Report to the Environmental Protection Agency

Maine Healthy Beaches Program Annual Beach Grant Report 2022 Season

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I. Program Accomplishments

Maine Healthy Beaches (MHB) is managed by the Maine Department of Environmental Protection (ME DEP). In 2022, MHB staff worked with 30 local management entities to conduct routine monitoring, assessment, and public notification of water quality conditions for 67 beach management areas spanning from Kittery to Mount Desert Island. MHB staff continued to build local capacity to make well-informed beach management decisions and address pollution issues.

The MHB program accomplished the following in 2022:

- Processed 1806 enterococci samples at 145 routine and enhanced monitoring locations.
- Trained approximately 200 beach managers, local staff, and volunteers to collect water samples, conducted technical trainings for local staff and volunteers, and facilitated planning/problem-solving meetings.
- Facilitated contamination advisories at 20 beaches, precautionary rainfall advisories at 21 beaches, and closures at one beach.
- Analyzed 129 samples for optical brightener levels to target human-sourced fecal contamination at 22 enhanced monitoring locations.
- Supported enhanced monitoring and pollution remediation efforts for: Ogunquit River watershed, Wells Harbor, Goose Rocks Beach watershed, Kennebunk River watershed, Biddeford Pool watershed, Crescent Beach State Park, Town Landing (Cumberland), and MDIBL efforts in Acadia.
- Continued partnering with universities and research institutions (University of New Hampshire (UNH), Bigelow Laboratory for Ocean Sciences) to support testing for human and non-human DNA markers using microbial source tracking (MST) techniques.
- Continued updates to the MHB Risk Assessment Matrix (RAM), an evaluation of water quality trends and potential sources of fecal bacteria impacting coastal beaches.
- Continued implementing objectives of MHB's EPA-approved Quality Assurance Project Plan (QAPP, 2021-2026).
- Continued implementing measures outlined in the EPA approved beach action value (BAV) justification.
- Provided technical guidance and field support to municipalities with beaches listed as impaired for the first time in the most recent cycle Maine's Integrated Water Quality Monitoring and Assessment Report (2018/2020/2022).
- Worked with participating management entities to develop a Beach Monitoring and Notification Plan documenting how the program will be implemented at the local level.
- Transformed data to action items and served on several working groups for improving water quality and ecosystem health.
- Provided expertise and advised towns/groups interested in monitoring freshwater recreation areas as well other areas along the coast.
- Presented to local and regional audiences.

II. Program Deliverables/Appendices

Appendix A MHB 2022 Budget Summary

Appendix B MHB 2022 Beach Management Area Classification/Tiered Monitoring Plan

Appendix C MHB 2022 Notification Table

III. Budget Information

Program Activities

The US EPA sponsored MHB program 2022 budget (Appendix A) supported all routine monitoring, assessment, notification, education/outreach, and enhanced monitoring efforts including:

- Salaries for three staff including two DEP staff and a Maine Conservation Corps (AmeriCorps) Environmental Steward. DEP staff included one full-time Program Coordinator position and one half-time Program Data Manager position[1]. This team of personnel provided support to 30 local management entities (towns, state parks, a national park, and private beach associations) including program coordination, quality-assured protocols and structure, field/lab trainings, technical assistance, volunteer recruitment, and education/outreach.
- The MHB Program Specialist provided data management services, transferred MHB data to DEP's Environmental and Geographic Analysis Database (EGAD) system, managed the submission of MHB data into the US EPA databases (STORET and PRAWN), and fulfilled data requests as needed.
- Planning and problem-solving meetings with diverse partners including local beach managers, conservation commissions, consultants, researchers, and state/federal agencies.
- Field monitoring supplies, equipment, volunteer training packets, and quality-assurance including annual field, database, and observational trainings for approximately 200 citizen volunteers and local staff.
- Laboratory equipment, supplies, labor, sample transport (courier), training, and quality assurance support for four laboratories processing enterococci samples for 67 beach management areas spanning a large geographic area (approximately 200 mi.).
- Enhanced monitoring and pollution identification efforts as well as numerous planning and problem-solving meetings with diverse partners.
- Education and outreach efforts including delivering presentations to local and regional audiences and the development and distribution of numerous resources.
- Miscellaneous expenses including travel, telephone, computer services, postage, office support and supplies, and photocopying.

Volunteer Contribution

MHB program participation is voluntary, and towns/parks designate local beach managers and field monitors to collect samples. Beach managers are typically town administrators, health nurses, fire chiefs, state park managers, and others who participate as an add-on to full-time jobs and schedules. Towns and state parks utilize citizen volunteers or devote paid staff time to sample collection, transport, and data entry. All volunteer monitors attend a pre-season field training and contribute an average of three hours of time per week during the monitoring season.

IV. Performance Criteria

In 2022, the MHB program continued to provide a unified structure and quality-assured tools to implement an adaptive monitoring regime, assess the risk of pollution, notify the public of water quality conditions, and promote best practices on the beach and surrounding drainage areas. MHB

[1] During this grant period, the Program Data Manager position was expanded to a full-time support position for the MHB program (hereafter referred to as the MHB Program Specialist). This position remains half funded by MHB's EPA-sponsored program budget.

staff also provided ongoing daily training and technical support including responding in real-time to water quality data, assessing pollution/risk of illness, and notifying the public of conditions on coastal beaches.

Monitoring

There are more than 29 miles of public access beaches along Maine's coast. The MHB program is voluntary and monitoring coastal water quality for swimming and other water contact is the responsibility of local jurisdictions and is not mandated by state law. US EPA funding supports monitoring of moderate to high use beaches with adequate public access. Maine law allows public use of private beaches for "fishing, fowling and navigation" only. Participating beaches must have a management entity capable of meeting objectives and requirements outlined in the MHB program QAPP and MHB Program Town/Park Agreement. New beaches will be recruited over time as resources and funding allow and/or circumstances change eligibility for program participation.

In 2022, MHB staff successfully worked with 30 diverse local management entities to conduct routine monitoring for 67 beach management areas (Appendix B), 52 were classified as "Tier-1" (monitored weekly or more frequently), 15 were classified as "Tier-2" (reduced monitoring effort), and "Tier-4"[2] beaches were not monitored (i.e. did not participate in the program). Through the 2016 BAV selection process, Maine's participating beaches were evaluated and reclassified where necessary in order to reallocate resources to support increased monitoring efforts for beaches categorized as "high-risk". For beaches considered "low-risk", reclassification resulted in a reduced monitoring frequency, typically to a bi-weekly or monthly routine.

Approximately 1806 samples were collected at 145 routine and enhanced monitoring locations spanning Kittery to MDI. Monitoring sites were based on where people swim, at freshwater inputs (rivers, streams, storm drains), and near other high-risk features, wildlife areas, etc. Samples were collected in two to three feet of water at six to eight inches below the surface. For areas experiencing chronic bacterial pollution, additional monitoring sites were added in suspect areas to help determine contributing pollution sources and/or the worst-case scenario for water quality.

Parameters included: enterococci bacteria, air and water temperature, salinity, tidal stage and direction, rainfall 48 hours prior to sampling, and additional weather/field conditions that may affect beach water quality. Monitoring sites were resampled as soon as possible following an exceedance and the monitoring frequency increased until results were within acceptable limits. Samples were transported to the laboratory (four regional – Maine Environmental Lab, Portland Water District, Rockland Wastewater Treatment Facility, Mount Desert Island Biological Laboratory) for analysis within six hours of collection. Samples were analyzed using the IDEXX Enterolert ® Most Probable Number enumeration method. All samples and parameters were collected and analyzed according to MHB's US EPA-approved QAPP.

Assessment

In addition to routine beach monitoring, MHB staff evaluated the risk of pollution and potential/actual sources via a Risk Assessment Matrix (RAM), and in some cases, through GIS mapping and analysis, enhanced monitoring, and other pollution source-tracking efforts. MHB staff continued updates to the RAM for each Beach Management Area (BMA) in 2022, and these

[2] MHB does not have any beaches with a status equivalent to EPA's Tier-3 beach designation.

preliminary assessments of shoreline characteristics, non-point and point sources of pollution (on and offshore) and water quality, were used to inform local beach management decisions. This risk-based ranking system also guides the program's beach classification and monitoring regime and determines the need for more in-depth monitoring and sanitary surveys.

On May 25, 2022, the current cycle (2018/2020/2022) of Maine's Integrated Water Quality Monitoring and Assessment Report (IR for short) received final approval from US EPA. MHB's participating beaches (referred to hereafter as coastal designated beaches) were included in this cycle of the IR for the first time based on a requirement of the 2014 National Beach Guidance and Required Performance Criteria for Grants[3]. Assessments for coastal designated beaches were based on bacteria monitoring data collected during beach seasons 2016-2020 (i.e., since Maine's BAV was approved by EPA). These data were used to determine the attainment of the primary recreation designated use (i.e., Recreation in the Water). For this IR cycle, 57 coastal designated beaches were included in Category 2 (unimpaired), five were included in Category 3 (impairment status undetermined), and three were included in Category 5-B (impaired). These three impaired beaches include Goose Rocks Beach - Batson River and Goose Rocks Beach - Little River in Kennebunkport and Riverside Beach in Ogunquit. For more information see Maine's 2018/2020/2022 Integrated Water Quality Monitoring and Assessment Report.

Notification

In 2022, beach monitoring results were recorded in the MHB program internal database that automatically updated the program website www.MaineHealthyBeaches.org. Maine's US EPA-approved single sample maximum safety threshold or Beach Action Value (BAV) for enterococci in marine waters was 104 most probable number (MPN[4])/100mL. Once a decision was made to post the beach, the information was made publicly available via the website and signage at beach access points. When results exceeded the safety limit, and/or a beach status change occurred, an automatic email alert was sent to local beach managers, MHB staff, and partners. In some cases, towns provided supplemental information by providing educational signage (e.g. risk following rainfall, stagnant tide pools), content on local websites, social media pages, and hotlines. Attribute, monitoring, and notification data for each beach was transferred to DEP's database for final submission into EPA's databases. The MHB program continued to make local beach information (site locations, monitoring and notification data, contact information, etc.) more easily accessible to the public via the program's website.

Beach postings fall under local jurisdiction authority and are not mandated by state law. The program made recommendations to local beach managers based on the best and most current information available. In some cases, local managers waited for resample results before posting contamination advisories. Typically, this was for "low-risk" beaches, and the decision was based on the results of neighboring sites, the magnitude of bacteria results, similarity of environmental conditions between sample collection day and results, historical water quality, risk of pollution,

[3] The IR is required under sections 303(d), 305(b) and 314 of the Clean Water Act, and in fulfillment of the reporting requirements of 38 M.R.S. Section 464(3)(A) of the State of Maine's Water Classification Program. Assessments for all waterbodies in the IR are based on five main listing categories describing their designated use attainment status.

[4] EPA's 2012 Recreational Water Quality Criteria (RWQC) recommends using EPA Method 1600 (resulting in colony forming units (CFUs)) to measure culturable enterococci, or another equivalent culturable method. MHB utilizes the equivalent IDEXX Enterolert ® method (resulting in most probable number (MPN) per 100mL).

and known pollution events. Many towns/parks continued posting precautionary rainfall advisories (PRAs) based on local precipitation levels rather than elevated bacteria in 2022. To facilitate efficient re-sampling and beach status notifications, MHB staff worked with each participating management entity prior to the 2022 monitoring season to develop a Beach Monitoring and Notification Plan that included relevant contact information and preferred contact methods for all local participants (i.e., beach managers and field monitors). Following each exceedance, MHB staff contacted local jurisdictions to ensure that program protocols were followed in a timely manner according to the program's QAPP. On a daily basis, MHB staff quality-checked the database for accurate entry of field, laboratory, and notification data.

Additionally, MHB staff responded to numerous data and information requests from program participants, state agency partners, non-profits, researchers, students, etc. The MHB program routine and enhanced monitoring data was used by partners to inform ongoing efforts to address impaired water quality including funding proposals to support pollution source identification and elimination projects, ongoing research initiatives, as well as watershed management, stormwater management, and comprehensive and water resource protection plans.

Education and Outreach

In 2022, MHB staff continued efforts to educate beach managers regarding program and notification protocols as needed and routinely shared research findings, program updates, etc. with local staff and volunteers. Additional support was provided as needed regarding local implementation of the program, issues of concern, etc. MHB staff delivered presentations to diverse audiences and provided extensive support to communities and organizations tackling bacterial pollution issues within and outside of Maine.

V. Data Summaries

- 1806 enterococci samples (including field and laboratory duplicates) were processed.
- 145 sites (88 routine beach sites and 57 enhanced monitoring sites[5]) were monitored.
- 67 beach management areas (BMAs) (routine beach sites) were monitored in 30 towns/state parks (Figure 1.).
- 7.0% routine samples exceeded Maine's beach action value (BAV) of 104 MPN/100mL.
- 194 beach action days were reported including 82 actions at 33 beach management areas. The majority of reported action days (156) were for contamination advisories and closures (49 advisories and 4 closures).
- Precautionary rainfall advisories accounted for 38 action days (29 advisories). These were based on local precipitation levels rather than recorded bacteria levels (Appendix C).
- 96.9% of total beach days (beach season length x beach management areas) were free of beach advisories or closures.

[5] Sites located in close proximity to BMAs or in enhanced monitoring locations to help identify pollution sources.

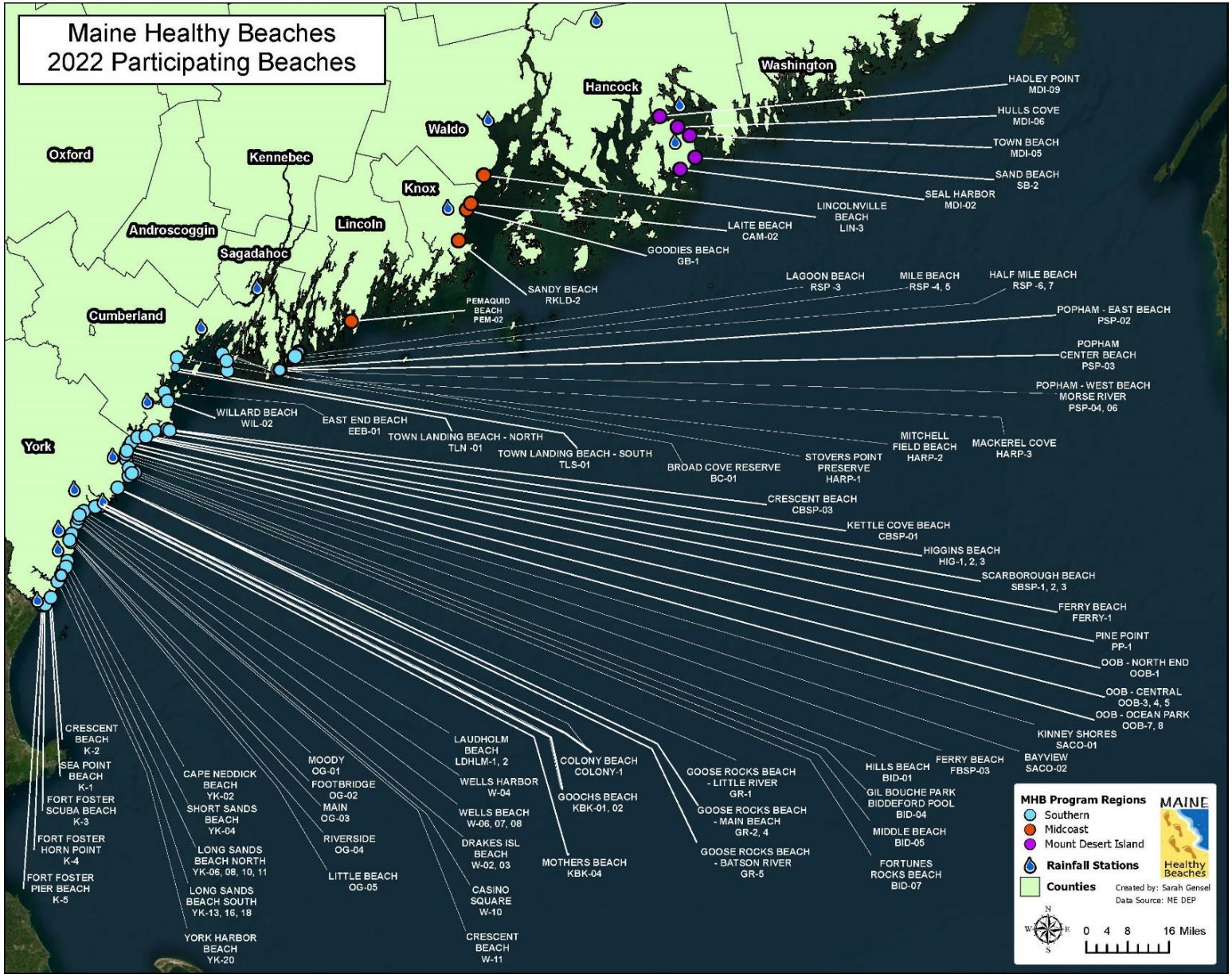
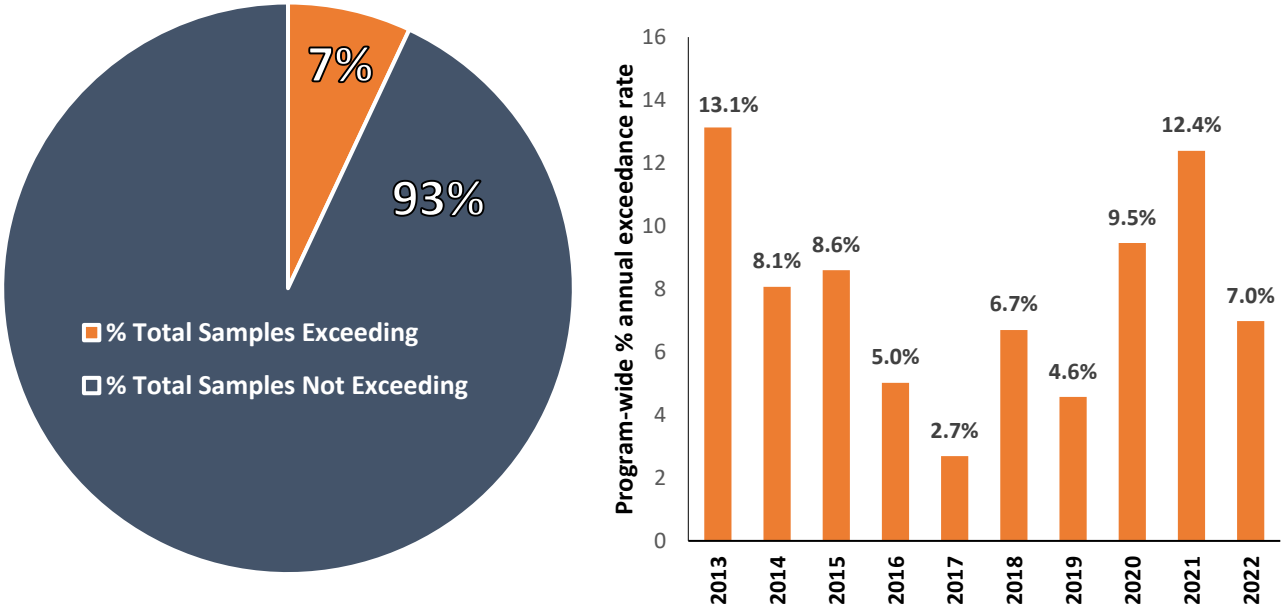


Figure 1. MHB's 2022 participating BMAs (Southern, Midcoast, and Mount Desert Island (MDI) regions) and NCDC rainfall stations

Exceedances

Maine's US EPA-approved single sample maximum safety threshold or Beach Action Value (BAV) for enterococci in marine waters is 104 MPN/100mL. The 2022 overall program exceedance rate of Maine's BAV was 7.0%, representing 87 total exceedances at 27 beach management areas (Figure 2, Table 1). This represents a decrease in the exceedance rate compared to the past 2 monitoring seasons (2020-2021)[6] (Figure 3).



Figures 2-3. The 2022 total % annual exceedance rate of Maine's BAV (104 MPN/100mL) and MHB's program-wide annual exceedance rate for the past ten monitoring seasons (2013-2022).

Maine's beaches span a wide geographic area and, as a result, average precipitation levels observed at 13 coastal rainfall stations located in close proximity to participating BMAs[7] varied distinctly (8.29 - 12.87 inches) (Figure 1). Typically, the pattern of yearly exceedance rates (shown in Figure 3) corresponds with the amount of average precipitation during the beach season. The average precipitation observed for the 2022 monitoring season (10.25 inches) was much less than was observed in 2021 (18.45 inches) and was similar to average precipitation observations for the 2018-2020 monitoring seasons. The total percent annual exceedance rate for the program followed the same general trend with a lower overall program exceedance rate in 2022 (7%) compared to 2021 (12.4%) and a similar total percent exceedance rate in 2022 compared to the 2018-2020 monitoring seasons (Figure 3).

Inter-annual variability of the total program percent exceedance rate is due to multiple factors including but not limited to: precipitation levels and timing of precipitation events, water temperatures, beach and watershed characteristics (e.g. impervious surfaces, pollution sources), sample collection day/time, and the number of monitoring sites and beach management areas.

[6] The 2020 monitoring season was delayed for the majority of the program's beaches due to the COVID-19 pandemic. This resulted in fewer monitoring events and total samples collected for the 2020 season.

[7] Precipitation data source: NOAA NCEI (https://www.ncei.noaa.gov/). For stations with incomplete datasets, local rainfall concentrations were obtained from nearby weather stations.

Table 1. All BMAs with exceedances of Maine's single sample maximum BAV for enterococci in marine waters (104 MPN/100mL) in 2022. Summaries include total number of samples, number of samples ≥104 MPN/100mL, and % samples ≥104 MPN/100mL.

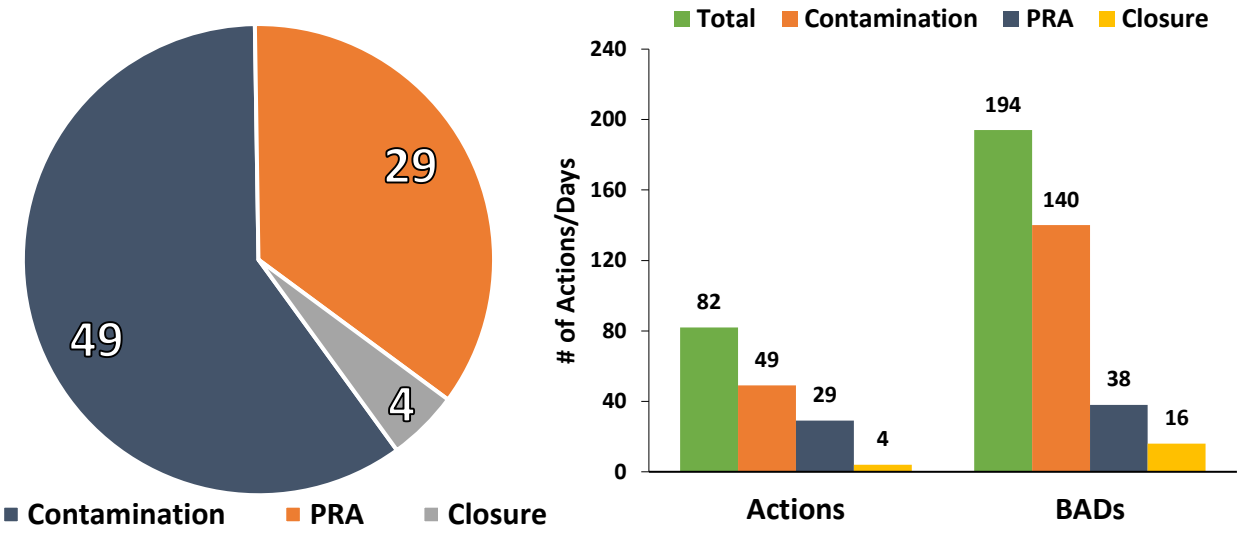
Beach Management Area	Site Name(s)	# Samples	# Samples ≥104	% Samples ≥104
GOOSE ROCKS BEACH - BATSON RIVER	GR-5	31	10	32.3%
FERRY BEACH (SCARBOROUGH)	FERRY-1	17	4	23.5%
LITTLE BEACH	OG-05	17	4	23.5%
GOOSE ROCKS BEACH - LITTLE RIVER	GR-1	30	7	23.3%
LAITE BEACH	CAM-02	18	4	22.2%
CAPE NEDDICK BEACH	YK-02	17	3	17.6%
RIVERSIDE (OGUNQUIT)	OG-04	17	3	17.6%
GOOCHS BEACH	KBK-01, KBK-02	59	9	15.3%
WILLARD BEACH	WIL-02	27	4	14.8%
MACKEREL COVE	HARP-3	15	2	13.3%
MOTHERS BEACH	KBK-04	30	4	13.3%
SEA POINT BEACH	K-1	15	2	13.3%
OOB - OCEAN PARK	OOB-8	32	4	12.5%
SHORT SANDS BEACH	YK-04	16	2	12.5%
LONG SANDS BEACH - NORTH	YK-06, YK-08, YK-10, YK-11	50	6	12.0%
GOOSE ROCKS BEACH - MAIN BEACH	GR-2, GR-4	55	5	9.1%
COLONY BEACH	COLONY-1	26	2	7.7%
GOODIES BEACH	GB-1	14	1	7.1%
PEMAQUID BEACH	PEM-02	14	1	7.1%
KINNEY SHORES	SACO-01	15	1	6.7%
LINCOLNVILLE BEACH	LIN-3	15	1	6.7%
MITCHELL FIELD BEACH	HARP-2	15	1	6.7%
PINE POINT	PP-1	15	1	6.7%
TOWN BEACH	MDI-05	15	1	6.7%
OOB - CENTRAL	OOB-4	47	3	6.4%
SANDY BEACH	RKLD-2	17	1	5.9%
HIGGINS BEACH	HIG-1, HIG-2, HIG-3	43	1	2.3%

Beach Actions

In Maine, beach actions include advisories (Contamination or Precautionary Rainfall) and closures. Contamination advisories represent those issued in response to elevated bacteria results, while Precautionary Rainfall Advisories (PRAs) are issued pre-emptively based on local precipitation levels (typically following 1 inch of rainfall or more in a 24-hour period). A Beach Action Day (BAD) represents the amount of time a beach is under an advisory or closure. This distinction is used as the duration of actions varies depending on the conditions under which they were posted. BADs are calculated for each beach as the number of days where the beach was under an action for any part of a day. This may over-estimate the length of BADs in some cases.

The MHB program provides beach management recommendations to local beach managers, but the decision to post an action at a beach falls under local jurisdiction. For that reason, the number of beach actions does not always align with the number bacteria exceedances as action posting protocols vary locally.

Overall, 96.9% of total beach days (beach season length x beach management areas) were free of beach actions in 2022. There were fewer total beach actions and beach action days in 2022 than were observed in 2021 (combining contamination advisories, precautionary rainfall advisories, and closures). There were 194 BADs in 2022, including 140 contamination (49 actions), 38 precautionary rainfall (29 actions), and 16 closure (4 actions)[8]. The total number of contamination BADs (including contamination advisories and closures) in 2022 **(**156) was far fewer than those reported by the program in 2021 (434) and nearly the same as those reported in 2020. Six beach management areas (Kennebunkport's Goose Rocks Beach – Batson River and Goose Rocks Beach – Little River, Ogunquit's Riverside Beach and Little Beach, Goochs Beach – Kennebunk, and Wells Harbor - Wells) collectively accounted for 53% of the reported contamination BADs in 2022 (Table 2).



Figures 4-5. The 2022 total number of beach actions (contamination, PRAs, closures) and BADs for all participating program beaches.

All four closure actions were issued by the Town of Wells for one BMA (Wells Harbor) where a sanitary force main crossing the harbor failed several times throughout the months of July and August. Although elevated bacteria results were not observed for MHB's routine or additional monitoring samples during this timeframe, the Town of Wells preemptively closed the BMA until the issue had been resolved.

The decrease in total beach actions and total BADs for 2022 was due, in-part, to decreased levels of precipitation in 2022 as compared to 2021, and therefore, fewer precautionary rainfall advisories. In Maine, there were nearly 100 fewer PRAs posted (29 actions) in 2022 as there were in 2021 (120 actions) and nearly the same number actions as in 2020 (20 actions). Rainfall advisories accounted for 20% of the total 194 recorded action days as well as 35% of the total number of actions in 2022 (Figures 4-5).

[8] Total BADs include all action types (Contamination, Closure, and Precautionary Rainfall).

Depending on the timing of results and the availability of monitors/laboratories, resampling did not always occur the same day results were available. Additionally, beach managers sometimes kept an advisory in place until the next routine monitoring day indicated acceptable enterococci levels, rather than collecting a resample. There were also some "running" advisories where PRAs blended with contamination advisories and vice versa. PRAs often preceded contamination advisories and once bacteria results were available, PRAs were lifted, and contamination advisories were put in place until routine results indicated safe levels. These factors, as well as the practice of counting any part of one day as an action day, inflated the duration and number of beach action days in 2022.

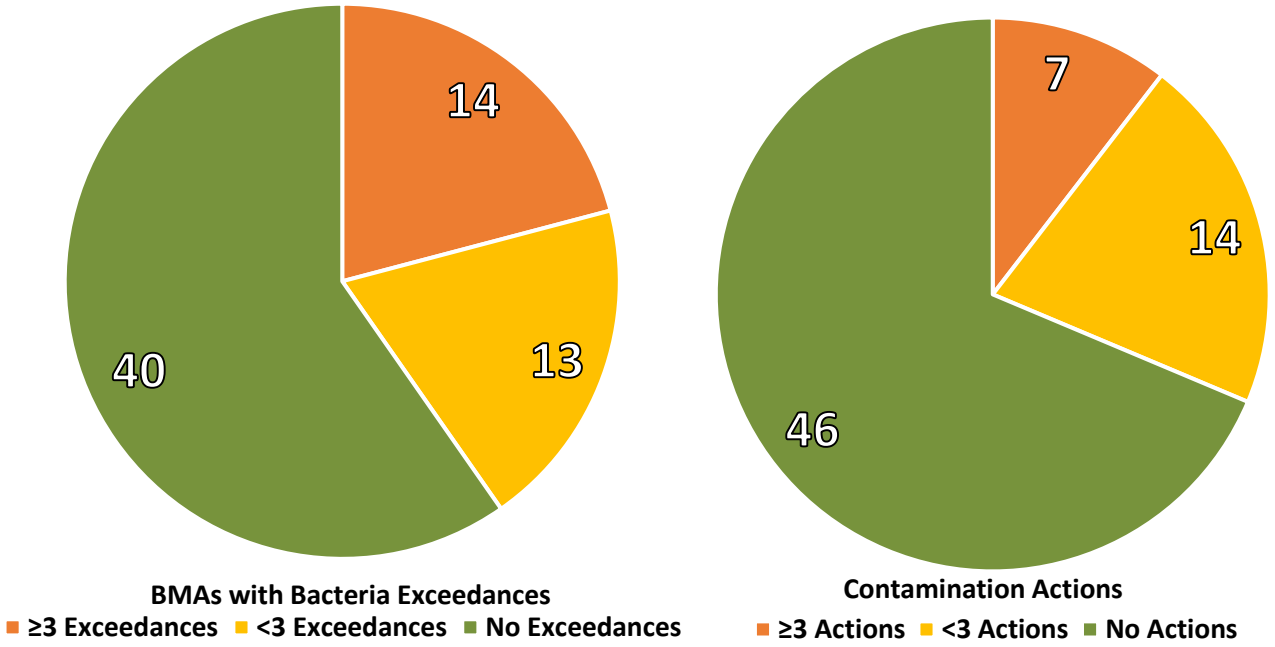
Table 2. All BMAs with contamination actions (contamination advisories and closures) in 2022. Summaries include the total number of contamination actions, number of contamination BADs, and the % of total contamination BADs the number of contamination BADs represents for each beach.

Beach Management Area	Site Name(s)	# Contamination Actions	# Contamination BADs	% Total Contamination BADs
GOOSE ROCKS BEACH - BATSON RIVER	GR-5	6	18	11.5
WELLS HARBOR	W-04	4	16	10.3
GOOCHS BEACH	KBK-1, KBK-2	6	15	9.6
GOOSE ROCKS BEACH - LITTLE RIVER	GR-1	5	14	9.0
LITTLE BEACH	OG-05	2	10	6.4
RIVERSIDE (OGUNQUIT)	OG-04	2	10	6.4
GOOSE ROCKS BEACH - MAIN BEACH	GR-2, GR-4	2	9	5.8
FERRY BEACH (SCARBOROUGH)	FERRY-1	2	9	5.8
WILLARD BEACH	WIL-02	4	8	5.1
LAITE BEACH	CAM-02	4	7	4.5
MOTHERS BEACH	KBK-04	4	7	4.5
MACKEREL COVE	HARP-3	1	6	3.8
HIGGINS BEACH	HIG-1, HIG-2, HIG-3	2	5	3.2
COLONY BEACH	COLONY-1	2	5	3.2
OOB - CENTRAL	OOB-4	1	5	3.2
PINE POINT	PP-1	1	3	1.9
GOODIES BEACH	CAM-02	1	2	1.3
MITCHELL FIELD BEACH	HARP-2	1	2	1.3
SEA POINT BEACH	K-1	1	2	1.3
SANDY BEACH	RKLD-2	1	2	1.3
LINCOLNVILLE BEACH	LIN-3	1	1	0.6

High Risk Beaches

In 2022, 60% of BMAs (40/67 BMAs) were free of bacteria exceedances. For the remaining 27 BMAs, 13 had <3 exceedances and 14 BMAs had ≥3 exceedances. The 14 BMAs with ≥3 exceedances accounted for the majority of exceedances: 80% or 70 out of the total 87 observed exceedances (Table 1, Figure 5). Contamination actions were observed at 21 BMAs in 2022, and of these 21, 14 BMAs had <3 contamination actions and 7 BMAs had ≥3 contamination actions

(Table 2, Figure 6). These 7 BMAs accounted for the majority of contamination actions: 62% or 33 out of the total 53 contamination actions (Table 2). While 60% of BMAs were free of bacteria exceedances in 2022, a greater number of BMAs, 69% (46/67 BMAs), were free of contamination beach actions. The percentage of BMAs with exceedances did not align with the percentage of contamination beach actions issued because the decision to post an action at a beach falls under local jurisdiction and action protocols vary locally.



Figures 5-6. The number of BMAs with ≥3, <3, or no bacteria exceedances and the number of BMAs with ≥3, <3, or no contamination actions for the 2022 beaches season.

Overall, most of MHBs participating BMAs experience either very few or no exceedances each monitoring season. Typically, a subset beaches contribute to the majority of exceedances and, as a consequence, the majority of beach actions issued. MHB considers these BMAs with persistent bacterial contamination issues to be "higher-risk" due to various non-point and point sources of pollution impacting those beaches. In 2022, there were 15 BMAs for which ≥10% of samples exceeded Maine's BAV, many of which were also among the top beaches with exceedances for the past several years. At all of these 15 BMAs, sample exceedances were associated with antecedent precipitation 50% or more of the time, and for 7 of these BMAs, sample exceedances were associated with antecedent precipitation 100% of the time (Table 3, Figure 7).

Table 3. BMAs for which ≥10% of enterococci samples exceeded Maine's BAV in 2022. Summaries include total number of samples, number of samples ≥104 MPN, % samples ≥104 MPN, and % exceedances associated with antecedent precipitation.

Beach Management Area	Site Name	# Samples	# Samples ≥104	% Samples ≥104	% Exceedances Antecedent Precipitation
GOOSE ROCKS BEACH - BATSON RIVER	GR-5	31	10	32.3%	63.6%
FERRY BEACH (SCARBOROUGH)	FERRY-1	17	4	23.5%	75.0%
LITTLE BEACH	OG-05	17	4	23.5%	75.0%

GOOSE ROCKS BEACH - LITTLE RIVER	GR-1	30	7	23.3%	75.0%
LAITE BEACH	CAM-02	18	4	22.2%	100.0%
CAPE NEDDICK BEACH	YK-02	17	3	17.6%	66.7%
RIVERSIDE (OGUNQUIT)	OG-04	17	3	17.6%	100.0%
GOOCHS BEACH	KBK-1, KBK-2	59	9	15.3%	100.0%
WILLARD BEACH	WIL-02	27	4	14.8%	100.0%
MACKEREL COVE	HARP-3	15	2	13.3%	100.0%
MOTHERS BEACH	KBK-04	30	4	13.3%	75.0%
SEA POINT BEACH	K-1	15	2	13.3%	100.0%
OOB - OCEAN PARK	OOB-8	32	4	12.5%	75.0%
SHORT SANDS BEACH	YK-04	16	2	12.5%	100.0%
LONG SANDS BEACH - NORTH	YK-06, YK-08, YK-10, YK-11	50	6	12.0%	50.0%

Antecedent precipitation calculations include any precipitation concentrations observed 48 hours prior to the monitoring date as well as any precipitation observed the day of sample collections because rainfall often occurred overnight and in the early pre-monitoring morning hours. Including the precipitation levels from the day of sample collection may over-estimate the % exceedances with antecedent precipitation as it includes a portion of the day after samples have been collected; however, a reliable dataset with the precision for hourly measurements is not available at this time.

Non-point source pollution likely contributed to fecal indicator bacteria (FIB) loading at BMAs with the greatest exceedance rates in 2022, as the majority of them are impacted by freshwater inputs (rivers, streams, storm drains). As a result, pollutants are transported from upland areas during all weather conditions, but especially when it rains. MHB's historical data demonstrates a relationship between antecedent precipitation and observed bacteria exceedances. In response, many of Maine's participating towns/state parks have begun implementing preemptive PRAs during and following moderate/heavy rainfall. Given the limited 1-2x per week sampling frequency for Tier 1 beaches, this preemptive advisory protocol allows beach managers to be more protective of public health at these BMAs when bacteria results are not available.

When feasible, MHB partners with towns/state parks managing high-risk BMAs to support ongoing efforts to find, fix, and prevent bacterial pollution sources (see VI. Collaborative Efforts).

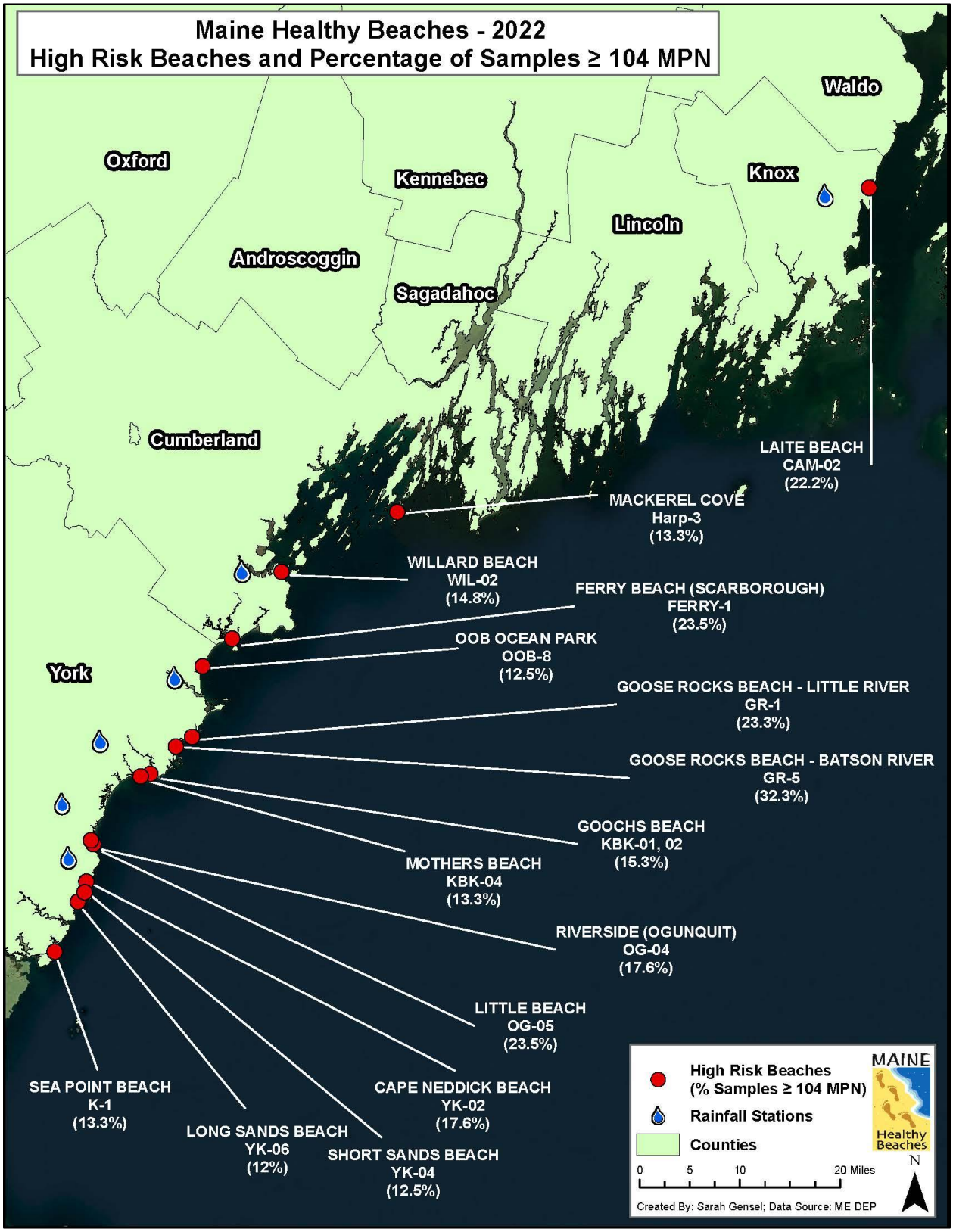


Figure 7. BMAs for which ≥10% of samples exceeded Maine's single sample maximum BAV for enterococci in marine waters (104 MPN/100mL) in 2022.

VI. Collaborative Efforts

Maine's coastal tourism and recreation industry contribute billions of dollars annually to Maine's economy and clean coastal waters are a major priority. Results from a 2015 survey of Maine residents and visitors revealed reducing coastal pollution as the first of 13 possible priority actions, and clean waters and sandy beaches were the two most important factors when planning visits to coastal areas. Improving coastal water quality can be challenging as sources of bacteria are typically difficult to find, often requiring intensive investigations beyond the immediate shoreline. For instance, the majority of Maine's beaches are impacted by freshwater inputs that transport pollutants from upland areas. Once sources are verified, solutions are often complex and expensive. Investing in improvements to coastal water quality can confer significant benefits to local economies largely sustained by revenue from coastal beach recreation activities by decreasing potential bacteria sources at beaches and in turn, costly beach advisories and closures (Lyon et al., 2018)[9].

The MHB program plays a critical role in keeping coastal waters healthy. Since 2003, the program has provided extensive support to communities experiencing bacterial pollution issues with a focus on sharing resources and solving problems. Some examples include: circulation studies, sanitary surveys, GIS mapping/analysis, stakeholder workshops, outreach campaigns, applying pollution source tracking tools like optical brighteners and DNA markers, etc. This work has built the foundation for historical and current local actions to identify, remove, and prevent pollution sources. For example, this work includes surveys of the shoreline and watershed, investigations of and improvements to wastewater/stormwater infrastructure, septic/cesspool removal, boat pump out installation, beach and watershed management plans, protective ordinances, local monitoring efforts, and outreach campaigns.

Enhanced monitoring

The MHB program has supported enhanced monitoring of multiple parameters (toolbox approach) targeting human sourced fecal contamination for areas demonstrating persistent bacterial pollution issues. Typically, as the number of parameters that exceed a threshold (or detectable) limit increases, so does the confidence that human sources are impacting water quality. The focus areas have changed over time with the primary targets being freshwater inputs to the shoreline. However, program data and support (historical and current) has raised awareness regarding water quality issues and has helped make addressing them a priority. Although limited resources and staff has reduced the number of toolbox parameters monitored for the past several years, MHB staff continued collaborating with universities and research institutions (University of New Hampshire (UNH), Bigelow Laboratory for Ocean Sciences) to incorporate microbial source tracking (MST) tools into ongoing pollution source identification and remediation efforts.

In an effort to improve water quality at participating BMAs, MHB supported efforts beyond routine beach monitoring in the Ogunquit River watershed, Wells Harbor, Goose Rocks Beach watershed, Kennebunk River watershed, Biddeford Pool watershed, Crescent Beach State Park, Town Landing (Cumberland), and MDIBL efforts in Acadia in 2022.

[9] Lyon, Sarina F.; Merrill, Nathaniel H.; Mulvaney, Kate K.; and Mazzotta, Marisa J. (2018) "Valuing Coastal Beaches and Closures Using Benefit Transfer: An Application to Barnstable, Massachusetts," Journal of Ocean and Coastal Economics: Vol. 5: Iss. 1, Article 1.

These efforts included the collection and analysis of 312 samples for enterococci bacteria at 57 enhanced monitoring locations in 2022. Samples were collected upland in freshwater inputs to the beach on designated dates throughout the season or were collected on a routine basis in "high-risk" areas such as the mouths of rivers and streams, storm drains, stagnant tide pools, etc. MHB also supported assessment of intermittent, suspected sources such as seepages and runoff typically associated with heavy rainfall. Additionally, MHB staff analyzed 129 samples for optical brightener (OB) levels at 22 enhanced monitoring locations in 2022. Optical brighteners are commonly used in commercial/retail products and are typically flushed down the drain. Therefore, when optical brightener concentrations are coupled with elevated fecal bacteria levels, it can be indicative of human-sourced fecal contamination.

Working groups and applied research partnerships

In 2022 MHB staff supported numerous working groups and applied research partnerships aimed at improving decision-making, addressing pollution issues, reaching diverse audiences, and supporting student advancement in Maine and beyond. MHB staff continued to seek feedback from local participants for the 2022 implementation of the EPA approved BAV plan (approved in 2016). In 2023, MHB staff will continue to collaborate with EPA, consulting their expertise on the latest research and development of new guidance, and to seek the expertise of its advisory committee, the research community, and other partners when necessary, in establishing important program policies as well as addressing challenges.

Coastal beaches are complex systems and the regrowth and persistence of enterococci in sand, seaweed and sediments confounds our understanding of recorded bacteria levels, especially because these "naturalized" contributions have not been linked to human illness. However, studies in Maine and elsewhere have indicated extremely elevated bacteria levels in seaweed that has been cast and warmed on the beach, as well as in neighboring beach water that has rinsed previously stranded algal mats. In response to concerns, MHB staff continued to consult experts in 2022 to guide information shared with beach managers, the public, press, etc. MHB staff also worked with local and state agency partners to inform strategies that would allow communities to better and more quickly respond to episodic events that pose safety and other concerns. More research is needed to understand any health risks posed by FIB levels generated from seaweed that's been "seeded" with fecal material from birds, pets, stormwater, etc. The MHB program will continue to consider FIB levels sourced from seaweed as a potential health risk until further research and guidance develops.

Additionally, Program staff served on the Goosefare Brook Restoration Committee, Casco Bay Working Group, Ogunquit River Watershed Steering Committee, and Coastal Watersheds Working Group. As part of MHB's ongoing efforts to improve the program and its effectiveness, MHB staff will continue to seek opportunities for collaboration in 2023.

The MHB program would like to thank EPA for their continued support.