New York City Department of Environmental Protection
Bureau of Water Supply

Waterfowl Management Program

October 31, 2021

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, 2020 to July 31, 2021.

Prepared by: Christopher A. Nadareski, Section Chief, Wildlife Studies
DEP, Bureau of Water Supply
Division of Watershed Protection Programs

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Acknowledgments

Special thanks to DEP wildlife biologists Michael Reid, Associate Project Manager and Sean Camillieri, Scientist, (Water Ecology III), Wildlife Studies Section, who reviewed this document, participated in data collection, conducted data analysis, and assisted in contract management.

Thanks goes to DEP contractor, HDR – Henningson, Durham, and Richardson P.C. (HDR), including Katherine Drury, (Project Manager), Steven Martin, (Assistant Project Manager), Ben Wood, (Field Site Supervisor), and numerous other HDR contractor staff for implementation of the Waterfowl Management Program Contract.

Thanks to Laurie Machung, Chief of Natural Resources Division, Watershed Protection Programs (WPP) and Dave Warne and Assistant Commissioner, WPP, Bureau of Water Supply (BWS) for a critical review of the document and logistical support. Thanks to Andrew Bader, Chief of Watershed Water Quality Operations (WWQO), Lori Emery, Director of Water Quality and Steven Schindler, former Director of Water Quality, DEP Bureau of Water Supply (BWS), for logistical support. Additional thanks to Brian O'Malley, Section Chief, and Theresa Kelly, Data Management, Water Quality Division, Lisa McDonald, Deputy Chief, WOH Laboratory Operations, and staff from WWQO field and laboratory for providing water quality data for Kensico, West Branch, Rondout, Ashokan, Croton Falls, and Cross River Reservoirs. Thanks to the WWQO, Aqueduct Monitoring Group (WWQO) for daytime bird counts. Thanks to Salome Freud, Chief, Distribution Water Quality Operations (DWQO), Aspa Capetanakis, Research Scientist (DWQO), and other DWQO staff for providing Hillview Reservoir water quality data. Thanks to Will Melendez, Chief, Water Treatment Operations South and Operations staff from DEP Bureau of Water Supply for maintenance of the bird deterrent equipment at Hillview Reservoir. Thanks to the Source Water Operations Directorate (Bradley Dromazos and Kenneth DeRose) for meteorological data. Thanks to Michael Risinik, DEP for report preparation support.

DEP would also like to acknowledge the United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA), NYS Director, Allen Gosser, District Supervisor, Kenneth Preusser and staff (Tyler DeLisle and Daniel Inserillo) for implementation of the Hillview Duck Management Contract.

The author, Mr. Christopher A. Nadareski, is a City Research Scientist and DEP's Section Chief of Wildlife Studies and Contract Project Manager. He is responsible for the Waterfowl Management Program development and implementation including data management, field data collection, and contract administration.

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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). New York City Department of Environmental Protection (DEP) developed and implemented a comprehensive Watershed Protection Plan 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 on December 28, 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. Average bacteria were 1.53×10^4 FC/g for Canada geese and 3.68×10^8 FC/g for ring-billed gulls. 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 - 2020). Waterbirds have been associated with elevated fecal coliform bacteria levels in several 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, and that effects on local communities and environmental conditions were evaluated, 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, 2020 through July 31, 2021.

2. Methods

Waterfowl Management Program

The objective of the program is to minimize fecal coliform loading to the reservoirs 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 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 such as birds to ensure compliance with the SWTR (DEP 1992). By December 1993, DEP initiated a daily (24-hour/day) program that was subsequently modified 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.

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 2.1, below.

Table 2.1 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

During this reporting period, the Waterfowl Management Program Contract (WMP-16 Renewal, the second of two (2) six-month extensions of the contract period) expired on July 29, 2021. The WMP-16R was extended until either the successor wildlife management contract is registered and effective, or April 30, 2022, whichever occurs sooner. DEP contractor Henningson, Durham, and Richardson, P.C. (HDR) of Omaha, Nebraska, provided services under WMP-16R.

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 waterbird 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 2.2 lists scheduled and actual DEP and contractor waterbird surveys conducted at Kensico, West Branch, Hillview Croton Falls, and Cross River Reservoirs from August 1, 2020 to July 31, 2021.

Table 2.2. Frequency of bird observation surveys by reservoir 2020/2021.

Reservoir	Bird Surveys Scheduled	Scheduled/Conducted Surveys
Kensico	Pre-dawn to post-dusk daily August 1, 2020 to March 31, 2021; Pre-dawn and post-dusk weekly April 1 to July 31, 2021	243/220[1,2] and 34/32[2]
West Branch	Pre-dawn, midday, and post-dusk, biweekly; August 1, 2020 to April 15, 2021	36/36
Hillview	Pre-dawn, midday, and post-dusk daily all year	365/355[2]

[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 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. Surveys of birds roosting overnight at West Branch were conducted biweekly from August 1, 2020 through April 15, 2021 in addition to the weekly daytime surveys.

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 were 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 Toughpads (Computer Tablets) to record observation locations with times for each reservoir. Data were entered in an Excel spreadsheet and were checked twice for Quality Assurance/Quality Control.

Each survey data point can consist of counts from one or two site visits (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 reported as no data. 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 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
- All water samples reported below the detection limit of one fecal coliform $100mL^{-1}$ were reported as non-detects
- Reanalysis samples are reported

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 2.3. Both contractors and DEP staff conducted dispersal techniques. Beginning at 8:00 a.m. 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 in 2020/2021 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, DEP renewed an Intergovernmental Cooperative Service Agreement contract 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 2.3. Reservoir bird mitigation (August 1, 2020 to July 31, 2021).

Reservoir	Dates of Bird Dispersal and Deterrence	Bird Dispersal and Deterrence Measures Used
Kensico[1,2]	August 1, 2020 – July 31, 2021	• 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 •
Hillview[3]	August 1, 2020 - July 31, 2021	• 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, 2020 to March 31, 2021
[2] Egg and nest depredation for geese and swans were conducted from April 1 to May 31, 2021
[3] Egg and nest depredation for mallards and swallows were conducted from April 1 to July 31, 2021

Bird deterrent infrastructure 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 preventing 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. Alewives and other bait-sized fish were collected 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.

Waterbird Reproductive Management

City reservoirs offer ideal breeding habitat for a number of waterfowl species such as Canada geese, mute swans, double-crested cormorants (*Phalacrocorax auritus*), mallard ducks and others. Egg and nest depredation activities targeted locally breeding Canada geese, mallards (*Anas platyrhynchos*), and mute swans (*Cygnus olor*) on City reservoir property. 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. 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. A USFWS Permit (MB.789947-0) covered mallard and swallow depredation work at Hillview.

3. Results and Discussion

3.1 General Results

Waterbird Monitoring, Dispersal and Deterrent Measures

During the 2020/2021 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

DEP's surveillance program to document and suppress reproductive success and nest-site fidelity continues to be highly effective. Table A.1 in Appendix A summarizes the 2020/2021 program activities.

DEP conducted 37 field surveys and depredated (punctured) 46 Canada goose nests containing 220 eggs at six New York City Reservoirs (Table A.1) during the spring of 2021 compared to 52 Canada geese nests containing 255 eggs in 2020. There were no mute swan nests identified in 2021. DEP did not place identification bands on Canada geese or double-crested cormorants in 2021.

There was no goose or swan breeding activity recorded at Hillview. DEP depredated five mallard nests containing 48 eggs in 2021 compared to one nest containing seven eggs in 2020. There were five adult mallards depredated at Hillview in 2021. DEP and contractor staff conducted 109 surveys for nesting mallards at Hillview Reservoir in 2021.

3.2. Kensico Reservoir

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 with a temporary mid-winter elevation 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) when compared to the present day.

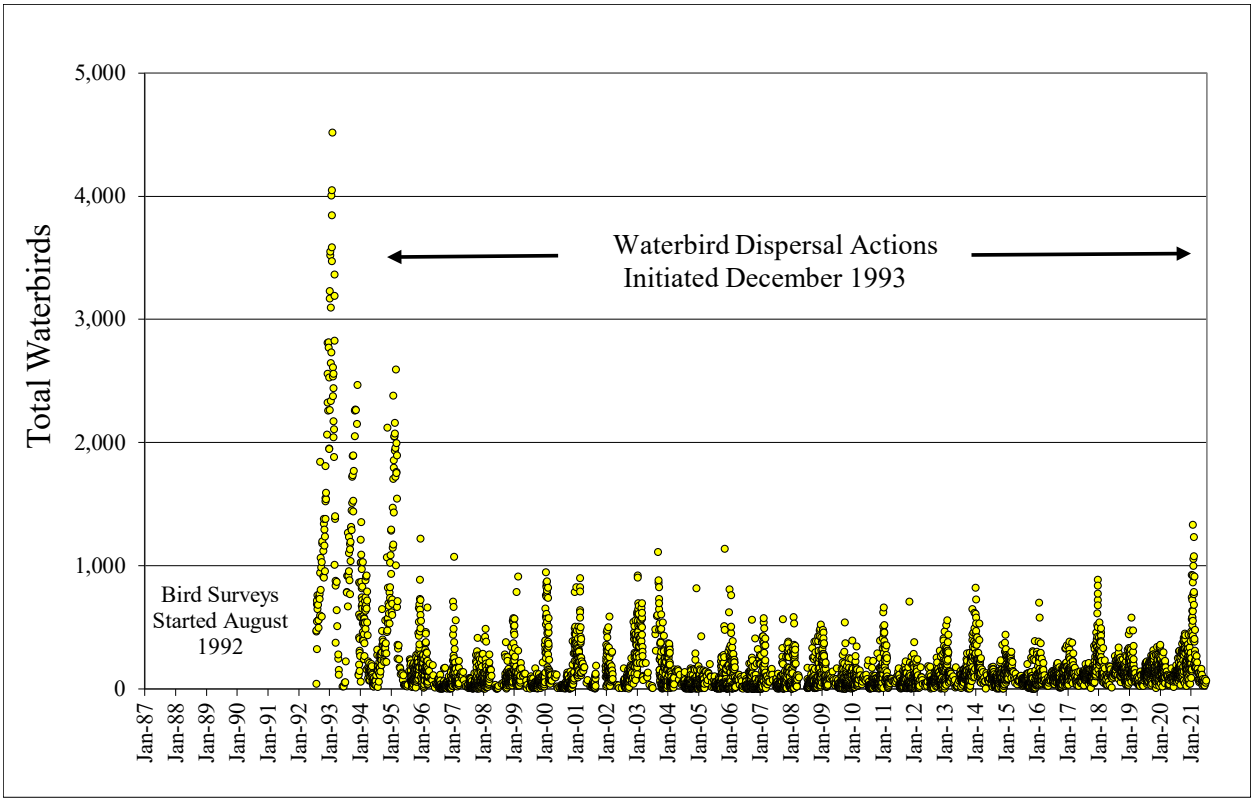

Figure 3.1. Kensico Reservoir waterbird totals.

Waterbird Monitoring

In 2020/2021, the DEP contractor attained 91% reportable data in completing reservoir-wide waterbird surveys. Approximately nine percent of the surveys were deemed "no reportable data" due to inadequate bird observations from unsuitable environmental conditions (e.g., fog, snow, or rain). Two hundred twenty reportable surveys were recorded from August 1, 2020 to March 31, 2021 (Figure 3.2) averaging about 243 birds per survey night compared to 143 in the previous reporting period. Waterbird activity spiked at 1,331 (184 geese, 55 gulls, and 1,036 ducks) on February 24, 2021 compared to a high count of 355 in the previous reporting period. The seasonal high count of gulls at 267 was recorded on October 17, 2020.

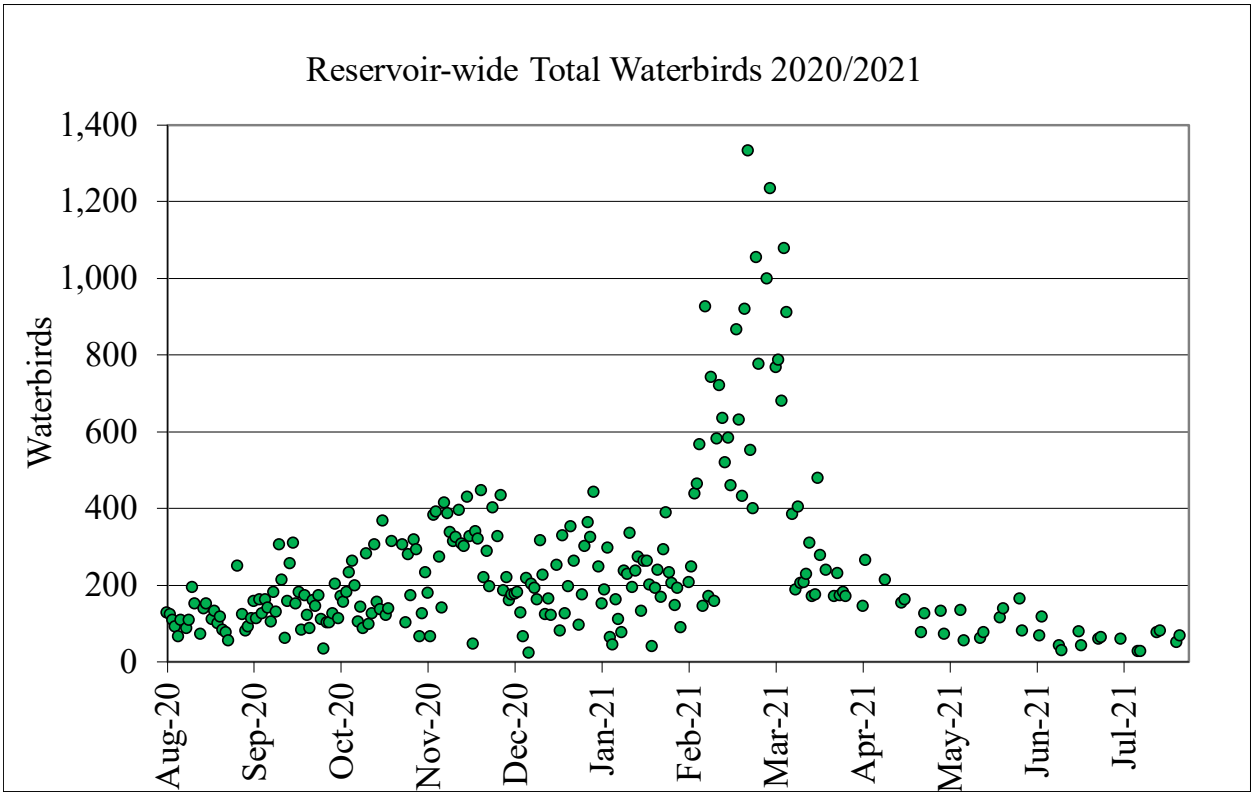

Figure 3.2. Kensico Reservoir total annual waterbirds (August 1, 2020 to July 31, 2021).

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.

In bird zone 2 (Figure 3.3), closest to Delaware Shaft 18 Effluent (DEL18DT), there were no observations of waterbirds on 218 of 230 reportable survey days (August 1 to March 31) or 95% of the time. The one-day high overnight count of 10 ducks observed on during the overnight survey on March 12, 2021 did not cause a fecal coliform bacterium elevation. During the non-dispersal period from April 1, 2021 to July 31, 2021, waterbirds were observed in zone 2 on only eight of 31 surveys with a high count of nine (five Canada geese and four ducks) during the spring/summer nesting season.

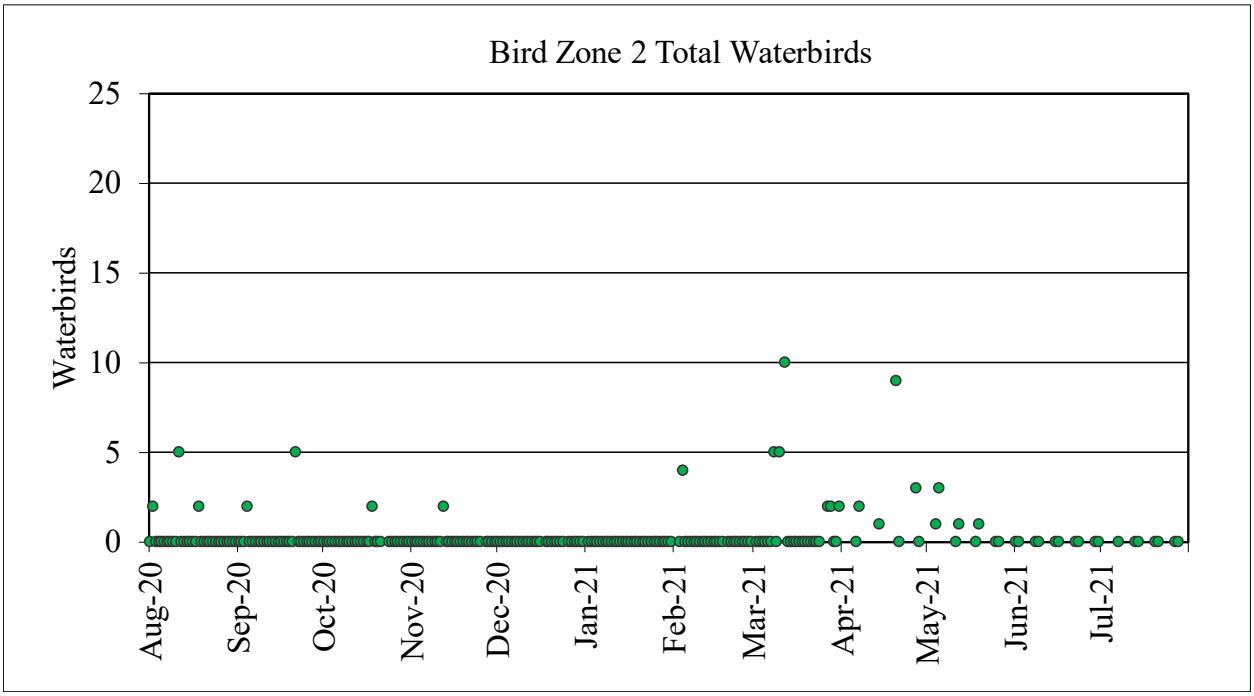

Figure 3.3. Kensico Reservoir bird zone 2 waterbirds (August 1, 2020 to July 31, 2021).

Birds were present on 12 out of 230 (5%) reportable survey days in bird zone 3 (Figure 3.4) during the August 1, 2020 to March 31, 2021 bird dispersal period. A high count of 69 geese was recorded on March 21, 2021.

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 49% of the total birds on the reservoir including 89% of gulls, 48% of ducks, and 7% of geese. There were no reportable data on 14 of the 243 or 6% of surveys conducted in bird zone 4 during the bird dispersal period (August 1, 2020 to March 31, 2021). The high count of waterbirds in zone 4 was recorded on February 23, 2021 with 477 waterbirds observed roosting overnight. The total high count of Canada geese was 42 observed on November 19, 2020 and the high gull count was on October 17, 2020 at 267 gulls, neither of which coincided with elevated bacteria levels.

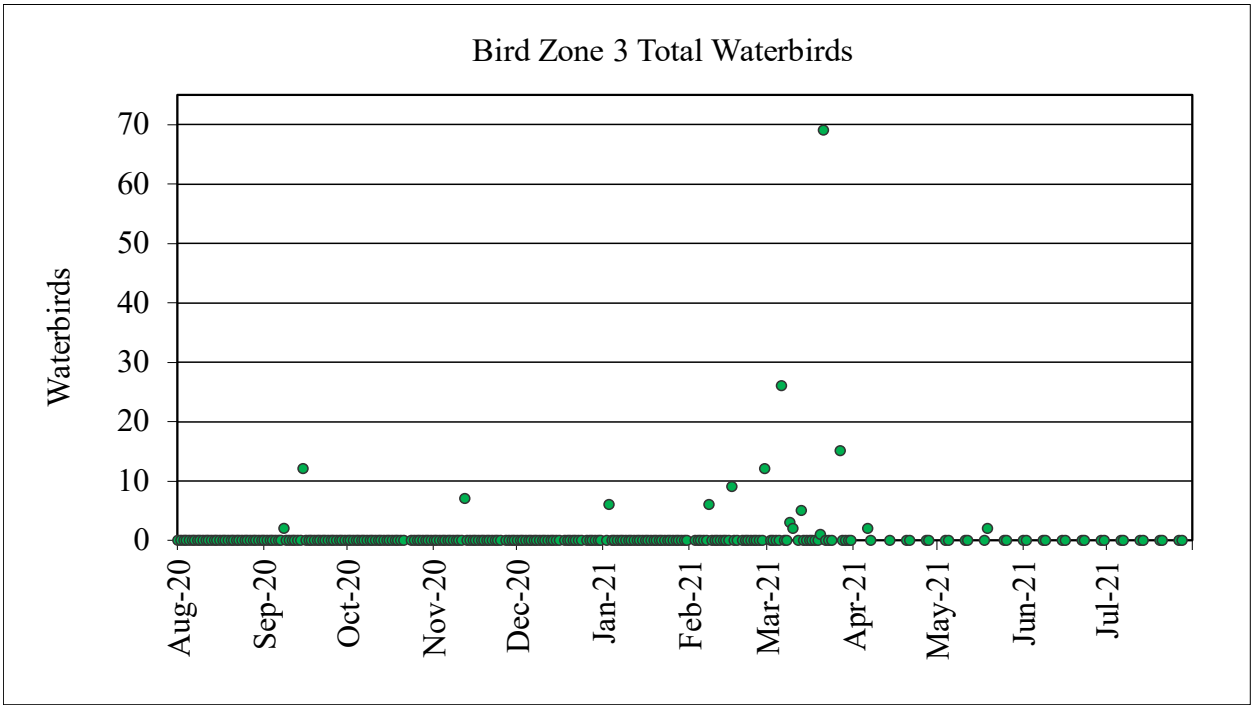

Figure 3.4. Kensico Reservoir bird zone 3 waterbirds (August 1, 2020 to July 31, 2021).

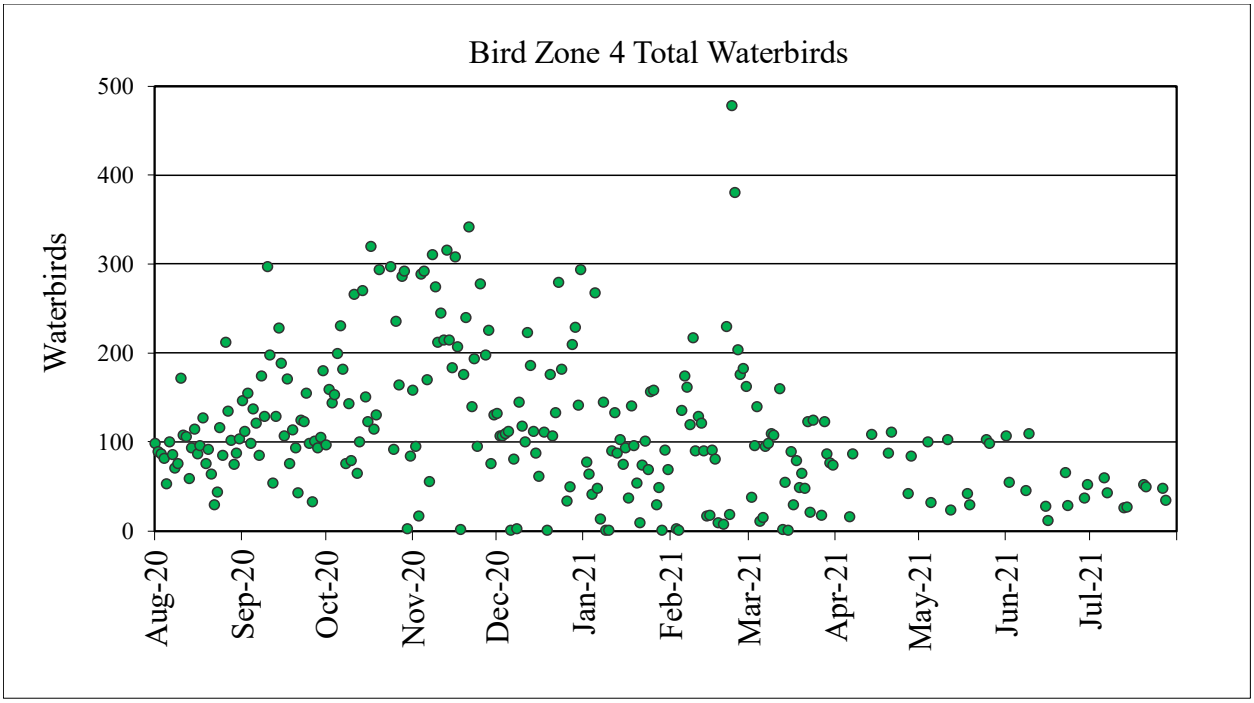

Figure 3.5. Kensico Reservoir bird zone 4 waterbirds (August 1, 2020 to July 31, 2021).

Canada geese, two species of gulls (Figure 3.6), ducks, swans, and cormorants make up the waterbird species typically observed at Kensico. The incidence of specific groups of waterbirds continues to follow trends for annual migration and over-wintering patterns at Kensico (Figure 3.7). Winter waterbird roosting locations are generally determined by extent of ice-cover, however during the winter of 2020/2021, ice-cover was mostly absent. Kensico reached 75% ice-cover on March 22, 2021 with minimal periods of partial ice-cover throughout the season. These conditions allowed continuous motorboat operations for bird dispersal activities. There was limited need for the operation of the two Biondo Airboats for bird dispersal activities due to the low incidence of ice-cover reported during this period.

During the bird dispersal period from August 1 to March 31, ducks continued to be the most commonly observed group averaging 199 birds per night or 75% of the total counts, compared to 99 birds per overnight count in 2019/2020. Gulls were the second most common group with an average nightly count of 37 birds (14%) compared to 46 birds per night in 2019/2020. Canada geese averaged 29 birds per night with reportable counts compared to six birds/night in 2019/2020.

Throughout the non-dispersal period from April 1 to July 31, 2021, geese averaged 11 birds per night, gulls averaged 10 birds per night and ducks averaged 74 birds per night. Total average bird counts in 2020/2021 was 95, identical to the 2019/2020 reporting period.

Figure 3.6. The ring-billed gull (left) and herring gull (right) are the predominant gull species that inhabit the NYC reservoirs primarily during the autumn and winter periods for migratory stop-overs and overwintering depending on food and open water availability.

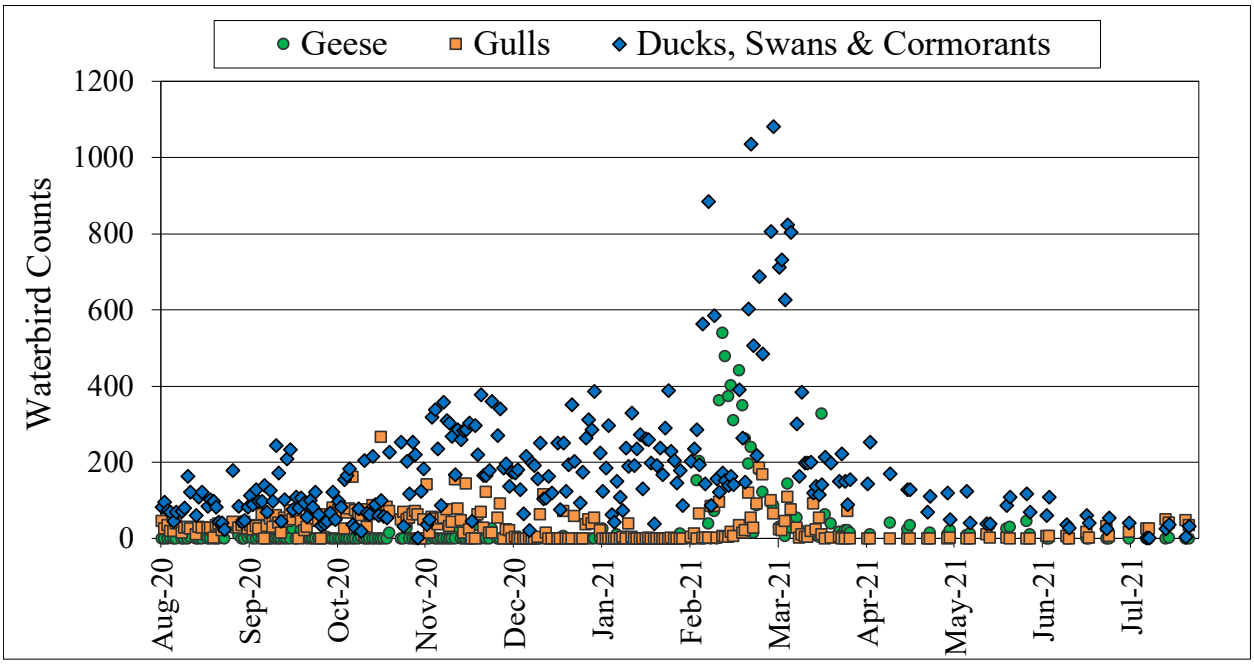

Figure 3.7. Kensico Reservoir bird guilds (August 1, 2020 to July 31, 2021).

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. Figure 3.8 displays the distance from the Kensico Dam security boom where waterbirds tend to roost approximately 0.5 miles to Shaft 18 where the keypoint water samples are collected.

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. Waterbirds use the dam security boom for roosting activity (Figure 3.9). Ducks were observed roosting overnight on the security boom while daytime roosting was more commons by gulls and cormorants. From the Kensico Dam, staff 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 (Figures 3.10 and 3.11).

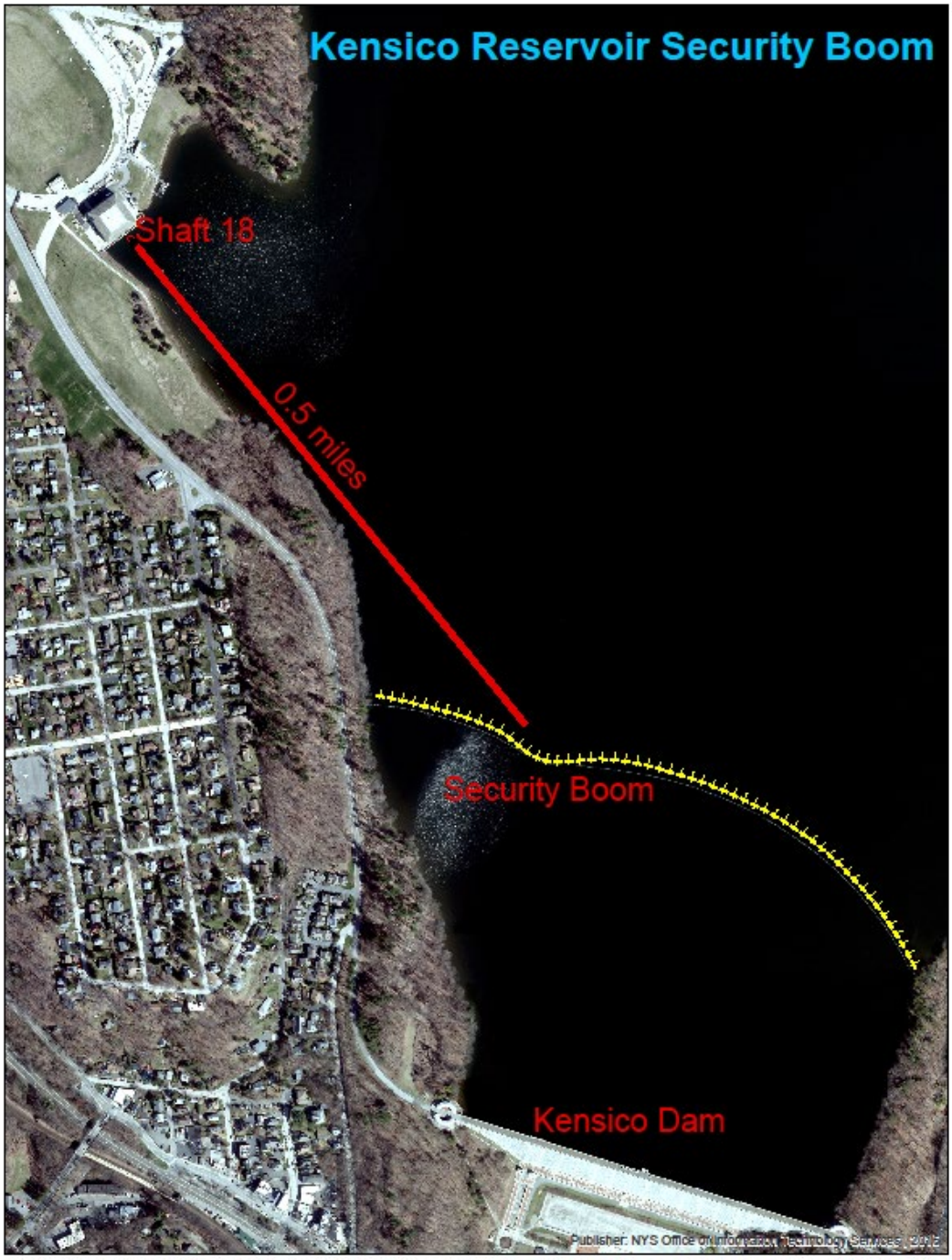

Figure 3.8. Distance from the Kensico Reservoir Dam security boom to Shaft 18.

Figure 3.9. Gulls being dispersed on the dam security boom at Kensico. Photo by Chris Nadareski.

From August 1, 2020 through March 31, 2021, there were 15,516 waterbird dispersal actions successfully dispersing 159,065 birds from the reservoir. Motorboat mitigation represented 68% of the dispersal actions followed by pyrotechnics at 22% and nearly 10% of the actions were from physical chasing. Of the waterbirds dispersed, 27% were gulls (down from 51%), 72% were ducks (up from 46%), and just over 1% were geese (slightly down from 2%).

Overall, the number of birds dispersed in 2020/2021 was up by approximately 11.5% when compared to the previous reporting year.

Figure 3.10. DEP wildlife staff using field tablet to record waterbird counts and pyrotechnic use at Kensico. Photo by Chris Nadareski.

Figure 3.11. Double-crested cormorants being dispersed at Kensico using watercraft. Photo by Chris Nadareski.

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 during this reporting period.

Figure 3.12 shows a long-term dramatic decline in fecal coliform bacteria simultaneous with the commencement of the bird dispersal efforts in December 1993, which continues through the present day.

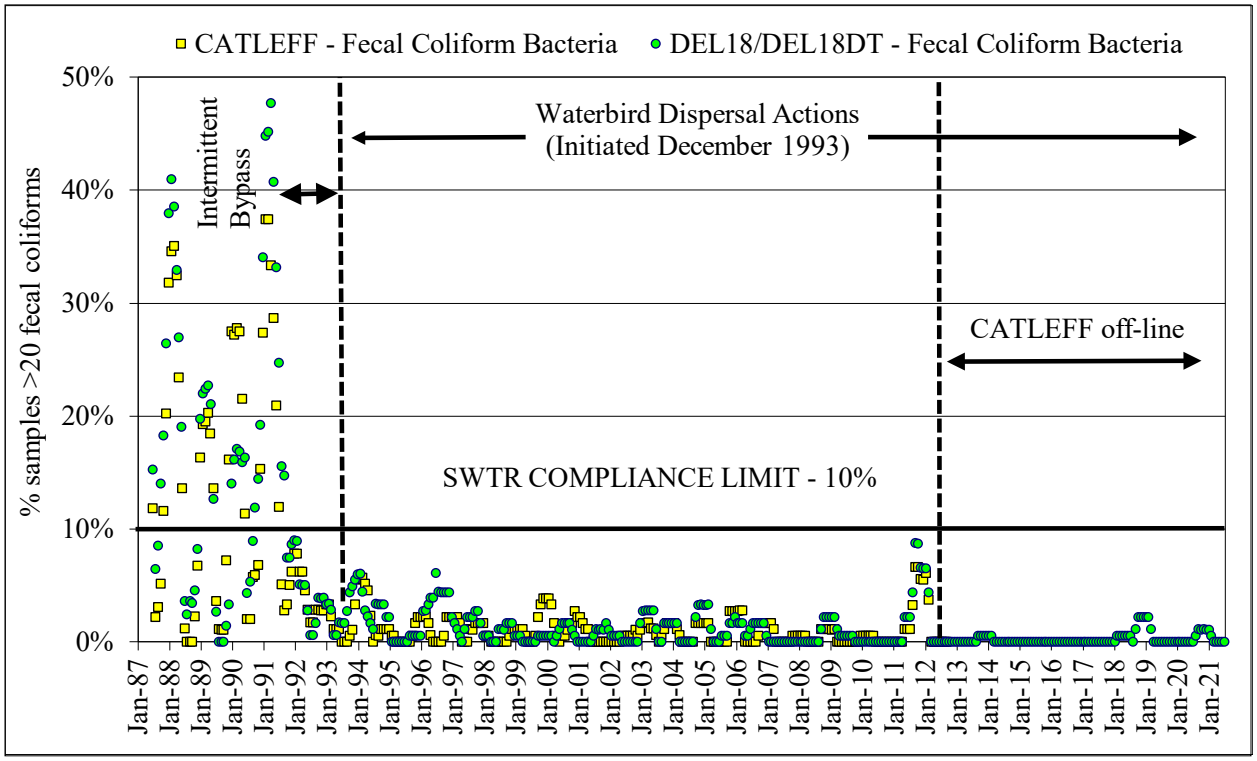

Figure 3.12. Kensico Reservoir Surface Water Treatment Rule compliance (fecal coliforms 100mL^{-1} at DEL18/DEL18DT/DEL18DTD and CATLEFF). Non-detects of fecal coliform are not included.

Figure 3.13 graphic shows a general association with elevated waterbird counts and slight increases in fecal coliform bacteria from September 2020 through early March 2021. Except for scattered intense precipitation events, 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.

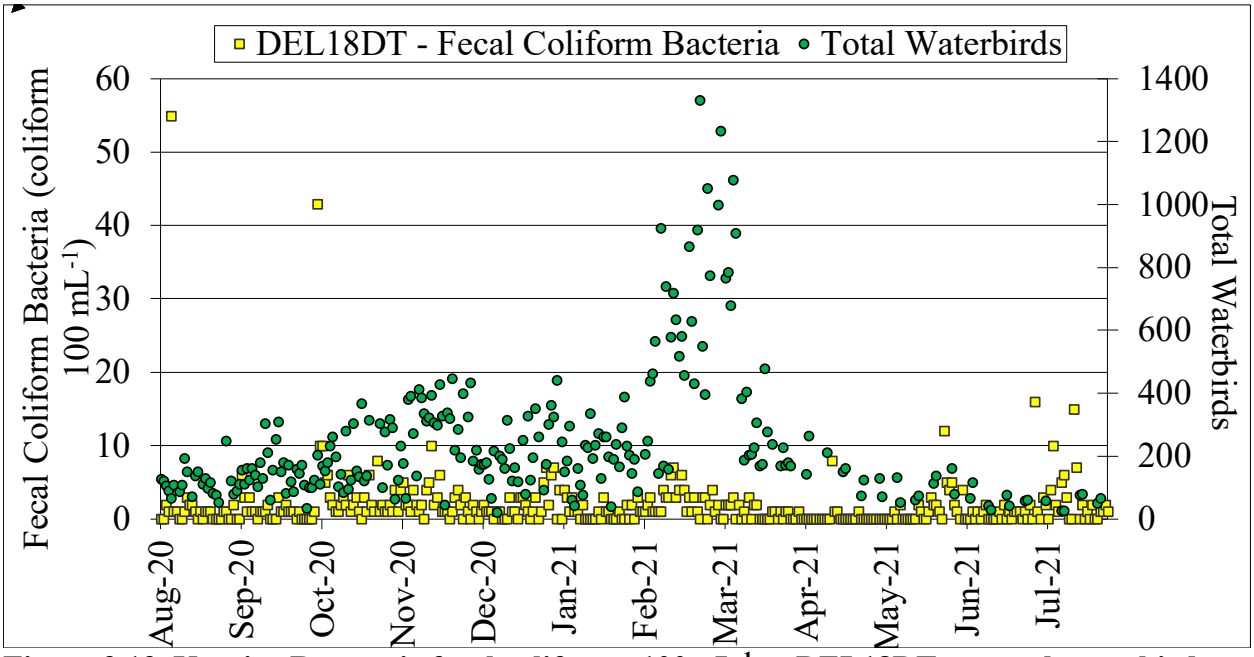

Figure 3.13. Kensico Reservoir fecal coliforms 100mL^{-1} at DEL18DT vs. total waterbirds (August 1, 2020 to July 31, 2021). Non-detects of fecal coliform are not included.

One hundred thirty eight out of 365 (38%) fecal coliform samples recorded at DEL18DT were non-detect (below the detection limit of one fecal coliform 100mL^{-1}) compared to 41% of the samples recorded in 2019/2020. In 2020, 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 2019 (DEP 2020). Non-detect fecal coliform counts during the waterbird dispersal period from August 1, 2020 through March 31, 2021 comprised 28% of the samples. During the non-dispersal period from April 1 to July 31, 2021 non-detects represented 57% of samples. Fecal coliform counts of less than or equal to five fecal coliforms 100mL^{-1} represented 91.5% of the annual samples. Twenty-nine fecal coliform samples collected at DEL18DT ranged from five to 16 fecal coliforms 100mL^{-1}.

Table 3.1 lists the highest fecal coliform counts 100mL^{-1} recorded at DEL18DT in 2020/2021 in relation to precipitation events and waterbird counts. During this reporting period there were two fecal coliform bacteria elevations that exceeded 20 fecal coliform 100mL^{-1}; one on August 5, 2020 (55 fecal coliforms 100mL^{-1}) and one on September 30, 2020 (43 fecal coliforms 100mL^{-1}). In comparison, there were no samples above the regulatory limit in 2019/2020 (DEP 2020). The August 5, 2020 sample was likely associated with a precipitation event ranging from 0.98 to 1.11 inches recorded in the previous three days. Bird counts remained relatively low in the bird zones closest to the water intake at 52 waterbirds and no birds were present in the bird zone 2 intake cove. The two aqueduct discharge facilities (DEL17 and CATIC

with water sampling location at CATALUM), supplying approximately 98% of the water entering Kensico, had fecal coliform bacteria samples recorded at nine and one fecal coliforms 100mL^{-1} from the DEL17 facility and CATALUM facility on August 5, respectively. The second elevation on September 30, 2020 was also associated with a precipitation event that ranged from 1.65 inches at the Westchester County Airport to 2.06 inches at the Kensico Meteorological Station. The waterbird counts in the bird zones closest to the water intake remained slightly elevated at 179 with no birds reported in the bird zone 2 intake cove. The DEL17 water sample was recorded at one fecal coliform 100mL^{-1} and the CATALUM sample was a non-detect (<1).

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
8/5/20	55 / E9 / E1	1.11	0.98	66 on 8/5/20	52 on 8/5/20
9/30/20	43 / E4 / <1	1.65	2.06	203 on 9/30/20	179 on 9/30/20

[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 three consecutive day precipitation events recorded at the Kensico Met Station, situated closest to the DEL18DT water quality sampling station in addition to those reported in Table 3.1 are listed in Table 3.2. The precipitation events reported on July 3 and July 10, 2021 may be associated with slight elevations in fecal coliform counts at the DEL18DT sampling site. Waterbird counts recorded on three of five precipitation dates do not appear to have had any impact on the fecal coliform data. Waterbirds recorded during the overnight roosting period are listed in Table 3.2.

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 3.14 compares the fecal coliform bacteria levels entering the reservoir at the DEL17 water sampling location with those leaving through the DEL18DT sampling location. Elevated fecal coliform bacteria entering

Kensico from the Delaware Aqueduct (DEL17) are generally associated with slightly higher 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.

Table 3.2. Highest three consecutive day 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 fecal coliform 100mL^{-1} (E = estimated count based on non-ideal plate)	[1]Precipitation within 3 days of elevated fecal coliform fecal coliform 100 mL^{-1} (inches rounded to the nearest 100th).	Waterbird Counts Reservoir-wide totals	Waterbird Counts in bird zones 2, 3, and 4 totals
10/29/20	E1	1.96	292 on 10/29/20	291 on 10/29/20
5/30/21	E5	2.37	138 on 5/26/21	98 on 5/26/21
6/9/21	E1	2.26	116 on 6/9/21	109 on 6/9/21
7/3/21	E16	1.57	62 on 6/30/21	51 on 6/30/21
7/10/21	E10	2.96	59 on 7/7/21	42 on 7/7/21

[1] **Precipitation data reported from DEP Kensico Reservoir (Shaft 18), Valhalla, New York**

Figure 3.15 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 some associated elevations of fecal coliform bacteria between the Catskill CATALUM sampling location and DEL18DT during the late spring, summer, and autumn periods. The Catskill Aqueduct was shut down for maintenance and repairs from early December 2020 through early February 2021 and therefore no fecal coliform data was reported from the CATALUM facility during the time.

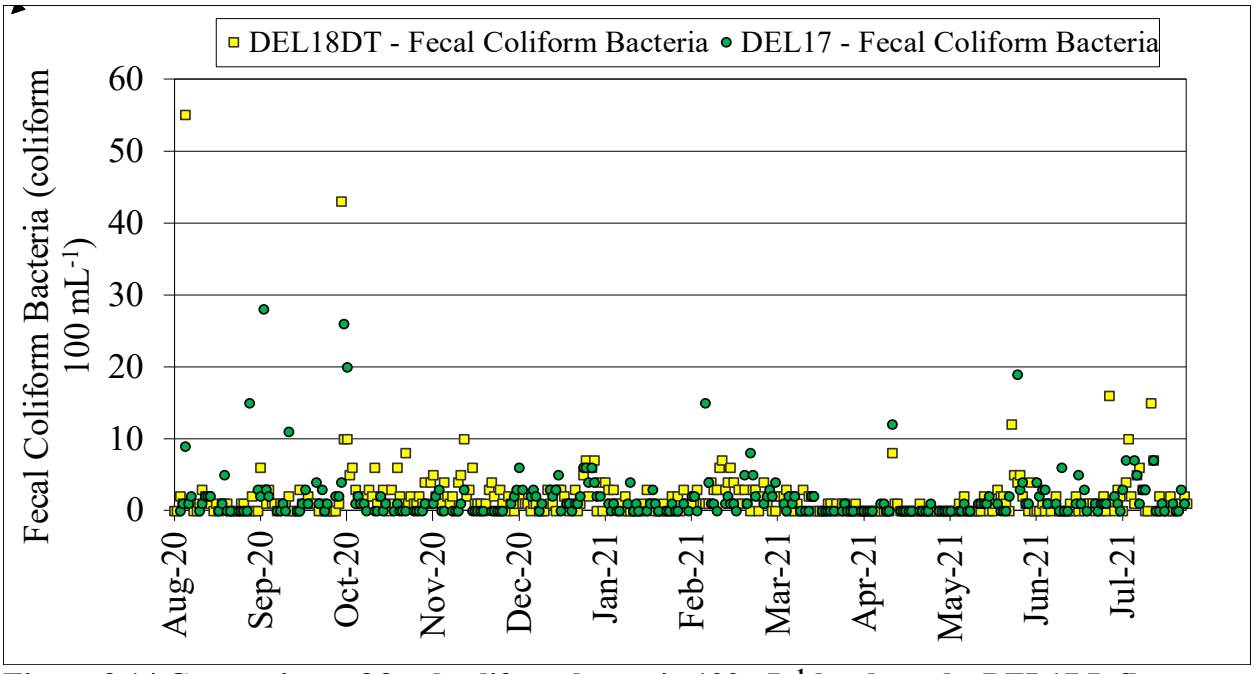

Figure 3.14 Comparison of fecal coliform bacteria 100mL^{-1} levels at the DEL17 Influent entering the reservoir and DEL18DT Effluent leaving the reservoir.

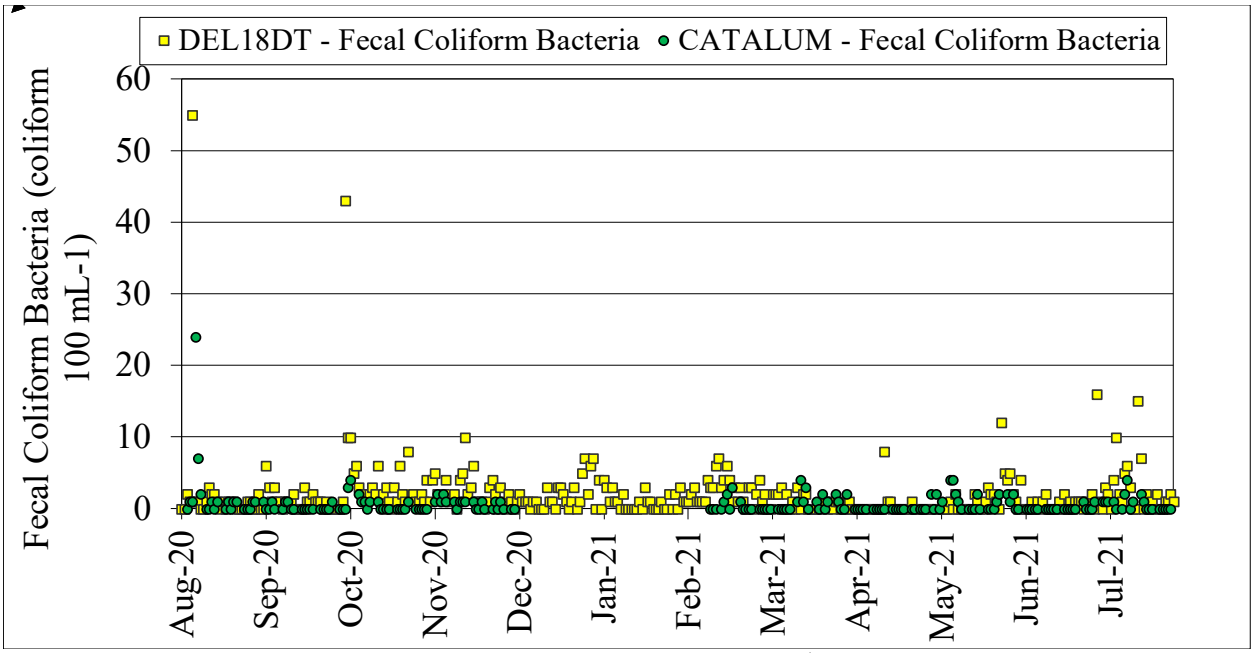

Figure 3.15. Comparison of fecal coliform bacteria 100mL^{-1} levels at the CATALUM Influent entering the reservoir and DEL18DT Effluent leaving the reservoir.

Nest and Egg Depredation

In the spring of 2021, a total of 8 Canada goose nests were found along the reservoir shoreline and on islands compared to 12 in 2020 (Appendix A, Table A.1); a 33% decrease in nesting activity. The findings demonstrate a second consecutive year with a significant decline in nesting geese that can be attributed to the depredation activity conducted by the USDA Wildlife Services for air-traffic safety from Westchester County Airport.

Twenty-nine eggs were depredated and placed back in the nests to allow the geese to continue to incubate in comparison to 53 eggs in 2020 (Figure 3.16). The average number of eggs per nest in 2021 was 3.6, as compared to 4.6 in the previous year. No hatch year geese (goslings) were observed in 2021 compared to three reported in the previous year, rendering the egg depredation success at 100% in 2021. Adult breeding geese or failed breeders generally disperse from the reservoir prior to the post-breeding season molt, which begins in June.

There were no mute swan nests observed at Kensico in 2021; however, there was one adult present. There were no double-crested cormorant nests observed but a new roosting location was recorded in bird zone 1 at Kensico during the 2021-nesting season.

Figure 3.16. Island searches for nesting Canada geese and pair of geese incubating eggs. 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 2020/2021 similar to the past two reporting seasons.

The netting installed on the DEL18DT sampling facility intake openings to prevent terrestrial bird species such as swallows, pigeons, starlings, and sparrows from nesting inside the effluent facility was seasonally inspected for integrity.

Canada Goose 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 keep 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. There were no airport depredation actions deemed necessary during this reporting period by USDA personnel under contract with the HPN.

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 2020/2021 DEP Wildlife Studies and contractor staff conducted 26 wildlife sanitary surveys adjacent to the Delaware Shaft 18 effluent. All wildlife excrement samples were identified to species, and disposed of off reservoir property.

Table 3.3 details the total wildlife excrement piles by species collected near the DEL18DT sampling location during this reporting period. The total collection represents a 37% increase from the previous reporting period in response to an increased number of surveys, 26 compared to 19, and a greater number of precipitation events recorded above one inch. Passerine birds, white-tailed deer (Figure 3.17), and Canada goose, were found in the highest concentrations on the sanitary surveys. Of the 602 excrement samples collected 594 or 99% were confirmed to species level.

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

Date of Survey	White-tail Deer	Raccoon	Cottontail Rabbit	Geese/ Waterfowl	Coyote/ Fox	Passerine (birds)	Mink	Other/Unknown Mammal	Total (all species)
8/3/20	2	0	0	0	0	0	0	0	**2**
8/13/20	0	0	0	0	0	0	0	0	**0**
9/9/20	0	0	0	0	0	0	0	0	**0**
9/28/20	2	12	0	0	1	0	0	0	**15**
10/3/20	0	0	0	0	0	0	0	1	**1**
10/16/20	3	0	0	0	1	8	0	0	**12**
10/28/20	5	7	0	0	0	11	0	0	**23**
11/10/20	5	1	1	2	0	0	1	0	**10**
11/23/20	68	0	7	0	0	0	1	0	**76**
11/29/20	16	1	5	0	0	0	0	0	**22**
12/3/20	5	3	0	0	0	0	0	2	**10**
12/16/20	21	5	15	0	0	0	0	0	**41**
12/24/20	15	0	7	4	0	0	0	0	**26**
12/31/20	22	0	1	0	0	0	0	1	**24**
1/15/21	7	0	1	0	0	0	0	1	**9**
2/28/21	16	2	3	8	0	0	0	2	**31**
4/14/21	0	0	0	52	0	0	0	1	**53**
4/21/21	0	0	0	8	0	0	0	0	**8**
5/4/21	0	0	0	14	0	0	0	0	**14**
5/26/21	0	0	0	32	0	43	0	0	**75**
6/9/21	0	0	0	4	0	2	0	0	**6**
6/15/21	0	0	0	0	1	8	0	0	**9**
6/22/21	0	0	0	0	0	25	1	0	**26**
6/30/21	0	0	0	0	0	58	0	0	**58**
7/6/21	0	0	0	0	0	48	0	0	**48**
7/27/21	0	0	0	0	0	3	0	0	**3**
Total by Species	**187**	**31**	**40**	**124**	**3**	**206**	**3**	**8**	**602**

Figure 3.17. White-tailed deer at Kensico. Photo by M. Reid.

Endangered Species Compliance

In the spring of 2021, DEP reconfirmed a nesting pair of bald eagles on the eastern side of Kensico Reservoir within ½ mile of the Westchester County Airport. Under the federal (USFWS) Bald and Golden Eagle Protection Act (BGEPA) 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.

Figure 3.18 shows the location where a pair of NYS endangered peregrine falcons bred in 2020 and 2021. DEP monitors the falcon's breeding activity and submits an annual report to the

NYSDEC for compliance.

Figure 3.18. Kensico Reservoir Rye Bridge where NYS endangered peregrine falcons nest. Photos by Chris Nadareski

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, 2020 through April 15, 2021 (Figure 3.19) to record annual trends that aid in identifying sources of elevated fecal coliform bacteria levels.

In overnight surveys from August 1 through mid-November 2020, waterbird counts ranged from three to 204 birds. Waterbird counts increased markedly from mid-November through mid-April reaching a high count of 2,613 on December 11, 2020 (Figure 3.19). Gulls peaked at 320 on March 5, 2020 and were only present on five of 18 reportable surveys. Canada geese peaked at 156 on February 2, 2021. Waterfowl, mostly ducks (mallards and common mergansers) were present on all 18 surveys and peaked at 2,613 on December 11, 2020.

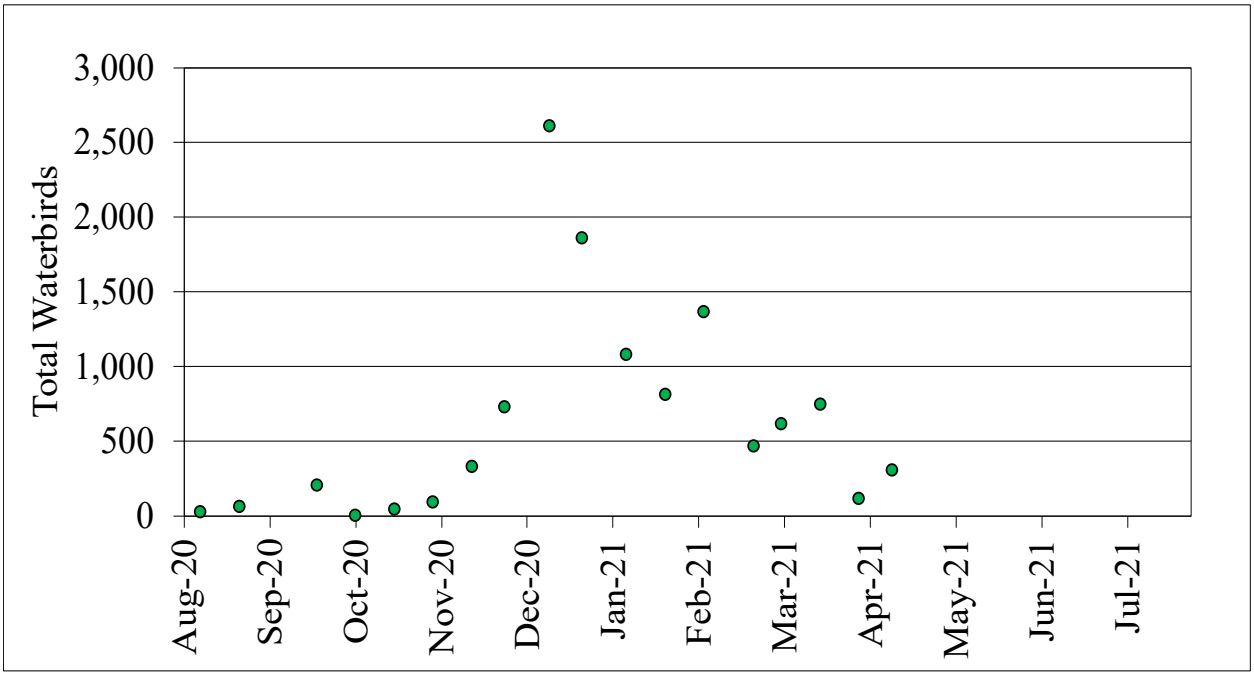

Figure 3.19. West Branch Reservoir total waterbirds (August 1, 2020 to July 31, 2021).

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. The primary trigger to implement "as needed" bird dispersal actions are fecal coliform bacteria concentrations, such that 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 CWB.1.5 from August 1, 2020 through July 31, 2021 (Figure 3.20). Of 260 water samples collected over the period from August 3, 2020 to July 30, 2021, 60% (156/260) were non-detect for fecal coliform bacteria.

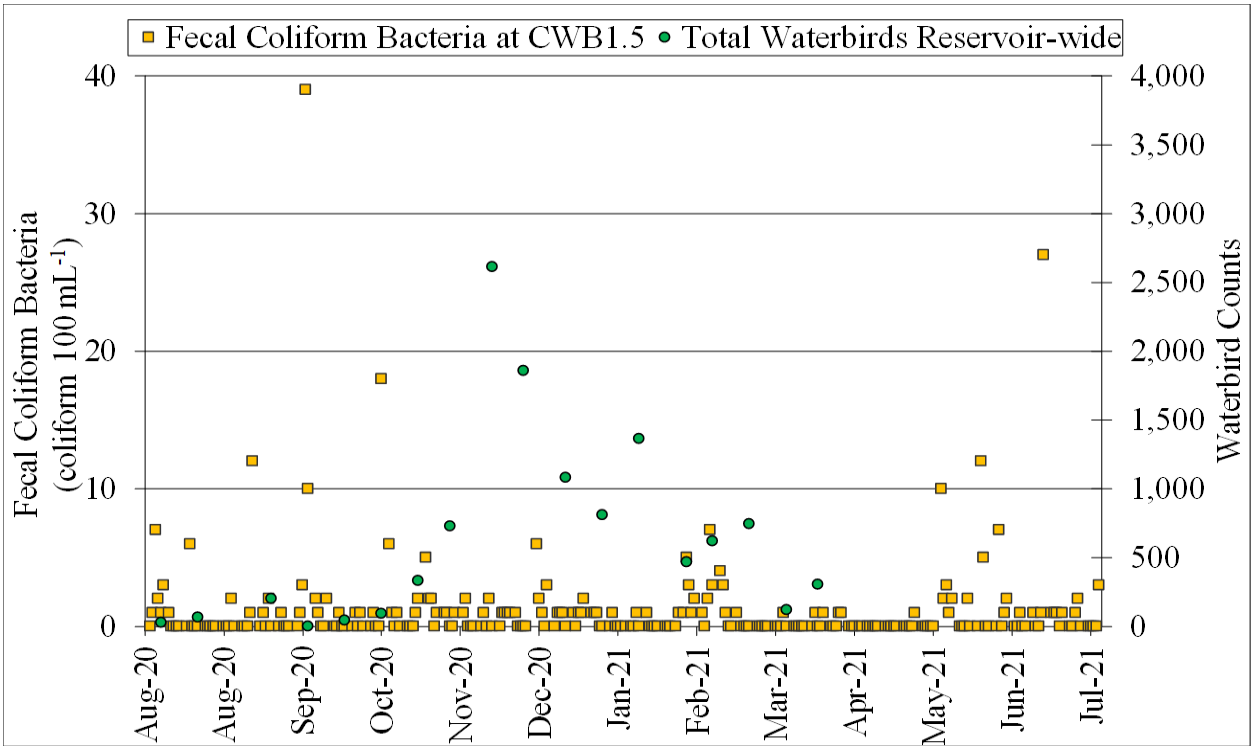

Figure 3.20. West Branch Reservoir fecal coliforms 100mL^{-1} at CWB.1.5 vs. total waterbirds (August 1, 2020 to July 31, 2021). Non-detects of fecal coliform are not included.

In 2020, a coliform-restricted assessment based on compliance with the SWTR for West Branch Reservoir determined that the basin status was 'non-restricted'. Figure 3.21 demonstrates the five-year comparison of fecal coliform bacteria recorded at the CWB.1.5 water quality sampling location and total waterbird counts from August 1 through April 1 annually. The annual waterbird peaks do not exhibit a clear relationship with elevated bacteria levels.

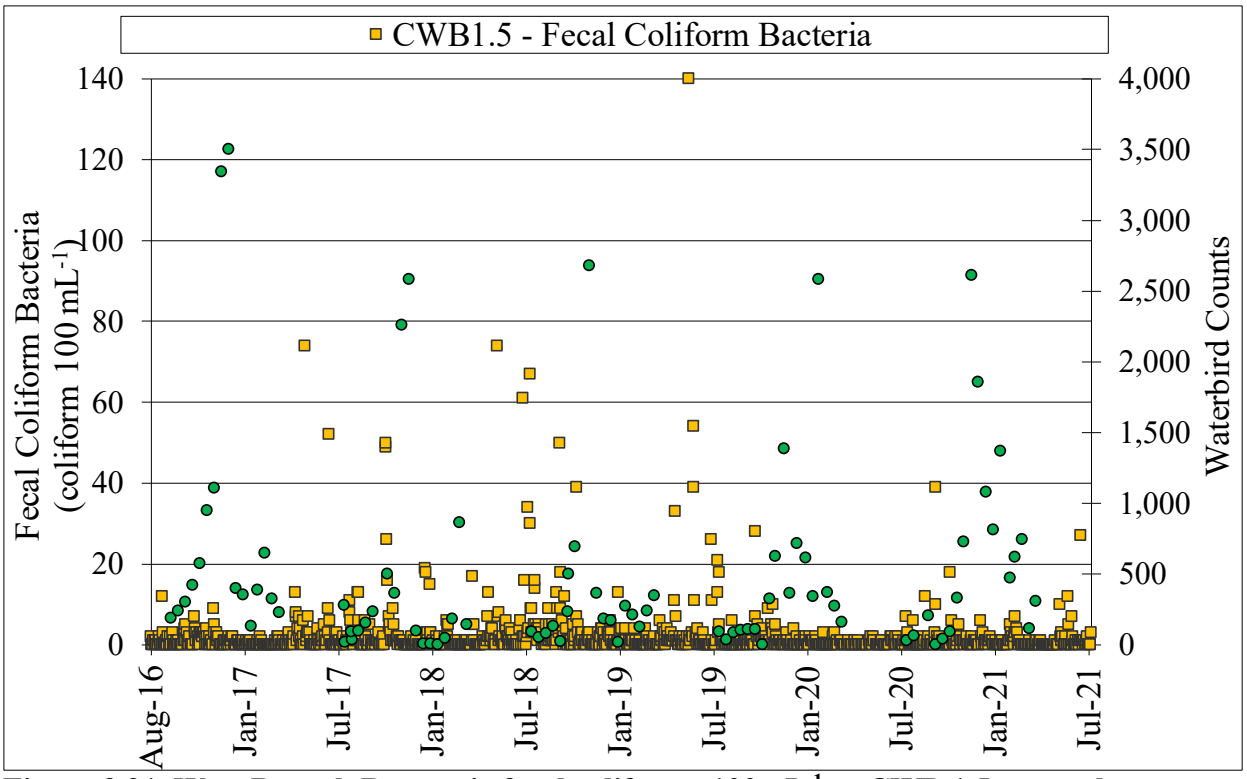

Figure 3.21. West Branch Reservoir fecal coliforms 100mL^{-1} at CWB.1.5 vs. total waterbirds August 1, 2016 to July 31, 2021). Non-detects of fecal coliform are not included.

Additional Surveys

DEP Water Quality Aqueduct Monitoring staff conducted additional daytime bird observations (un-aided eye) 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), adjacent to water quality sampling site CWB.1.5 are listed in Table 3.4. Twenty-four of 42 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
08/3/20	11:10	1-50
08/14/20	10:50	1-50
08/19/20	11:05	1-50
09/02/20	09:44	1-50
09/09/20	09:53	1-50
10/07/20	09:57	1-50
10/14/20	09:49	1-50
10/21/20	09:41	1-50
10/28/20	10:19	1-50
11/04/20	10:00	1-50
12/02/20	10:18	1-50
12/16/20	09:33	1-50
12/23/20	10:06	1-50
01/13/21	12:00	1-50
02/17/21	10:53	1-50
03/03/21	12:15	1-50
03/10/21	11:36	1-50
03/31/21	11:37	1-50
04/14/21	11:37	1-50
05/12/21	12:35	1-50
06/09/21	12:03	1-50
06/16/21	12:37	1-50
07/14/21	09:51	1-50
07/28/21	11:21	1-50

Nest and Egg Depredation

DEP conducted reproductive control on nesting Canada geese from April 1 through May 31, in 2021 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 2021, seven nests with 30 eggs were depredated compared to six nests and 26 eggs depredated in 2020 (Appendix A, Table A.1). Egg depredation efforts were deemed 100% successful. There were no mute swans or double-crested cormorants observed nesting at West Branch during the spring of 2021.

Deterrence

DEP continued to inspect 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 at West Branch Reservoir. Photo by Chris Nadareski.

Endangered Species Compliance

There was one active bald eagle nest at West Branch during the 2021nesting 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. 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 conducted in 2006.

Waterbird Monitoring

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

Water Quality Summary

In 2020/2021, there were no bacteria counts above 20 fecal coliforms 100mL^{-1} in samples collected from the Rondout Effluent Chamber (REC) in Figure 3.23. Of 212 water samples collected over the period from August 3, 2020 to July 29, 2021, no fecal coliform bacteria were detected in 106 (50%) of the samples.

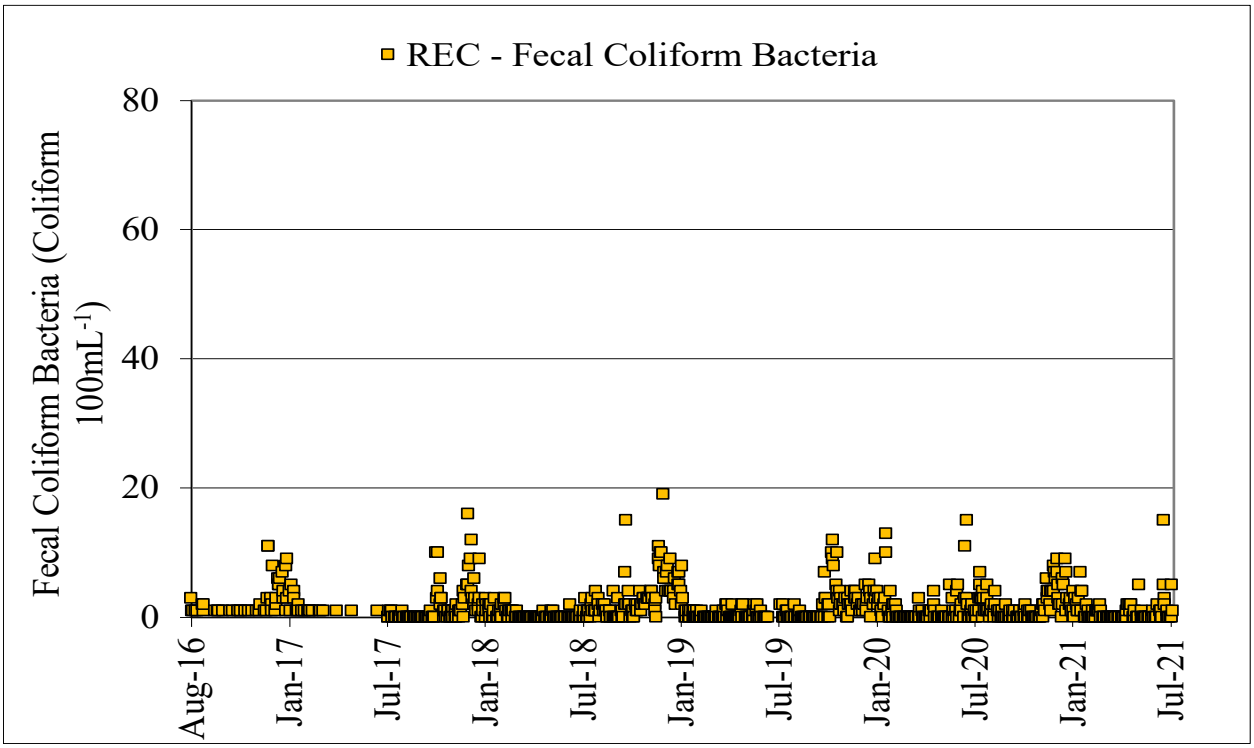

Figure 3.23. Rondout Reservoir fecal coliforms 100mL^{-1} at Rondout Effluent (August 1, 2016 to July 29, 2021). Non-detects of fecal coliform are not included.

Figure 3.23 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 2020, a coliform-restricted assessment determined that the Rondout basin status was 'non-restricted'.

Additional Surveys

DEP Aqueduct Monitoring staff conducted 50 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. Eleven of the 50 surveys reported bird counts ranging from one to 50.

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

Date	Time of Observation	Bird Count Range or Actual Bird Counts
08/10/20	10:16	1-50
09/01/20	09:04	1-50
09/08/20	10:07	6
09/14/20	10:47	1-50
10/19/20	10:54	1-50
11/09/20	09:48	1-50
12/04/20	08:05	1-50
03/22/21	11:10	1-50
06/01/21	10:23	1-50
06/07/21	10:53	1-50
07/19/21	11:24	1-50

Waterbird Dispersal Actions

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

Nest and Egg Depredation

DEP also conducted reproductive control of nesting Canada geese at Rondout in the spring of 2021 (Figure 3.24). 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.

Figure 3.24. Territorial pair of Canada Geese (left) and nest with marked depredated eggs. Photos by Chris Nadareski

Three Canada goose nests containing 15 eggs were depredated during the spring of 2021 compared to three nests with 14 eggs depredated in 2020 (Appendix A, Table A.1). Figure 3.25 shows a Canada goose nest on an island on the western end of the reservoir. Five goslings were documented at the reservoir spillways in 2021 resulting in a 75% success rate. There were no mute swan or double-crested cormorant nests observed at Rondout Reservoir in 2021.

Figure 3.25. Springtime surveys for Canada goose nests (red flag) on islands at Rondout Reservoir. Photos by Chris Nadareski.

Endangered Species Compliance

There were two active bald eagle nests at Rondout during the 2021 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 2020/2021.

Waterbird Monitoring

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

Water Quality Summary

Figure 3.26 shows the fecal coliform bacteria 100mL^{-1} levels recorded since from August 1, 2016 through July 29, 2021 at the EARCM water quality sampling location on the reservoir's east basin.

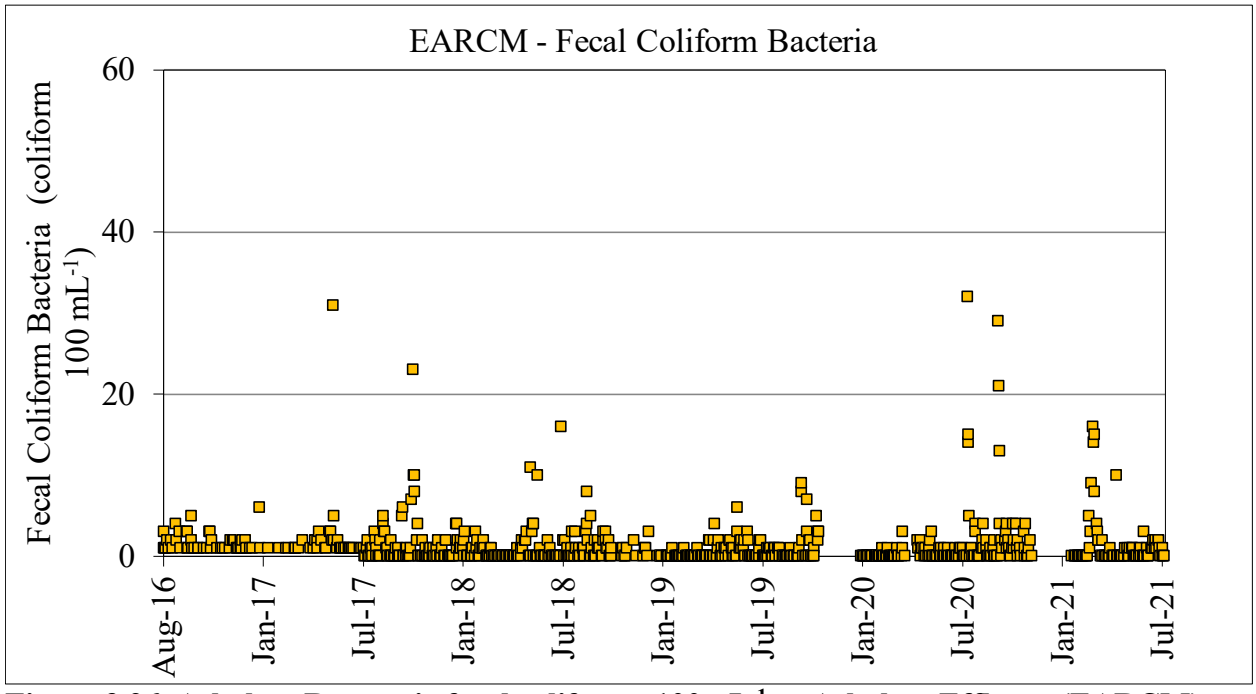

Figure 3.26. Ashokan Reservoir fecal coliforms 100mL^{-1} at Ashokan Effluent (EARCM) August 1, 2016 to July 29, 2021. Non-detects of fecal coliform are not included.

In 2020, a coliform-restricted assessment for Ashokan Reservoir determined that the basin status was 'non-restricted' status. Of 165 fecal coliform bacteria samples collected over the period from August 3, 2020 to July 29, 2021, eighty-four (51%) were non-detects for fecal coliform bacteria present. There were three bacteria samples reported above the 20 fecal coliform bacteria 100mL^{-1} level during this reporting period. Figure 3.27 shows gulls roosting on reservoir shaft buildings monitored by DEP wildlife staff throughout the year.

Figure 3.27. Monitoring shaft building rooftop waterbird roosting at the Ashokan Reservoir east basin.

Additional Surveys

DEP Aqueduct Monitoring staff conducted daytime bird observations (un-aided eye) during routine site visits. Eleven of the 26 observations reported birds at the Ashokan East Basin Effluent and 13 of 26 reported birds at the Ashokan West Basin Effluent during this reporting 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
08/03/20	11:10	1-50
08/17/20	11:41	1-50
08/31/20	09:16	1-50
09/14/20	10:08	1-50
09/28/20	10:43	1-50
10/26/20	11:54	1-50
03/22/21	09:37	1-50
04/19/21	09:57	1-50
06/01/21	09:35	1-50
06/07/21	10:07	1-50
06/21/21	09:25	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
08/10/20	09:17	1-50
08/17/20	11:41	1-50
08/24/20	10:16	1-50
08/31/20	09:16	1-50
09/14/20	10:11	1-50
09/28/20	10:43	1-50
10/26/20	11:54	1-50
03/22/21	09:37	1-50
04/19/21	09:58	1-50
06/07/21	10:08	1-50
06/21/21	09:26	1-50
07/06/21	11:31	1-50
07/19/20	09:23	1-50

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.

Nest and Egg Depredation

DEP conducted reproductive control on nesting Canada geese from April 1 through May 31, 2021. In 2021, eight Canada goose nests were identified and 40 eggs were depredated

(Appendix A, Table A.1). In the previous reporting period, six Canada goose nests were identified with 33 eggs depredated. The egg-depredation success rate at the Ashokan Reservoir was 95% in 2021. Two goslings were observed in late spring 2021 compared to five in 2020. There were no mute swans or double-crested cormorants found nesting in 2021.

Endangered Species Compliance

DEP monitored and recorded three nesting pairs of bald eagles at the Ashokan Reservoir in 2021. 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 3.28). DEP Wildlife Studies staff conducted seasonal surveys at all bald eagle nest sites for compliance with the DEP Bald Eagle Conservation Plan.

Figure 3.28. Adult bald eagle incubating. Photo by Michael Reid.

3.6. Croton Falls Reservoir

The 2017 FAD lists Croton Falls Reservoir (Figure 3.29) 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.

Figure 3.29. Croton Falls Reservoir Dam, effluent facility, spillway and waterbird observation site. Photo by C. Nadareski.

Waterbird Monitoring

The reservoir is divided into five bird zones associated with reservoir water quality sampling sites (Appendix B, Figure B.8). DEP was not required conduct overnight waterbird surveys during the 2020/2021 for compliance with DEP's Operational Guidance Plan (Croton Falls Pump Station Operations Monitoring). There were no supplemental waterbird surveys under the FAD requirement conducted during this reporting period.

Water Quality Summary

Of eleven water quality samples collected over the period from September 8, 2020 to July 13, 2021, 36% were non-detectable and two samples were above the 20 fecal coliform 100mL^{-1} limit. Figure 3.30 demonstrates a relationship between elevated waterbird counts (2019/2020 only) and elevated fecal coliform bacteria at the Croton Falls Keypoint water sampling location (CROFALLSVC).

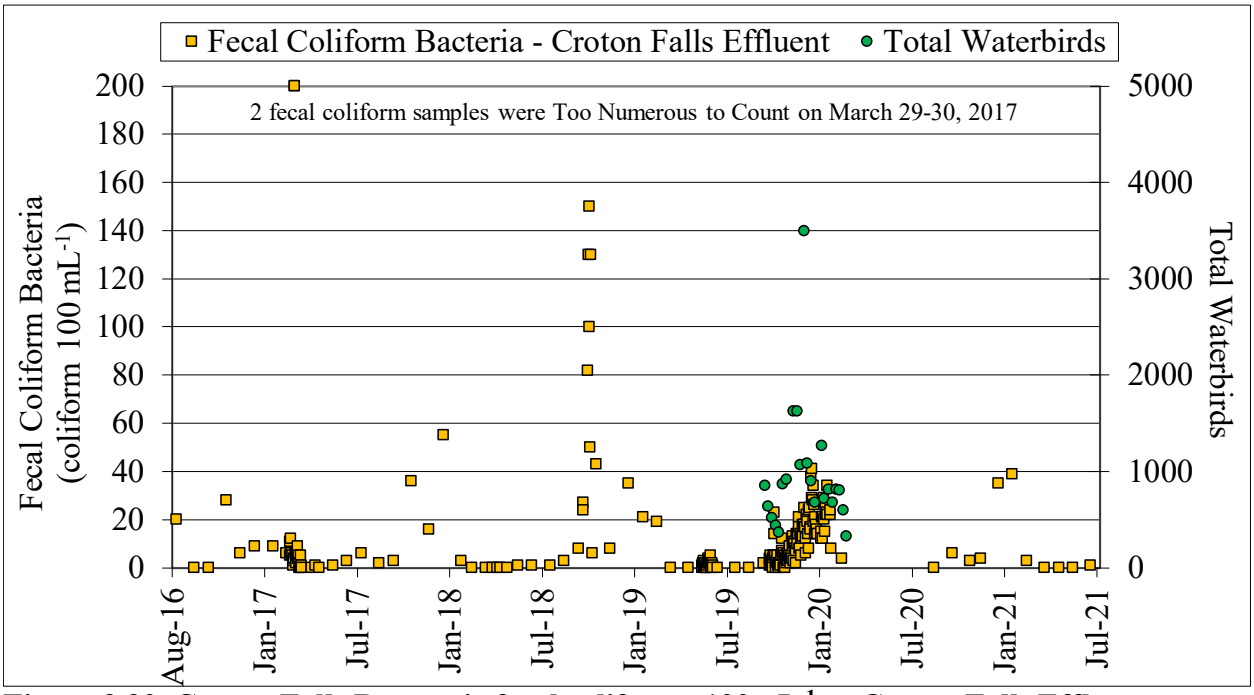

Figure 3.30. Croton Falls Reservoir fecal coliforms 100mL^{-1} at Croton Falls Effluent vs. total waterbirds (August 1, 2016 to July 31, 2021). Non-detects of fecal coliform are not included.

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.

Nest and Egg Depredation

DEP conducted eight site visits for reproductive control of Canada geese from April 1 through May 31, 2021 to reduce fecundity at Croton Falls (Appendix A, Table A.1). In 2021, nine Canada geese nests were identified with 49 eggs depredated compared to 15 nests and 82 eggs in 2020. The Canada goose egg-depredation success rate at Croton Falls for 2021 was 100% with no goslings that hatched. There were no mute swan or double-crested cormorant nests observed in 2021.

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 bird zones associated with reservoir water quality sampling locations (Appendix B, Figure B.9). DEP was not required conduct overnight waterbird surveys during the 2020/2021 for compliance with DEP's Operational Guidance Plan (Cross River Pump Station Operations Monitoring). There were no supplemental waterbird surveys under the FAD requirement conducted during this reporting period.

Water Quality Summary

Of the 11 water samples collected and analyzed from September 8, 2020 to July 13, 2021 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.

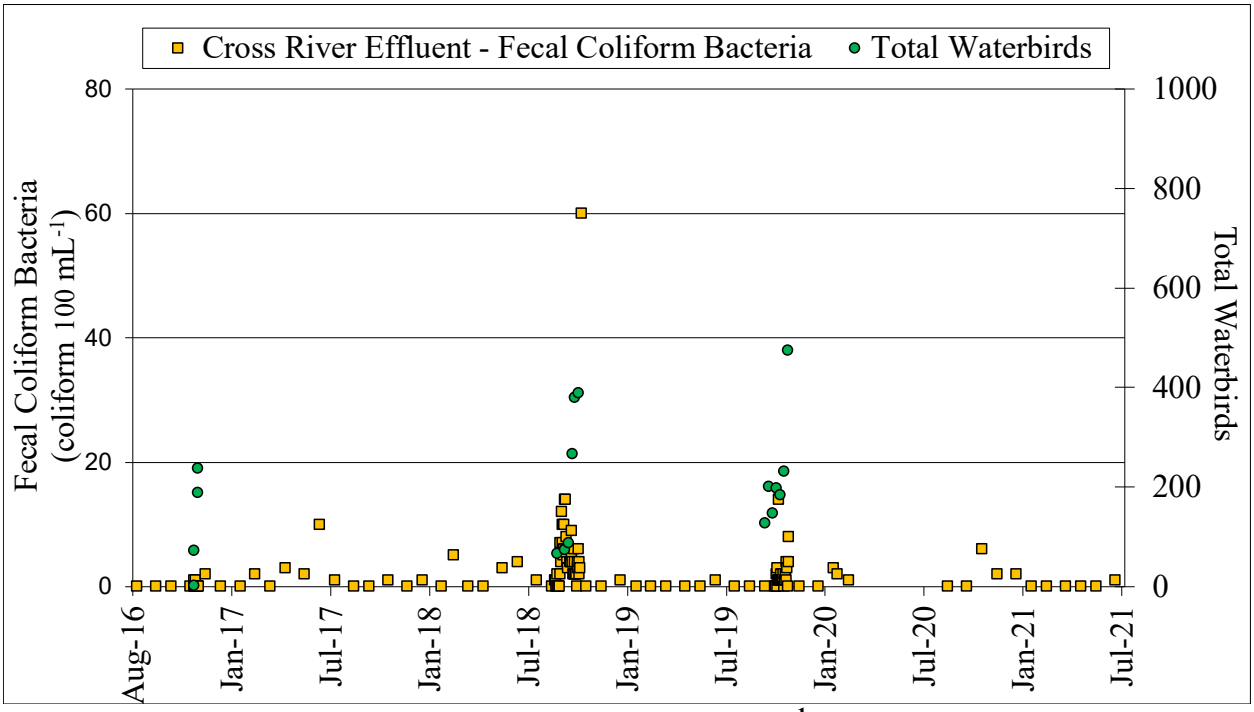

Figure 3.31. Cross River Reservoir fecal coliforms 100mL^{-1} at Cross River Effluent vs. total waterbirds (August 1, 2016 to July 31, 2021). Non-detects of fecal coliform were not included.

Of 11-water quality samples collected in this reporting period, seven (64%) were recorded as non-detect for fecal coliforms. DEP determined it was unnecessary to initiate a waterbird dispersal action based on the fecal coliform bacteria levels below the SWTR limit of 20 fecal coliforms $100mL^{-1}$.

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.

Nest and Egg Depredation

DEP conducted reproductive control on nesting Canada geese from April 1 through May 31 in 2021. In 2021, 11 nests were identified and 57 eggs depredated during seven site visits compared to 10 nests and 47 eggs in 2020 (Appendix A, Table A.1). The Canada goose egg-depredation success rate for Cross River in 2021 was 92% with observations of five goslings. Figure 3.32 shows a rock face along the Cross River spillway where a Canada geese nest was documented but could not be accessed for egg depredation. The five goslings that hatched were suspected from this nest. There were no mute swans or double-crested cormorants found nesting in 2021.

Endangered Species Compliance

DEP monitored one nesting pair of bald eagles that ultimately failed at the Cross River Reservoir in 2021. 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. View of cliff face Canada goose nesting area at Cross River Reservoir adjacent to the dam. Photos by Mike Reid and 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 2020/2021, night-roosting guilds of birds were comprised of ducks (approximately 99%) and Canada geese (less than one percent). Three hundred fifty-five out of 365 (97%) overnight surveys conducted were successful for the collection of data in 2020/2021. There were 10 no-data days due to weather and fog. No gulls were observed on the reservoir during the overnight surveys in this reporting period. There were only two observations of Canada geese with counts of one and two recorded during the overnight surveys. Overnight waterbird counts peaked at 35 on November 10, 2020. When birds were observed during the early morning surveys, ducks were the most commonly observed waterbirds. There were no birds observed on 71% (253/356 reportable days) of the overnight waterbird surveys. There were 10 no data days due to weather and fog.

Figures 3.34 and 3.35 show the overnight and daytime waterbird count data August 1, 2020 to July 31, 2021. 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. Mallards were mostly observed during the spring and summer nesting periods.

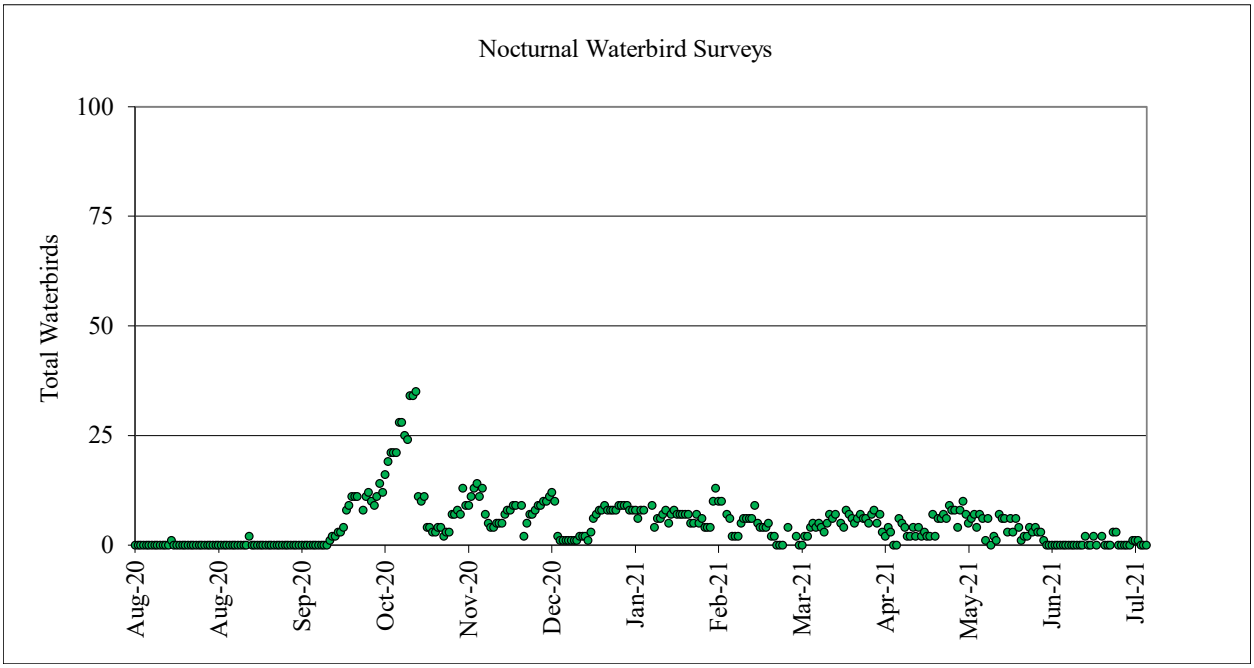

Figure 3.34. Hillview Reservoir total waterbirds nocturnal counts (August 1, 2020 to July 31, 2021).

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.

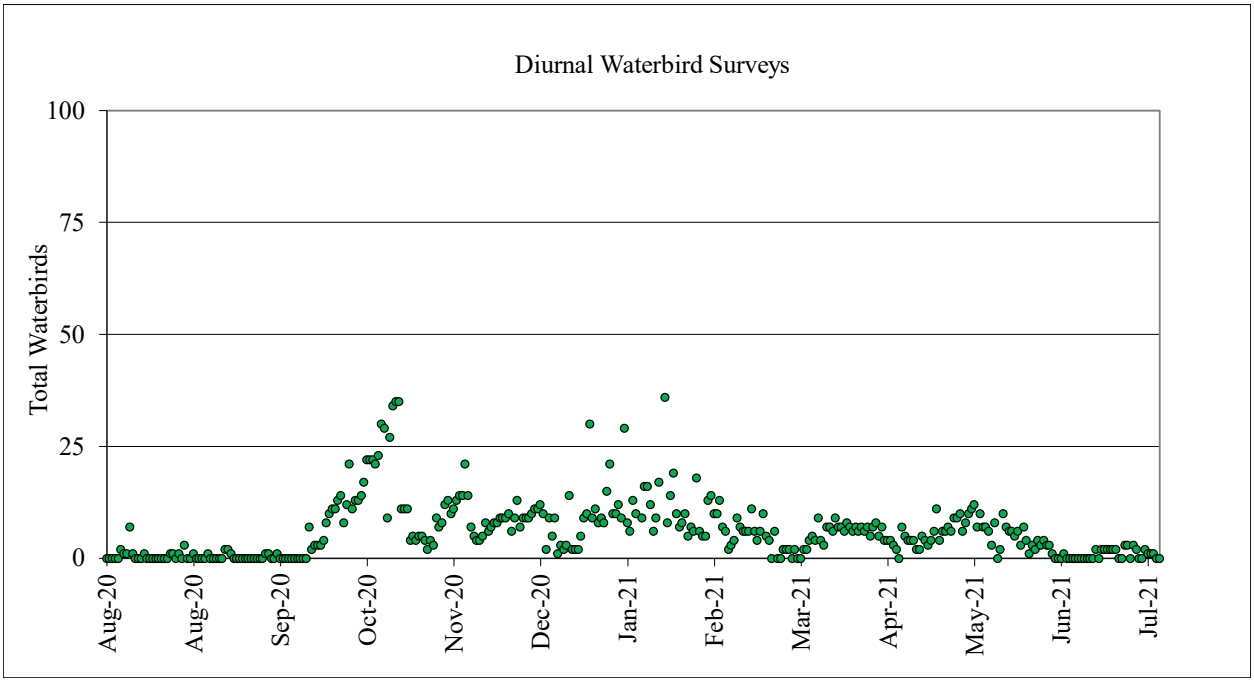

Figure 3.35. Hillview Reservoir total waterbirds diurnal counts (August 1, 2020 to July 31, 2021).

Waterbird Dispersal Actions

During this reporting period, 1,543 bird harassment actions dispersed 1,882 waterbirds including 514 Canada geese, 554 gulls, and 814 ducks. Dispersal actions included six uses of the remote-control boats, 424 physical chases on the reservoir-dividing wall, and discharge of 1,113 bird banger pyrotechnics. Early morning dispersal actions from pre-dawn to 8a.m. were restricted to physical chasing due to noise ordinance compliance with the surrounding residential communities. From 8a.m. 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 5a.m. until post-dusk. 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, blackbirds, and sparrows upon observation.

Figure 3.36. DEP wildlife biologists using remote control motorboats to disperse diving ducks. Photos by Mike Reid and Chris Nadareski.

Waterbird Deterrence

The overhead bird deterrent wires were inspected daily. Thirteen bird deterrent wires were replaced in 2020/2021. Bird deterrence netting covering the reservoir shaft building openings was maintained, preventing swallows from nesting. Daily inspections of the bird deterrent wire strung along the reservoir's half mile long dividing wall railings were inspected and maintained daily and have been largely successful at keeping gulls from roosting during the daytime periods.

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; one entering the reservoir and one leaving the reservoir (Figures 3.37 and 3.38). *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.11) reported in September 2020. There was no *E. coli* elevation recorded during the high count of overnight waterbirds reported on November 10, 2020.

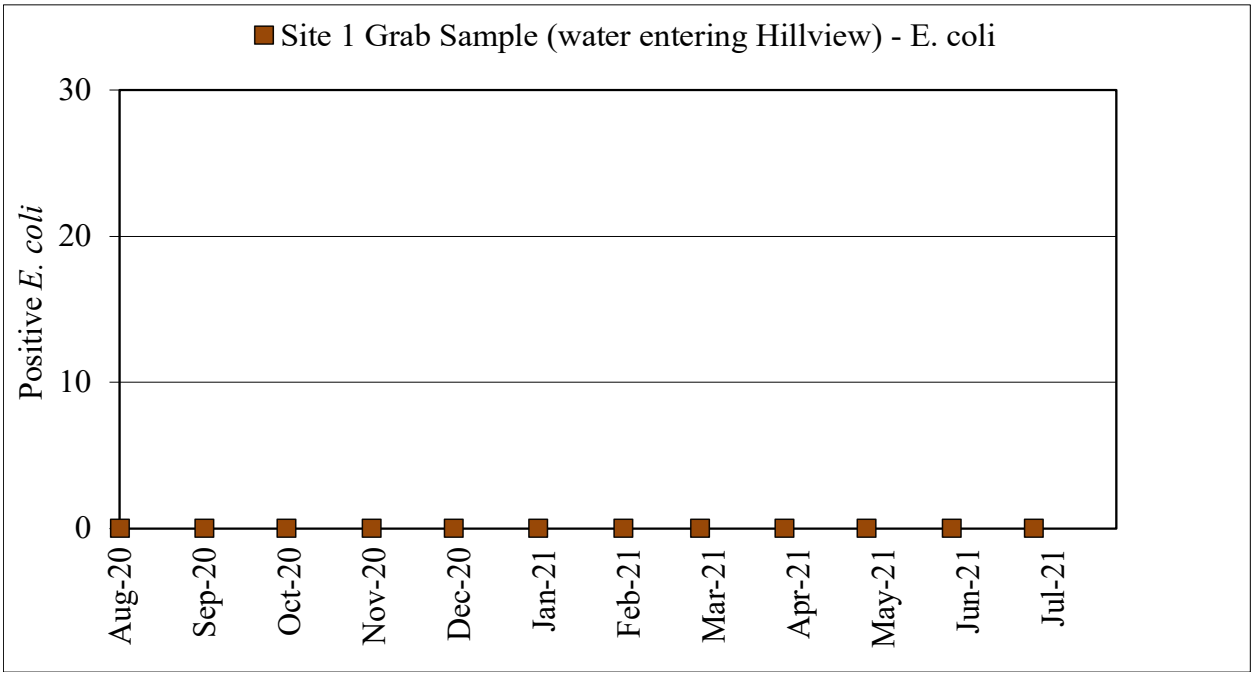

Figure 3.37. Hillview Reservoir number of positive *E. coli* (grab sample) at water sampling site 1 (August 1, 2020 to July 31, 2021).

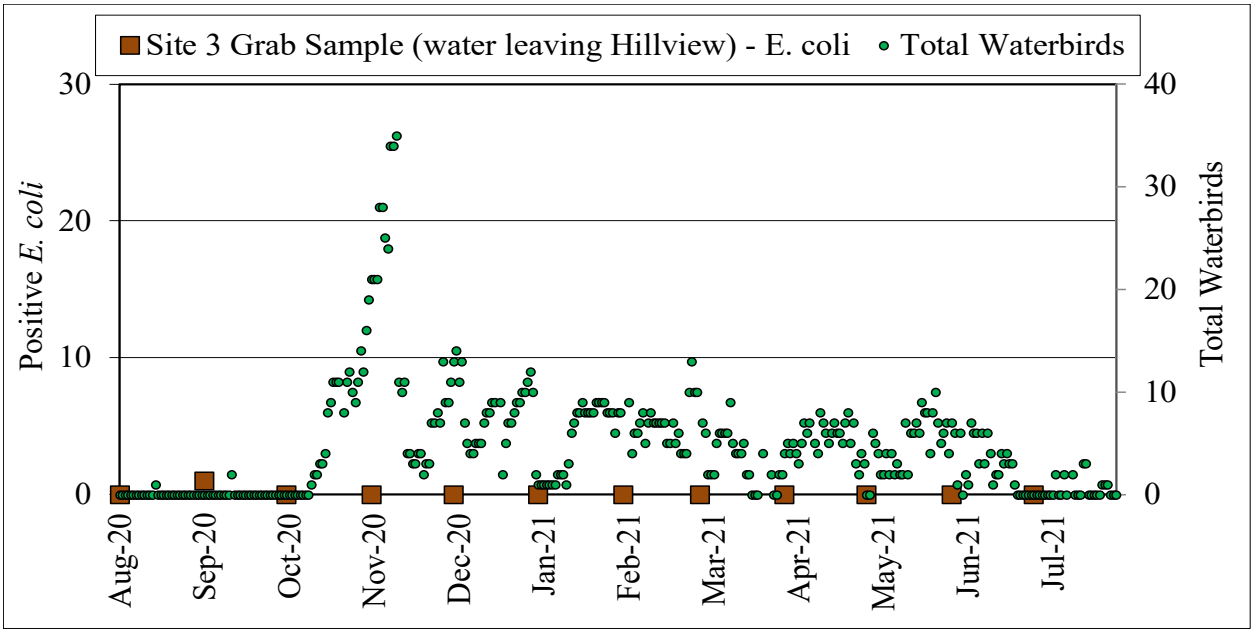

Figure 3.38. Hillview Reservoir number of positive *E. coli* (grab sample) at water sampling site 3 versus total waterbirds (August 1, 2020 to July 31, 2021).

Nest and Egg Depredation

During the spring and summer 2021 waterbird nesting season there were no reported nesting attempts by Canada geese or mute swans. A total of 115 surveys were conducted during the spring and summer of 2021 for nesting mallards (Appendix A, Table A.1). In June 2021, five mallard nests were identified and 48 eggs were depredated under the U.S. Department of Agriculture, Wildlife Services under a federal USFWS Depredation Permit. No mallard ducklings hatched in 2021.

Waterfowl and Swallow Depredation

The ruddy duck is a diving duck species that often does not respond to conventional bird dispersal measures. In 2020/2021, 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 stopover at Hillview. USDA Wildlife Services conducted several depredation actions from October 2020 through June 2021 to remove 61 ruddy ducks, one bufflehead (*Bucephala albeola*), one lesser scaup (*Aythya affinis*), and five mallard ducks that did not respond to the conventional types of bird dispersal methods. Four additional ruddy ducks were found dead and removed and one ruddy duck was found injured and brought to a veterinarian.

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 conducted nest searches from April through July in 2021. In 2021, two partially constructed cliff swallow nests were removed. There were no barn swallow nests observed during the spring and summer period of 2021 similar to the previous year.

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 3.8). Traps were generally set around the Downtake 1 and Uptake 1 (Appendix B, Figure B.10) 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. DEP uses large, medium, and small sized live traps that are inspected during pre-dawn hours five days per week (Figure 3.39). 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.

All trapped specimens were euthanized (except for feral cats and birds) and subsequently composted at the DEP Animal Compost Facility located in Ulster County. 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).

Mammals trapped and subsequently depredated under NYSDEC approval include raccoons (*Procyon lotor*), mice (*Peromyscus* spp.), striped skunks (*Mephitis mephitis*), Virginia opossums (*Didelphis virginiana*), eastern gray squirrels (*Sciurus carolinensis*), and a Norway rat (*Rattus norvegicus*). Live-trapped (non-target) feral cats were transferred to the City of Yonkers Animal Control Unit or released off Hillview Reservoir property. When animals are observed during daytime hours and cannot be captured wildlife staff will actively disperse species from the Hillview property as is shown in Figure 3.39.

Figure 3.39. DEP wildlife biologist setting mammal traps. Virginia opossum observed and subsequently removed by DEP staff. Photo by Sean Camillieri.

DEP conducted 4,146 trap nights setting live and lethal traps from August 1, 2020 to July 31, 2021 (Table 3.8). A single mammal trapping night consists of one trap baited for one night. The success of the trapping program by year is outlined in Table 3.9. For comparison, in 2019/2020, four thousand one hundred fifty live and lethal traps were set. Since 2011, 33,284 mammal trapping-nights have been conducted. Twenty specimens from six species were trapped in the first half of 2021.

Sixty animals from seven mammal species, one bird species, and feral cats were trapped during this reporting period. From August 1, 2011 to July 31, 2021 a total of 710 animals have been trapped. In addition several species of non-target passerine birds were trapped and released (Table 3.9).

Table 3.8. Mammal trapping summary August 1, 2020 through July 31, 2021.

Month/Year	Number of live-traps and lethal traps set	Trapping Success
Aug-20	340	5 *Peromyscus* spp. and 2 striped skunks
Sep-20	434	12 gray squirrels and 3 *Peromyscus* spp.
Oct-20	418	6 *Peromyscus* spp., 4 gray squirrels, and 1 opossum
Nov-20	214	3 *Peromyscus* spp.
Dec-20	308	2 *Peromyscus* spp.
Jan-21	364	No captures
Feb-21	242	1 house mouse
Mar-21	396	2 *Peromyscus* spp., 2 raccoons, and 1 opossum
Apr-21	396	No captures
May-21	330	1 raccoon and 1 house mouse
Jun-21	352	6 *Peromyscus* spp., 1 Norway rat, 2 house sparrows, and 2 feral cats (released)
Jul-21	352	2 *Peromyscus* spp. and 1 feral cat (released)
Annual Trapping Totals	**4,146**	**9 Wildlife Species (7 mammals, 1 marsupial, and 1 bird)**

Table 3.9 Trapping success summary for Hillview Reservoir (August 2011 to July 31, 2021).

Species Trapped	2011 (8/1 to 12/31)	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021 (1/1 to 7/31)	Totals
Raccoon	8	5	6	6	5	0	4	6	5	3	3	**51**
Striped Skunk	0	1	0	7	3	0	1	1	3	2	0	**18**
Virginia Opossum	0	0	0	4	6	1	6	9	4	2	1	**33**
Mice (*Peromyscus* Spp.)	7	0	11	7	13	116	165	39	29	53	10	**450**
Meadow Vole	0	0	4	0	0	6	6	1	1	0	0	**18**
Short-tailed Shrew	0	0	1	0	0	6	10	2	0	0	0	**19**
House Mouse	0	0	0	21	2	7	11	2	2	1	2	**48**
Norway Rat	0	0	0	1	4	1	3	8	2	0	1	**20**
Gray Squirrel	0	0	0	1	0	1	1	7	7	18	0	**35**
Feral Cat	0	0	0	4	1	1	0	3	5	1	3	**18**
Annual Totals	**15**	**6**	**22**	**51**	**34**	**139**	**207**	**78**	**58**	**80**	**20**	**710**

As part of the ongoing wildlife management initiatives, nighttime motion activated 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 trapping success and camera detections with photographs of animals. In this reporting period there were eight camera detection nights, four of which were on nights when traps were set and four camera detections on nights when traps were not set. Of the eight detections seven were of raccoons and one of a coyote. Coyotes were not successfully trapped during this reporting period.

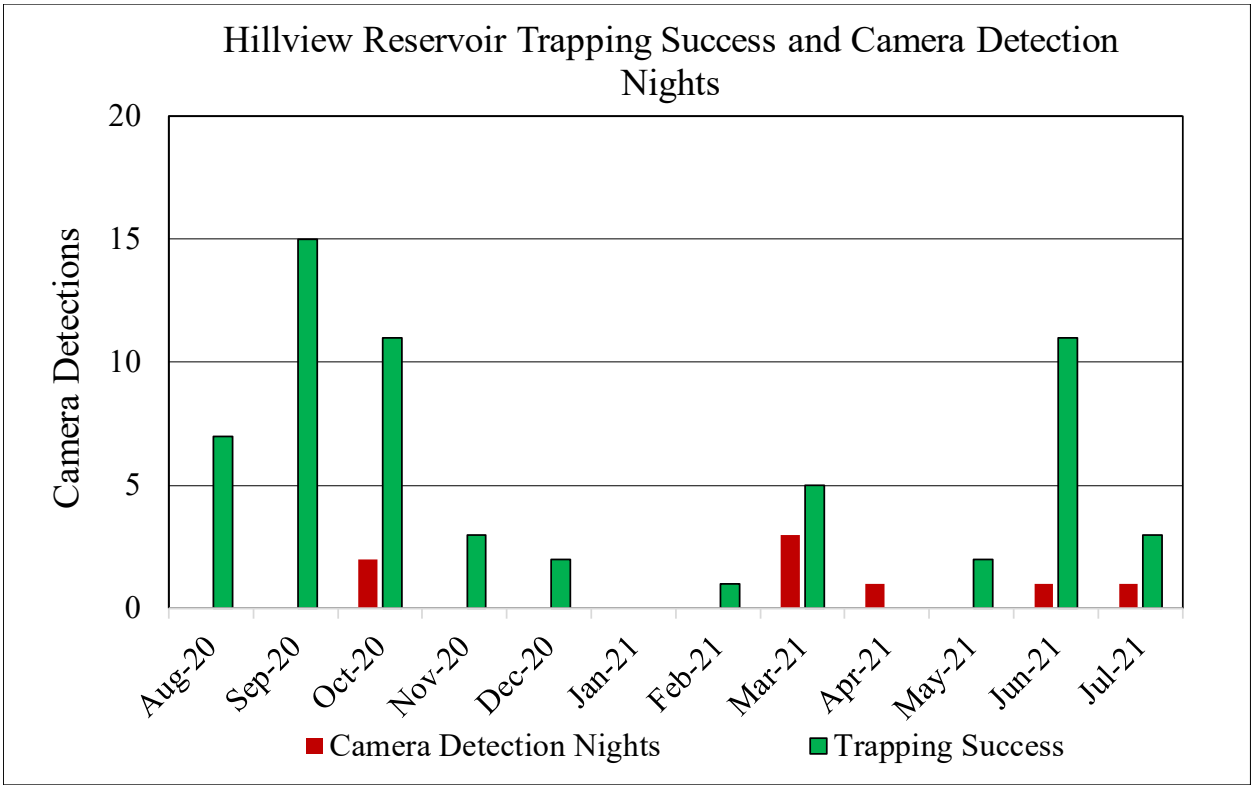

Figure 3.40. Occurrences of remote nighttime photography of animals recorded on the reservoir catwalk and dividing wall versus trapping success (August 1, 2020 to July 31, 2021).

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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 one 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.) and the USEPA Administrative Order on Consent governing the covering of Hillview Reservoir (Docket No. SDWA-02-2010-8027 Catskill Delaware System).

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 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 2020, 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 41 springtime Canada goose and mute swan nest depredation actions on six reservoirs resulting in 37 goose nest depredations whereby 220 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 deemed unnecessary by the USDA on the Kensico Reservoir as part of the Westchester County Airport depredation order for public safety 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 fifteen 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 2020/2021, propane cannons provide an alternative means to conduct 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, DEP conducted mammal trapping inside the reservoir perimeter fence and on the reservoir-dividing wall at Hillview Reservoir. DEP conducted 4,146 trap-nights during 2020/2021, in an attempt to eliminate small mammal activity inside the reservoir perimeter fence. In 2021, 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 contracted with USDA Wildlife Services to lethally remove 68 ducks that did not 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 for Hillview Reservoir with low seasonal elevations of fecal coliform bacteria and *E.coli* recorded annually from late autumn through early winter. DEP has implemented a comprehensive wildlife management program for water quality improvement and protection the past 29 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. Waterbird Egg and Nest Depredation Summary

Table A.1. 2021 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 = 8	Canada geese = 29	100% (0 Canada geese goslings)
West Branch	8	Canada geese = 7	Canada geese = 30	100% (0 Canada geese gosling)
Rondout[1]	3	Canada geese = 3	Canada geese = 15	75% (5 Canada geese goslings)
Ashokan	3	Canada geese = 8	Canada geese = 40	95% (2 Canada geese goslings)
Croton Falls	8	Canada geese = 9	Canada geese = 49	100% (0 Canada goose goslings)
Cross River	7	Canada geese = 11	Canada geese = 57	92% (5 Canada goose goslings)
Hillview[2]	115	Mallard = 4	Mallard = 48	Mallard = 100% (0 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

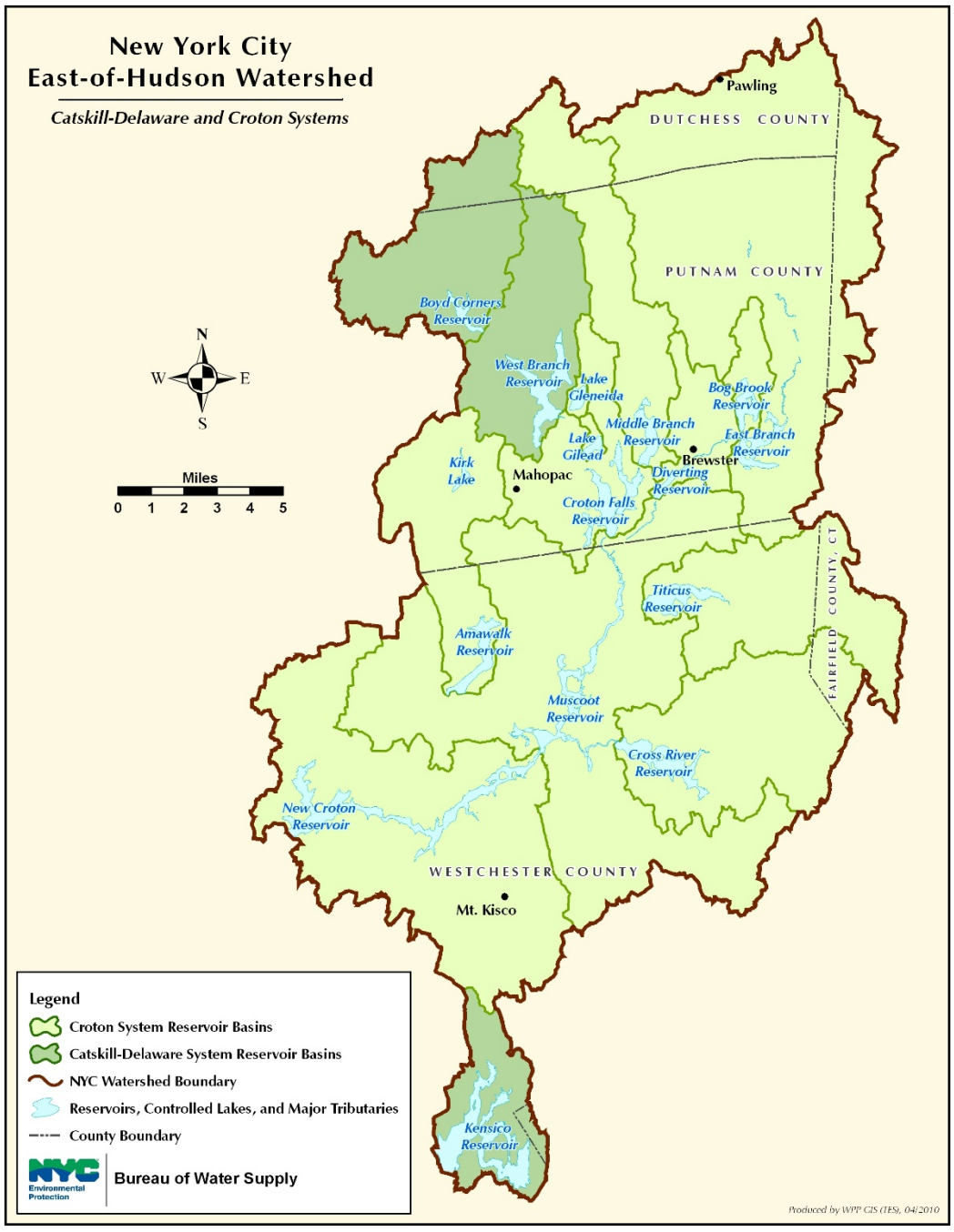

Figure B.1. Map of New York City Water Supply System – East of Hudson watershed.

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

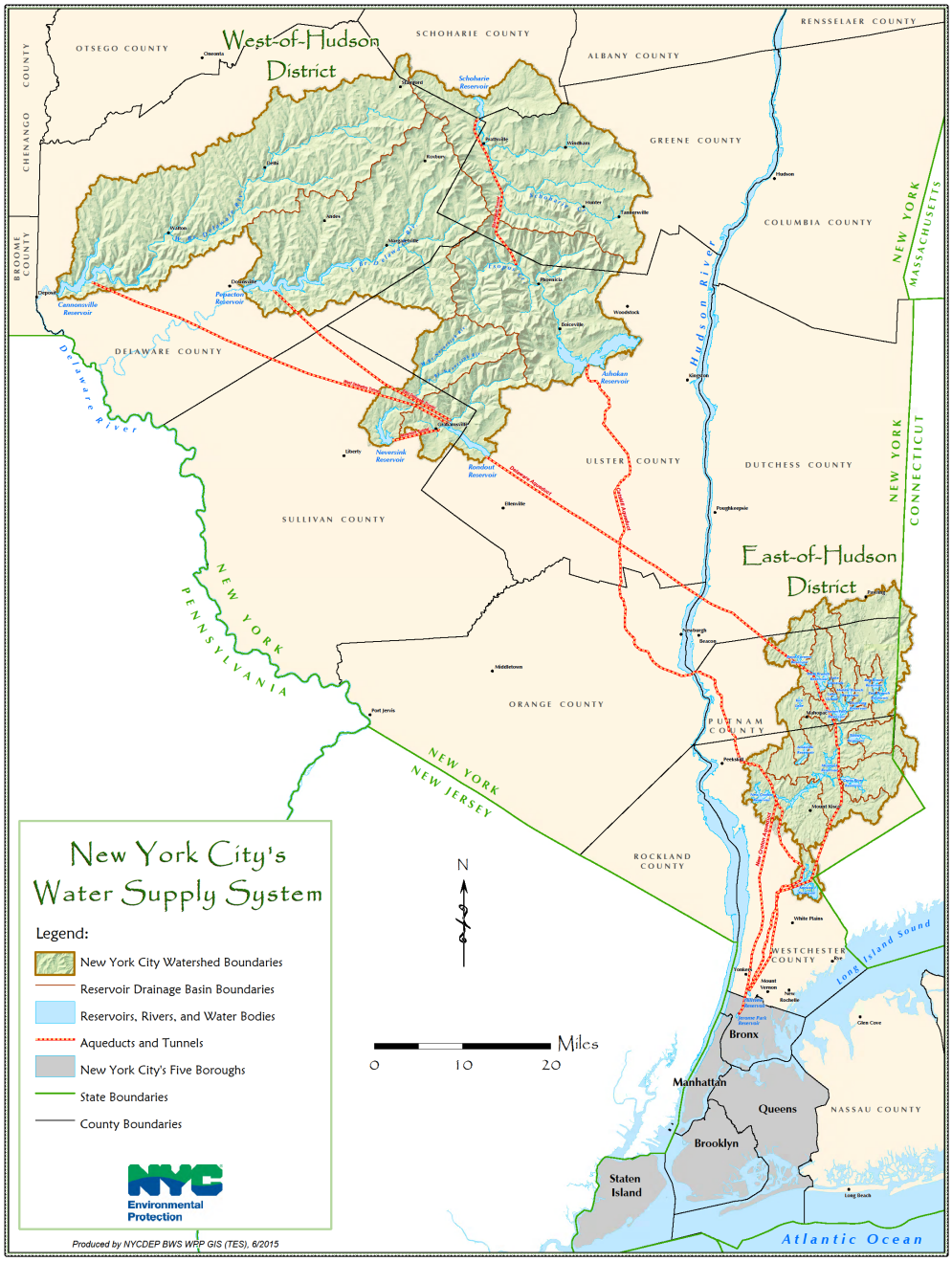

Figure B.3. Catskill, Delaware and Croton Systems.

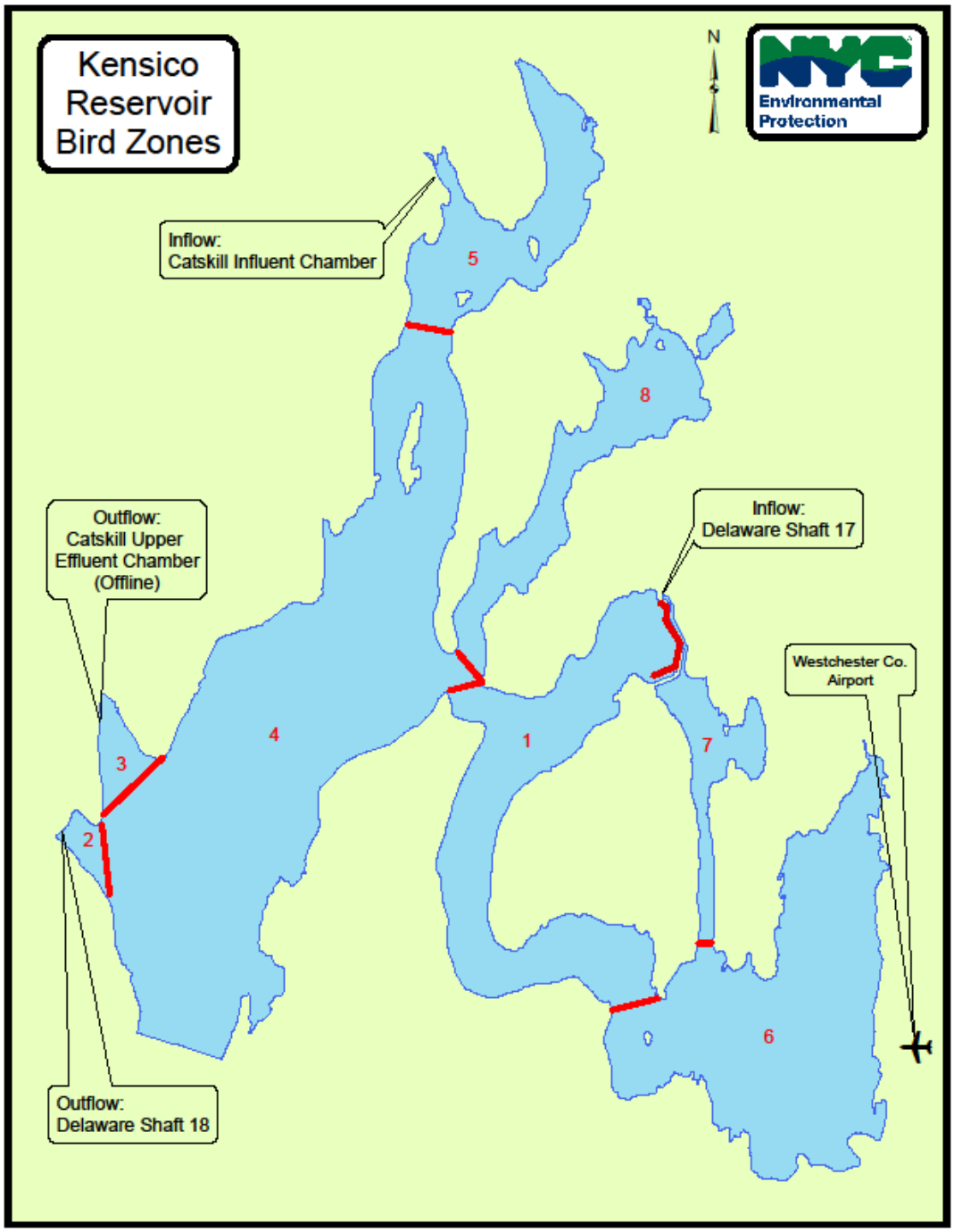

Figure B.4. Map of Kensico Reservoir bird zones.

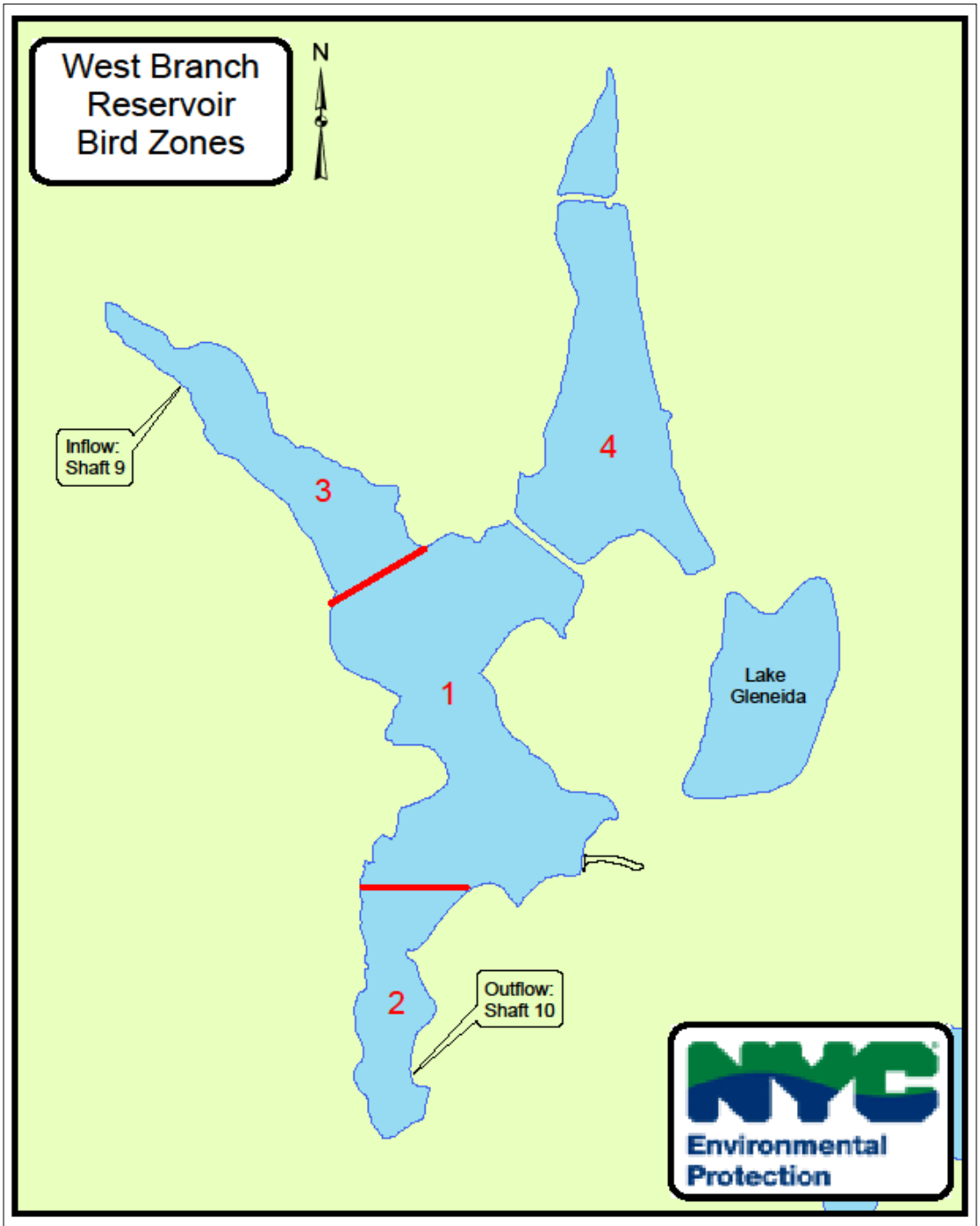

Figure B.5. Map of West Branch Reservoir bird zones.

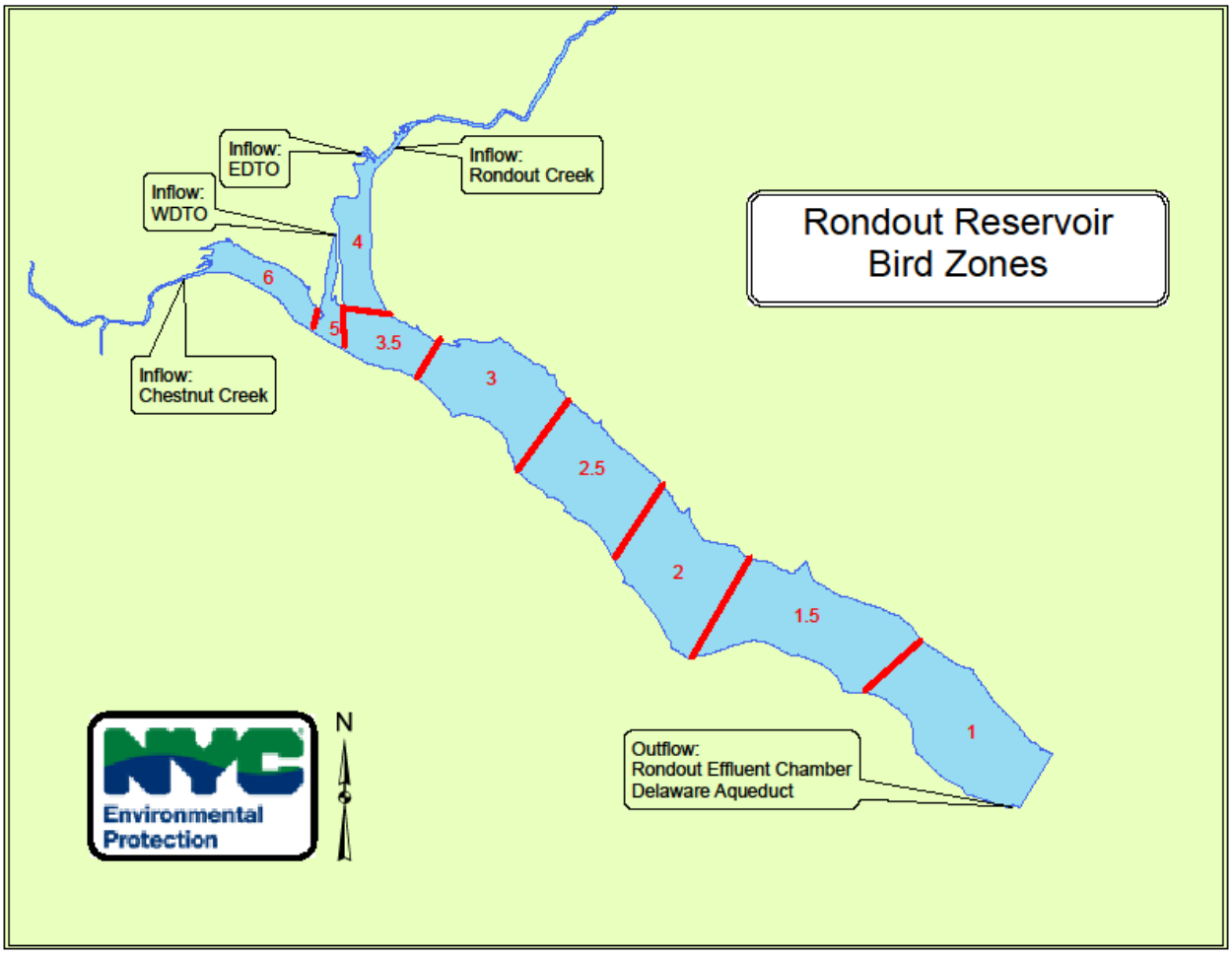

Figure B.6. Map of Rondout Reservoir bird zones.

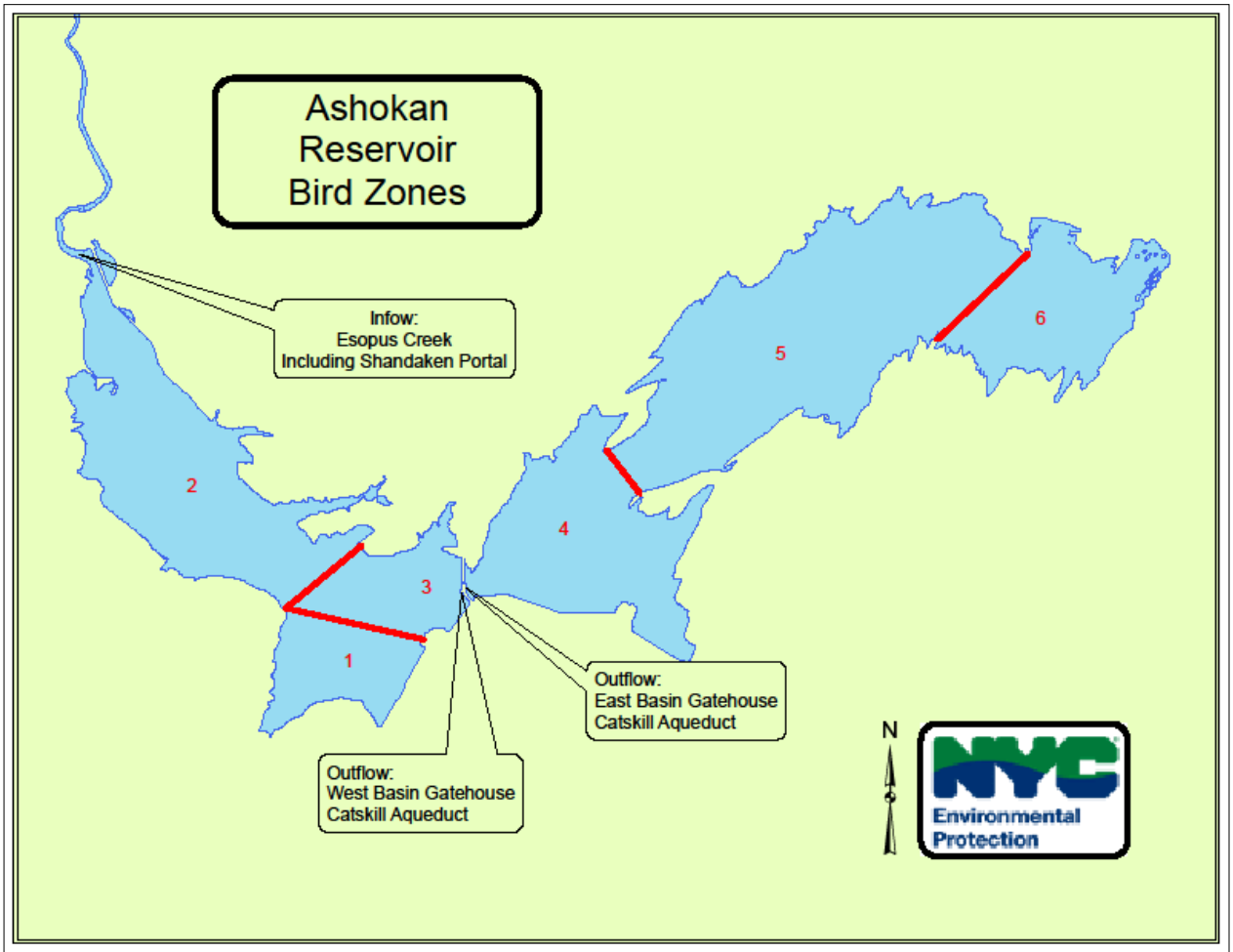

Figure B.7. Map of Ashokan Reservoir bird zones.

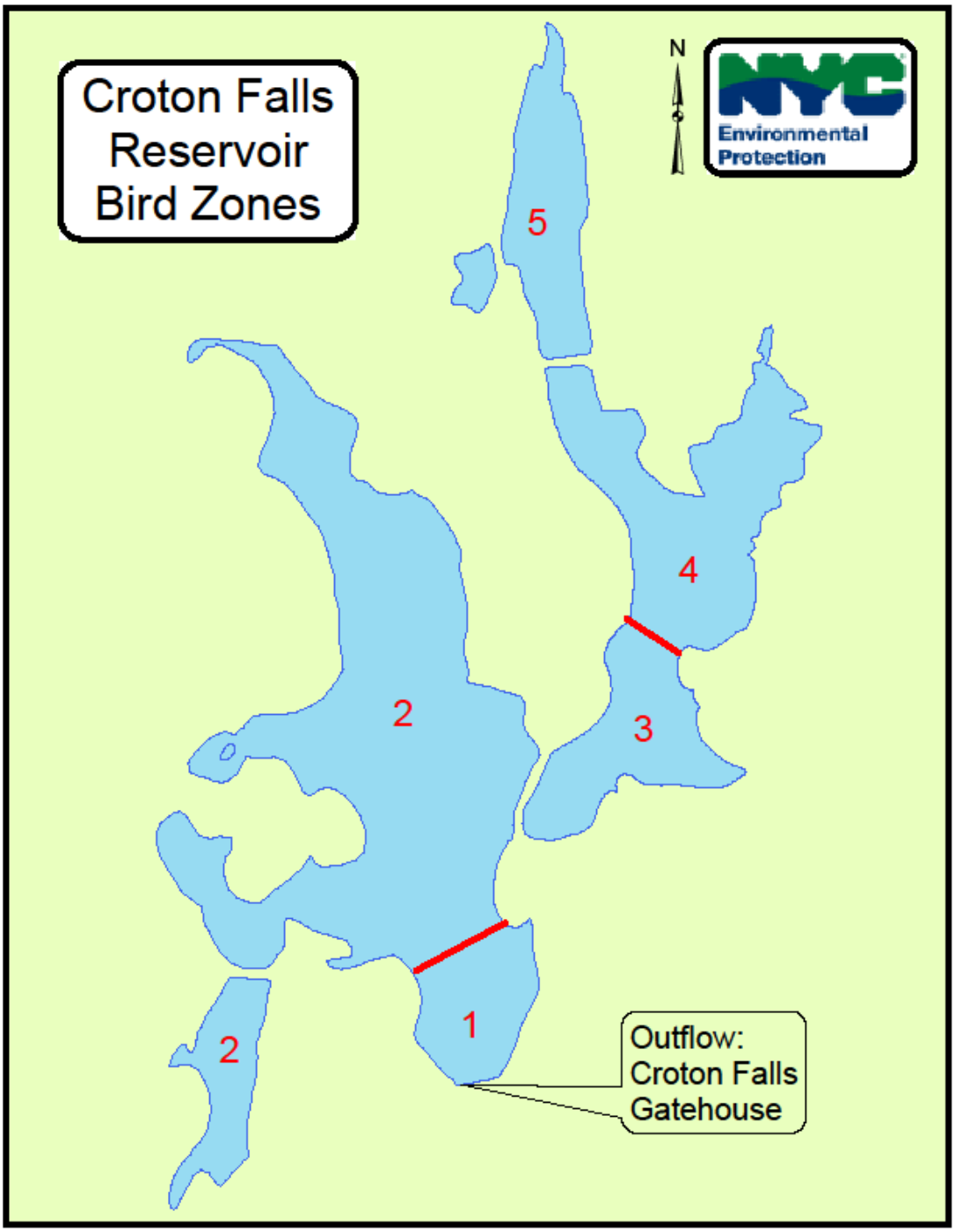

Figure B.8. Map of Croton Falls Reservoir bird zones.

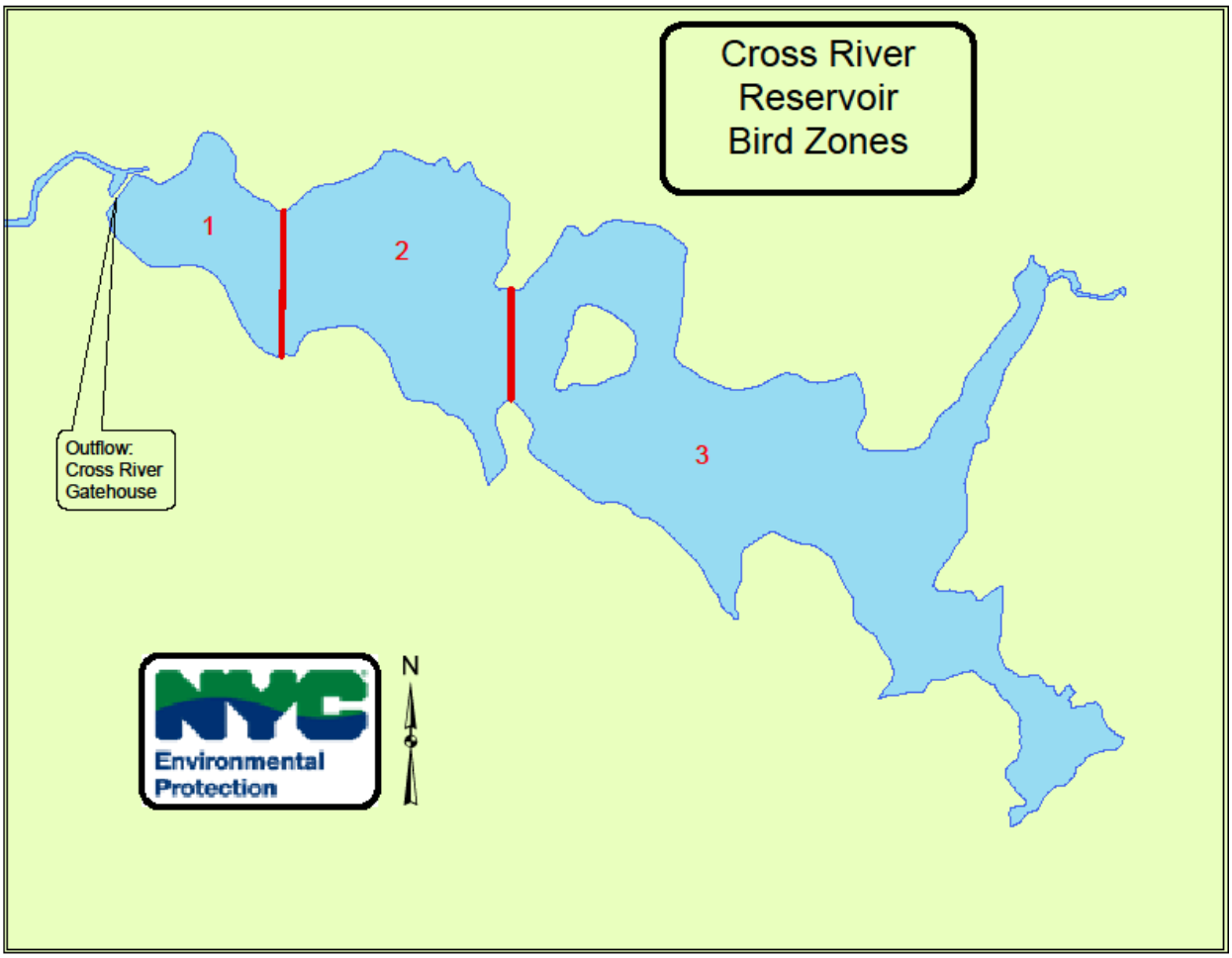

Figure B.9. Map of Cross River Reservoir bird zones.

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

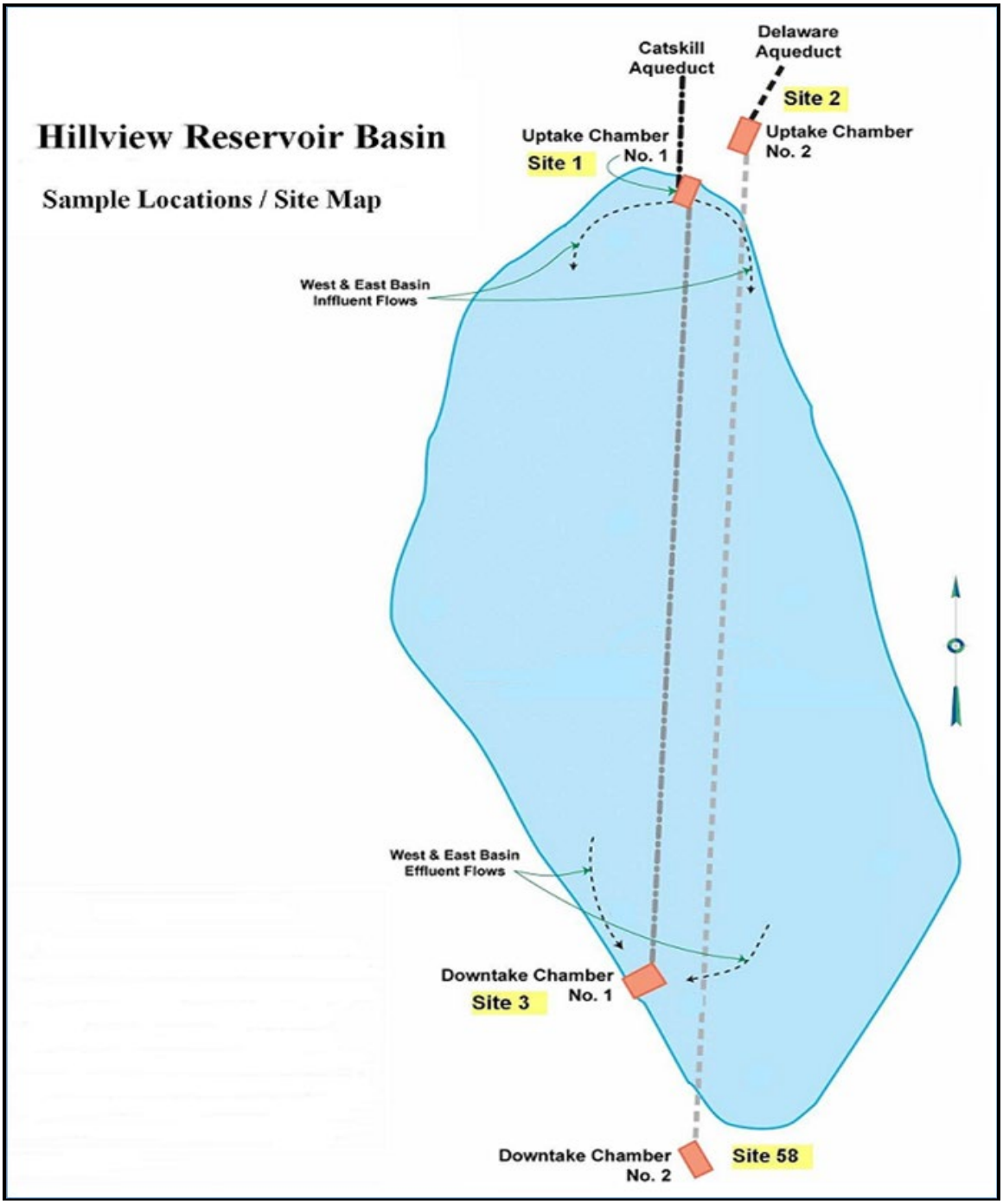

Figure B.11. Map of Hillview Reservoir water sampling locations.