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#### Introduction

IEC's Volunteer Pathogen Monitoring Program is intended to facilitate interested organizations in testing their local waterways for pathogens. This program targets areas that are not routinely monitored by regulatory agencies or other established monitoring programs. IEC provides assistance to volunteer groups in project design, sampling site selection, as well as hands-on field sampling training, supplies and equipment, and QA/QC oversight for the project. Laboratory analyses for pathogens is conducted in the IEC laboratory by IEC staff. Participating organizations and volunteers sample along publicly-accessible shoreline areas and in tidal creeks. Surveys include *in situ* measurements of water temperature, salinity, dissolved oxygen, and pH, though these parameters can vary depending on the needs of IEC's partners. Pathogen samples are taken to the IEC laboratory where they are analyzed for *Enteroccoccus* and Fecal Coliform, indicators of sewage waste, using membrane filtration (EPA 1600) and/or the newer IDEXX<sup>®</sup> Enterolert methods. All sampling and analytical procedures are outlined in an EPA-approved Quality Assurance Project Plan.

In 2020, the Volunteer Monitoring Program spanned 10-15 weeks, starting in July. Due to the pandemic, this year the Program faced unprecedented challenges. The IEC laboratory was closed for the first three weeks of sampling, so samples collected during this time period were analyzed by a contract laboratory using methods which, while EPA-certified, differed from the methodology utilized by IEC. However, due to the perseverance of our partners, we completed the season to produce a robust dataset for 2020. All sampling events were scheduled in advance and occurred regardless of recent precipitation, unless conditions were dangerous. This season included four groups: Hackensack Riverkeeper, the Lower Raritan Watershed Partnership, Gowanus Conservancy and Freshkills Park. Each group completed 15 sampling events with the exception of the Gowanus Conservancy, which had originally planned for 10 due to COVID-19. Each group sampled between one and six sites, for a total of 14 sites (Figure 1). The groups that participated in this program produced data that spread across estuaries in two states. While each of these systems were very different, all data gathered and analyzed with IEC is comparable across sites.



Figure 1: Map of Participants in the 2020 Volunteer Pathogen Monitoring Program.

### **Enterococcus and Fecal Coliform criteria**

The EPA recommends that a single *Enterococcus* sample be less than 110 Colony Forming Unit per 100mL (CFU/100mL) for primary contact such as swimming. New Jersey State recommends that a single *Enterococcus* sample be less than 104 CFU/100mL to be safe for swimming.

EPA describes the recreational water quality criteria by both a geometric mean and a statistical threshold value of the pathogen indicator. The statistical threshold value (STV) approximates the 90th percentile of the water quality distribution. No more than 10% of all samples taken over a 30-day period can be above the statistical threshold value. As this study takes 5 samples over a 30-day period, if one sample is over the STV, 20% of all samples are over the STV. This exceeds the criteria. Thus, for the purposes of this study, the statistical threshold value is a Single Sample Maximum.

EPA's water quality criteria, the STV is less than 110 CFU/100mL for a single sample and less than 30 CFU/100mL for a 5-day geometric mean for the purposes of this study. EPA has a second set of criteria

(130 CFU/100mL STV and 35 CFU/100mL geometric mean) that can be used as well, should volunteers wish to use a slightly less stringent set of criteria.

NJ DEP uses *Enterococcus* for primary recreation and Fecal Coliform for secondary contact. For primary contact, and for waters classified as SE1, NJ DEP's regulations require that *Enterococcus* shall not exceed a geometric mean of 35 CFU/100mL. No single sample can be over 104 CFU/100mL for *Enterococcus*. For secondary contact, Fecal Coliform levels cannot exceed a geometric mean of 770 CFU/100mL for waters classified as SE2 or 1,500 CFU/100mL for water classified SE3.

NYS DEC uses *Enterococcus* for coastal waters of classes SA and SB, areas where primary contact and recreation may occur. The 30-day geometric mean of samples may not exceed 35 CFU/100mL in New York State. In all other waters, Fecal Coliform geometric mean may not exceed 200 CFU/100mL.

*Figure 2: New Jersey State water classifications. Not shown: the brackish water in the Raritan River is classified FW2-NT/SE1 and FW2-NT farther upstream.* 



**Geometric Means** 

Shown below are the 5-day geometric means of each site, from each group. The red line marks 30 CFU/100mL, the EPA criteria for the *Enterococcus* Geometric Mean. The New Jersey criteria for the *Enterococcus* geometric mean is slightly higher, at 35 CFU/100mL. Fecal Coliform geometric means are shown as well; Fecal coliform counts may exceed 30 CFU/100mL, as the criteria are different for different indicator species.

## Freshkills Park

After 53 years of landfill operations spanning from 1948 to 2001, Freshkills Park is now in its development stage. The waterways inside the site include the Fresh Kill, Main Creek, and Richmond Creek. Freshkills Park sampled two sites: the Main Creek (Freshkills 1) and Richmond Creek (Freshkills 2).

Shown here are the 5-day geometric means of both sites. The EPA geometric mean criteria of 30 CFU/100 mL is only for *Enterococcus*. Both sites are classified as SC in New York State. The Fecal Coliform geometric mean criteria in New York State is 200 CFU/100 mL, so the Fecal Coliform geometric mean must be less than 200 CFU/100 mL to comply with the NYS SC classification. Please note that these data contain three weeks of *Enterococcus* MPN combined with two weeks of *Enterococcus* CFU data in the 7/15/20-8/12/20 time period, therefore geometric means for this time period are rough estimations only and should not be used for regulatory purposes, due to the combination of methods. All Fecal Coliform samples, however, were analyzed using the same methods with results in the same units (CFU/100mL), though in two different labs for that same time period (7/15/20-8/12/20 slot).



Figure 3. Freshkills Site 1: Main Creek



While Freshkills' geometric means often exceed the EPA criteria for primary contact such as swimming (30 CFU/100mL), geometric means did not exceed the New York criteria (200 CFU/100 mL).

## Hackensack Riverkeeper

Hackensack Riverkeeper sampled five sites: Ridgefield Park (RFP), River Barge Park (RVP), Laurel Hill Park (LHP), Rutkowski Park (BRP), and City Park (BCP). All locations were chosen because they are the most heavily-used waterfront access points on the Hackensack River and Newark Bay. Shown here are the 5-day geometric means of all sites. The EPA geometric mean criteria of 30 CFU/100 mL is only for *Enterococcus*. The New Jersey *Enterococcus* geometric mean criteria is 35 CFU/100mL. Ridgefield Park (RFP) is located in waters classified as SE1; Riverbarge Park (RVP) and Laurel Hill Park (LHP) are in waters classified as SE2 and Rutkowski Park (BRP) and City Park (BCP) are in waters classified as SE3.

New Jersey's criteria for primary contact in SE1 waters is a geometric mean of 35 CFU/100mL and a single sample maximum of 104 CFU/100mL for Enterococcus. For secondary contact (activities such as boating where a person is unlikely to swallow any water), 5-day Fecal Coliform Geometric Means must be less than 700 CFU/100 mL for waters classified SE2 or 1,500 CFU for water classified SE3.

Please note that these data contain three weeks of *Enterococcus* MPN combined with two weeks of *Enterococcus* CFU data in the 7/14/20-8/11/20 timeframe, and therefore geometric means for this time period are rough estimations only and should not be used for regulatory purposes, due to the combination of methods. All Fecal Coliform samples, however, were analyzed using the same methods with results in the same units (CFU/100mL), though in two different labs for that same time period (7/14/20 - 8/11/20).

Figure 5. Hackensack Site: Ridgefield Park (RFP)



## Figure 6. Hackensack Site: River Barge Park (RVP)



Figure 7. Hackensack Site: Laurel Hill Park (LHP)



Please note that the 8/18/20 – 9/15/20 bars have a 4-day geometric mean for Laurel Hill Park data.





Figure 9. Hackensack Site: City Park (BCP)



Please note that the 8/18/20 – 9/15/20 bars have a 4-day geometric mean for City Park data.

Hackensack Riverkeeper's upstream sites often exceeded *Enterococcus* criteria for primary contact, however its downstream sites often did not. It should be noted again that the data shown here are geometric means over time and not instantaneous readings.

### Lower Raritan Watershed Partnership

The Lower Raritan Watershed Partnership (LRWP) sampled six sites: Riverside Park, Rutgers Boathouse, Edison Boathouse, Ken Buchanan Waterfront Park, South Amboy Waterfront Park and 2<sup>nd</sup> Street Park (Perth Amboy). All sites are non-bathing beach sites with active kayak/canoe launches and/or fishing and other primary contact activities that, as non-bathing beach sites, are not regularly monitored by the New Jersey Department of Environmental Protection or the New Jersey Department of Health and Human Services and lack sufficient water quality data.

Shown here are the 5-day geometric means of all LRWP sites. All Raritan sites are classified FW2-NT/SE1 for Shellfish harvesting/bathing except for Riverside Park, which is FW2-NT. The EPA geometric mean criteria of 30 CFU/100 mL is only for *Enterococcus*; New Jersey's criteria for SE1 waters is a geometric mean of 35 CFU/100mL and a single sample maximum of 104 CFU/100mL for Enterococcus.

For secondary contact (activities such as boating where a person is unlikely to swallow any water), 5-day Fecal Coliform Geometric Means must be less than 700 CFU for waters classified SE2 or 1,500 CFU for water classified SE3.

Please note that these data contain two weeks of *Enterococcus* MPN combined with three weeks of *Enterococcus* CFU data in the 7/23/20-8/20/20 time period, and therefore geometric means for this time period are rough estimations only and should not be used for regulatory purposes, due to the

combination of methods. All Fecal Coliform samples, however, were analyzed using the same methods with results in the same units (CFU/100mL), though in two different labs for that same time period (7/23/20 - 8/20/20 slot).



Figure 10. Lower Raritan Watershed Partnership Site: Riverside Park

Figure 11. Lower Raritan Watershed Partnership Site: Rutgers Boathouse



Figure 12. Lower Raritan Watershed Partnership Site: Edison Boathouse



Figure 13. Lower Raritan Watershed Partnership Site: Ken Buchannan Waterfront Park



Figure 14. Lower Raritan Watershed Partnership Site: South Amboy Waterfront Park



Figure 15. Lower Raritan Watershed Partnership Site: 2<sup>nd</sup> Street Park (Perth Amboy)



Nearly all sites exceeded *Enterococcus* geometric mean criteria, with the exception of South Amboy. Like Hackensack Riverkeeper, geometric means were lower downstream than they were upstream.

### Gowanus Conservancy

The Gowanus Conservancy sampled one site, the Salt Lot, which is located at 2 2nd Avenue, Brooklyn, NY 11215. Samples were collected directly from the Gowanus Canal, accessible by the edge of the shoreline. They sampled late in the season, and only sampled for ten weeks, and thus have two 5-day geometric means. Shown here are the 5-day geometric means for that site. The EPA geometric mean criteria of 30 CFU is only for *Enterococcus*. The Gowanus Canal is classified as SD in New York state; Fecal

coliform must not exceed 200 CFU/100mL. Please note that this data was gathered much later in the season than the others. All analysis was performed using comparable methods (membrane filtration).



Figure 16. Gowanus Conservancy Sampling Site: Salt Lot

Gowanus conservancy salt lot site exceeded the *Enterococcus* geometric mean criteria for their monitoring season.

## Discussion

During 2020, the four groups in this program regularly monitored a total of 14 sites that would otherwise remain unmonitored. Some of these sites have been monitored for multiple years, a far greater breadth of study than IEC would have been able to accomplish on its own. A program of this scope can foster understanding and involvement with local waterways, a goal that our nonprofit partners are working to accomplish. Especially in the midst of a global pandemic, it is important to connect people with their local natural places.

Two new groups joined the program this year, allowing for the expansion of coverage of non-bathing beaches. Most sites this year experienced at least one excursion, showing the importance of continued monitoring. Each group utilizes its data in a different manner, which is a strength of this program: some raise awareness, some work for change, and some are staying accountable for a change that has already occurred. All data gathered are all comparable, and with an increase in participating groups and an increase in returning groups, some patterns are beginning to emerge. Bacteria counts were higher upstream than they were downstream on both the Hackensack River and the Raritan River. These rivers are not connected, so this similarity is interesting and merits further study. As we continue into the next season, we may be able to find more similarities between groups. IEC looks forward to working with you all again in 2021.