



**MIAMI  
WATERKEEPER®**

# **Report to the City of Fort Lauderdale: Weekly Waterway Monitoring**

YEAR 3

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**CITY OF FORT LAUDERDALE**



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## EXECUTIVE SUMMARY

Miami Waterkeeper was contracted by the City of Fort Lauderdale to conduct waterway quality monitoring for fecal indicator bacteria (FIB) at ten high-value inland recreational sites for the last three years (January 2021- December 2023). The data is rapidly made available to the residents and visitors of the City of Fort Lauderdale through the online app Swim Guide, social media and the Miami Waterkeeper website so they can make informed decisions about the potential health risks related to ingestion of or contact with the water within recreational areas.

While there are many parameters that comprise waterway quality, this monitoring effort was mainly focused on fecal indicator bacteria (FIB). FIB, including enterococci, are measured in water bodies to determine whether there are potential pathogens present that may be harmful to human health. High amounts of enterococci at a site can indicate a nearby source(s) of FIB. Enterococci can come from various fecal sources, including human sewage, dogs, birds, and wildlife, brought into the waterways from stormwater runoff, septic tanks, sewage leaks, vessel discharges, and bird rookeries. High enterococci concentrations aren't always associated with the presence of fecal contamination. Enterococci blooms can exist independently from a fecal source by utilizing excess nutrients and stable substrates along waterways. While enterococci is an excellent metric for health-related waterway quality, its presence is more like a symptom of a deeper issue, which is why routine monitoring is vital. When the enterococci levels exceed the threshold (70+ CPU/MPN per 100 mL) established for swimming beaches, the Florida Department of Health (DOH) advises that contact with the water may pose an increased health risk.

In August 2023, three of the previous ten sites were replaced with three new sites. These sites were selected because they were considered recreational areas, while the three discontinued sites were not. It should be noted that the monitoring sites in this study are inland waterways not specifically swimming beaches.

The data collected from three years of waterway quality monitoring around the City of Fort Lauderdale provides a better understanding the waterway quality trends at each site. Overall, 44% of the weekly samples collected had exceeded the DOH recommended threshold for potential health impacts. As noted by DOH, the presence of high concentrations of Enterococci in recreational waters may cause human disease, infections or rashes if ingested while swimming or enter the skin through a cut or sore.

In year 3 of this study, three sites, Sweeting Park, Himmarshee Canal and Tarpon River, stood out due to persistent waterway quality issues. One of the three new sites, Middle River NE 18th St Dock, stood out compared to the other two new additions.

- Himmarshee Canal: Had the highest FIB average, as well as multiple spikes over the past 3 years of 24,000+ MPN (Most Probable Number)
- Tarpon River: Highest turbidity and third highest rate of enterococci exceedance over the DOH criteria for FIB
- Sweeting Park: Lowest dissolved oxygen of the 10 original sampling sites, highest chlorophyll and highest number of exceedances over the DOH criteria for FIB
- Middle River NE 18th St Dock: Maintained the lowest dissolved oxygen and relatively high exceedance rate in the later portion of 2023.

It should be noted that a number of extreme rain events, including the 26-inch rainfall on April 12, 2023, had a significant impact on local waterway quality. Significant stormwater discharges and sanitary sewer overflows contributed to FIB exceedances throughout the month of April, 2023 and following other events in June, September and November.

## HIGHLIGHTS FROM THREE YEARS OF WATERWAY QUALITY MONITORING (2021 - 2023)

*All metrics below exclude the resample and replicate collections, unless noted otherwise.*

- Three (3) sampling locations were replaced as of August 1, 2023
  - Discontinued: Royal Palm Dr. Las Olas Blvd., Himmarshee Canal and Tarpon River (sampled from January 12, 2021 - August 1, 2023)
  - Recently Added: Cooley's Landing Park, Middle River NE 18th St Dock and Sunrise Paddleboards (sampled from August 8, 2023 - present)
- 1,523 total water samples were collected and analyzed (500 in 2021, 508 in 2022 and 515 in 2023) for FIB, dissolved oxygen, temperature, salinity, turbidity, and chlorophyll a.
- 624 samples were in exceedance of the DOH recommended FIB threshold for public recreation, out of 1,523 collected samples or 41%, (40 % in 2021, 39% in 2022, 44% in 2023)
  - Recreational area with most exceedances: Sweeting Park (Failed 96% of the time)
  - Recreational area with least exceedances: Lake Sylvia (Failed 13% of the time)
- There were 33,441 total Swim Guide views at City of Fort Lauderdale-sponsored locations (11,509 in 2021, 10,652 in 2022 and 11,280 in 2023)
  - Recreational area with the most views in 2023: Sandbar
  - Recreational area with the least views 2023: Middle River NE 18th St Dock
- Three sites stood out as having good waterway quality and are located within the City of Fort Lauderdale designated Watersport Activity Areas:
  - Lake Sylvia (Passed 83% of the time)
  - Sunrise Bay /Hugh Taylor Birch State Park (Passed 80% of the time)
  - Sandbar at SE 10th Street (Passed 74% of the time)
- Three sites stood out as having consistently poor water quality, according to the DOH recommended FIB threshold for public recreation:
  - New River North Fork at Sweeting Park (96% exceedance)
  - Middle River NE 18th St Dock (95% exceedance)
  - Tarpon River at Rio Vista Boulevard (71% exceedance)

## INTRODUCTION

Visiting a beach or waterway is the number one activity of Florida's tourists, undeniably the biggest draw for the state's \$112 billion annual tourism revenue. Almost half a million people are directly employed in Florida's ocean economy. Florida's tourism industry, job market, recreation, environment, and even Florida's culture depends on having clean waterways.

South Florida's waterways are also particularly vulnerable to pollution because of our low elevation, porous limestone geology, aging infrastructure, and the threat of sea-level rise. Without clean waterways, our ocean economy, job market, recreation, environment, and culture are all at risk. If we don't protect our waterways, we risk jeopardizing our coastal community and environment for all future generations.

The City of Fort Lauderdale hosts a thriving community fueled by tourism, recreation, and real estate. The recreational use of waterways is valuable to the Fort Lauderdale community; however, despite its importance to the community, relatively little data about waterway quality was available in real time to the residents or visitors who use the waterways for recreation. While the Florida Department of Health (DOH) monitors for Fecal Indicator Bacteria (FIB), the data is hard to find and only focuses on beaches rather than inland waterways such as canals, rivers, or lakes. While there is a higher potential for ingestion of the bacteria while swimming at the beach, the canals and rivers are often used by residents and visitors who enjoy kayaking, paddle boarding, canoeing, and other recreational watersports.

Miami Waterkeeper has addressed these gaps over the last three years through a contract with the City of Fort Lauderdale. Our weekly waterway quality monitoring program emulates the DOH methodology and frequency for ten inland waterways for which publicly-accessible waterway quality data is a necessity. Miami Waterkeeper makes the FIB data available to the public as soon as it is available, along with the DOH data, through the Swim Guide app and social media so that residents and visitors can make informed decisions before interacting with the inland waterways in the City of Fort Lauderdale.

Waterway quality issues may impact the health of those who come in contact with recreational water. It is important to many concerned residents and visitors of the City of Fort Lauderdale to have access to relevant waterway quality data to ensure they are informed about potential health risks before interacting with the water at recreational areas. Waterway quality threats, including Sanitary Sewage Overflows (SSOs) which can cause temporary FIB impairments, are being addressed by the City of Fort Lauderdale and have been reduced over the last few years due to the infrastructure investments.

With information about waterway quality from the same locations taken over time, we can gather baseline data about conditions and inform the public about changes in waterway quality. This report summarizes data collected during three years of weekly sampling at ten sites in the City of Fort Lauderdale.

## ABOUT MIAMI WATERKEEPER

As a Miami-based non-profit organization, Miami Waterkeeper is dedicated to protecting South Florida's coastal waters and the surrounding watershed. Launched in 2010, Miami Waterkeeper has become a leading advocate for clean water, inspiring a movement of empowered citizens dedicated to achieving swimmable, drinkable, fishable water. Often tackling issues on multiple fronts, we address environmental, social, and policy water issues using community outreach, scientific research, and civic and legal action.

Miami Waterkeeper defends the public's right to use and enjoy clean water by focusing on clean water, ecosystem protection, and sea-level rise readiness in South Florida.

Miami Waterkeeper's jurisdiction spans a watershed that serves more than five (5) million people across Miami-Dade and Broward counties and encompasses the mid-section of the Florida Reef Tract. As part of our science and research platform, our waterway quality monitoring program samples 33 locations weekly in Miami-Dade and Broward Counties to determine the level of the fecal indicator bacteria (FIB) enterococci and the potential health risks of the waters for swimming or other activities and immediately share the results with the public.



## ABOUT THIS PROGRAM

The City of Fort Lauderdale initially contracted with Miami Waterkeeper on November 13, 2020, to expand waterway quality monitoring to inland waterways, focusing on areas of high recreational value. The contract was renewed to include sampling throughout 2025, and includes the right to extend the agreement for two (2) additional one-year terms.

At the ten weekly sampling sites, samples for the analysis of the fecal indicator bacteria (FIB) enterococci were collected, along with parameters such as dissolved oxygen (DO), chlorophyll a, salinity, turbidity, and temperature. Sample collection, processing, and analyses were performed under protocols similar to that of the Florida Department of Health (DOH)'s Florida Healthy Beaches Program. When FIB levels in the waterway exceed the DOH threshold for recreational waters, it could indicate possible risks to human health. Miami Waterkeeper collected samples from an exceeding site a second time in the same week, referred to as a "resample."

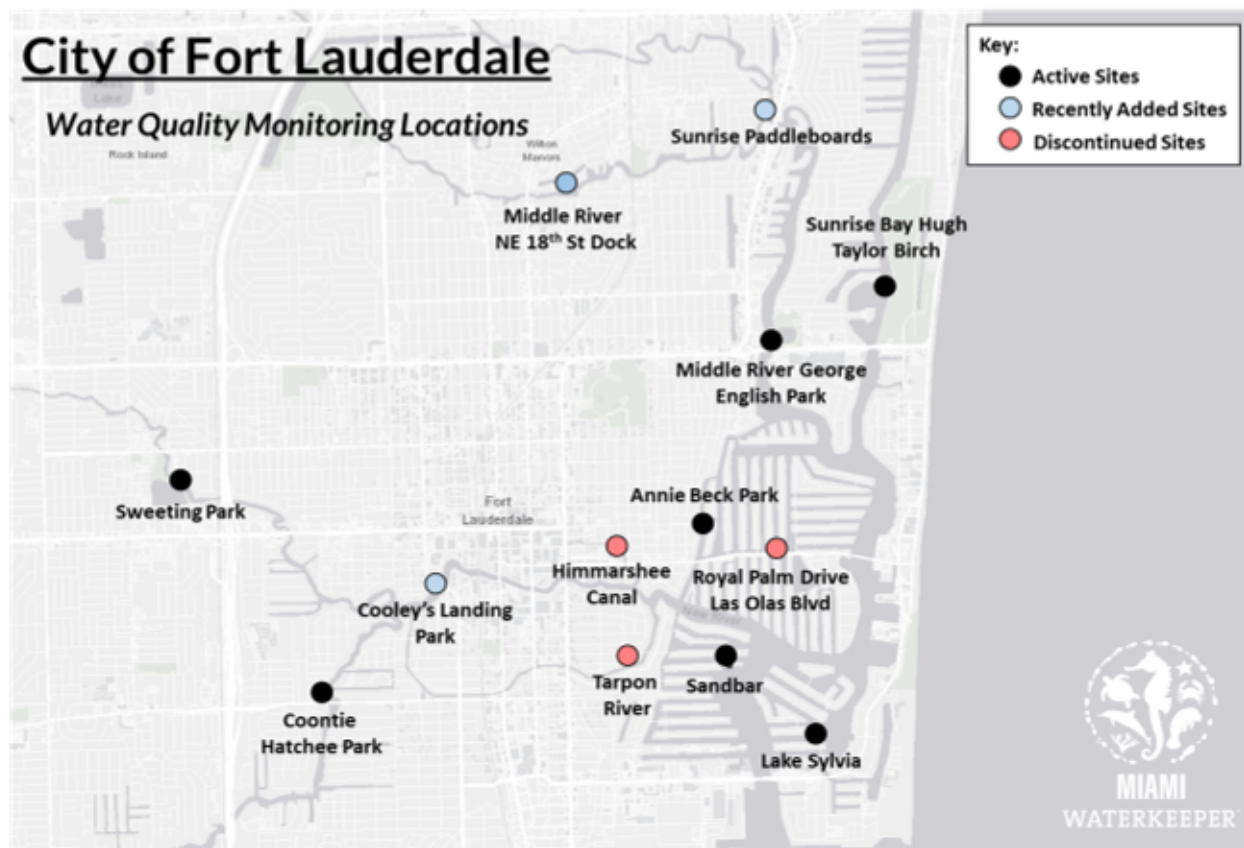
The aims of the contract were to:

- Provide weekly waterway quality monitoring at ten City of Fort Lauderdale sites
- Provide a baseline understanding of FIB in local waterways
- Inform the local community about waterway quality monitoring results in near real time

### *Swim Guide*

We publish our waterway quality testing information along with the waterway quality testing information produced by the state DOH for Broward County beaches via the Swim Guide application, our social media channels, and on our website [www.miamiwaterkeeper.org/water\\_monitoring](http://www.miamiwaterkeeper.org/water_monitoring). Numeric data are also available for the public to download on our website.

The app utilizes an easy-to-read format, with **green** indicating good water quality (0-70 CFU/MPN enterococci per 100 mL sample) and **red** indicating poor water quality (71+ CFU/MPN enterococci per 100 mL sample). Historical data is also accessible. All weekly monitoring sites and the most recent results are available to the public for easy access.



**Figure 1.** Map of the ten sites that are monitored for water quality by Miami Waterkeeper, including the three discontinued sites. All monitoring is sponsored by the City of Fort Lauderdale. While Miami Waterkeeper no longer samples at Tarpon River and Himmarshee Canal, the City of Fort Lauderdale has continued to monitor at these two sites with Miami Waterkeeper posting the weekly results to Swim Guide.

**Site Descriptions:**

Ten locations in the City of Fort Lauderdale were selected in coordination with the Public Works Department (Figure 1). These included:

**Annie Beck Park (ABP)** is approximately 2.4 acres and is located in the Victoria Park neighborhood. It is located next to the Rio Navarro canal. It offers amenities such as nature trails, open areas, and waterfront suitable for kayak launching.

**Coontie Hatchee Park (CH)** (South Fork of the New River) is approximately 2.6 acres along the South Fork of the New River and has amenities such as a kayak/canoe launch, waterfront views, bicycle racks, fitness trail with stations, picnic tables and pavilions.

**Lake Sylvia (LS)** is designated by the City of Fort Lauderdale as a Watersports Activity Area suitable for water skiing, tubing, kneeboarding, and wakeboarding. Lake Sylvia is within the Harbor Beach neighborhood.

**Middle River at George English Park (MRGE)** is designated by the City of Fort Lauderdale as a Watersports Activity Area suitable for water skiing, tubing, kneeboarding, and wakeboarding. George English Park is approximately 19.7 acres and offers amenities such as kayaking, paddleboarding, fishing, boat access/ramp, and walking/jogging trails.

**Sandbar (SBR)** is designated by the City of Fort Lauderdale as a Watersports Activity Area suitable for water skiing, tubing, kneeboarding, and wakeboarding. It is also a popular area for boaters to moor and enjoy the water.

**Sunrise Bay at Hugh Taylor Birch State Park (SBHT)** is designated by the City of Fort Lauderdale as a Watersports Activity Area suitable for water skiing, tubing, kneeboarding, and wakeboarding. Sunrise Bay is within the Coral Ridge neighborhood and is adjacent to Hugh Taylor Birch State Park. Hugh Taylor Birch is the city's own "Central Park," complete with gopher tortoises and boat access from the intracoastal waterway.

**Sweeting Park (SWP)** (North Fork of the New River) is approximately 0.3 acres along the North Fork of the New River and has amenities such as fishing, a dock, and park benches.

### ***Discontinued Sites\* - sampled until August 1, 2023***

**Himmarshee Canal (HC)** was a tributary of the New River, historically a major artery in and out of the Everglades. The word translates to "new water" or "new river." The Himmarshee Canal now starts near US1/Federal Highway and traverses the neighborhoods of Colee Hammock and Beverly Heights as it flows under Las Olas Blvd and out to the New River. Floating vegetation, foam/organic film on the water's surface, and slow flow are frequently noted at this site.

**Royal Palm Drive at Las Olas (RPLO)** is located within the Nurmi Isles neighborhood north of Las Olas Blvd. The Isles were dredged in the 1920's to create land for one of the City's most picturesque waterfront residential districts.

**Tarpon River (TR)\*** at Rio Vista Boulevard intersects with the New River at two locations, SW 8th Ave and Ponce De Leon Drive. The Tarpon River traverses the neighborhoods of Tarpon River, Downtown Fort Lauderdale, and Rio Vista.

\* While Miami Waterkeeper no longer samples at Tarpon River and Himmarshee Canal, the City of Fort Lauderdale has continued to monitor these two sites with Miami Waterkeeper posting the weekly results to Swim Guide.

***Recently Added Sites - initiated August 8, 2023***

**Cooley's Landing Park (CL)** is a 2.96 acre park offering boat ramps, fishing, picnic areas, and waterfront walkways. The marina is dedicated to William Cooley, one of Fort Lauderdale's founding settlers.

**Middle River NE 18th St Dock (MRD)** is located in a residential community on 18th Street in Middle River. This small dock offers water access and features a floating dock to launch paddleboards and kayaks.

**Sunrise Paddleboards (SPB)** is a popular surf shop that offers paddleboard rentals and guided tours on Middle River.

## METHODS

This monitoring program implements Miami Waterkeeper's fecal indicator bacteria (FIB) monitoring protocols to include ten sites of high recreational value in the City of Fort Lauderdale. Sample collection occurs weekly, along with resampling and reanalysis at sites where the threshold of 70 MPN is exceeded.

Miami Waterkeeper uses the IDEXX system for routine sampling collection and enumeration of the FIB enterococci present in water quality samples. The IDEXX system only presents results as whole numbers. Prior to collecting samples, precautions are taken to ensure that sampling bottles are sterile; this includes using an autoclave to sanitize the bottles of any bacteria or impurities with heat and pressure. Gloves are always used when handling the samples so they do not become contaminated. Samples are collected approximately 6-12 inches below the surface to best capture conditions where recreational activities take place. Samples are immediately (within 15 min of collection) placed on ice for preservation.

IDEXX trays containing the water sample and the IDEXX enterolert reagent are placed in an incubator for 24-28 hours and then analyzed under UV light for the Most Probable Number (MPN).

Sample collection, processing, and analysis protocols are based on the EPA Method 1600 protocol and the Florida Department of Health (DOH) standards for enterococci. This protocol is also modified to also meet the protocols FQ 1000, FS 1000 and FT 1000 established by the Florida Department of Environmental Protection (DEP). The field technicians include recent graduates and students from local universities who are trained in collecting field samples, sample processing, and laboratory analyses.

### *Enterococci Criteria*

The following are the EPA-recommended enterococci criteria that the DOH uses to determine waterway quality:

- 0-35 MPN/CFU enterococci per 100 mL sample: **Good**
- 36 - 70 MPN/CFU enterococci per 100 mL sample: **Moderate**
- 71+ MPN/CFU enterococci per 100 mL sample: **Poor**

The Florida Department of Environmental Protection (DEP) uses different enterococci criteria in their regulatory requirements for class III surface waters (Florida Administrative Code: 62-302). The rule outlines the following criteria for predominantly marine waters:

- MPN or MF counts shall not exceed a monthly geometric mean of 35
- MPN or MF counts shall not exceed the Ten Percent Threshold Value (TPTV) of 130 in 10% or more of the samples during any 30-day period

### ***Field Collections and Chain of Custody Quality Control***

For each sampling batch, we conduct field blanks and site replicate samples to assess field collection and sample handling techniques. A temperature control bottle accompanies each sampling batch to ensure samples are properly preserved (< 6°C) throughout the process. Field technicians undergo audits in the first month of independent sampling and every six months thereafter, with random audits possible at any time. Images of the site accompany each sample to ensure data integrity.

### ***Laboratory Quality Control***

Every batch includes a laboratory blank to evaluate aseptic technique, laboratory sanitation practices, and equipment sterility. Laboratory technicians undergo audits in the first month of independent analysis and every six months thereafter, with random audits possible at any time. Images of IDEXX trays under UV light accompany each sample for analysis.

### ***Environmental Data***

We use a multiparameter datasonde to collect water temperature, dissolved oxygen, salinity, turbidity, and chlorophyll immediately after each sample collection. We record observational data on environmental conditions such as weather, tide, temperature, and rainfall. Wind speed and air temperature data are sourced from the AccuWeather app, which pulls from NOAA weather sites, while rainfall and tide data are sourced from the NOAA National Centers for Environmental Information (NCEI) database.

### ***Documentation and Data Management***

Data is recorded on data sheets and manually entered into a master spreadsheet on Google Drive by technicians. All data entries are audited and analyzed by the Science & Research Manager for quality assurance and accuracy. Scans of data sheets and images from quality control protocols are stored in Google Drive. Exceedance results are reviewed by the Science Engagement Coordinator before publication on Swim Guide.

### ***Methods for Analysis***

We conducted three sets of analyses: descriptive statistics evaluation of the entire study period for Fort Lauderdale sites, ANOVA to understand spatial similarities between site characterizations, and correlations and linear regression models to determine relationships between factors and FIB concentrations (January 2021 - December 2023).

## RESULTS

The sampling period is from January 13, 2021-December 26, 2023

- Sampling for Himmarshee Canal (HC), Royal Palm Drive Las Olas Blvd (RPLO) and Tarpon River (TR) were discontinued as of August 1, 2023
- Sampling for Cooley’s Landing Park (CL), Middle River NE 18th St Dock (MRD) and Sunrise Paddleboards (SPB) were initiated on August 8, 2023

The following results section includes all thirteen sites that were sampled in 2023, including the 3 discontinued sites.

### Swim Guide Views

In this reporting period, there were a total of 11,280 visits to the thirteen City of Fort Lauderdale sites that we sampled (Table 1) which represents a 5.9% increase over the previous year. Since the initiation of this monitoring program, there have been 33,441 total views. The website was the preferred platform when compared to accessing the app from a mobile device. In 2023, Sandbar was visited the most on Swim Guide, followed by Annie Beck Park, Lake Sylvia, and Middle River George English Park.

| Swim Guide Traffic Analytics                        | 2023         |          |               | 2022         |          |               | Total (2022-2023) |          |               |
|---|--------------|----------|---------------|--------------|----------|---------------|-------------------|----------|---------------|
|   | Mobile       | Internet | Total         | Mobile       | Internet | Total         | Mobile            | Internet | Total         |
| Annie Beck Park                                     | 94           | 1,269    | 1,363         | 126          | 1,237    | 1,363         | 220               | 2,506    | 2,726         |
| Coontie Hatchee Park                                | 95           | 699      | 794           | 136          | 607      | 743           | 231               | 1,306    | 1,537         |
| Middle River George English Park                    | 96           | 1,098    | 1,194         | 116          | 969      | 1,085         | 212               | 2,067    | 2,279         |
| Lake Sylvia   | 73           | 1,203    | 1,276         | 60           | 1,141    | 1,201         | 133               | 2,344    | 2,477         |
| Sandbar   | 235          | 1,252    | 1,487         | 218          | 1,080    | 1,298         | 453               | 2,332    | 2,785         |
| Sunrise Bay Hugh Taylor Birch Park                  | 75           | 941      | 1,016         | 67           | 889      | 956           | 142               | 1,830    | 1,972         |
| Sweeting Park                                       | 102          | 700      | 802           | 179          | 629      | 808           | 281               | 1,329    | 1,610         |
| <b>Discontinued (January 2021- July 2023)</b>       |              |          |               |              |          |               |                   |          |               |
| Royal Palm Drive Las Olas Blvd                      | 44           | 441      | 485           | 59           | 759      | 818           | 103               | 1,200    | 1,303         |
| Himmarshee Canal                                    | 64           | 1,074    | 1,138         | 106          | 1,133    | 1,239         | 170               | 2,207    | 2,377         |
| Tarpon River  | 77           | 852      | 929           | 146          | 995      | 1,141         | 223               | 1,847    | 2,070         |
| <b>Recently Added (August 2023 - December 2023)</b> |              |          |               |              |          |               |                   |          |               |
| Cooley’s Landing Park                               | 5            | 291      | 296           |              |          |               | 5                 | 291      | 296           |
| Middle River NE 18th St Dock                        | 13           | 175      | 188           |              |          |               | 13                | 175      | 188           |
| Sunrise Paddleboard                                 | 6            | 306      | 312           |              |          |               | 6                 | 306      | 312           |
|   | <b>TOTAL</b> |          | <b>11,280</b> | <b>TOTAL</b> |          | <b>10,652</b> | <b>TOTAL</b>      |          | <b>21,932</b> |

Table 1. Total mobile and internet visits on the Swim Guide application.

## Waterway Quality Results

All results below exclude the resamples and replicates collections, unless noted otherwise.

Since the initiation of this monitoring program, Miami Waterkeeper has collected 1,523 water samples (2,486 with resamples and replicates). Of the samples, 515 were collected in 2023 (847 with resamples and replicates).

### Exceedances

In 2023, at all sites, 44% of waterway quality samples collected were in exceedance of the DOH threshold for enterococci (70 Most Probable number [MPN]) and 29% were in exceedance of the DEP threshold for enterococci (130 MPN); this is a slight increase in the occurrence of exceedances compared to 2022, which was 40% (Table 2).

During 2023, the site with the most exceedances in the weekly sampling was Sweeting Park (96%), which was the same in 2022 (Table 2, Figure 3). However, the number of exceedances at this site of the DEP standard decreased during the same time period. Coontie Hatchee Park (-8%) and Himmarshee Canal (-23%) had a lower percent exceedance in 2023 than in 2022. Annie Beck Park (+1%), Lake Sylvia (+5%), Middle River George English Park (+11%), Royal Palm Las Olas (+5%), Sunrise Bay Hugh Taylor Birch Park (+12%), Sandbar (+10%) and Tarpon River (+16%) all showed a higher percent exceedance in 2023 than in 2022.

| Number of Exceedances                               | 2023              |                       |            |            |            | 2022              |                       |            |            |            | Total (2021-2023) |                       |            |            |            |
|---|-------------------|-----------------------|------------|------------|------------|-------------------|-----------------------|------------|------------|------------|-------------------|-----------------------|------------|------------|------------|
|   | Number of Samples | Number of Exceedances |            |            |            | Number of Samples | Number of Exceedances |            |            |            | Number of Samples | Number of Exceedances |            |            |            |
|   |                   | DOH                   | DOH %      | DEP        | DEP %      |                   | DOH                   | DOH %      | DEP        | DEP %      |                   | DOH                   | DOH %      | DEP        | DEP %      |
| Annie Beck Park                                     | 52                | 28                    | 54%        | 18         | 35%        | 51                | 28                    | 53%        | 20         | 39%        | 153               | 75                    | 49%        | 48         | 31%        |
| Coontie Hatchee Park                                | 52                | 18                    | 35%        | 11         | 21%        | 51                | 22                    | 43%        | 11         | 22%        | 153               | 63                    | 41%        | 30         | 20%        |
| Lake Sylvia   | 52                | 7                     | 13%        | 5          | 10%        | 51                | 4                     | 8%         | 3          | 6%         | 153               | 16                    | 10%        | 10         | 7%         |
| Middle River George English                         | 52                | 16                    | 31%        | 8          | 15%        | 51                | 10                    | 20%        | 8          | 16%        | 153               | 34                    | 22%        | 21         | 14%        |
| Sandbar   | 50*               | 13                    | 26%        | 10         | 20%        | 51                | 8                     | 16%        | 4          | 8%         | 151               | 27                    | 18%        | 18         | 12%        |
| Sunrise Bay Hugh Taylor Birch                       | 51*               | 10                    | 20%        | 3          | 6%         | 49*               | 4                     | 8%         | 1          | 2%         | 150               | 15                    | 10%        | 5          | 3%         |
| Sweeting Park                                       | 50*               | 48                    | 96%        | 40         | 80%        | 51                | 49                    | 96%        | 45         | 88%        | 151               | 146                   | 97%        | 128        | 85%        |
| <b>Discontinued (January 2021- July 2023)</b>       |                   |                       |            |            |            |                   |                       |            |            |            |                   |                       |            |            |            |
| Himmarshee Canal                                    | 31                | 17                    | 55%        | 12         | 39%        | 51                | 40                    | 78%        | 28         | 55%        | 132               | 101                   | 77%        | 76         | 58%        |
| Royal Palm Drive Las Olas Blvd                      | 31                | 6                     | 19%        | 4          | 13%        | 51                | 7                     | 14%        | 6          | 12%        | 132               | 23                    | 17%        | 16         | 12%        |
| Tarpon River  | 31                | 22                    | 71%        | 15         | 48%        | 51                | 28                    | 55%        | 19         | 37%        | 132               | 83                    | 63%        | 51         | 39%        |
| <b>Recently Added (August 2023 - December 2023)</b> |                   |                       |            |            |            |                   |                       |            |            |            |                   |                       |            |            |            |
| Cooley's Landing Park                               | 21                | 13                    | 62%        | 5          | 24%        |                   |                       |            |            |            | 21                | 13                    | 62%        | 5          | 24%        |
| Middle River NE 18th St Dock                        | 21                | 20                    | 95%        | 15         | 71%        |                   |                       |            |            |            | 21                | 20                    | 95%        | 15         | 71%        |
| Sunrise Paddleboard                                 | 21                | 8                     | 38%        | 3          | 14%        |                   |                       |            |            |            | 21                | 8                     | 38%        | 3          | 14%        |
| <b>TOTAL</b>  | <b>515</b>        | <b>226</b>            | <b>44%</b> | <b>149</b> | <b>29%</b> | <b>508</b>        | <b>200</b>            | <b>39%</b> | <b>145</b> | <b>29%</b> | <b>1,523</b>      | <b>624</b>            | <b>41%</b> | <b>426</b> | <b>28%</b> |

**Table 2.** Samples collected by site in the City of Fort Lauderdale. Exceedances are presented for both the DOH (Florida Department of Health) recommended threshold for enterococci (>70 MPN) and the DEP (Florida Department of Environmental Protection) threshold for enterococci (>130 MPN).

(\*Samples were not collected due to unforeseen barriers that prevented access to the site.)

# WATERWAY QUALITY MONITORING REPORT TO THE CITY OF FORT LAUDERDALE

It should be noted that a number of extreme rain events, including the 26 inch rainfall on April 12, 2023, had a significant impact on the waterway quality. Significant stormwater discharges and sanitary sewer overflows contributed to FIB exceedances throughout the month of April, 2023 and following other events in June, September and November.

## Enterococci concentrations

All averages are reported as (Mean ± Standard Deviation).

The average enterococci concentration across all samples at all sites was 260 ± 1224 MPN (Table 3). The highest concentrations of FIB from January 3 - August 1, 2023 were at Himmarshee Canal (1377 ± 4513 MPN) and Tarpon River (922 ± 1696 MPN). The highest concentrations of FIB from August 8 - December 26, 2023 were at Sweeting Park (952 ± 3295 MPN). In 2022, the highest concentrations were found at Himmarshee Canal (1272 ± 3904 MPN), followed by Sweeting Park (703 ± 1696 MPN).

| Enterococci Concentrations                          | 2023       |                   |      | 2022       |                   |      | Total (2021-2023) |                   |      |
|---|------------|-------------------|------|------------|-------------------|------|-------------------|-------------------|------|
|   | n          | MPN               | ± SD | n          | MPN               | ± SD | n                 | MPN               | ± SD |
| Annie Beck Park                                     | 52         | 295 ± 715         |      | 51         | 309 ± 700         |      | 153               | 261 ± 648         |      |
| Coontie Hatchee Park                                | 52         | 109 ± 199         |      | 51         | 173 ± 480         |      | 153               | 119 ± 303         |      |
| Himmarshee Canal                                    | 31         | 1377 ± 4513       |      | 51         | 1272 ± 3904       |      | 132               | 952 ± 3295        |      |
| Lake Sylvia   | 52         | 39 ± 68           |      | 51         | 34 ± 76           |      | 153               | 33 ± 65           |      |
| Middle River George English                         | 52         | 62 ± 86           |      | 51         | 122 ± 447         |      | 153               | 77 ± 267          |      |
| Sandbar   | 50         | 108 ± 240         |      | 51         | 60 ± 171          |      | 151               | 69 ± 176          |      |
| Sunrise Bay Hugh Taylor Birch                       | 51         | 41 ± 55           |      | 49         | 26 ± 49           |      | 150               | 33 ± 74           |      |
| Sweeting Park                                       | 50         | 518 ± 890         |      | 51         | 703 ± 1696        |      | 151               | 608 ± 1362        |      |
| <b>Discontinued (January 2021- July 2023)</b>       |            |                   |      |            |                   |      |                   |                   |      |
| Himmarshee Canal                                    | 31         | 1377 ± 4513       |      | 51         | 1272 ± 3904       |      | 132               | 952 ± 3295        |      |
| Royal Palm Drive Las Olas Blvd                      | 31         | 65 ± 135          |      | 51         | 36 ± 67           |      | 132               | 59 ± 134          |      |
| Tarpon River  | 31         | 922 ± 2417        |      | 51         | 360 ± 1276        |      | 132               | 531 ± 1641        |      |
| <b>Recently Added (August 2023 - December 2023)</b> |            |                   |      |            |                   |      |                   |                   |      |
| Cooley's Landing Park                               | 21         | 146 ± 198         |      |            |                   |      | 21                | 146 ± 198         |      |
| Sunrise Paddleboard                                 | 21         | 90 ± 135          |      |            |                   |      | 21                | 90 ± 135          |      |
| Middle River NE 18th St Dock                        | 21         | 241 ± 208         |      |            |                   |      | 21                | 241 ± 208         |      |
| <b>TOTAL</b>  | <b>515</b> | <b>278 ± 1342</b> |      | <b>508</b> | <b>311 ± 1478</b> |      | <b>1523</b>       | <b>260 ± 1224</b> |      |

**Table 3.** Average fecal indicator bacteria (FIB) concentrations reported as Most Probable Number (MPN) for samples collected in 2023, 2022, and from 2021-2023. Cells in yellow indicate that on average, the waterway quality at this site is considered "moderate" by DOH (Florida Department of Health) criteria. Cells in red indicate that on average, the waterway quality at this site is considered "poor" by DOH criteria. SD is standard deviation.

## Environmental data

All of the sites had brackish water, and the lowest salinity was at Sweeting Park, which is the furthest inland (Table 4). Dissolved oxygen was biologically sufficient at most sites (>4.00

## WATERWAY QUALITY MONITORING REPORT TO THE CITY OF FORT LAUDERDALE

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mg/L), with the highest readings found at Sandbar ( $6.89 \pm 1.06$  mg/L) and the lowest at Sweeting Park ( $4.90 \pm 1.66$  mg/L). Middle River NE 18th St Park had the lowest average dissolved oxygen, but the dataset for this site is limited to the latter half of 2023 and is not yet a representative characterization.

Chlorophyll was highest at Sweeting Park ( $12.30 \pm 12.26$  ug/L). Turbidity was highest at Tarpon River ( $6.52 \pm 15.71$  NTU), which is well within the DEP threshold of 10 NTU.

On average, all sites passed for the DEP criteria for turbidity, which is 10 NTU.

| Environmental Data                                  | Water Temperature |      |       | Salinity |       | Turbidity |        | Dissolved Oxygen |        |      |       | Chlorophyll a |        |
|---|-------------------|------|-------|----------|-------|-----------|--------|------------------|--------|------|-------|---------------|--------|
|   | n                 | °C   | ±SD   | ppt      | ±SD   | NTU       | ±SD    | %                | ±SD    | mg/L | ±SD   | ug/L          | ±SD    |
| Annie Beck Park                                     | 153               | 27.9 | ± 3.2 | 20.5     | ± 7.0 | 2.0       | ± 3.0  | 84.9             | ± 13.1 | 6.0  | ± 0.9 | 2.8           | ± 2.7  |
| Coontie Hatchee Park                                | 153               | 27.9 | ± 3.3 | 10.3     | ± 7.9 | 2.4       | ± 4.1  | 75.7             | ± 14.1 | 5.6  | ± 1.0 | 5.1           | ± 3.7  |
| Lake Sylvia   | 153               | 27.4 | ± 3.0 | 28.7     | ± 6.7 | 1.7       | ± 3.5  | 92.0             | ± 9.0  | 6.2  | ± 0.6 | 1.8           | ± 3.4  |
| Middle River George English                         | 153               | 27.6 | ± 3.4 | 20.3     | ± 8.1 | 1.7       | ± 2.5  | 84.9             | ± 11.9 | 6.0  | ± 0.9 | 2.6           | ± 2.3  |
| Sandbar   | 151               | 27.6 | ± 3.0 | 27.0     | ± 7.5 | 1.9       | ± 3.3  | 99.7             | ± 17.0 | 6.7  | ± 1.1 | 2.0           | ± 3.3  |
| Sunrise Bay Hugh Taylor Birch                       | 150               | 27.4 | ± 3.3 | 25.3     | ± 5.7 | 1.3       | ± 1.1  | 86.3             | ± 11.8 | 5.9  | ± 0.9 | 2.7           | ± 2.9  |
| Sweeting Park                                       | 151               | 27.0 | ± 2.9 | 4.2      | ± 4.9 | 2.4       | ± 1.9  | 61.3             | ± 22.8 | 4.8  | ± 1.7 | 11.5          | ± 10.8 |
| <b>Discontinued (January 2021- July 2023)</b>       |                   |      |       |          |       |           |        |                  |        |      |       |               |        |
| Himmarsee Canal                                     | 132               | 27.4 | ± 3.2 | 17.3     | ± 7.8 | 1.9       | ± 2.5  | 70.8             | ± 14.9 | 5.1  | ± 1.1 | 3.0           | ± 2.3  |
| Royal Palm Drive Las Olas Blvd                      | 132               | 27.5 | ± 3.2 | 24.9     | ± 6.1 | 1.4       | ± 1.2  | 85.5             | ± 12.7 | 5.9  | ± 0.8 | 2.3           | ± 2.7  |
| Tarpon River  | 132               | 27.6 | ± 3.4 | 17.1     | ± 8.2 | 5.9       | ± 13.8 | 75.9             | ± 17.2 | 5.4  | ± 1.2 | 4.5           | ± 5.1  |
| <b>Recently Added (August 2023 - December 2023)</b> |                   |      |       |          |       |           |        |                  |        |      |       |               |        |
| Cooley's Landing Park                               | 21                | 28.3 | ± 3.2 | 7.4      | ± 7.8 | 1.3       | ± 0.7  | 69.6             | ± 14.1 | 5.2  | ± 1.2 | 4.8           | ± 1.9  |
| Middle River NE 18th St Dock                        | 21                | 26.9 | ± 3.0 | 2.8      | ± 3.8 | 1.8       | ± 1.1  | 49.9             | ± 13.9 | 3.9  | ± 1.2 | 7.9           | ± 3.1  |
| Sunrise Paddleboard                                 | 21                | 27.7 | ± 3.1 | 9.8      | ± 6.0 | 1.9       | ± 3.1  | 62.3             | ± 13.1 | 4.7  | ± 1.1 | 3.9           | ± 1.2  |

*Table 4. Average environmental parameter data for samples collected in 2021-2023.*

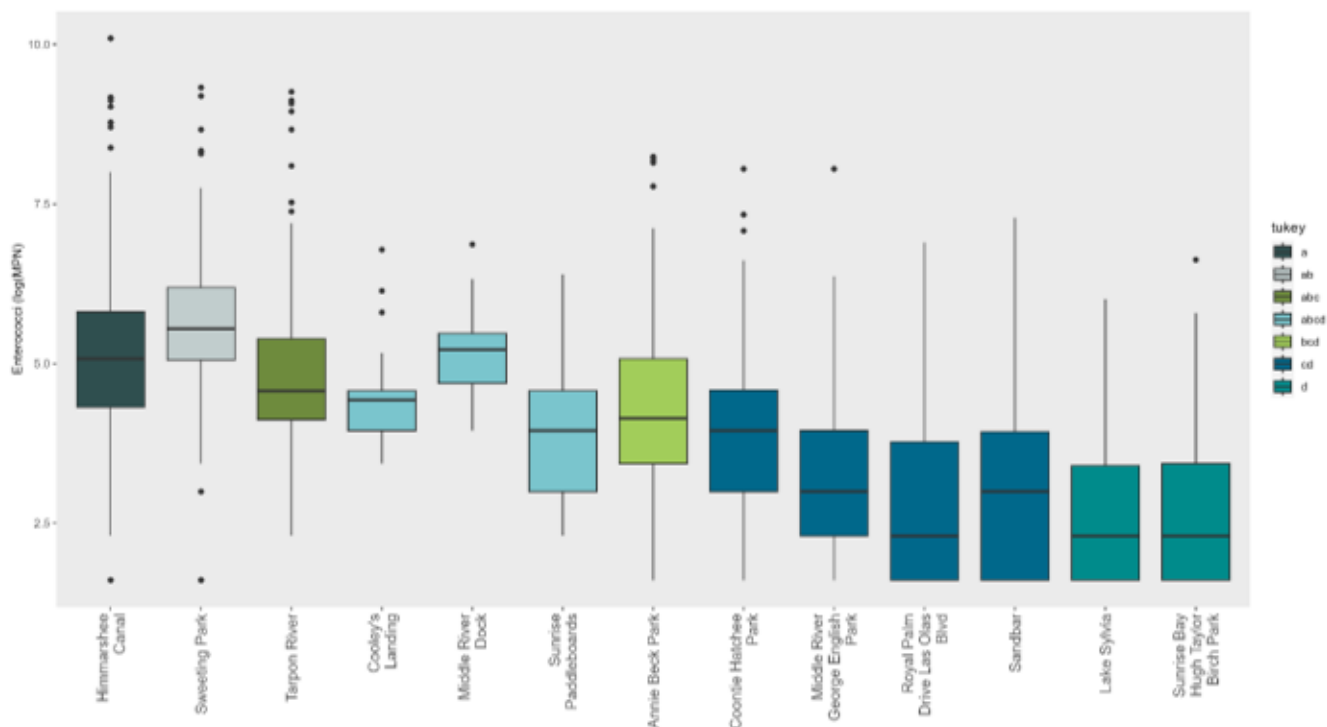
## Data Analysis of City of Fort Lauderdale sites over the Entire Period of Study

### Temporally across reporting years

For all sites, ANOVA indicated no significant temporal differences among enterococci concentration, water temperature, salinity, dissolved oxygen, and chlorophyll (Figure 2).

### Spatially across sites

At the City of Fort Lauderdale sites for this period of study (January 2021 - December 2023), ANOVA indicated no significant spatial differences in water temperature, and significant spatial differences in all other parameters. A post hoc Tukey test (alpha=0.05) showed that dissolved oxygen (DO) was significantly higher at Sandbar, Lake Sylvia and Annie Beck Park. At Tarpon River, Sweetening Park, Sunrise Bay Hugh Taylor Birch and Royal Palm Drive Las Olas Blvd, DO was significantly lower and chlorophyll was significantly higher. Chlorophyll was significantly lower in the three recently added sites, compared to the rest of the active and discontinued sites.

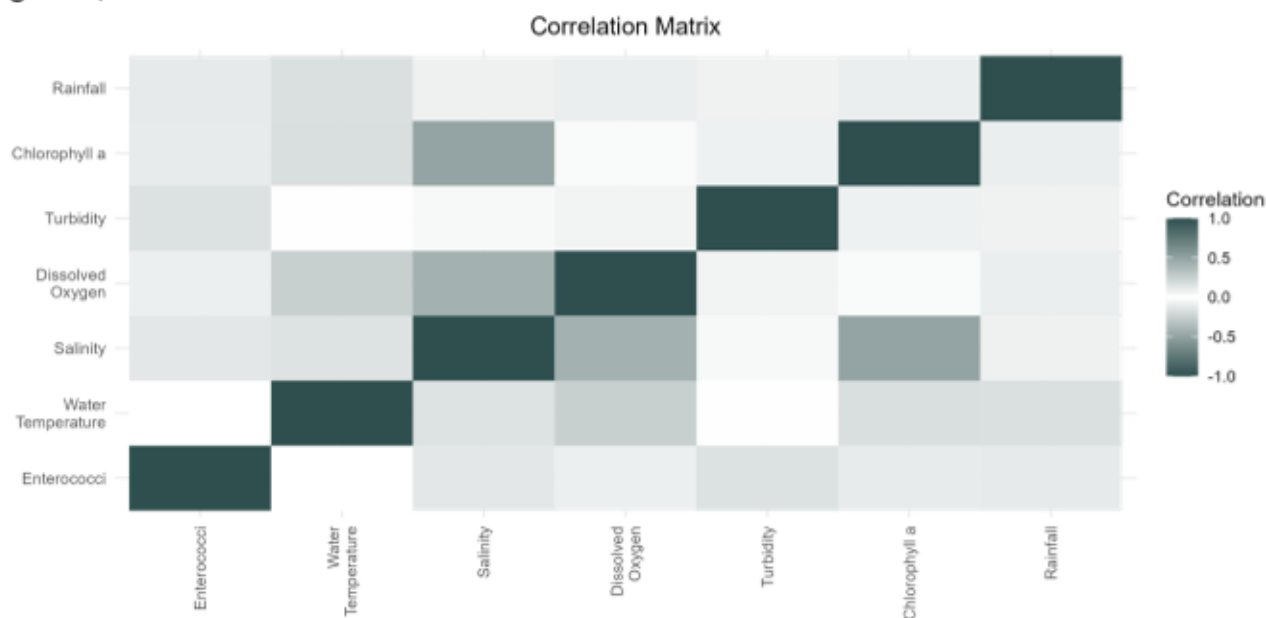


**Figure 2.** Boxplot of enterococci concentrations (log(MPN)) across sites throughout the study period (2021-2023). The color/letter combinations indicate significant differences between enterococci. MPN=Most Probable Number. Sites that have the same color/letter combination were statistically similar.

Enterococci was significantly higher at Himmarshee Canal, Sweeting Park and Tarpon River (Figure 4). The three recently added sites, clustered together in enterococci, likely due to the temporal limitations of the dataset, since the sites have less than 5 months of data represented.

**Correlations between parameters**

Salinity was correlated with chlorophyll a ( $R^2 = -0.49$ ) and dissolved oxygen ( $R^2 = 0.41$ ) (Figure 3).



**Figure 3.** Correlations between water quality parameters tested within this three-year study (2021-2023).

**Between FIB and environmental conditions**

For the linear regression models, we isolated four concerning Fort Lauderdale sites. Himmarshee Canal, Sweeting Park and Tarpon River were isolated from the original batch of ten sites to analyze since they had the highest enterococci and relatively low dissolved oxygen. Of the three recently added sites, we isolated Middle River NE 18th St Dock to analyze since it had the lowest average dissolved oxygen.

Linear regressions were performed with enterococci and each environmental parameter for the entire period of study. The parameter demonstrating the greatest correlation with enterococci was chlorophyll a ( $p < 0.001$ ).

❖ Himmarshee Canal

Linear regression showed that only chlorophyll had a significant effect on enterococci ( $p < 0.001$ ). Rainfall did not have a significant effect on enterococci.

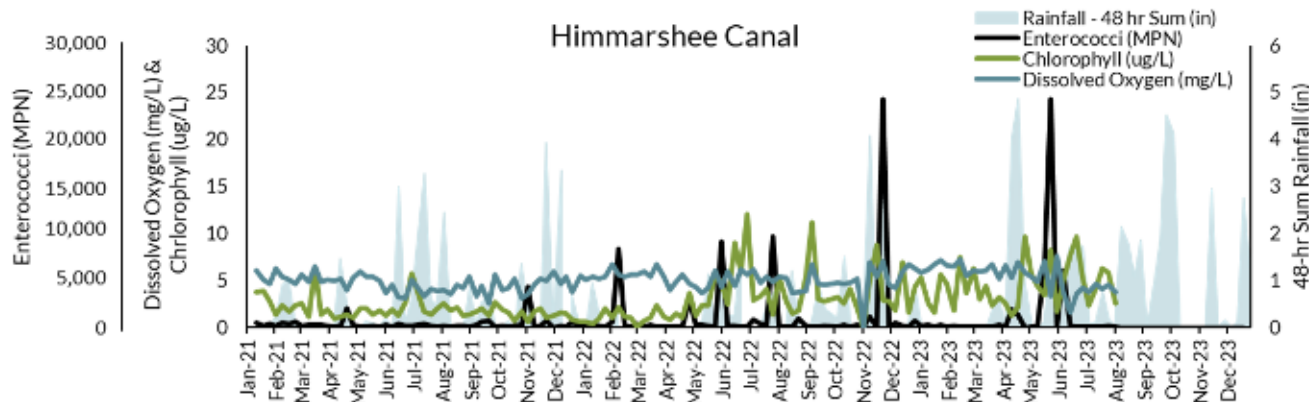


Figure 4. Rainfall, enterococci, chlorophyll and dissolved oxygen at Himmarshee Canal (2021-2023).

❖ Tarpon River

Linear regression showed that turbidity ( $p < 0.05$ ) and chlorophyll ( $p < 0.001$ ) had a significant effect on enterococci. Rainfall did not have a significant effect on enterococci.

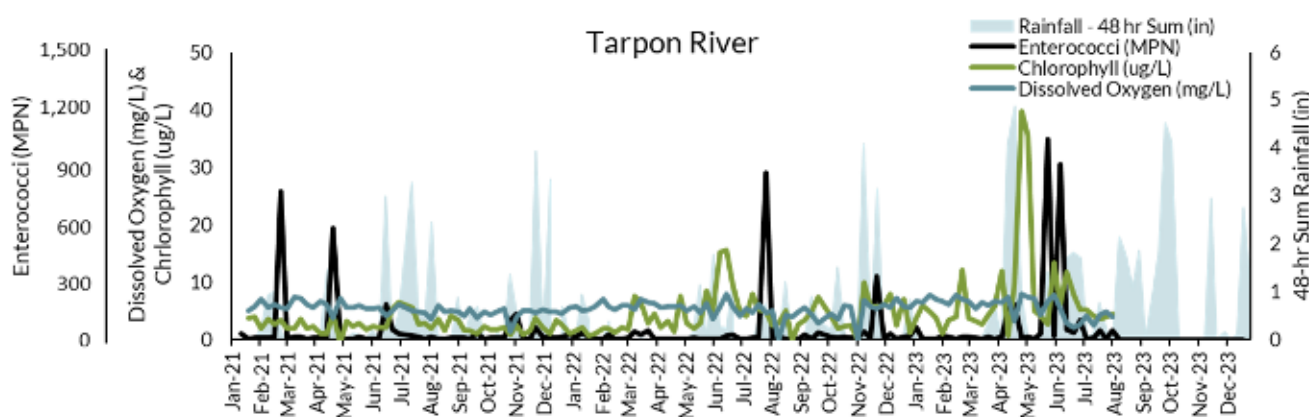


Figure 5. Rainfall, enterococci, chlorophyll and dissolved oxygen at Tarpon River (2021-2023).

❖ Sweeting Park

Linear regression showed that rainfall ( $p < 0.01$ ), chlorophyll ( $p < 0.001$ ), dissolved oxygen ( $p < 0.05$ ) and salinity ( $p < 0.001$ ) had a significant effect on enterococci.

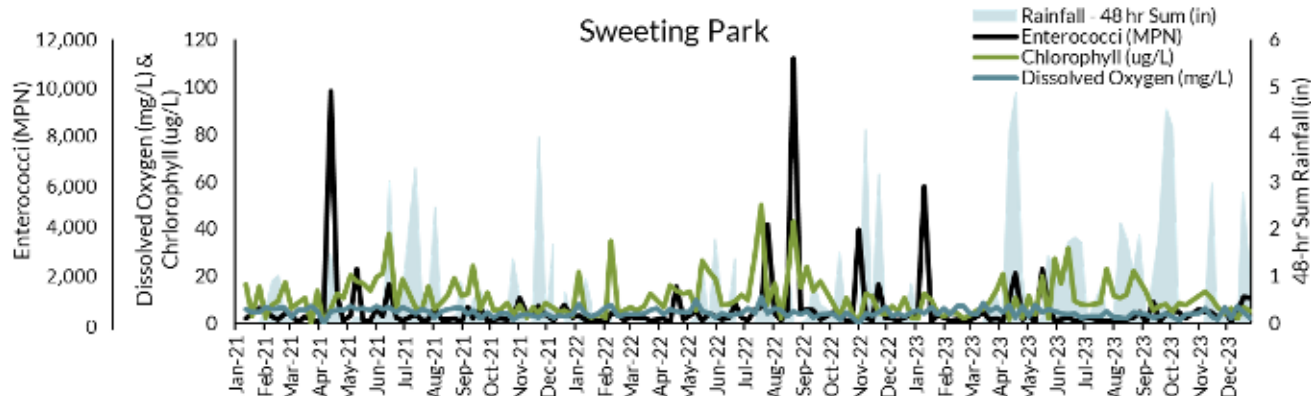


Figure 6. Rainfall, enterococci, chlorophyll and dissolved oxygen at Sweeting Park (2021-2023).

❖ Middle River NE 18th St Dock

Linear regression showed that rainfall ( $p < 0.05$ ) and dissolved oxygen ( $p < 0.001$ ) had a significant effect on enterococci.

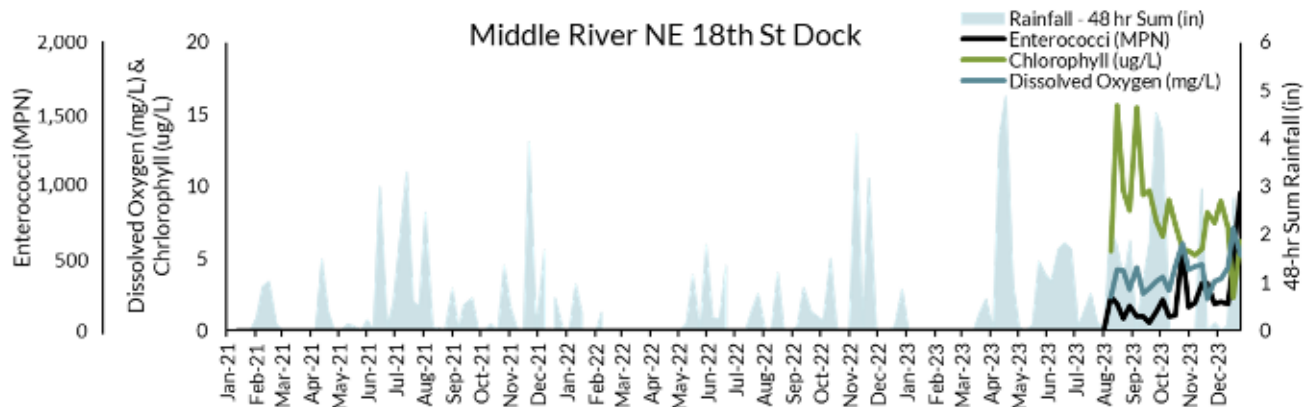


Figure 7. Rainfall, enterococci, chlorophyll and dissolved oxygen at Middle River NE 18th St Dock (2021-2023).

## CONCLUSIONS

### *Waterway Quality in the City of Fort Lauderdale*

The data collected from three years of waterway quality monitoring around the City of Fort Lauderdale has expanded our understanding of the waterway quality trends. Our results show that the City of Fort Lauderdale coastal sites are in exceedance of FIB concentrations around 44% of the time. Several spatial trends are solidifying as the dataset becomes more robust.

### *Environmental Factors:*

At Himmarshee Canal, Tarpon River and Sweeting Park, the correlation between chlorophyll and enterococci is indicative of the presence of excess nutrients that can sustain algal and microbial blooms. Since these sites are more sheltered within the inshore canal system, a lower residence time of the water could have exacerbated the enterococci bloom. The decomposition of organic material in the water column would provide the ideal nutrient supply and substrate required to sustain enterococci blooms. This tracks with the relatively low average dissolved oxygen detected.

At Sweeting Park, rainfall, dissolved oxygen and salinity also demonstrated significant effects on enterococci concentrations. Salinity and rainfall as predictor variables indicate a freshwater source of enterococci contamination, which could be stormwater derived. Since chlorophyll was not significantly related to enterococci, the source of enterococci is potentially fecal material, but this can only be verified with further investigation and microbial source tracking (MST). Note that the presence of fecal material does not necessarily imply that it was anthropogenically-derived. MST analysis would be the most efficient way to identify whether the source is human or wildlife.

Rainfall demonstrated a significant effect on enterococci at Sweeting Park and Middle River NE 18th St Dock but not Himmarshee Canal or Tarpon River. These sites are the furthest inland and are likely influenced by the large stormwater outfalls located near the sampling site. Further investigation would be required to identify the source of the enterococci.

### *Annual Differences:*

Compared to previous years, there was no significant difference in concentration of enterococci. The site that increased the most in enterococci exceedances was Himmarshee Canal which presented some anomalous high spikes, including a spike of over 20,000 MPN on May 23, 2023. This spike was caused by a wastewater leak that occurred on May 17, 2023 when a 10-inch sanitary sewer force main broke behind Las Olas Shops. Effluent flowed over land into the nearest storm drain which conveyed it to the Himmarshee Canal. A recreational waterway advisory was issued. Subsequent sampling has shown that the enterococci levels dissipated after the sewage leak.

### *Overall Recommendations:*

With three years of data, we have been able to understand more about the overall trends in spatial and temporal variability of enterococci. While three years is still a short time span for a monitoring program, we have been able to highlight sites that consistently meet and fail to meet the DOH and DEP standards for clean recreational waters. This has allowed the City of Fort Lauderdale to efficiently use their resources to address issues at the locations that present as potential human health hazards. Developing a robust monitoring program can provide an alert to any concerning developments that would require immediate attention by establishing a unique baseline for each location.

Enterococci is an effective fecal indicator bacteria for waterway quality monitoring, but it is limited in identifying the exact sources of the potential bacterial contamination. High concentrations of enterococci can be viewed as a symptom of a larger issue of fecal matter discharge. Further investigations into elucidating the sources of the enterococci would be helpful. We recommended testing for additional parameters at these sites, including nutrients, microbial source tracking and sediment isotopes. Quarterly sampling has been conducted by Broward County at several inland recreational areas

Understanding the factors that are influencing the enterococci spikes would enhance the City of Fort Lauderdale's ability to evaluate changes in waterway quality, as well as to recommend management practices to improve waterway quality especially in areas of a recreational focus. The ephemeral nature of most enterococci spikes makes response complicated, especially in tidally influenced waterways, which is why weekly monitoring and resampling is vital to ensure locations with consecutive spikes or chronic high levels of enterococci are prioritized.

### *Initiatives from the City of Fort Lauderdale*

The City has been implementing best management practices related to wastewater system maintenance, stormwater infrastructure upgrades, sustainable development programs, nature-based stormwater solutions (Rover Oaks Stormwater Preserve) and outreach campaigns to reduce fertilizer, leaf trimmings, pet waste etc. These efforts are intended to support improvements in waterway quality at all recreational sites. Several inland waterways have been dredged, including portions of Middle River, Tarpon River and Himmarshee Canal. The City has also investigated the wastewater infrastructure around Sweeting Park to identify and repair both public and private wastewater gravity systems that may be a source of human fecal bacteria.

Currently, the City of Fort Lauderdale is comprehensively updating the stormwater infrastructure in the Durrs and Doresy Riverbend neighborhoods that discharge stormwater to the North Fork near Sweeting Park. This update will include additional water quality structures that will remove sediment and debris before it enters the waterway.

The City of Fort Lauderdale is working to ensure the community's sustainability and resilience to climate change. The government representatives and community members are committed to

enhancing its resilience by prioritizing the establishment of sustainable infrastructure and employing adaptable solutions to protect its waterway resources. By proactively addressing concerns related to waterway quality, the City is taking significant steps to safeguard the well-being of the constituents and minimize any possible adverse effects on the environment.

Fort Lauderdale is particularly vulnerable to impacts from rising sea levels and storm events. The City of Fort Lauderdale has already developed a comprehensive stormwater master plan, conducted vulnerability assessments, implemented benthic dredging projects, and initiated vital sewage and stormwater infrastructure improvement projects. The City has also partnered with agencies and local partners to improve coordination efforts and represent the needs of the City of Fort Lauderdale community. The overall goal for the City of Fort Lauderdale is adaptive best management practices to mitigate for the impacts of sea level rise and climate change.

*Some additional recommendations are outlined below:*

1. Regular Monitoring of Waterway Quality:
  - **Comprehensive Waterway Quality Program:** Collaborate with local agencies and research institutions to assess Fort Lauderdale's waterways' health and identify pollution sources.
  - **Expand Monitoring Programs:** Incorporate Microbial Source Tracking (MST), nutrients, and organics into monitoring efforts. Install new technologies along the canals for continuous monitoring and real-time alerts.
  - **Monthly Waterway Quality Workshops:** Conduct workshops led by environmental experts to educate the community on waterway quality's importance and its impact on local ecosystems.
2. Community Engagement and Education:
  - **Signage and Informational Resources:** Install signage at City-sponsored locations directing visitors to Swim Guide for waterway quality results.
    - Provide information on the City's efforts to enhance waterway quality at recreational sites.
  - **Community Workshops and Events:** Organize workshops and events to educate residents, businesses, and visitors about reducing nutrient pollution and their role in preserving Biscayne Bay's health.
  - **Storm Event Communication:** Increase communication before significant storm events, emphasizing guidance on water management, proper disposal of hazardous materials, reporting potential pollution discharges and limiting interaction with floodwater..
  - **Pollution Event Alert System:** Develop a dashboard with an interactive map that shows live alerts for waterway quality advisories, from the City or DOH
3. Implementation of Green Infrastructure for Stormwater Management:
  - **Preservation of Green Spaces:** Prioritize the establishment and preservation of green spaces and coastal buffer zones to mitigate nutrient runoff and provide natural filtration for stormwater.
  - **Green Infrastructure Implementation:** Establish green roofs, rain gardens, and permeable pavement in urban areas to capture and filter stormwater before reaching water

- bodies. Encourage Low Impact Development (LID) and the inclusion of green infrastructure in local legislation and code.
- **Incentivization Program:** Launch a city-wide program incentivizing residents to follow stormwater master plan guidelines by adopting eco-friendly practices.
4. Integration of Sustainable Development Guidelines:
- **Sustainable Development Planning:** Integrate sustainable development guidelines into municipal planning, promoting eco-friendly building materials and low-impact development techniques.
  - **Encourage LID Techniques:** Promote Low Impact Development (LID) techniques such as bioretention cells, vegetated swales, and constructed wetlands to treat stormwater and reduce nutrient runoff.
  - **Incentives for Sustainable Development:** Offer incentives for developers incorporating solar panels, rainwater harvesting systems, and green roofs into their projects. Encourage the use of recycled materials and energy-efficient technologies.
  - **Erosion and Sediment Control:** Enforce strict erosion and sediment control measures at construction sites to prevent sediment and nutrient-laden runoff from entering water bodies.

### *Future work*

The City remains dedicated to monitoring and enhancing Fort Lauderdale's waterway quality. Monitoring Fecal Indicator Bacteria (FIB) offers timely insights into bacteria concentrations at key sites with timely reporting ensuring residents' ability to stay informed about potential health risks associated with water recreation.

Miami Waterkeeper's collaboration with the City of Fort Lauderdale has proven instrumental in disseminating crucial information through Swim Guide, a resource thousands of residents and visitors rely on to make informed decisions about recreational activities within Fort Lauderdale's waterways.

Looking ahead, Miami Waterkeeper aims to expand waterway quality monitoring efforts, bolstering the impact of our educational initiatives. Sustaining this partnership, we aim to deepen public awareness, enabling individuals to engage in recreational activities while safeguarding their health and the well-being of Fort Lauderdale's water ecosystems. Together, we strive for an informed and engaged community dedicated to preserving our cherished waterways' vitality and sustainability.



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