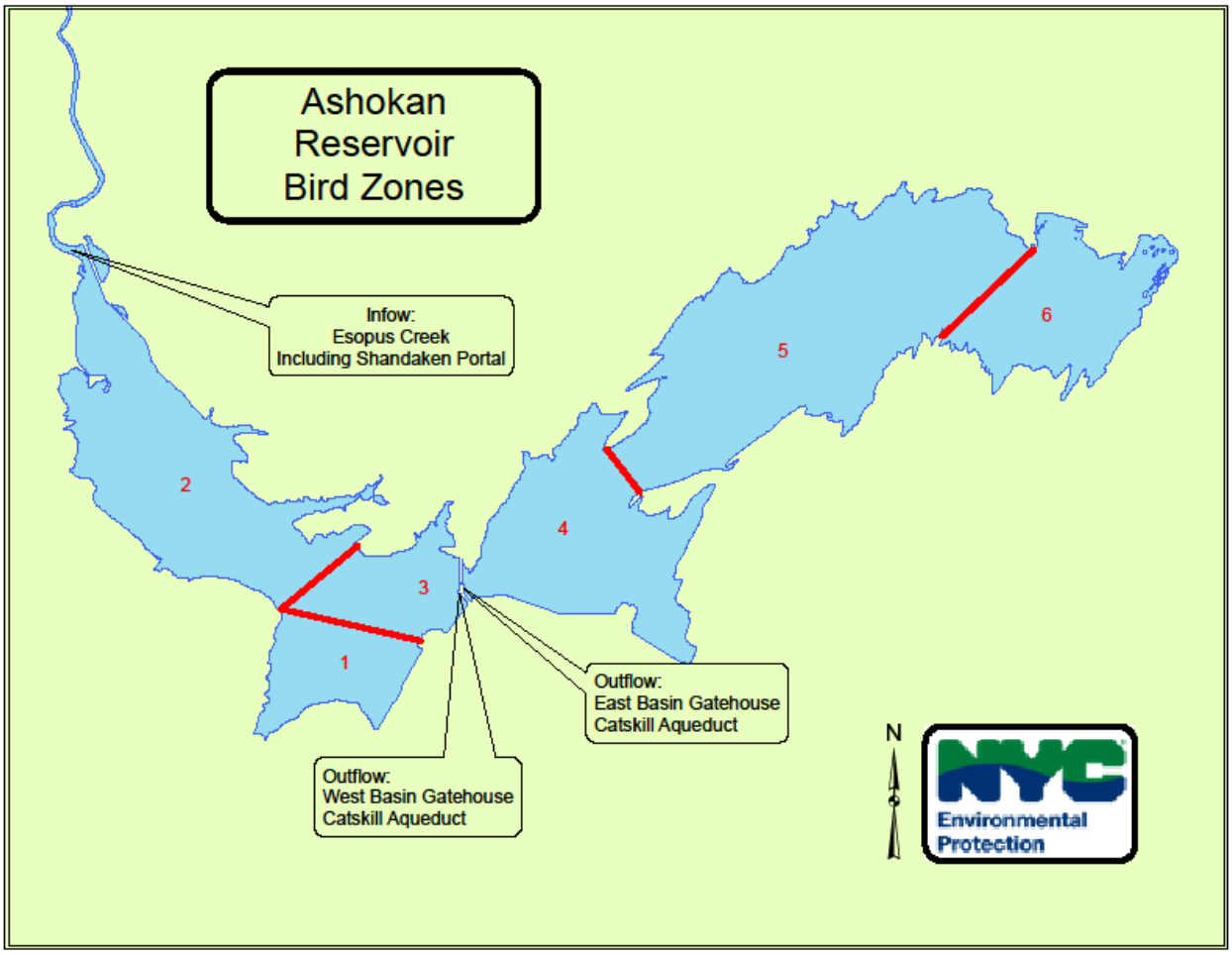

Figure B.7. Map of Ashokan Reservoir bird zones.

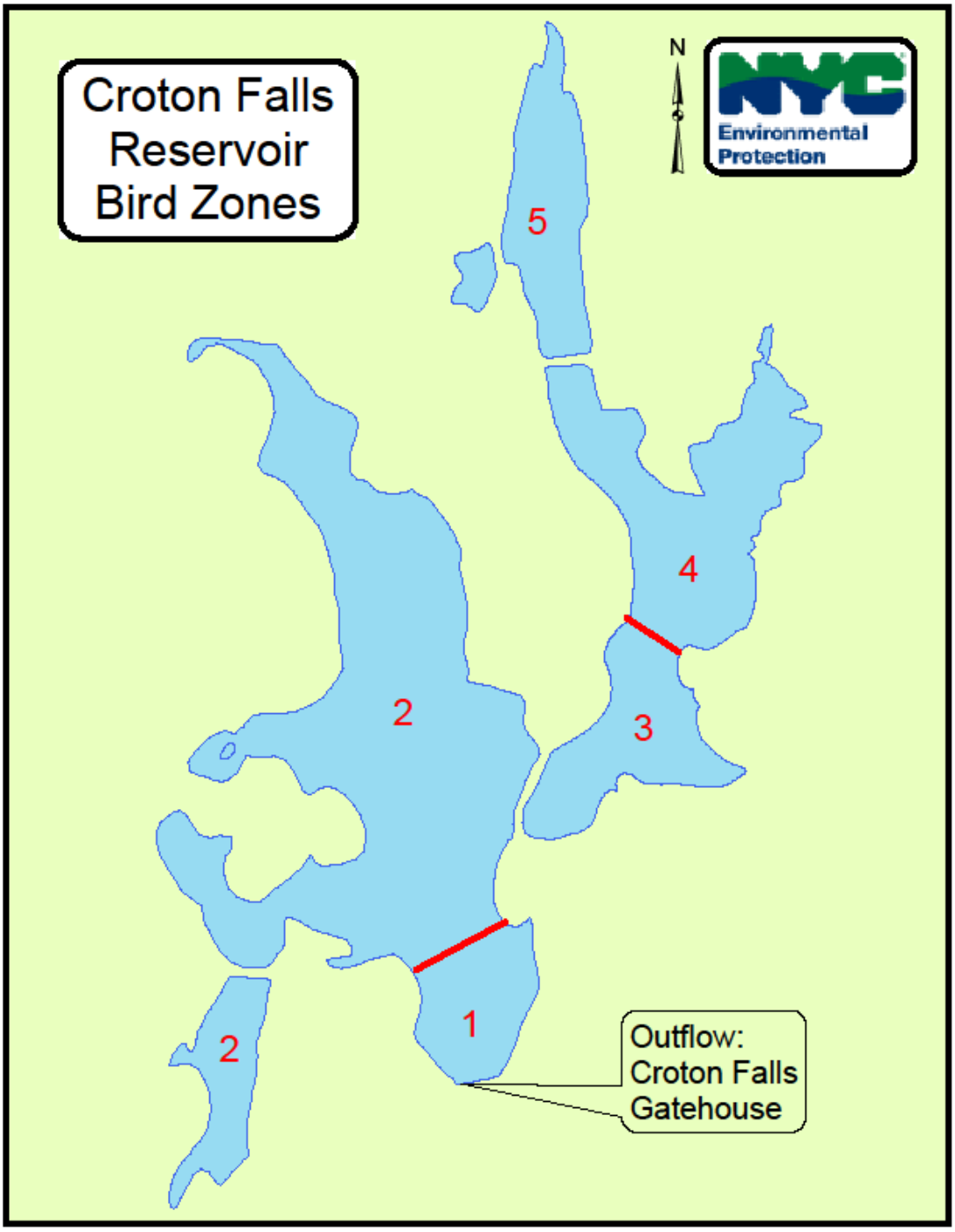

Figure B.8. Map of Croton Falls Reservoir bird zones.

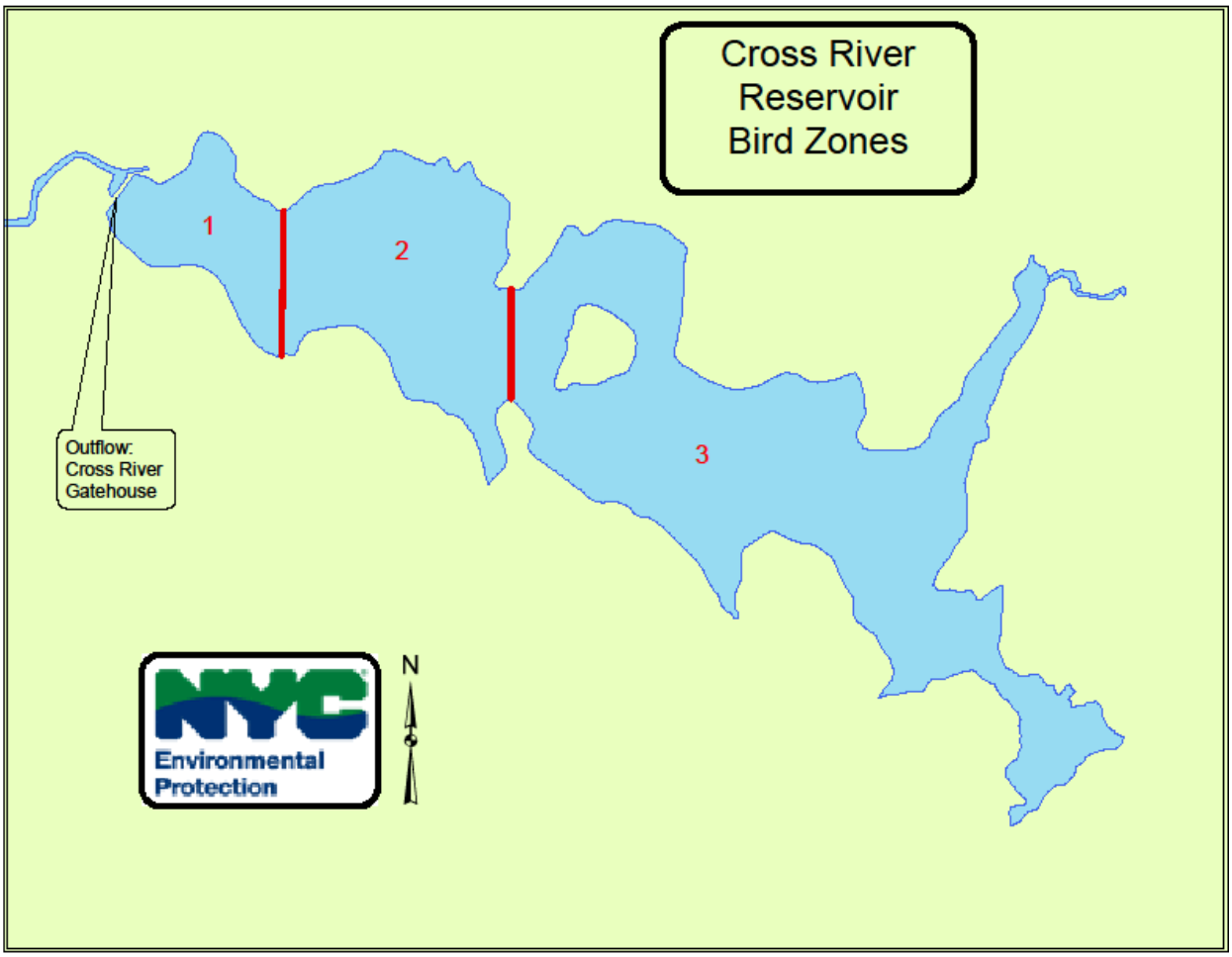

Figure B.9. Map of Cross River Reservoir bird zones.

Figure B.10. Map of Hillview Reservoir bird zones.

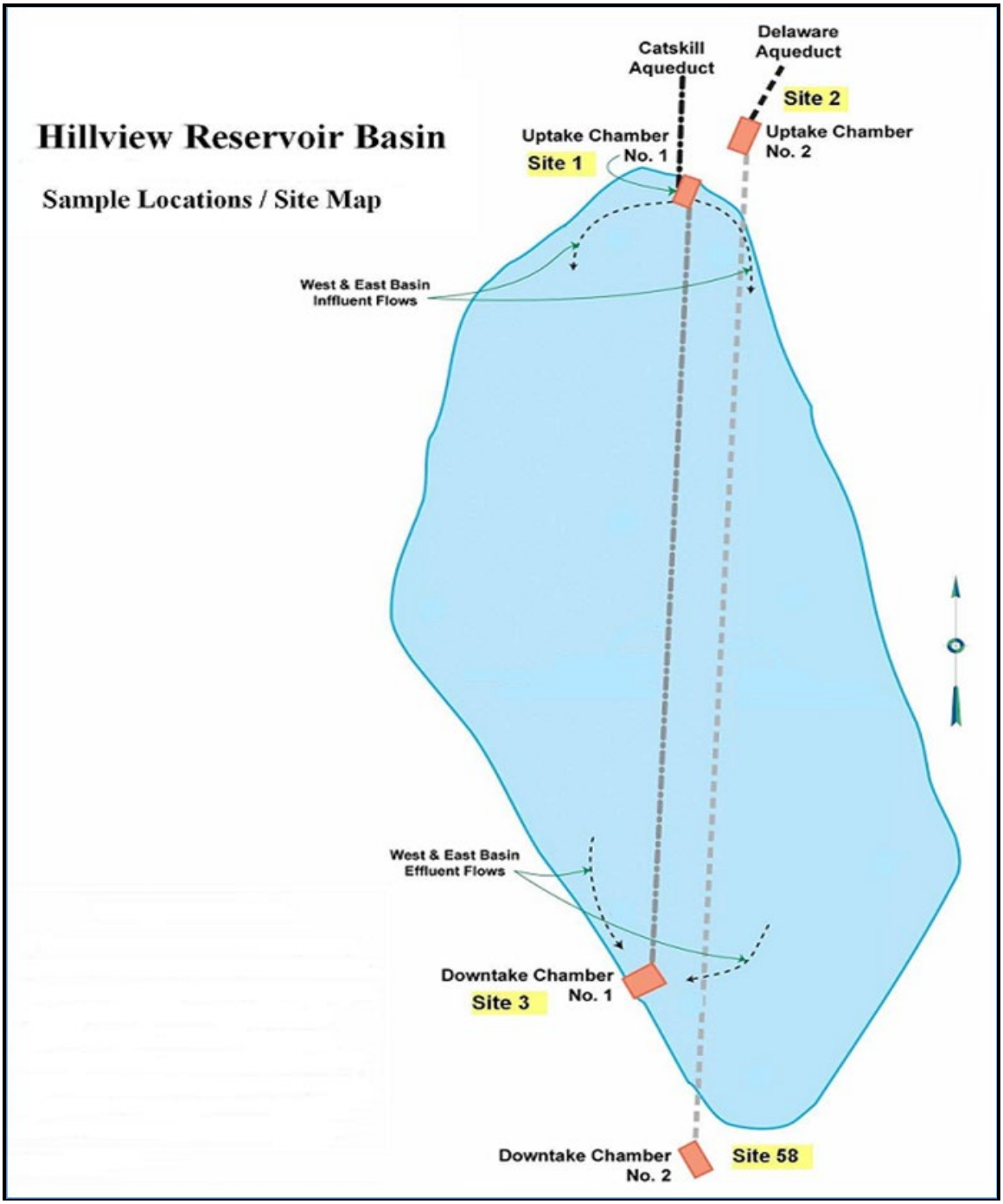

Figure B.11. Map of Hillview Reservoir water sampling locations.