# Appendix G.  2022 Water Quality Sampling and Analysis

## 2 Methodology and Data Collected

Sampling was performed once per week on Monday mornings from June 6, 2022 through August 29, 2022 at seven (7) locations around the Bay by Town Bay Constables and the Committee's summer intern, with the exception that the sampling for the July 4th week was moved to Wednesday, July 6th. Bacteria samples were collected using a simple dip method at the surface. Depth was determined using a depth sounder on the boat, when available. Some data measurements, site conditions, date, time, and other information were recorded on chain of custody data sheets and labeled with the Station ID (MB-1, -2, etc). These chain of custody sheets are provided by, transcribed by, and maintained by the Nassau County Department of Health. Every morning after sampling, Nassau County Department of Health personnel collected the refrigerated bacteria samples (and chain of custody forms) from Town Dock and performed the analysis at their ELAP-certified lab. Data is supplied to the Executive Director in Microsoft Excel.

GPS coordinates, temperature, dissolved oxygen, pH, and salinity readings were taken at the surface (approximately one foot depth to top of probe) using the MBPC's YSI ProDSS (Professional Digital Sampling System) Multiparameter probe (Fig. 3) and turbidity measurements were taken via 78-010 Fieldmaster Secchi Disk (pronounced seckky) with half-meter markings on the line. The YSI multiparameter probe was calibrated before every sampling at Town Dock. The Committee maintains and provided the intern and Bay Constables with SOPs for the operation of the YSI. Data was downloaded by the intern using Xylem's Korr software. Water depth was collected via a sounder onboard the boat. The parameters that were analyzed and the sampling methodology are given in Table G-1.

**Table G-1. Summary of Water Quality Parameters and Sampling Methodology**

| Parameter | Sampling Methodology Description |
|---|---|
| Temperature<br>Salinity<br>Dissolved Oxygen<br>pH<br>GPS Coordinates | YSI ProDSS |
| Enterococci | Membrane Filter, SM 9222 D-2006 |
| Fecal coliform | Membrane Filter, EPA 1600 |
| Water Clarity | Secchi Disk |
| Water Depth | Onboard depth sounder |

### 2.f Other Observations and Activities on the Bay

2022 saw a large fish kill that affected many areas around Long Island Sound. While a summer fish kill is to be expected, 2022's fish kill was larger than most and has been attributed to the higher than average temperatures.

## 3 Results

### 3.a Bacteria Levels v. Ambient Water Quality Standards

Bacteria counts for both species at all sites by day is located in Appendix G-1. Daily weather data for this report was acquired from the NOAA Weather Station at LaGuardia airport (this is made available in both tab-delimited format and pdf). In the raw data set, a "T" denotes a rainfall amount that is "Trace" (not measurable, < 0.01"). Since this is nominal, all "T"s in the data set were made "0." There are some additional limitations for this data. Given time constraints, only daily weather logs were used, forcing the assumption that all rainfall the day-of sampling occurs prior to the sampling. Total rainfall (given in inches) for dates corresponding with 2022 sampling dates is given in Table G-2 below.

The Pearson Correlation calculates an *r*-value between -1 and +1 in order to determine if and how strong a relationship is between two variables (an *r*-value of zero means that there is no relationship). If the coefficient is positive, then the two variables tend to increase together. If the coefficient is negative, one variable tends to decrease as the other variable increases. As positive *r*-values approach "+1," the two variables are more closely related (a value of +1 indicates a perfect correlation), therefore *r-values* equal to and higher than 0.70 are significant. No *r*-values less than zero generated for these data sets were significant ($r > -0.70$). Untransformed bacteria data was used for these calculations. As always, correlations do not necessarily mean causation, however, the premise (based on watershed models) of the MS4 and other programs is that rainfall affects bacteria counts in the Bay for up to two (2) days. This test was chosen as it was the same test performed for previous water quality analysis. These correlations can be found in Table G-3 below.

**Table G-2. Total rainfall amount (in inches) for two-days prior, one-day prior, and day-of sampling.**

| Sampling Date | Total rainfall (inches) for | | |
|---|---|---|---|
| | 2-days prior | 1-day prior | day of |
| 06/06/22 | 0.00 | 0.00 | 0.00 |
| 06/13/22 | 0.00 | 0.27 | 0.04 |
| 06/20/22 | 0.00 | 0.00 | 0.00 |
| 06/27/22 | 0.00 | 0.00 | 0.01 |
| 07/06/22 | 0.00 | 0.00 | 0.08 |
| 07/11/22 | 0.29 | 0.00 | 0.00 |
| 07/18/22 | 0.00 | 0.55 | 0.24 |
| 07/25/22 | 0.00 | 0.00 | 0.00 |
| 08/01/22 | 0.02 | 0.00 | 0.39 |
| 08/08/22 | 0.00 | 0.00 | 0.61 |
| 08/15/22 | 0.00 | 0.00 | 0.00 |
| 08/22/22 | 0.00 | 0.00 | 0.00 |
| 08/29/22 | 0.28 | 0.00 | 0.00 |

**Table G-3. Pearson correlations (*r*-values) for bacteria data v. rainfall in the windows of two-days prior to sampling, one-day prior to sampling, and day of sampling. Significant findings are highlighted.**

| | Rainfall two-days prior to sampling | | Rainfall one-day prior to sampling | | Rainfall the day-of sampling | |
|---|---|---|---|---|---|---|
| | ***Fecal Coliform*** | ***Enterococci*** | ***Fecal Coliform*** | ***Enterococci*** | ***Fecal Coliform*** | ***Enterococci*** |
| MB-1 | -0.10 | -0.07 | -0.11 | -0.12 | 0.47 | 0.49 |
| MB-2 | 0.00 | -0.05 | 0.33 | 0.50 | 0.03 | 0.86 |
| MB-3 | -0.01 | -0.06 | 0.66 | 0.16 | 0.20 | 0.45 |
| MB-4 | -0.14 | -0.13 | 0.77 | 0.58 | 0.25 | 0.49 |
| MB-5 | -0.16 | 0.21 | -0.10 | -0.04 | 0.66 | 0.80 |
| MB-6 | -0.03 | 0.13 | 0.32 | -0.03 | 0.04 | 0.46 |
| MB-7 | -0.08 | -0.06 | -0.08 | -0.09 | 0.49 | 0.47 |

### 3.a.i Leeds Pond (MB-1)

The Leeds Pond station is located in Portion 1 of Manhasset Bay, which is classified as SA waters. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4 for class SA waters: "the geometric mean of Enterococci samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL (or MPN) and no

more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL." Considering that:

- More than 10% of the samples in the same 30-day period exceeded 130 CFU of Enterococci from July 6th through the end of sampling, because the Enterococci sample on August 1st exceeded the standard (Table G-4).
- Rainfall was not a factor at this site in 2022 ($p < 0.70$; Table G-3).

**Table G-4. 2022 Enterococci counts (CFU/100mL) and 5-sample rolling geometric means for Leeds Pond (MB-1). Exceedances are highlighted.**

**Leeds Pond - MB1**
Portion 1 (Enterococci)

| | ***Enterococci*** | |
|---|---|---|
| **Date** | **CFU/100ml.** | **GeoMean** |
| 06/06/22 | 0.10 | |
| 06/13/22 | 0.10 | |
| 06/20/22 | 3.00 | |
| 06/27/22 | 1.00 | |
| 07/06/22 | 0.10 | 0.31 |
| 07/11/22 | 9.00 | 0.77 |
| 07/18/22 | 4.00 | 1.61 |
| 07/25/22 | 2.00 | 1.48 |
| 08/01/22 | 640.00 | 5.40 |
| 08/08/22 | 38.00 | 17.73 |
| 08/15/22 | 7.00 | 16.86 |
| 08/22/22 | 3.00 | 15.92 |
| 08/29/22 | 1.00 | 13.86 |

10% of samples exceeds standard
Geometric mean exceeds standard

### 3.a.ii Kennelworth (MB-2)

The Kennelworth station is located in Portion 1 of Manhasset Bay, which is classified as SA waters. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4 for class SA waters: "the geometric mean of Enterococci samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL (or MPN) and no more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL." Considering that, at Kennelworth these standards were never exceeded in 2022 (Table G-5). However, rainfall the day of sampling was shown to have a correlation ($p > 0.70$) with increased Enterococci counts at this site in 2022 (Table G-3).

### Table G-5. 2022 Enterococci counts (CFU/100mL) and 5-sample rolling geometric means for Kennelworth (MB-2). Exceedances are highlighted.

**Kennelworth - MB 2**
Portion 1 (Enterococci)

***Enterococci***

| Date | CFU/100ml. | GeoMean |
|---|---|---|
| 06/06/22 | 0.10 | |
| 06/13/22 | 3.00 | |
| 06/20/22 | 0.10 | |
| 06/27/22 | 0.10 | |
| 07/06/22 | 0.10 | 0.20 |
| 07/11/22 | 4.00 | 0.41 |
| 07/18/22 | 9.00 | 0.51 |
| 07/25/22 | 1.00 | 0.82 |
| 08/01/22 | 8.00 | 1.96 |
| 08/08/22 | 9.00 | 4.82 |
| 08/15/22 | 0.10 | 2.30 |
| 08/22/22 | 0.10 | 0.94 |
| 08/29/22 | 0.10 | 0.59 |

10% of samples exceeds standard
Geometric mean exceeds standard

### 3.a.iii Manorhaven (MB-3)

The Manorhaven station is located in Portion 2 of Manhasset Bay, which is classified as SB waters. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4 for SB waters:

- *"The monthly geometric mean, from a minimum of five examinations for fecal coliforms, shall not exceed 200 CFU/100 mL.*
- *"For Enterococci the geometric mean of samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL (or MPN) and no more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL."*

For the Manorhaven site, these standards were never exceeded in 2022 (Table G-6). Additionally, there was no correlation ($p < 0.70$) between rainfall and bacteria counts at this site (Table G-3).

### Table G-6. 2022 Enterococci and Fecal coliform counts (CFU/100mL) and 5-sample rolling geometric means for Manorhaven (MB-3). Exceedances are highlighted.

**Manorhaven - MB 3**

Portion 2 (Fecal Coliform and Enterococci)

| | *Enterococci* | | *Fecal Coliform* | |
|---|---|---|---|---|
| **Date** | **CFU/100ml.** | **GeoMean** | **CFU/100ml.** | **GeoMean** |
| 06/06/22 | 2.00 | | 4.00 | |
| 06/13/22 | 1.00 | | 5.00 | |
| 06/20/22 | 0.10 | | 10.00 | |
| 06/27/22 | 0.10 | | 1.00 | |
| 07/06/22 | 0.10 | 0.29 | 6.00 | 4.13 |
| 07/11/22 | 2.00 | 0.29 | 7.00 | 4.62 |
| 07/18/22 | 3.00 | 0.36 | 21.00 | 6.15 |
| 07/25/22 | 2.00 | 0.65 | 3.00 | 4.84 |
| 08/01/22 | 2.00 | 1.19 | 2.00 | 5.56 |
| 08/08/22 | 4.00 | 2.49 | 10.00 | 6.15 |
| 08/15/22 | 0.10 | 1.37 | 8.00 | 6.32 |
| 08/22/22 | 5.00 | 1.52 | 12.00 | 5.65 |
| 08/29/22 | 1.00 | 1.32 | 8.00 | 6.88 |

10% of samples exceeds standard

Geometric mean exceeds standard

### 3.a.iv NUN 4 (MB-4)

The NUN 4 station is located in Portion 1 of Manhasset Bay, which is classified as SA waters. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4 for class SA waters: "the geometric mean of Enterococci samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL (or MPN) and no more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL." Considering that, for the NUN-4 site these standards were never exceeded in 2022 (Table G-7). However, there was a correlation ($p > 0.70$) for rainfall that occurred the day before sampling and higher bacteria counts at this site in 2022 (Table G-3).

### Table G-7. 2022 Enterococci counts (CFU/100mL) and 5-sample rolling geometric means for NUN-4 (MB-4). Exceedances are highlighted.

**NUN 4 - MB 4**

Portion 1 (Enterococci)

***Enterococci***

| Date | CFU/100ml. | GeoMean |
|---|---|---|
| 06/06/22 | 0.10 | |
| 06/13/22 | 0.10 | |
| 06/20/22 | 0.10 | |
| 06/27/22 | 0.10 | |
| 07/06/22 | 0.10 | 0.10 |
| 07/11/22 | 1.00 | 0.16 |
| 07/18/22 | 5.00 | 0.35 |
| 07/25/22 | 0.10 | 0.35 |
| 08/01/22 | 4.00 | 0.72 |
| 08/08/22 | 1.00 | 1.15 |
| 08/15/22 | 2.00 | 1.32 |
| 08/22/22 | 1.00 | 0.96 |
| 08/29/22 | 0.10 | 0.96 |

10% of samples exceeds standard

Geometric mean exceeds standard

### 3.a.v Baxter Beach (MB-5)

The Baxter Beach station is located in Portion 2 of Manhasset Bay, which is classified as SB waters. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4 for SB waters:

- *"The monthly geometric mean, from a minimum of five examinations for fecal coliforms, shall not exceed 200 CFU/100 mL.*
- *"For Enterococci the geometric mean of samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL (or MPN) and no more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL."*

Considering that, at Baxter Beach the Enterococci geometric mean was exceeded on August 8, 2022, meaning that this site was out of compliance for the 30-days before and after this sampling date (Table G-8). However, rainfall the day of sampling was shown to correlate ($p > 0.70$) with higher counts of Enterococci at this site (Table G-3), which could be a factor in that exceedance.

### Table G-8. 2022 Enterococci and Fecal coliform counts (CFU/100mL) and 5-sample rolling geometric means for Baxter Beach (MB-5). Exceedances are highlighted.

**Baxter Beach - MB 5**
Portion 2 (Fecal Coliform and Enterococci)

| | *Enterococci* | | *Fecal Coliform* | |
|---|---|---|---|---|
| **Date** | **CFU/100ml.** | **GeoMean** | **CFU/100ml.** | **GeoMean** |
| 06/06/22 | 0.10 | | 3.00 | |
| 06/13/22 | 0.10 | | 132.00 | |
| 06/20/22 | 0.10 | | 28.00 | |
| 06/27/22 | 33.00 | | 48.00 | |
| 07/06/22 | 0.10 | 0.32 | 46.00 | 30.04 |
| 07/11/22 | 54.00 | 1.12 | 80.00 | 57.94 |
| 07/18/22 | 35.00 | 3.62 | 62.00 | 49.81 |
| 07/25/22 | 25.00 | 10.93 | 330.00 | 81.58 |
| 08/01/22 | 60.00 | 12.32 | 230.00 | 111.61 |
| 08/08/22 | 92.00 | 48.22 | 370.00 | 169.35 |
| 08/15/22 | 8.00 | 32.92 | 21.00 | 129.60 |
| 08/22/22 | 14.00 | 27.40 | 88.00 | 139.00 |
| 08/29/22 | 23.00 | 26.95 | 55.00 | 97.14 |

10% of samples exceeds standard
Geometric mean exceeds standard

### 3.a.vi Manorhaven Beach (MB-6)

The Manorhaven Beach station is located in Portion 2 of Manhasset Bay, which is classified as SB waters. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4 for SB waters:

- *"The monthly geometric mean, from a minimum of five examinations for fecal coliforms, shall not exceed 200 CFU/100 mL.*
- *"For Enterococci the geometric mean of samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL (or MPN) and no more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL."*

Considering that, at Manorhaven Beach, Enterococci counts exceeded the standard in more than 10% of samples through July and August of 2022. Rainfall was not a factor ($p < 0.70$) at this site in 2022 (Table G-3).

### Table G-9. 2022 Enterococci and Fecal coliform counts (CFU/100mL) and 5-sample rolling geometric means for Manorhaven Beach (MB-6). Exceedances are highlighted.

**Manorhaven Beach - MB 6**

Portion 2 (Fecal Coliform and Enterococci)

| | *Enterococci* | | *Fecal Coliform* | |
|---|---|---|---|---|
| **Date** | **CFU/100ml.** | **GeoMean** | **CFU/100ml.** | **GeoMean** |
| 06/06/22 | 4.00 | | 27.00 | |
| 06/13/22 | 7.00 | | 440.00 | |
| 06/20/22 | 2.00 | | 15.00 | |
| 06/27/22 | 1.00 | | 74.00 | |
| 07/06/22 | 0.10 | 1.41 | 45.00 | 56.84 |
| 07/11/22 | 77.00 | 2.55 | 120.00 | 76.60 |
| 07/18/22 | 36.00 | 3.54 | 31.00 | 45.06 |
| 07/25/22 | 5.00 | 4.25 | 39.00 | 54.55 |
| 08/01/22 | 220.00 | 12.50 | 53.00 | 51.03 |
| 08/08/22 | 21.00 | 36.42 | 110.00 | 61.02 |
| 08/15/22 | 19.00 | 27.53 | 27.00 | 45.28 |
| 08/22/22 | 6.00 | 19.24 | 11.00 | 36.80 |
| 08/29/22 | 7.00 | 20.57 | 18.00 | 31.53 |

10% of samples exceeds standard

Geometric mean exceeds standard

### 3.a.vii Great Neck (MB-7)

The Great Neck station is located in Portion 3 of Manhasset Bay, which is classified as SC waters. Note that this station was not sampled in 2016. NYSDEC Division of Water has set the following recreational ambient water quality standards as identified in NYCRR 6 Part 703.4: "the monthly geometric mean, from a minimum of five examinations for fecal coliforms, shall not exceed 200 CFU/100 mL." Considering this, at the Great Neck site these standards were never exceeded in 2022 (Table G-10). Rainfall was not a factor ($p < 0.70$) at this site in 2022 (Table G-3).

# Appendix G

**Table G-10. 2022 Fecal coliform counts (CFU/100mL) and 5-sample rolling geometric means for Great Neck (MB-7). Exceedances are highlighted.**

**Great Neck - MB 7**
Portion 3 (Fecal Coliform)
***Fecal Coliform***

| CFU/100ml. | GeoMean |
|---|---|
| 11.00 | |
| 116.00 | |
| 15.00 | |
| 34.00 | |
| 15.00 | 25.00 |
| 23.00 | 28.97 |
| 50.00 | 24.48 |
| 14.00 | 24.15 |
| 620.00 | 43.16 |
| 110.00 | 64.29 |
| 88.00 | 84.08 |
| 160.00 | 106.10 |
| 87.00 | 152.89 |

10% of samples exceeds standard

Geometric mean exceeds standard

## 3.b Is There a Relationship Between Counts of the Two Indicator Bacteria Species and Rainfall?

This varied between the stations. Rainfall was not a factor ($p < 0.70$) at Leeds Pond (MB-1), Manorhaven (MB-2), Manorhaven Beach (MB-6), and Great Neck (MB-7).

Rainfall the day of sampling was shown to correlate ($p > 0.70$) with higher counts of Enterococci at Kennelworth (MB-2) and Baxter Beach (MB-5). And there was a correlation ($p > 0.70$) for rainfall that occurred the day before sampling and higher bacteria counts at NUN-4 (MB-4).

## 3.c. Physical Parameters

### 3.c.i Comparison to Ambient Water Quality Standards for DO

The dissolved oxygen standard for all three portions of Manhasset Bay is a daily average of 4.8 mg/L, with allowable excursions to not less than 3.0 mg/L.[1] Kennelworth (MB-2) is the only station that never went below these standards. Manorhaven (MB-3) and the Nun-4 buoy (MB-4) had the second best track records, with only one excursion each on August 29th and August 8th, respectively. Great Neck (MB-7) in the back portions of the Bay, had multiple dates below the 3.0 mg/L standard (Table G-11).

[1] https://www.dec.ny.gov/docs/water_pdf/togs116.pdf

# Appendix G

### Table G-11. 2022 comparisons of dissolve oxygen against NYSDEC standards.

Dissolved oxygen concentrations below 4.8mg/L are highlighted in yellow; dissolved concentrations below 3.0mg/L are highlighted in red.

| Site Name | MB-1 | MB-2 | MB-3 | MB-4 | MB-5 | MB-6 | MB-7 |
|---|---|---|---|---|---|---|---|
| Date | Dissolved Oxygen (mg/L) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (mg/L) | Dissolved Oxygen (mg/L) |
| 6-Jun-22 | 9.77 | 10.83 | 11.92 | 11.80 | 10.72 | 10.37 | 9.82 |
| 13-Jun-22 | 7.50 | 7.34 | 7.57 | 7.52 | 7.31 | 8.40 | 6.97 |
| 20-Jun-22 | 9.57 | 8.7 | 8.7 | 9.03 | 7.85 | 8.54 | 8.65 |
| 27-Jun-22 | 7.08 | 7.34 | 7.85 | 7.41 | 6.53 | 6.02 | 5.94 |
| 6-Jul-22 | 5.71 | 6.43 | 6.89 | 6.42 | 6.63 | 6.24 | 2.57 |
| 11-Jul-22 | 7.56 | 6.96 | 6.68 | 7.20 | 5.06 | 5.81 | 5.05 |
| 18-Jul-22 | 5.04 | 6.74 | 6.85 | 6.83 | 6.41 | 6.75 | 2.87 |
| 25-Jul-22 | 3.99 | 5.99 | 6.84 | 6.78 | 5.28 | 6.45 | 2.47 |
| 1-Aug-22 | 4.23 | 6.15 | 5.94 | 5.57 | 4.13 | 4.93 | 2.46 |
| 8-Aug-22 | 3.95 | 4.89 | 5.49 | 4.09 | 4.19 | 5.26 | 2.12 |
| 15-Aug-22 | 4.12 | 5.46 | 6.05 | 5.68 | 4.81 | 4.45 | 1.84 |
| 22-Aug-22 | 4.75 | 5.45 | 6.65 | 5.30 | 2.60 | 5.40 | 1.63 |
| 29-Aug-22 | 2.71 | 6.03 | 4.53 | 5.53 | 2.50 | 4.59 | 0.81 |

### 3.c.ii pH

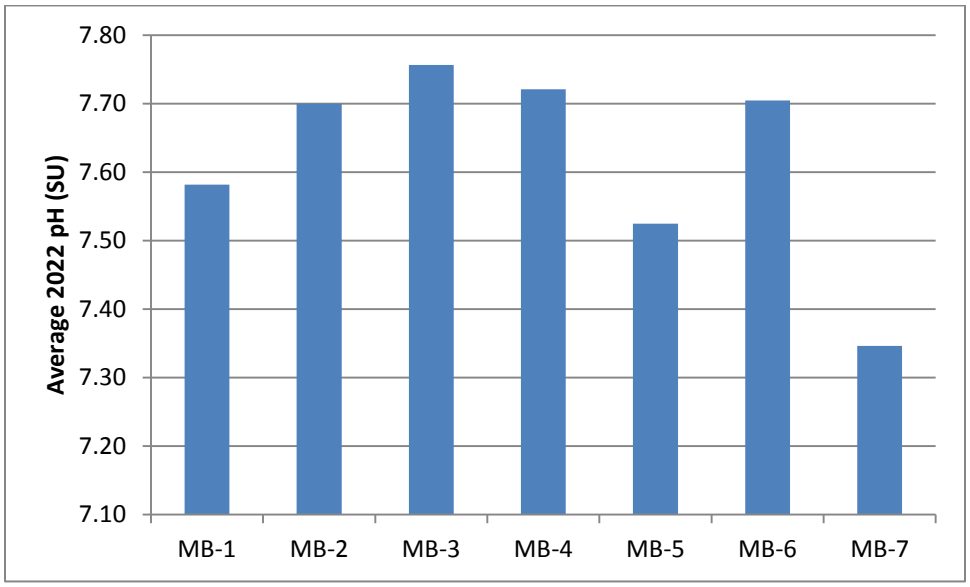
pH is a measure of hydrogen ions in a solution. Climate change is expected to lower the pH of ocean and estuarine waters, making them acidic. A consequence of an acidic Manhasset Bay would be that shellfish could no longer grow, as the shells of juvenile shellfish would dissolve. For this reason, the Committee has chosen to begin monitoring pH in Manhasset Bay. In 2022, pH ranged from 6.97 to 8.37 across the Bay (Table G-12). Average pH for each station and year was charted and this shows that pH at the Great Neck (MB-7) station was lower than all the other stations (Fig. G-1). This was also seen in the 2017 and 2019 data, previously reported.

# Appendix G

**Table G-12. 2022 pH levels by station. Average, minimum, and maximum measurements are also given.**

| Site Name | MB-1 | MB-2 | MB-3 | MB-4 | MB-5 | MB-6 | MB-7 |
|---|---|---|---|---|---|---|---|
| **Date** | pH (SU) | pH (SU) | pH (SU) | pH (SU) | pH (SU) | pH (SU) | pH (SU) |
| 6-Jun-22 | 8.14 | 8.23 | 8.37 | 8.34 | 8.20 | 8.26 | 8.11 |
| 13-Jun-22 | 7.72 | 7.72 | 7.72 | 7.72 | 7.57 | 7.91 | 7.62 |
| 20-Jun-22 | 8.14 | 8.01 | 8.04 | 8.11 | 7.92 | 7.99 | 8.03 |
| 27-Jun-22 | 7.72 | 7.75 | 7.87 | 7.79 | 7.57 | 7.69 | 7.51 |
| 6-Jul-22 | 7.44 | 7.63 | 7.73 | 7.63 | 7.68 | 7.67 | 6.97 |
| 11-Jul-22 | 7.79 | 7.68 | 7.64 | 7.71 | 7.26 | 7.55 | 7.41 |
| 18-Jul-22 | 7.36 | 7.61 | 7.64 | 7.65 | 7.50 | 7.60 | 7.12 |
| 25-Jul-22 | 7.36 | 7.61 | 7.77 | 7.68 | 7.46 | 7.77 | 7.12 |
| 1-Aug-22 | 7.45 | 7.71 | 7.68 | 7.64 | 7.42 | 7.56 | 7.20 |
| 8-Aug-22 | 7.35 | 7.47 | 7.58 | 7.40 | 7.37 | 7.60 | 7.15 |
| 15-Aug-22 | 7.30 | 7.44 | 7.54 | 7.50 | 7.35 | 7.39 | 6.99 |
| 22-Aug-22 | 7.42 | 7.52 | 7.70 | 7.50 | 7.21 | 7.59 | 7.10 |
| 29-Aug-22 | 7.37 | 7.72 | 7.55 | 7.70 | 7.31 | 7.58 | 7.17 |
| **Average** | **7.58** | **7.70** | **7.76** | **7.72** | **7.52** | **7.70** | **7.35** |
| **Minimum** | 7.3 | 7.44 | 7.54 | 7.4 | 7.21 | 7.39 | 6.97 |
| **Maximum** | 8.14 | 8.23 | 8.37 | 8.34 | 8.2 | 8.26 | 8.11 |

**Figure G-1. Average pH by station**



### 3.c.iii Salinity

Manhasset Bay is an estuary and estuaries have brackish water (a mix of salt water from the ocean water and freshwater from the land). Ocean water is around 35 psu (practical salinity units) and freshwater is 0 psu. Salinity across the Bay ranged from 23.6 to 28.3 with an average salinity (across all stations and dates) of 26.5 (Table G-13).

**Table G-13. 2022 salinity data by station. Average, minimum, and maximum measurements are also given.**

| Site Name | MB-1 | MB-2 | MB-3 | MB-4 | MB-5 | MB-6 | MB-7 |
|---|---|---|---|---|---|---|---|
| Date | Salinity (ppt) | Salinity (ppt) | Salinity (ppt) | Salinity (ppt) | Salinity (ppt) | Salinity (ppt) | Salinity (ppt) |
| 6-Jun-22 | 24.3 | 24.8 | 24.7 | 24.6 | 24.1 | 24.9 | 23.6 |
| 13-Jun-22 | 25.1 | 25.5 | 25.6 | 25.6 | 24.6 | 24.7 | 25.1 |
| 20-Jun-22 | 23.6 | 26.1 | 26.0 | 26.0 | 25.4 | 26.1 | 24.2 |
| 27-Jun-22 | 26.5 | 26.8 | 26.6 | 26.7 | 25.7 | 26.2 | 26.1 |
| 6-Jul-22 | 26.5 | 27.0 | 26.7 | 26.8 | 25.1 | 26.5 | 25.9 |
| 11-Jul-22 | 26.3 | 26.9 | 27.0 | 27.0 | 25.6 | 26.8 | 26.2 |
| 18-Jul-22 | 26.6 | 26.9 | 26.7 | 26.5 | 26.1 | 26.6 | 26.7 |
| 25-Jul-22 | 27.0 | 27.4 | 27.1 | 27.3 | 26.3 | 26.8 | 26.8 |
| 1-Aug-22 | 27.0 | 27.3 | 27.4 | 27.4 | 26.4 | 26.6 | 25.4 |
| 8-Aug-22 | 26.8 | 27.3 | 27.0 | 27.4 | 25.3 | 26.4 | 26.8 |
| 15-Aug-22 | 27.9 | 28.3 | 28.1 | 28.1 | 27.4 | 28.0 | 26.6 |
| 22-Aug-22 | 27.8 | 28.2 | 28.0 | 28.2 | 27.8 | 27.9 | 27.5 |
| 29-Aug-22 | 27.2 | 28.2 | 27.8 | 27.9 | 27.3 | 28.0 | 27.3 |
| Average | **26.4** | **27.0** | **26.8** | **26.9** | **25.9** | **26.6** | **26.0** |
| Minimum | 23.6 | 24.8 | 24.7 | 24.6 | 24.1 | 24.7 | 23.6 |
| Maximum | 27.9 | 28.3 | 28.1 | 28.2 | 27.8 | 28.0 | 27.5 |

### 3.c.iv Water Clarity

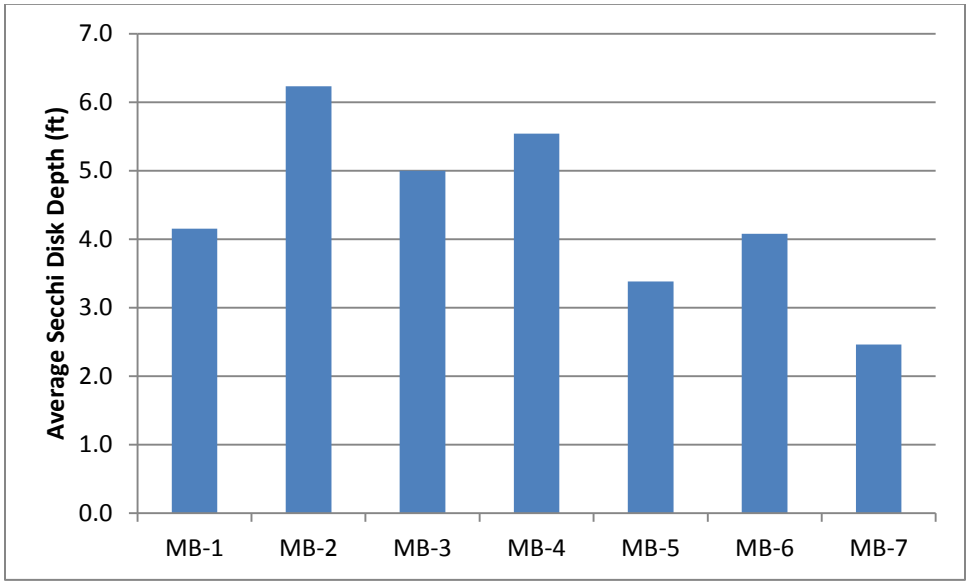
Water clarity is a measurement of how deep light penetrates, which is important for marine algae and plants that use photosynthesis to generate energy. Water clarity is determined using a secchi disk. The larger the secchi depth, the deeper light penetrates. Secchi disk depths were taken to the nearest whole foot (ft).

Average secchi disk depth ranged from 2.5 ft at MB-7 (Great Neck, in the back of the Bay) to 6.2 ft at MB-2 (Kennelworth; Table G-14). This pattern fits with what would be expected: clearer water at a site closer to Long Island Sound which, therefore, experiences more flushing and more turbid water at the station in the back of the Bay which does not experience as much tidal flushing.

**Table G-14. 2022 water clarity data by station. Average, minimum, and maximum measurements are also given.**

| Site Name | MB-1 | MB-2 | MB-3 | MB-4 | MB-5 | MB-6 | MB-7 |
|---|---|---|---|---|---|---|---|
| Date | Secchi Disk Depth (ft) | Secchi Disk Depth (ft) | Secchi Disk Depth (ft) | Secchi Disk Depth (ft) | Secchi Disk Depth (ft) | Secchi Disk Depth (ft) | Secchi Disk Depth (ft) |
| 6-Jun-22 | 6 | 6 | 4 | 5 | 3 | 4 | 3 |
| 13-Jun-22 | 5 | 9 | 6 | 6 | 3 | 3 | 4 |
| 20-Jun-22 | 3 | 4 | 5 | 5 | 4 | 5 | 1 |
| 27-Jun-22 | 2 | 5 | 4 | 5 | 2 | 5 | 1 |
| 6-Jul-22 | 5 | 8 | 4 | 5 | 4 | 3 | 3 |
| 11-Jul-22 | 4 | 6 | 5 | 6 | 4 | 5 | 2 |
| 18-Jul-22 | 4 | 6 | 4 | 5 | 4 | 4 | 3 |
| 25-Jul-22 | 5 | 6 | 6 | 6 | 4 | 5 | 3 |
| 1-Aug-22 | 3 | 6 | 5 | 5 | 2 | 4 | 1 |
| 8-Aug-22 | 4 | 7 | 6 | 7 | 4 | 4 | 3 |
| 15-Aug-22 | 4 | 6 | 4 | 5 | 3 | 3 | 2 |
| 22-Aug-22 | 5 | 7 | 6 | 6 | 5 | 5 | 3 |
| 29-Aug-22 | 4 | 5 | 6 | 6 | 2 | 3 | 3 |
| Average | **4.2** | **6.2** | **5.0** | **5.5** | **3.4** | **4.1** | **2.5** |
| Minimum | 2.0 | 4.0 | 4.0 | 5.0 | 2.0 | 3.0 | 1.0 |
| Maximum | 6.0 | 9.0 | 6.0 | 7.0 | 5.0 | 5.0 | 4.0 |

**Figure G-2. Average secchi disk depth (feet) by station**



## 3.d How Do Rainfall and Temperature Affect Physical Parameters

Pearson Correlations were again used to determine what, if any, relationships existed between rainfall, temperature, and physical parameters. The Pearson Correlation calculates an *r*-value between -1 and +1 in order to determine if and how strong a relationship is between two variables (an *r*-value of zero means that there is no relationship). If the coefficient is positive, then the two variables tend to increase together. If the coefficient is negative, one variable tends to decrease as the other variable increases. As positive *r*-values approach "+1," the two variables are more closely related (a value of +1 indicates a perfect correlation), therefore *r-values* equal to and higher than 0.70 are significant. No *r*-values less than zero generated for these data sets were significant ($r > -0.70$). As always, correlations do not necessarily mean causation.

### 3.d.i Effect of Rainfall and Temperature on Dissolved Oxygen

Pearson Correlations run between dissolved oxygen (DO) values and rainfall showed no correlations in the two day sampling window. There was, however, a strong negative correlation between DO and water temperature ($r < -0.70$; Table G-15), which is expected and also demonstrated in the large and persistent fish kill seen during the summer.

**Table G-15. Pearson correlations for dissolved oxygen data v. rainfall in the windows of two-days prior to sampling, one-day prior to sampling, and day of sampling as well as temperature. Significant findings are highlighted.**

| Station ID | Pearson coefficients | | | |
|---|---|---|---|---|
| | Rainfall Two-days prior | Rainfall One-day prior | Rainfall Day-of | Temperature |
| MB-1 | -0.14 | 0.00 | -0.37 | -0.90 |
| MB-2 | -0.09 | 0.04 | -0.39 | -0.76 |
| MB-3 | -0.37 | 0.00 | -0.35 | -0.63 |
| MB-4 | -0.12 | 0.04 | -0.49 | -0.68 |
| MB-5 | -0.39 | 0.19 | -0.23 | -0.73 |
| MB-6 | -0.32 | 0.21 | -0.28 | -0.75 |
| MB-7 | -0.18 | 0.02 | -0.32 | -0.87 |

### 3.d.ii Salinity v. Rainfall

Pearson Correlations were run for salinity against rainfall, but no correlations were indicated ($-0.7 < p < 0.7$; Table G-16).

**Table G-16. Pearson correlations for salinity data v. rainfall in the windows of two-days prior to sampling, one-day prior to sampling, and day of sampling as well as tidal height. Significant findings are highlighted.**

| Station ID | Pearson coefficients | | |
|---|---|---|---|
| | Rainfall Two-days prior | Rainfall One-day prior | Rainfall Day-of |
| MB-1 | 0.14 | -0.09 | 0.18 |
| MB-2 | 0.25 | -0.23 | 0.10 |
| MB-3 | 0.28 | -0.21 | 0.12 |
| MB-4 | 0.25 | -0.28 | 0.14 |
| MB-5 | 0.21 | -0.13 | -0.13 |
| MB-6 | 0.37 | -0.24 | -0.07 |
| MB-7 | 0.27 | 0.04 | 0.12 |

### 3.d.iii Water Clarity v. Rainfall

Pearson Correlations were run for secchi disk depth against rainfall, but no correlations were indicated ($-0.7 < p < 0.7$; Table G-17).

**Table G-17. Pearson correlations for 2019 secchi disk depth data v. rainfall in the windows of two-days prior to sampling, one-day prior to sampling, and day of sampling. There were no significant findings.**

| Station ID | Pearson coefficients | | |
|---|---|---|---|
| | Rainfall Two-days prior | Rainfall One-day prior | Rainfall Day-of |
| MB-1 | -0.08 | 0.07 | -0.20 |
| MB-2 | -0.25 | 0.24 | 0.19 |
| MB-3 | 0.24 | -0.16 | 0.15 |
| MB-4 | 0.30 | -0.13 | 0.34 |
| MB-5 | -0.19 | 0.12 | 0.00 |
| MB-6 | -0.03 | -0.20 | -0.11 |
| MB-7 | -0.01 | 0.37 | -0.01 |

## 3.f Is There a Spatial Difference in Bacteria Concentrations Within the Bay

Plotting the geometric mean of Enterococci bacteria counts by station into a line graph clearly and quickly shows where the highest counts are generally found. Additionally, as this is the standard used by NYSDEC, it gives an idea of how these stations fare compared to the standard. The standard states that the geometric mean of Enterococci samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL.

Early in the summer (June and beginning of July), geometric means of Enterococci were similar. However, as the summer progressed, the highest counts were at Baxter Beach (MB-5), Manorhaven

Beach (MB-6), and Great Neck (MB-7), which are all in portions of the Bay expected to receive less flushing, as compared to the lowest counts which were at Kennelworth (MB-2), Manorhaven (MB-3), and NUN-4 (MB-4), which are expected to experience more flushing (Fig. G-3).

## 3.g. Are there any trends in interannual bacteria concentrations at each site?

In order to ascertain if bacteria counts are changing, 2022 data was compared to 2017 data using a t-test. 2017 was chosen as the data for comparison as this is the first year that has data for all seven (7) sites and because this gives a five year period to view any trends over. A t-test calculates a p-value in order to determine if there is a significant difference between two sets of data which cannot be explained by chance. A p-value equal to or less than 0.05 was used as the threshold at which there is a significant difference. A Two-sample Assuming Unequal Variances t-Test was run between bacteria counts for both years for each station (this test was selected after determining that the variances were too different utilizing an f-test). The t-test indicated that there was no significant difference between 2017 and 2022 data for either bacteria species at any station ($p > 0.05$; Tables G-18 through G-24). The data was also plotted in line graphs for visual comparison (Fig. G-4 through G-10).

## Appendix G

**Figure. G-3. Line graph of the 5-sample rolling geometric means of Enterococci (CFU/100ml) by station**

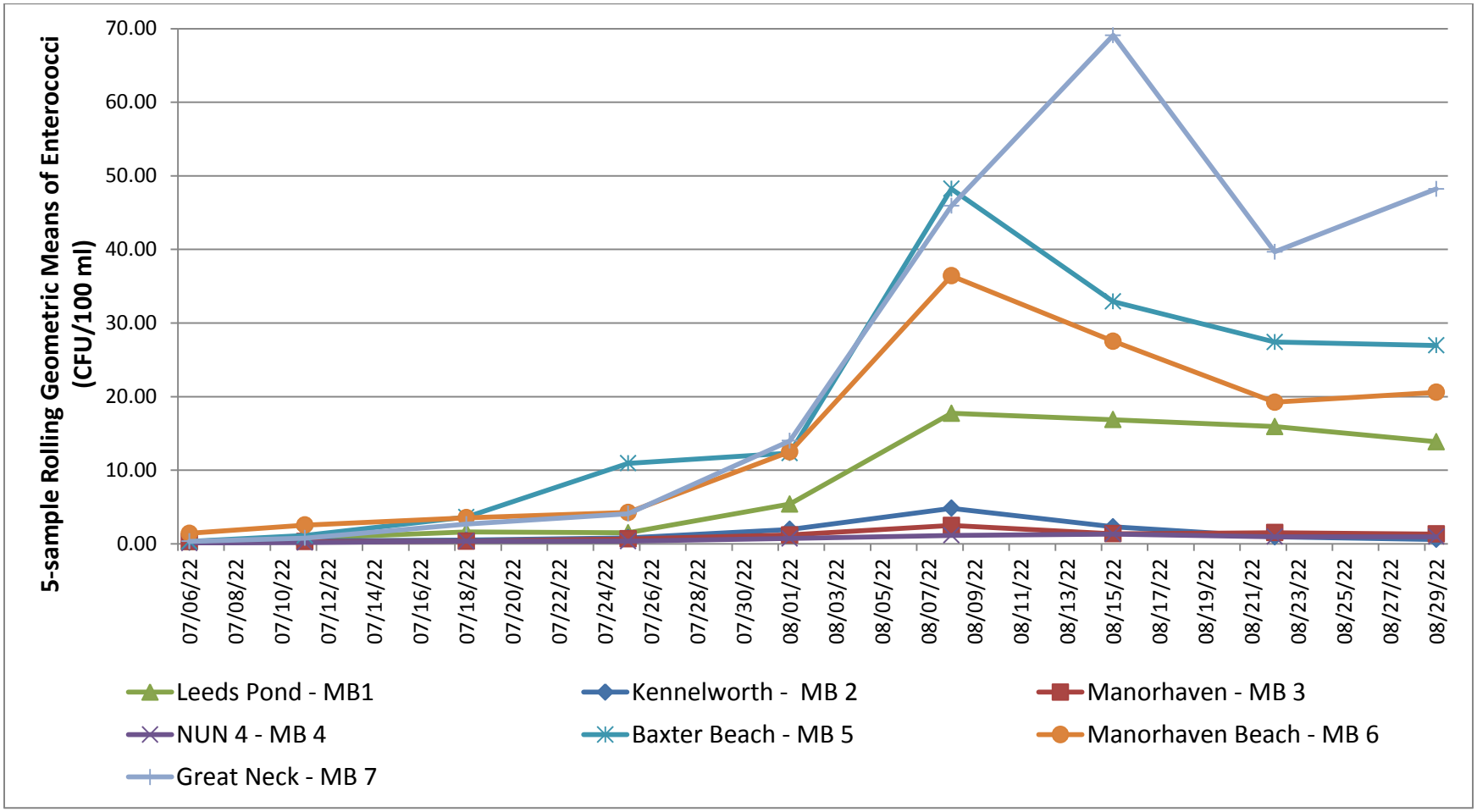


**Table G-18. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at Leeds Pond (MB-1). There were no significant findings.**

| **Leeds Pond - MB-1** ***Fecal Coliform*** | | | **Leeds Pond - MB-1** ***Enterococci*** | | |
|---|---|---|---|---|---|
| t-Test: Two-Sample Assuming Unequal Variances | | | t-Test: Two-Sample Assuming Unequal Variances | | |
| | *2022* | *2017* | | *2022* | *2017* |
| Mean | 80 | 50.7 | Mean | 54.48461538 | 4.253846154 |
| Variance | 25369 | 2391.553333 | Variance | 31051.88141 | 25.64935897 |
| Observations | 13 | 13 | Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | | Hypothesized Mean Difference | 0 | |
| df | 14 | | df | 12 | |
| t Stat | 0.634052526 | | t Stat | 1.027349591 | |
| P(T<=t) one-tail | 0.268134804 | | P(T<=t) one-tail | 0.162259846 | |
| t Critical one-tail | 1.761310136 | | t Critical one-tail | 1.782287556 | |
| P(T<=t) two-tail | 0.536269609 | | P(T<=t) two-tail | 0.324519692 | |
| t Critical two-tail | 2.144786688 | | t Critical two-tail | 2.17881283 | |

**Table G-19. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at Kennelworth (MB-2). There were no significant findings.**

**Kennelworth - MB-2**

Fecal Coliform

t-Test: Two-Sample Assuming Unequal Variances

| | *2022* | *2017* |
|---|---|---|
| Mean | 14.47692308 | 26.46153846 |
| Variance | 573.2885897 | 1039.269231 |
| Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 22 | |
| t Stat | -1.076064067 | |
| P(T<=t) one-tail | 0.146779067 | |
| t Critical one-tail | 1.717144374 | |
| P(T<=t) two-tail | 0.293558134 | |
| t Critical two-tail | 2.073873068 | |

**Kennelworth - MB-2**

***Enterococci***

t-Test: Two-Sample Assuming Unequal Variances

| | *2022* | *2017* |
|---|---|---|
| Mean | 2.669230769 | 3.753846154 |
| Variance | 13.28730769 | 68.57435897 |
| Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 16 | |
| t Stat | -0.432222275 | |
| P(T<=t) one-tail | 0.33567429 | |
| t Critical one-tail | 1.745883676 | |
| P(T<=t) two-tail | 0.67134858 | |
| t Critical two-tail | 2.119905299 | |

# Appendix G

**Table G-20. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at Manorhaven (MB-3). There were no significant findings.**

| **Manorhaven - MB-3** ***Fecal Coliform*** | | | **Manorhaven - MB-3** ***Enterococci*** | | |
|---|---|---|---|---|---|
| t-Test: Two-Sample Assuming Unequal Variances | | | t-Test: Two-Sample Assuming Unequal Variances | | |
| | *2022* | *2017* | | *2022* | *2017* |
| Mean | 7.461538462 | 22.84615385 | Mean | 1.723076923 | 2.353846154 |
| Variance | 27.43589744 | 817.8076923 | Variance | 2.453589744 | 32.16935897 |
| Observations | 13 | 13 | Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | | Hypothesized Mean Difference | 0 | |
| df | 13 | | df | 14 | |
| t Stat | -1.907951701 | | t Stat | -0.38650948 | |
| P(T<=t) one-tail | 0.039364429 | | P(T<=t) one-tail | 0.352465106 | |
| t Critical one-tail | 1.770933396 | | t Critical one-tail | 1.761310136 | |
| P(T<=t) two-tail | 0.078728859 | | P(T<=t) two-tail | 0.704930213 | |
| t Critical two-tail | 2.160368656 | | t Critical two-tail | 2.144786688 | |

**Table G-21. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at NUN-4 (MB-4). There were no significant findings.**

**NUN 4 - MB-4**

Fecal Coliform

t-Test: Two-Sample Assuming Unequal Variances

| | *2022* | *2017* |
|---|---|---|
| Mean | 6.153846154 | 11.94615385 |
| Variance | 41.64102564 | 132.149359 |
| Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 19 | |
| t Stat | -1.584201528 | |
| P(T<=t) one-tail | 0.064825632 | |
| t Critical one-tail | 1.729132812 | |
| P(T<=t) two-tail | 0.129651264 | |
| t Critical two-tail | 2.093024054 | |

**NUN 4 - MB-4**

***Enterococci***

t-Test: Two-Sample Assuming Unequal Variances

| | *2022* | *2017* |
|---|---|---|
| Mean | 1.130769231 | 1.153846154 |
| Variance | 2.620641026 | 5.566025641 |
| Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 21 | |
| t Stat | -0.029080109 | |
| P(T<=t) one-tail | 0.488537648 | |
| t Critical one-tail | 1.720742903 | |
| P(T<=t) two-tail | 0.977075296 | |
| t Critical two-tail | 2.079613845 | |

**Table G-22. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at Baxter Beach (MB-5). There were no significant findings.**

| **Baxter Beach - MB-5** ***Fecal Coliform*** | | | **Baxter Beach - MB-5** ***Enterococci*** | | |
|---|---|---|---|---|---|
| t-Test: Two-Sample Assuming Unequal Variances | | | t-Test: Two-Sample Assuming Unequal Variances | | |
| | *2022* | *2017* | | *2022* | *2017* |
| Mean | 114.8461538 | 61.70769231 | Mean | 26.49230769 | 16.03846154 |
| Variance | 14277.14103 | 6179.009103 | Variance | 798.6741026 | 976.3358974 |
| Observations | 13 | 13 | Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | | Hypothesized Mean Difference | 0 | |
| df | 21 | | df | 24 | |
| t Stat | 1.339580144 | | t Stat | 0.894638077 | |
| P(T<=t) one-tail | 0.097349902 | | P(T<=t) one-tail | 0.189932699 | |
| t Critical one-tail | 1.720742903 | | t Critical one-tail | 1.71088208 | |
| P(T<=t) two-tail | 0.194699804 | | P(T<=t) two-tail | 0.379865398 | |
| t Critical two-tail | 2.079613845 | | t Critical two-tail | 2.063898562 | |

## Appendix G

**Table G-23. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at Manorhaven Beach (MB-6). There were no significant findings.**

**Manorhaven Beach - MB-6**

Fecal Coliform

t-Test: Two-Sample Assuming Unequal Variances

| | *2022* | *2017* |
|---|---|---|
| Mean | 77.69230769 | 80.31538462 |
| Variance | 13045.89744 | 35558.05974 |
| Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 20 | |
| t Stat | -0.042898972 | |
| P(T<=t) one-tail | 0.483103736 | |
| t Critical one-tail | 1.724718243 | |
| P(T<=t) two-tail | 0.966207472 | |
| t Critical two-tail | 2.085963447 | |

**Manorhaven Beach - MB-6**

***Enterococci***

t-Test: Two-Sample Assuming Unequal Variances

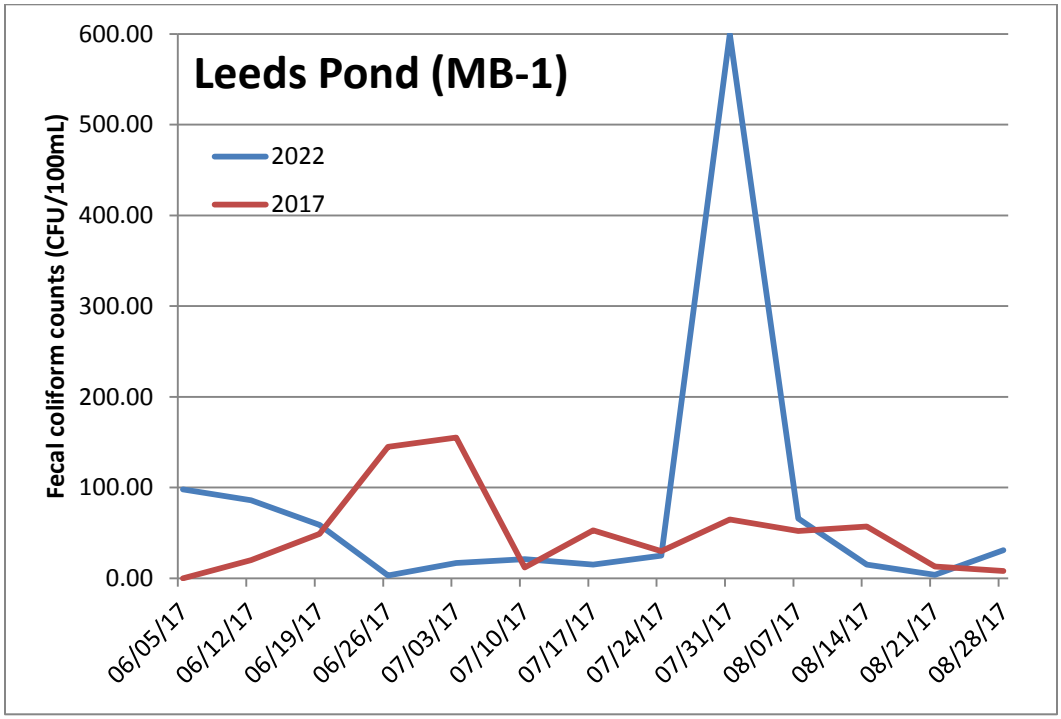
| | *2022* | *2017* |
|---|---|---|
| Mean | 31.16153846 | 26.88461538 |
| Variance | 3665.289231 | 7251.073077 |
| Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | |
| df | 22 | |
| t Stat | 0.147592451 | |
| P(T<=t) one-tail | 0.442004364 | |
| t Critical one-tail | 1.717144374 | |
| P(T<=t) two-tail | 0.884008728 | |
| t Critical two-tail | 2.073873068 | |

**Table G-24. t-Tests assuming unequal variances for 2022 v. 2017 Fecal coliform data at Great Neck (MB-7). There were no significant findings.**

| GREAT NECK - MB-7 *Fecal Coliform* | | | GREAT NECK - MB-7 *Enterococci* | | |
|---|---|---|---|---|---|
| t-Test: Two-Sample Assuming Unequal Variances | | | t-Test: Two-Sample Assuming Unequal Variances | | |
| | *2022* | *2017* | | *2022* | *2017* |
| Mean | 103.3076923 | 66.23076923 | Mean | 88.94615385 | 27.46153846 |
| Variance | 26423.23077 | 5134.358974 | Variance | 65816.29936 | 3560.269231 |
| Observations | 13 | 13 | Observations | 13 | 13 |
| Hypothesized Mean Difference | 0 | | Hypothesized Mean Difference | 0 | |
| df | 16 | | df | 13 | |
| t Stat | 0.752529361 | | t Stat | 0.84165039 | |
| P(T<=t) one-tail | 0.23133073 | | P(T<=t) one-tail | 0.207599203 | |
| t Critical one-tail | 1.745883676 | | t Critical one-tail | 1.770933396 | |
| P(T<=t) two-tail | 0.462661459 | | P(T<=t) two-tail | 0.415198405 | |
| t Critical two-tail | 2.119905299 | | t Critical two-tail | 2.160368656 | |

**Figure G-4. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for Leeds Pond (MB-1) for 2017 and 2022**

*(a)*




*(b)*

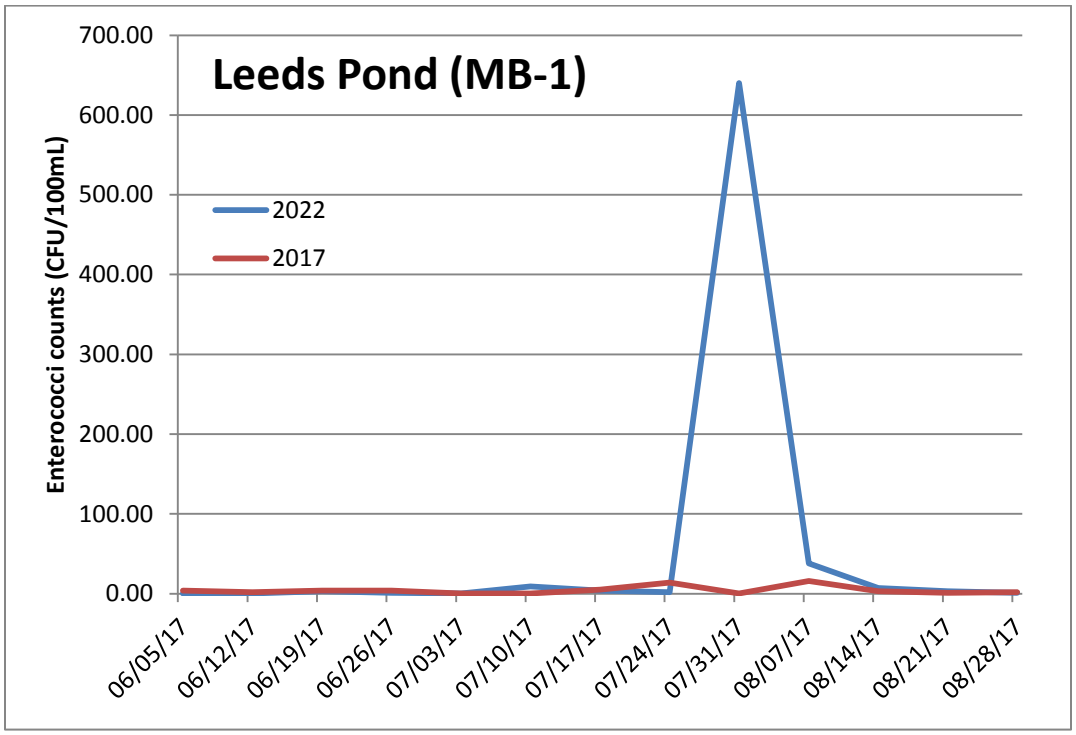
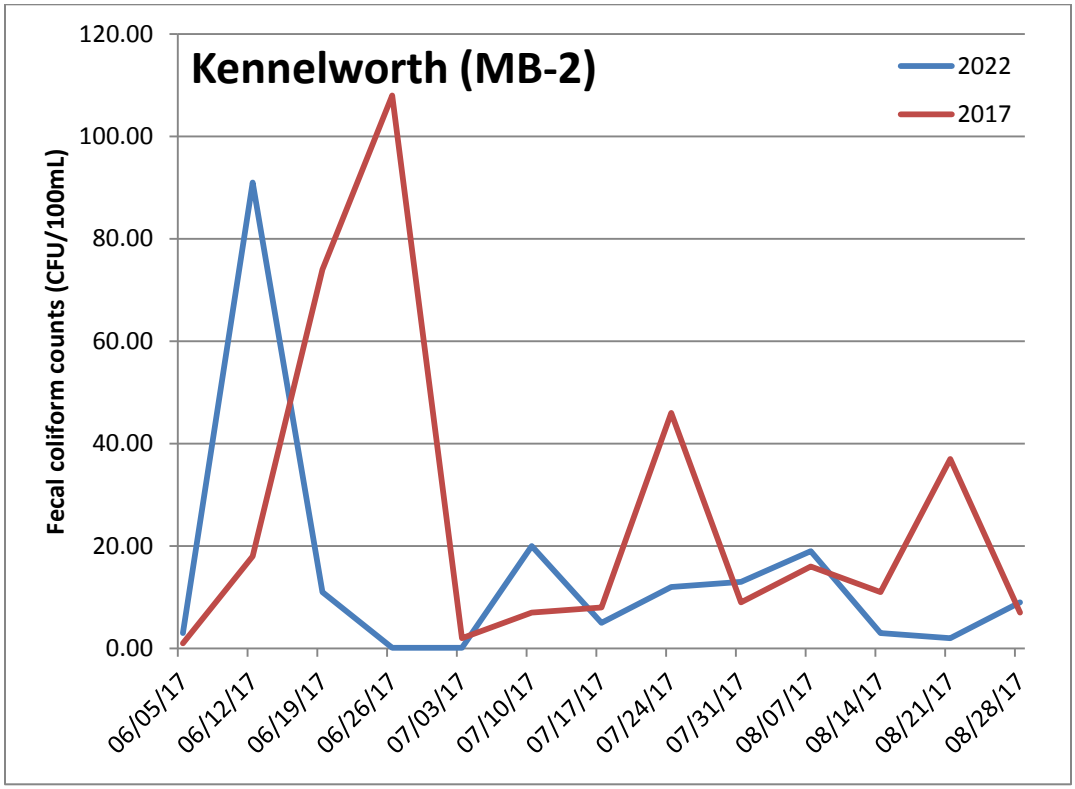


**Figure G-5. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for Kennelworth (MB-2) for 2017 and 2022**

*(a)*




*(b)*

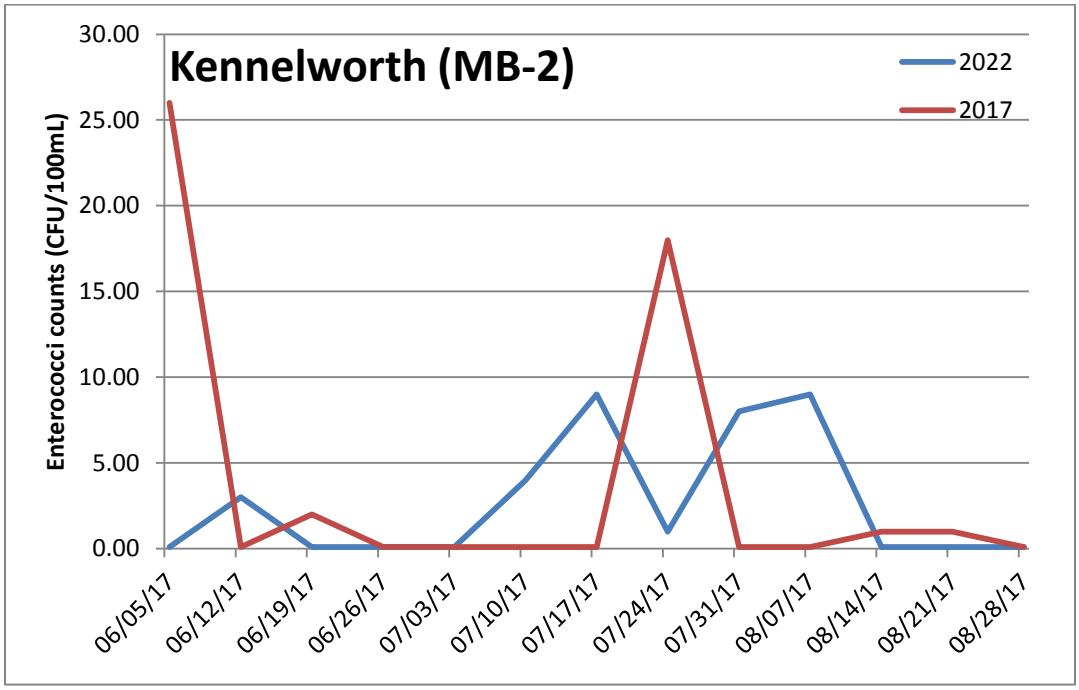
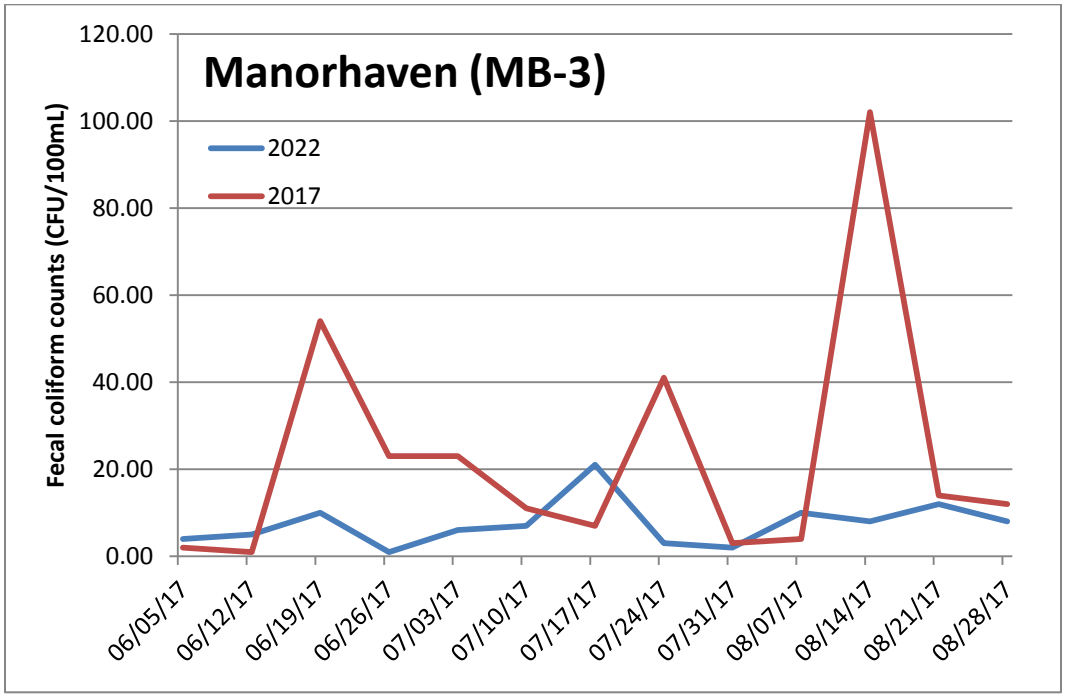


**Figure G-6. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for Manorhaven (MB-3) for 2017 and 2022**

*(a)*




*(b)*

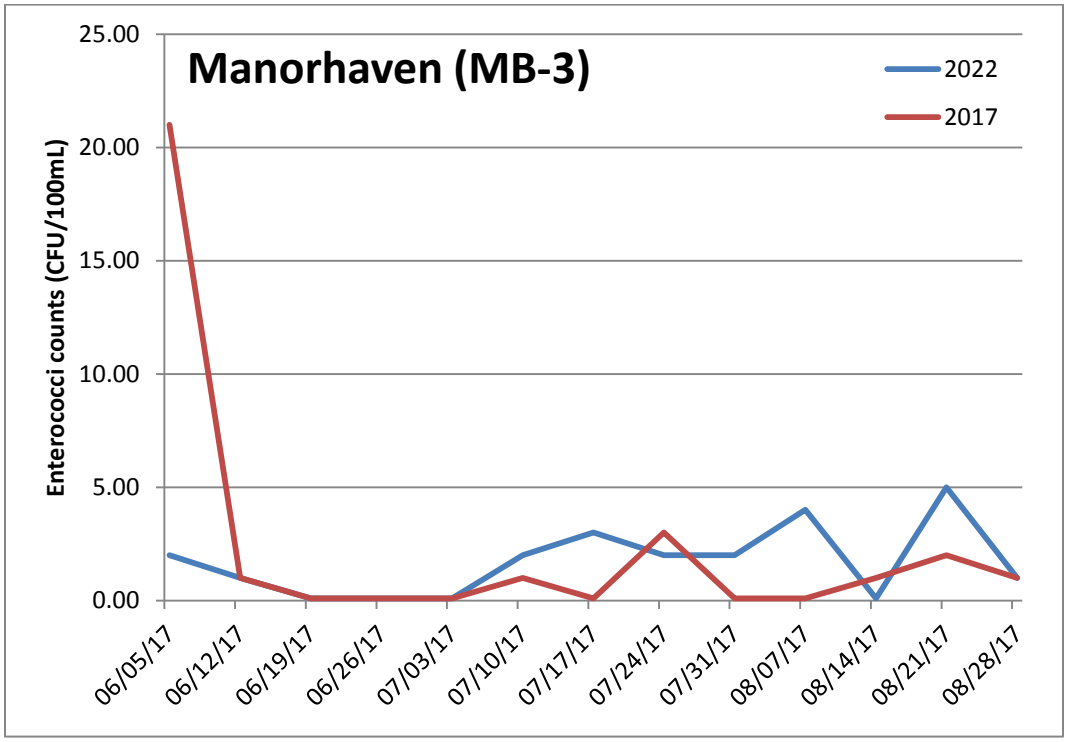
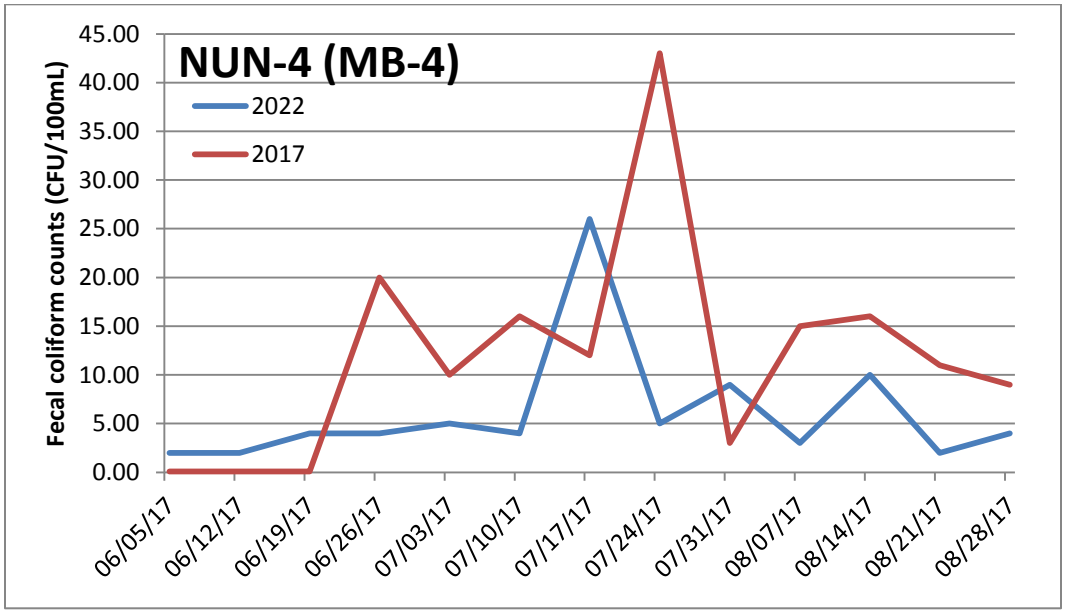


**Figure G-7. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for NUN-4 (MB-4) for 2017 and 2022**

*(a)*




*(b)*

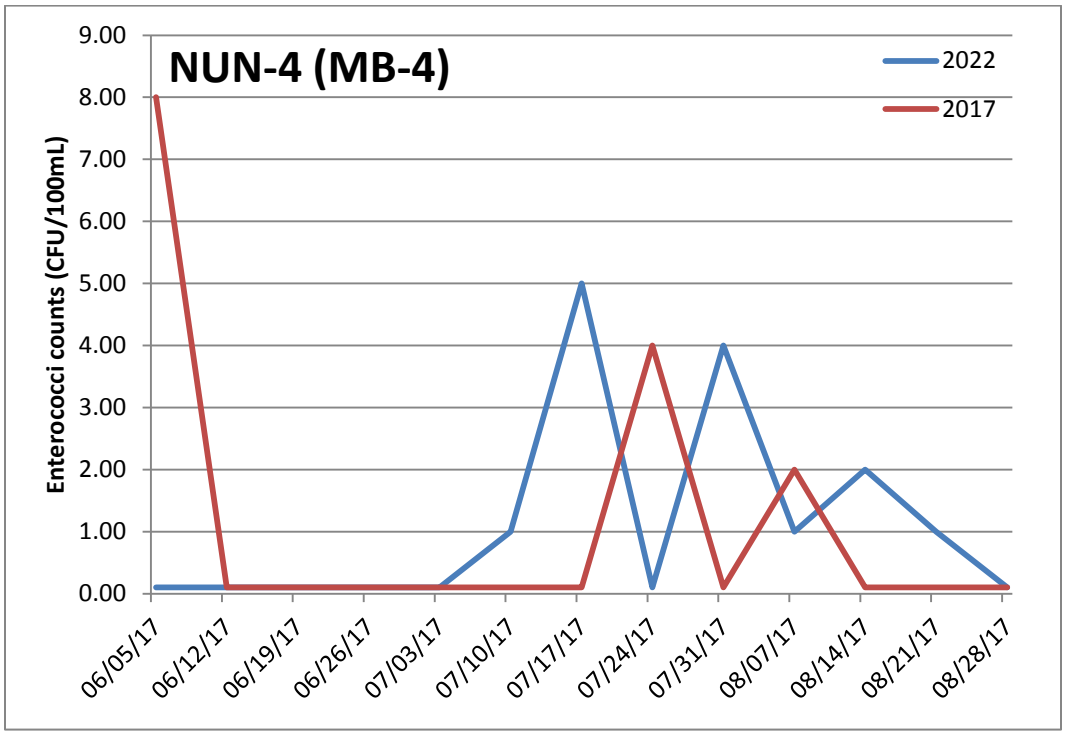
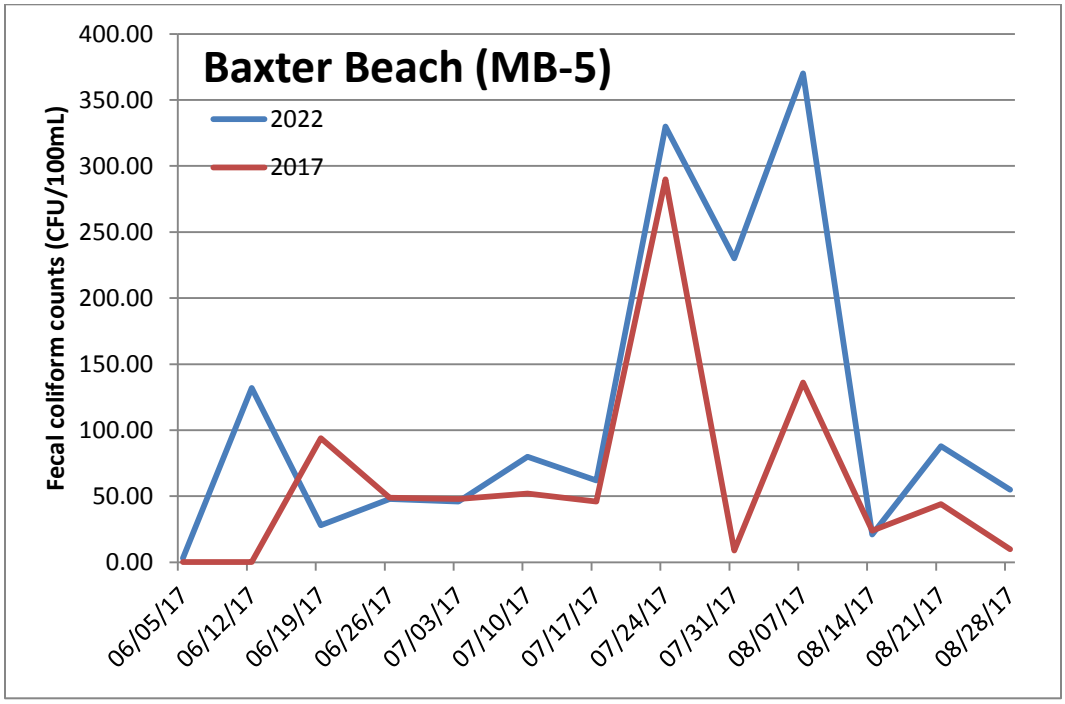


**Figure G-8. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for Baxter Beach (MB-5) for 2017 and 2022**

*(a)*




*(b)*

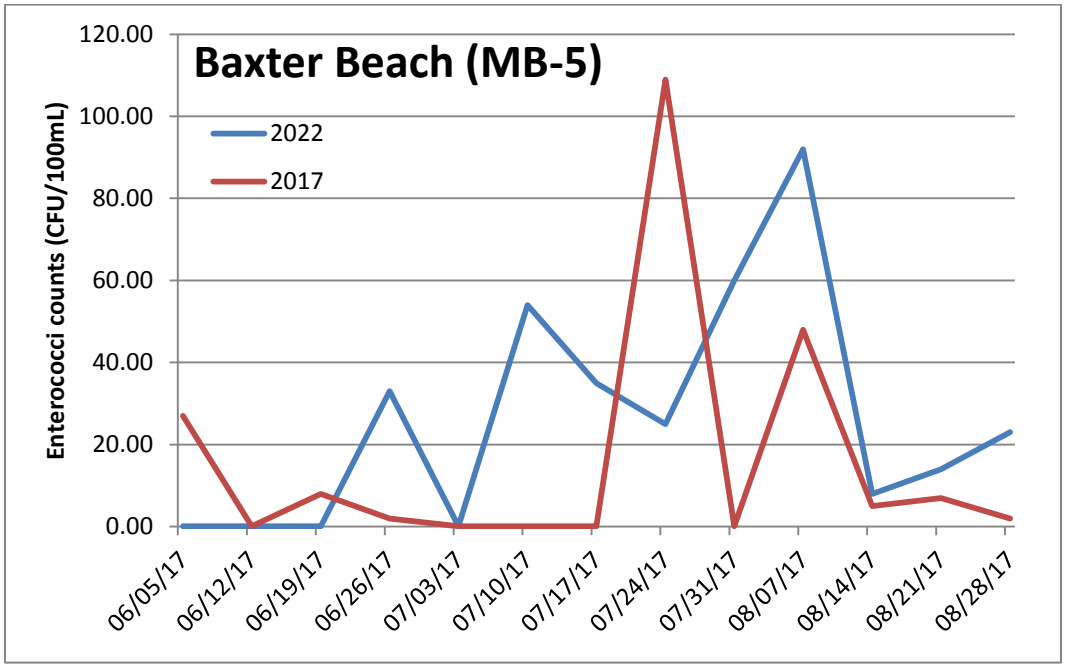
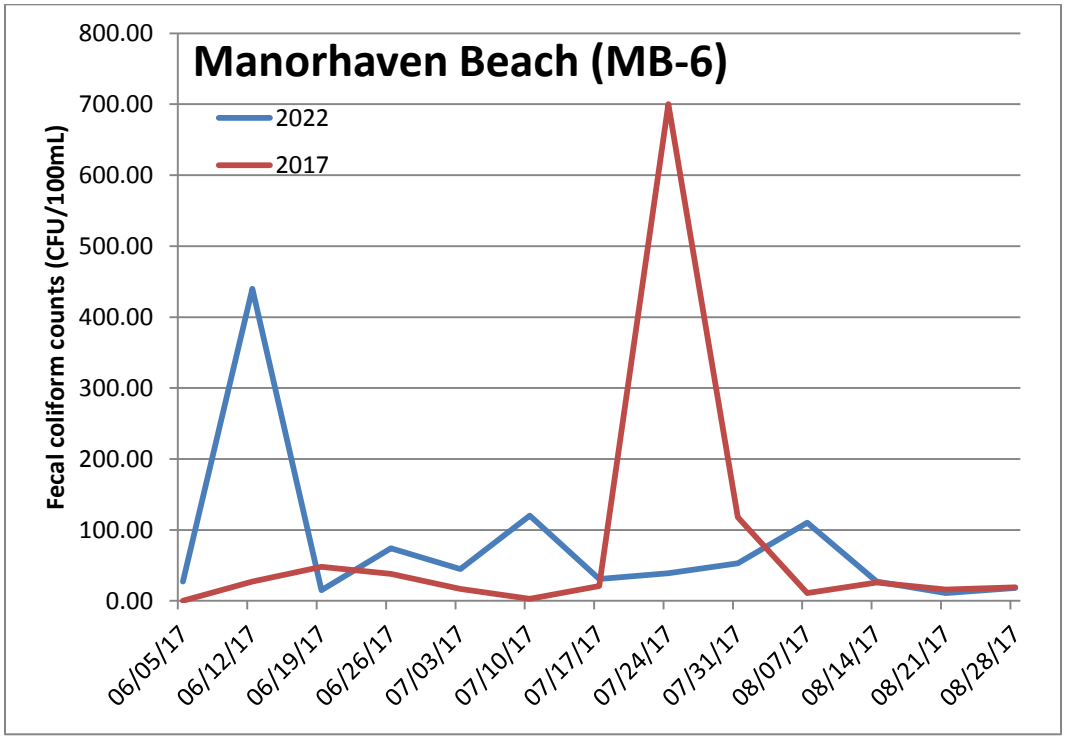


**Figure G-9. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for Manorhaven Beach (MB-6) for 2017 and 2022**

*(a)*




*(b)*

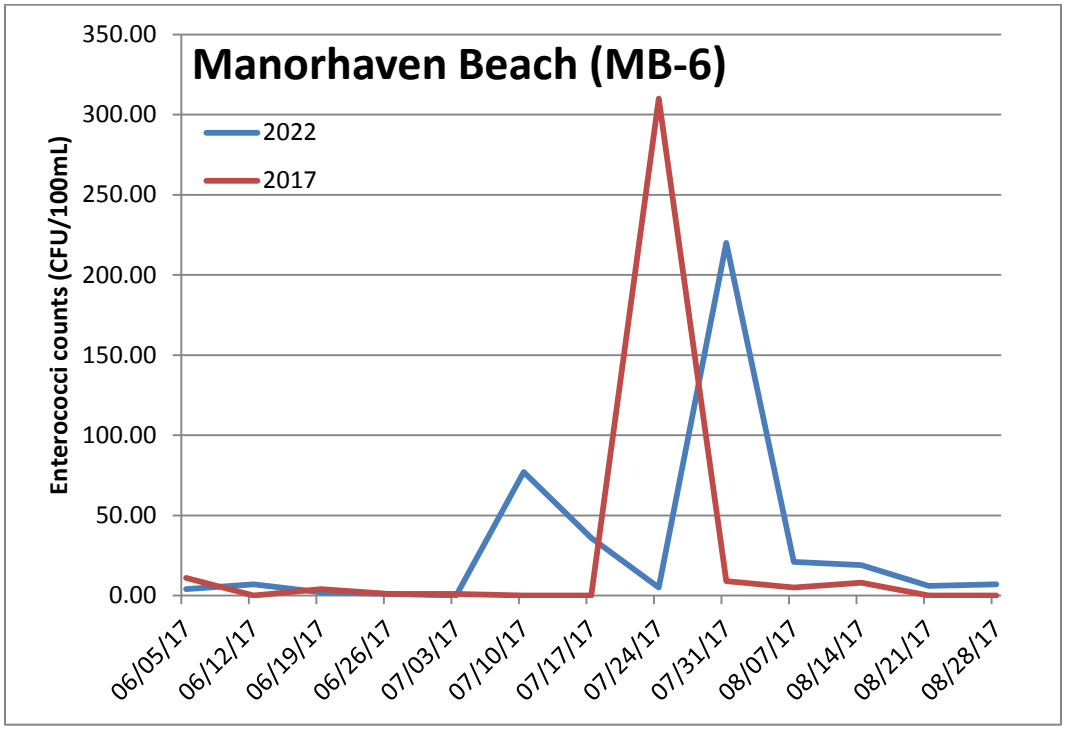
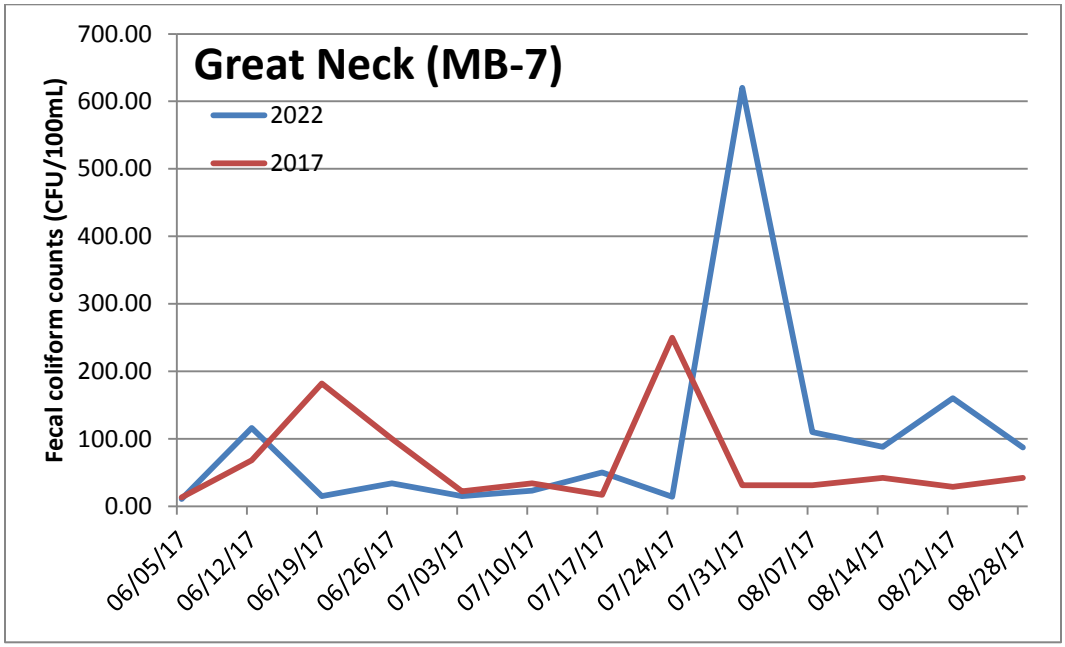
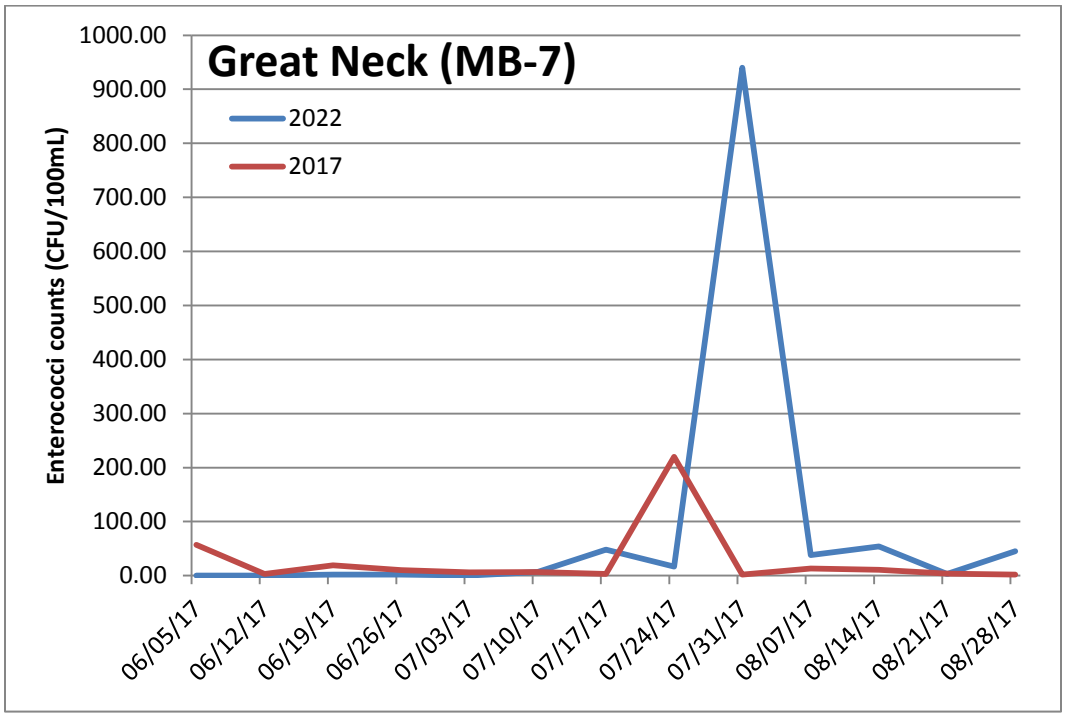


**Figure G-10. Line graph comparing the (a) Fecal coliform and (b) Enterococci counts (CFU/100mL) for Great Neck (MB-7) for 2017 and 2022**

*(a)*




*(b)*



# 4 Discussion

## 4.a Are in-bay bacteria levels safe for swimming?

In order to protect primary contact recreation (e.g., swimming) both NYSDEC and EPA use a geometric mean and statistical threshold value of Enterococci counts (CFU/100mL of water). The standard states, "the geometric mean of Enterococci samples collected over any consecutive 30-day period shall not exceed 35 CFU/100 mL and no more than 10 percent of the samples collected in the same 30-day period shall exceed 130 CFU/100 mL." Based on this:

- The standard was never exceeded at Kennelworth (MB-2), Manorhaven (MB-3), or the NUN-4 buoy (MB-4);
- The Leeds Pond (MB-1) and Manorhaven Beach (MB-6) stations exceeded the standard from July 6th through the end of sampling and this cannot be attributed to rainfall as rainfall was not a factor at these sites in 2022 ($p < 0.70$; Table G-3);
- Baxter Beach (MB-5) exceeded the standard from July 9 through September 7 (Table G-8). However, rainfall the day of sampling was shown to correlate ($p > 0.70$) with higher counts of Enterococci at this site (Table G-3), which could be a factor in that exceedance;
- Great Neck (MB-7) exceeded the standard starting on July 6th and going into September (according to the date of the sampling of the first and last exceedance; Table G-25) and this cannot be attributed to rainfall as rainfall was not a factor at these sites in 2022 ($p < 0.70$; Table G-3). Note that Great Neck is in Class SC waters which are not classified for primary contact recreation.

Unfortunately, there is no pattern to predict whether swimming will be safe at any station at any given time.

**Table G-25. 2022 Enterococci (CFU/100mL) and 5-sample rolling geometric means for Great Neck (MB-7). Exceedances are highlighted.**

. **Great Neck - MB 7**

***Enterococci***

| Date | CFU/100ml. | GeoMean |
|---|---|---|
| 06/06/22 | 0.10 | |
| 06/13/22 | 0.10 | |
| 06/20/22 | 2.00 | |
| 06/27/22 | 2.00 | |
| 07/06/22 | 0.10 | 0.33 |
| 07/11/22 | 7.00 | 0.78 |
| 07/18/22 | 48.00 | 2.66 |
| 07/25/22 | 17.00 | 4.09 |
| 08/01/22 | 940.00 | 14.00 |
| 08/08/22 | 38.00 | 45.91 |
| 08/15/22 | 54.00 | 69.09 |
| 08/22/22 | 3.00 | 39.68 |
| 08/29/22 | 45.00 | 48.21 |

10% of samples exceeds standard
Geometric mean exceeds standard

## 4.b Is there relationship between counts of the two indicator bacteria species and rainfall and can rainfall account for exceedances?

Again, there is no clear pattern of correlation between rainfall and the two bacteria species. The only instance where rainfall ***may*** have accounted for a standard exceedance is at Baxter Beach (MB-5). But, as detailed in the attached report covering 2016 through 2021, the impact of rain on bacteria at each station is different from year to year.

## 4.c How do abiotic factors, such as precipitation, affect other water quality parameters?

The only relationship appeared to be between temperature and dissolved oxygen (DO): as temperatures went up, dissolved oxygen declined. And this was demonstrated in the large and persistent fish kill seen during the summer of 2022. No relationships were indicated between DO and rainfall, salinity and rainfall, and water clarity and rainfall.

## 4.d Is there a spatial difference in bacteria concentrations within the bay?

Early in the summer (June and beginning of July), geometric means of Enterococci were similar among the stations. However, as the summer progressed, the highest counts were at Baxter Beach (MB-5),

Manorhaven Beach (MB-6), and Great Neck (MB-7), which are all in portions of the Bay expected to receive less flushing, as compared to the lowest counts which were at Kennelworth (MB-2), Manorhaven (MB-3), and NUN-4 (MB-4), which are expected to experience more flushing and, therefore, be "cleaner" (Fig. G-3). Again, though this pattern generally fits the pattern that is expected, as detailed in the attached report covering 2016 through 2021, this pattern can vary from year to year.