Rhode Island Department of Environmental Management

Office of Water Resources – Shellfish Water Quality Program

2022 Shellfish Program Growing Area Classification Report

For 2022 Calendar Year

May 2023

2022 RI Shellfish Growing Area Classification Report

Introduction

This shellfish growing area classification report and statistical evaluation summarizes 2022 pollution source surveys and fecal coliform monitoring of RI shellfish growing waters. Water samples were collected from shellfish growing areas by the RI DEM Office of Water Resources (OWR) Shellfish Program and were analyzed by the RI Department of Health State Health Laboratory. The Shellfish Program monitors Rhode Island's shellfish growing waters as part of the effort to ensure the proper classification of shellfish growing waters and to ensure compliance with FDA and NSSP public health guidelines.

Shellfish Growing Area Fecal Coliform Monitoring

A total of 2,082 growing area fecal coliform samples and 171 pollution source samples were collected and analyzed during 2022 as part of the Shellfish Growing Area Monitoring (SGAM) Program (summary tables below). This report summarizes those data and compares growing area fecal coliform compliance statistics to NSSP fecal coliform standards.

Growing Area #	Growing Area Name	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
1A	Upper Narragansett Bay Area A	14		28		14	28	14	14	31		28	
1B	Upper Narragansett Bay Area B	2		4		4	4		4	12		4	
2	Barrington & Palmer Rivers												
3	East Middle Bay	22	44	22			22			24		22	
4	Sakonnet River						22	22	44			22	
5	Kickemuit River		8	10			20	10	10		9	19	10
6	East Passage	27			27		27		27		27		27
7	West Passage	13		13			13	13			13		13
7_2	Narrow River	5	5		5	5	5	5	5	5	5	5	5
8	Greenwich Bay		15			18	40	20	20	16		18	36
9	West Middle Bay	13		13			13	13		2	13		13
10	Pt. Judith & Potter Ponds				26	26	25	26		26	25		
11NG	Ninigret & Green Hill Ponds					24	24		24	25	49		
11QW	Quon. & Winn. Ponds					18		17	18	18	36		
12	Little Narragansett Bay					15	15	15					
13	Block Island Salt Pond	15		15	15	15	15	15	14	14	14		
14	Offshore	2		1	1		8	27	3	6	13	10	1
15	Seekonk River			8			8	3					
16	Providence River	6		18		6	24	23	22	11		12	
17	Mt. Hope Bay		16	16			32	16	16		16	32	16

Table 1: Summary of number of fecal coliform samples collected during monitoring of RI shellfish growing waters during 2022. Table sorted by number of samples analyzed in each growing area during each month of 2022. Total = 2,082 samples.

Shoreline Surveys

Shoreline surveys of shellfish growing areas are conducted on a rotating basis to identify and evaluate fecal coliform and other potential pollution sources to RI shellfish growing waters. For 2022, a comprehensive 12-year sanitary survey of the East Middle Bay (GA3) was completed. In addition, triennial update surveys or annual update surveys were completed in other shellfish growing areas as described following chapters of this report. A total of 171 shoreline source samples were collected and analyzed during 2022 shellfish shoreline surveys (Table 2).

Growing Area #	2022 Survey Type	# Source Samples Collected
1 - Upper Narragansett Bay	Annual	26
3 - East Middle Bay	12-year	51
4 - Sakonnet River	Triennial	55
6 - East Passage	Annual	14
7 - West Passage	Triennial	9
8 - Greenwich Bay	Annual	4
9 - West Middle Bay	Triennial	1
13 - Block Island Salt Pond	Annual	1
16 - Providence River	Annual	10
Total		171

Table 2: Summary of number of fecal coliform samples collected during shoreline surveys of RI shellfish growing areas during 2022. A comprehensive 12-year shoreline sanitary survey of GA3 was completed during 2022. Annual and triennial surveys completed in other areas as noted.

HAB Phytoplankton Monitoring

RI DEM Office of Water Resources Shellfish Program and the RI Department of Health State Health Laboratory monitor RI shellfish growing waters for the presence of potentially harmful biotoxin-producing phytoplankton. The last chapter of this report is a summary of 2022 HAB phytoplankton monitoring of RI shellfish waters.

There were no phytoplankton biotoxin shellfish closures in RI during 2022.

Growing Area 1

Upper Narragansett Bay
2022 Annual Update

Contents

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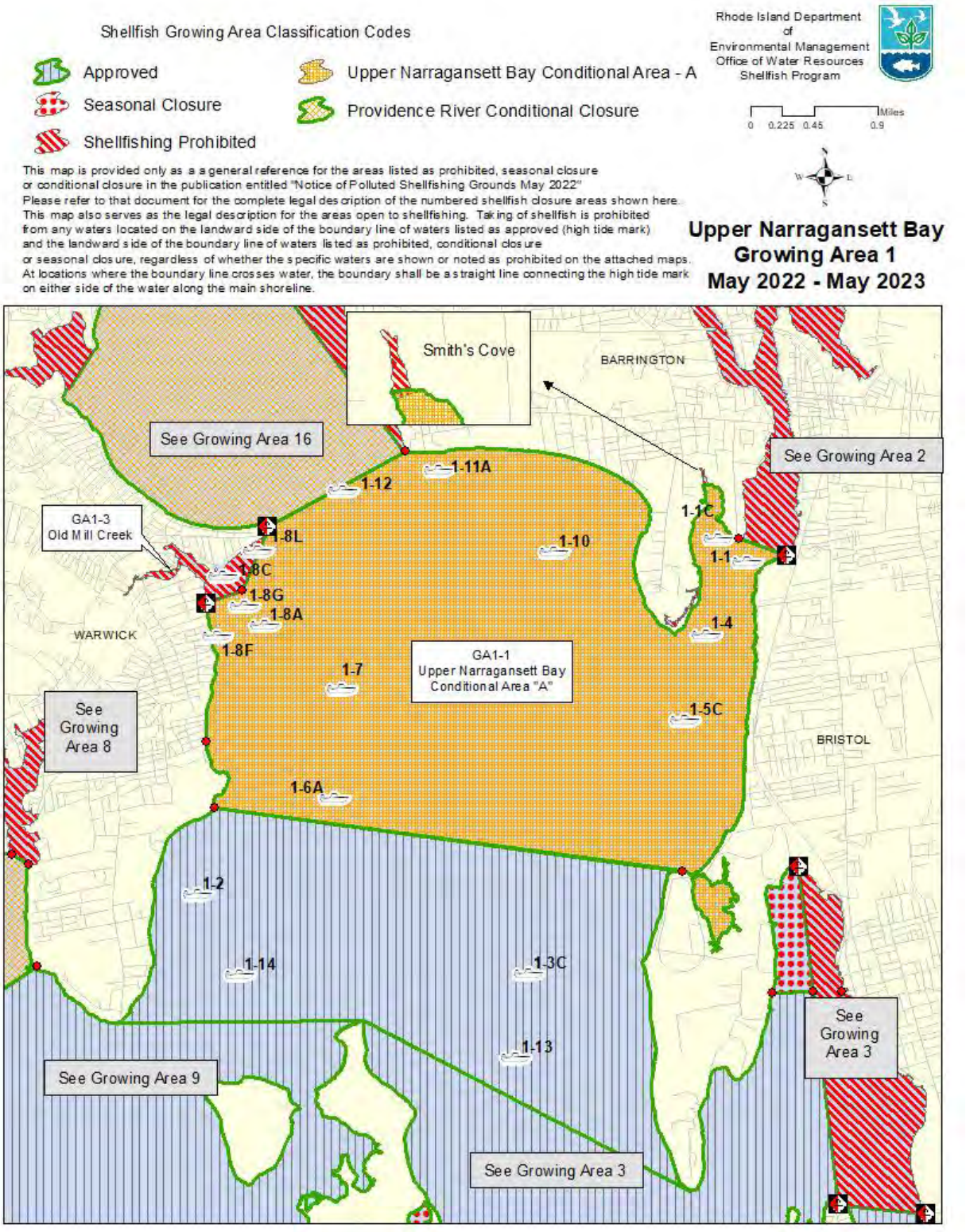
1. Introduction

Growing Area 1 is the waters of Upper Narragansett Bay south of a line from Conimicut Point in Warwick across the mouth of the Providence River to Nayatt Point in Barrington (Figure 1). The Upper Bay growing area continues southward to a line from the point of Warwick Neck eastward to the northern tip of Prudence Island and then southeastward to the southernmost tip of Poppasquash Point. The growing area includes the waters of the Warren River and Smith's Cove south of a line from the southern tip of Adams Point in Barrington to Jacobs Point in Bristol. This northern line coincides with the southern extent of the prohibited shellfish closure line for the Barrington, Palmer and Warren Rivers (Growing Area 2). Growing Area 1 includes the waters of Old Mill Cove/ Creek (classified as Prohibited) in Warwick and those waters referred to as "Mill Gut" in Colt State Park in the town of Bristol.

A twelve (12) year sanitary survey of Upper Narragansett Bay Growing Area 1 was conducted in 2021. The next 12-year comprehensive sanitary survey will be conducted in 2033. A total of eighty-one (81) actual or potential sources were identified during the 12-year sanitary survey in 2021. Two sources were sampled in 2022 (2022-1-51A and 2022-1-008) due to high results in the previous year's sanitary survey.

Figure 1: 2022-2023 Shellfish Classification Map of GA 1 with routine monitoring stations



2. Pollution Source Survey

The 2022 annual shoreline survey took place on 1/31/23 under wet weather conditions when the conditionally approved portion of the growing area was in the open status. There had been a multiple rain storm total of 1.84 inches of rain (measured at KPVD weather station at TF Green Airport) in the seven days prior to the shoreline survey. None of these rain storms exceeded the 1.2" in 24-hour closure threshold in effect for Upper Bay GA1, hence the area was in the open status during the survey.

Source 2022-1-008 (Figure 2) is a 18" corrugated plastic pipe at the end of a right of way, just south of Buckeye Brook draining into prohibited water (closure GA1-3). This source flowing at .02 cfs, yielded a coliform result of <100 cfu/100mL, and samples taken 25 ft in either direction yielded 4 cfu/100mL, and 2 cfu/100ml. This source does not negatively impact the microbial water quality of the growing area as demonstrated by the low flow recorded during wet weather, the low instream results that showed rapid dilution in the receiving waters and the fact that the receiving waters are classified as prohibited.

The other source sampled during this annual survey was source 2022-1-051A (Figure 3), a stream approximately 1 foot wide and 2 inches deep and had an estimated flow of 0.136 cfs that drains uplands. This source yielded a fecal coliform result of 300 cfu/100 mL. Instream samples taken north of where the stream flows into receiving waters had a result of 200 cfu/100 mL, instream samples taken south had a result of <2 cfu/100mL indicating rapid dilution of the source after it enters the receiving waters. This source flows into approved waters of GA1 Upper Bay Area "B" just south of Rocky Point. The minimal flow of this source and the fact that instream samples had low fecal coliform abundance demonstrate rapid dilution and show that this source has minimal impact on the microbiological water quality of the growing area. Further, the acceptable fecal results at nearby routine monitoring station 1-2 demonstrate that this source does not negatively impact the water quality of the growing area (Table 3).

Figure 2: Source 2022-1-008.

Figure 3: Source 2022-1-051A.

Figure 4: 2022-2023 Pollution Sources in GA1

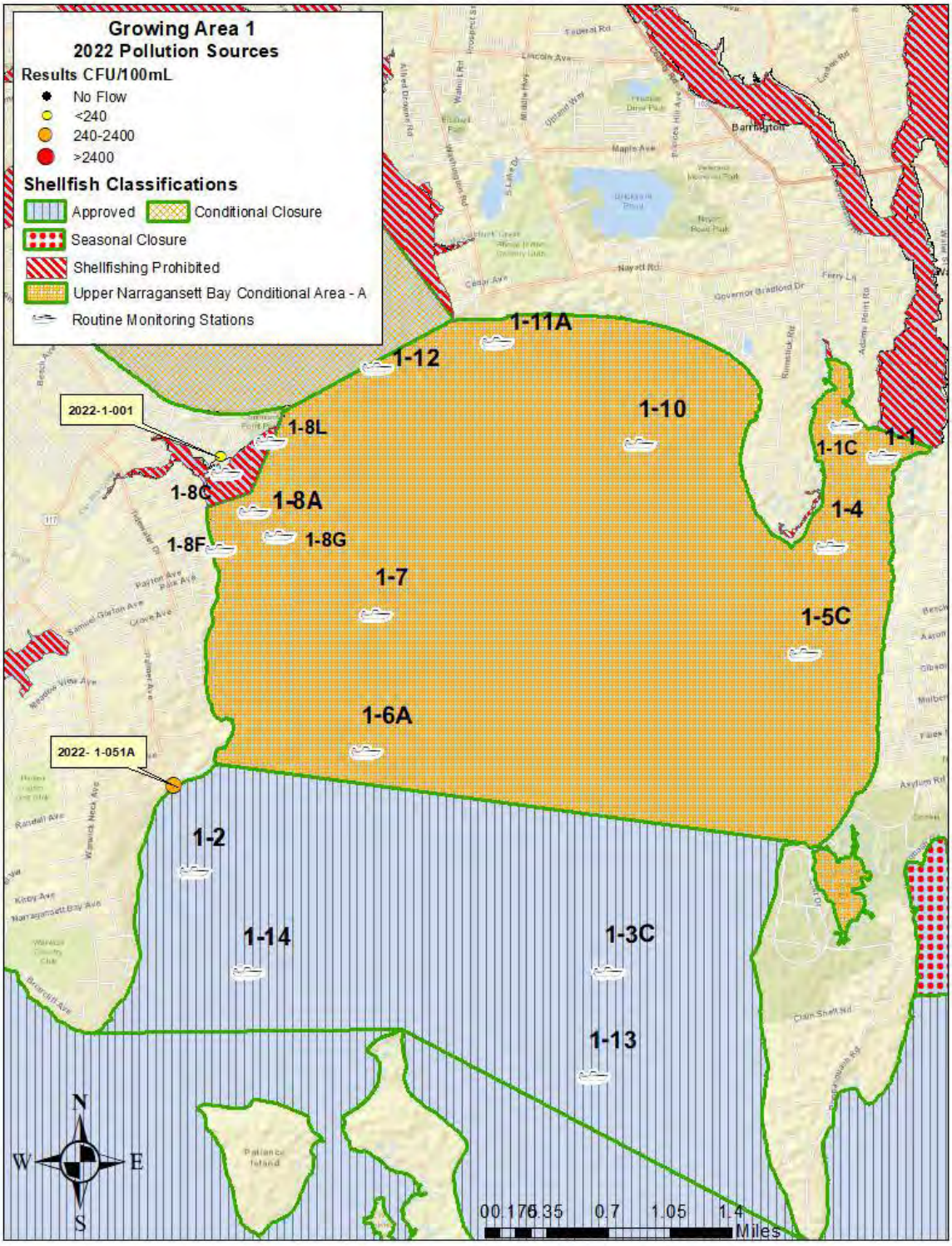


Table 1: 2022 Summary of Pollution Sources in GA 1

Source ID	Date Visited	Lat	Long	Description	Receiving waters classification	Act /Pot	Dir /Ind	2022 Results mTEC cfu/100ml	2022 Volumetric Flow (cfs)
2022-1-001	1/31/23	41.71385	-71.3645	18" plastic pipe	Prohibited	Actual	Direct	<100	.020
2020-1-51A	1/31/23	41.68684	-71.3697	Stream from uplands	Approved	Actual	Direct	300	0.136

3. Wastewater Treatment Facilities

No municipal WWTF discharge directly to the conditionally approved waters of Upper Bay GA1. However, the growing area is downstream of three (3) municipal WWTF that discharge treated effluent to the prohibited waters of the Seekonk River (Growing Area 15) and the prohibited waters of the Providence River (Growing Area 16) and one WWTF, the Warren WWTF, that discharges to the adjacent prohibited waters of GA2 (Barrington and Palmer Rivers). The Providence and Seekonk Rivers receive treated effluent from the Narragansett Bay Commission (NBC) Bucklin Point WWTF, NBC Fields Point WWTF and the City of East Providence WWTF. The NSSP MO requires assignment of the Prohibited classification to waters adjacent to a WWTF within an effluent dilution zone of less than 1,000:1 under normal, efficient operating conditions (Normal Operating Conditions, NOC; NSSP MO, Sect IV Guidance Documents – Chap. II, I, Guidance for Dilution Ratios). Waters beyond this zone can be classified as conditionally approved. RI has chosen a more conservative approach and has established prohibited WWTF dilution zones that are of sufficient size to allow proper dilution under WWTF minor upset conditions such as a limited loss of disinfection. Decades of WWTF upgrades (RI DEM, 2016) and CSO abatement in the Providence area have resulted in increased WWTF efficiency and improved microbial water quality GA1 and in the adjacent Providence River as described in the GA1 and GA16 Conditional Area Management Plans. An analyses of WWTF performance and dilution zones completed in 2021 (see analysis in the RI DEM document "Establishing the Closure Zones and Shellfish Water Classifications Adjacent to Waste Water Treatment Facilities (WWTF) in the Providence River (GA16)", RIDEM February 2021) documented that there is sufficient dilution within the prohibited waters of GA15 and GA16 such that effluent discharged to the upper Providence River and the upper Warren River while the treatment plants are operating under normal treatment and permitted flow conditions will not degrade the microbial water quality of the conditionally approved waters of GA1. The WWTF that discharge to the waters upstream of GA1 are modern, efficient, and well-run facilities that rarely exceed permitted effluent criteria .

A review of RI DEM data indicated that there were no flow or fecal coliform permit violations in 2022 at NBC Bucklin Point, NBC Fields Point, or the East Providence WWTFs.

The Woonsocket WWTF discharges treated effluent to the Blackstone River approximately 23 miles upstream of the conditionally approved waters of GA1. The Woonsocket WWTF experienced three coliform bacteria permit violations during 2022, with effluent fecal coliform of 24,000,000 MPN/100mL on 1/31/22, 19,900 MPN/100mL on 3/31/22, and 5,170 MPN/100mL on 6/30/22. Dilution analyses indicated that there was sufficient volume of water in the Blackstone River to dilute this elevated discharge to <14 cfu/100 ml before reaching conditionally approved shellfish waters of GA1. In addition, DEM OWR shellfish staff sampled the Providence and Seekonk Rivers (Prohibited waters) and conditionally approved waters of GA1 and GA16 in response to these Woonsocket WWTF upsets. Results from those water samples demonstrated acceptable fecal coliform levels in the conditionally approved waters of GA1 and GA16.

4. Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) as codified in the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain certification.

Water samples are collected at eighteen (18) monitoring stations throughout the growing area. Four (4) stations are in Approved waters, twelve (12) stations are in Conditionally Approved waters and two (2) stations are in Prohibited waters.

Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1999) for the standard fecal coliform membrane filtration method (sm48, mTEC) utilized exclusively since August 2012. The procedures for water sample holding times and temperature control are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedures, August 2021 update (copy in the Program's permanent file).

Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

2022 Review of Growing Area Statistics

HIGHLIGHTS

Upper Bay – Area 1A ('Area A')

*** Area A sampled 12X in 2022 (9X when open, 3X when closed).**
*** Statistics represent most recent data collected 4/28/2021 to 11/30/2022 (n = 15) while in the open status.**
*** All conditionally approved areas in compliance.**
*** Data run 1/9/2023**

Upper Bay – southern section ('Area B')

*** Improvements in water quality resulted in a change in classification of the southern portion of the Upper Bay (formerly known as Area B) from conditionally approved to approved on May 27, 2017.**
*** Area B sampled 8X during 2022, 7X when open (1 wet and 6 dry weather).**
*** Statistics for stations 1-2, 1-3C, 1-13 and 1-14 represent recent 30 samples collected during 3/5/2019 or 7/5/2019 to 11/1/2022 under all weather conditions (10 wet and 20 dry weather samples).**
*** All approved stations in area in compliance.**
*** Data run 1/9/2023.**

COMMENTARY

Area 1A: Upper Narragansett Bay Conditional Area 1A (Growing Area 1A or 'Area A') was sampled twelve times (9x open; 3x closed) during 2022, which meets minimum sampling requirements for conditionally approved areas.

Overall, 2022 was slightly drier than average, with 45.8" of rain falling compared to a long-term average rain total of 48.5" per year at TF Green Airport (NOAA weather station KPVD). However, the spring (March, April, May) and summer (July and August) of 2022 were much drier than usual. The dry spring featured rainfall of only 8.6" during March, April, May compared to a long-term average of 12.8" for those months. May 2022 was especially dry with only 1.5" of rain falling compared to an average of 3.5" for that month. June 2022 had near average rain, followed by dry weather during July and August 2022. Only 0.46" of rain fell in the area during July 2022 compared to an average of 3.26" rain in July, resulting in a drought warning for the area. August 2022 was also dry, with approximately 50% of the normal rain falling during that month (1.7" of rain fell at TF Green Airport during August 2022 compared to a long-term average of 3.4"). Rainfall patterns returned to slightly wetter than-normal during September through December 2022. The dry spring and summer weather resulted in Area A being in the open status for 291 days during 2022 (open 80% of days during 2022).

There was one emergency closure of Upper Bay Area A during 2022. A sewage spill near Warwick Pond, which flows into Buckeye Brook and the Upper Bay south of Conimicut Point, resulted in an emergency closure of Upper Bay Area A from noon on 9/16/2022 through sunrise 9/21/22 (a 4.5 day closure of Area A). Dilution analysis followed with sampling of the area indicated acceptable fecal coliform in the eastern side of GA1 such that the spatial extent of the

precautionary closure was reduced on 9/16/2022. From 9/16/2022 through 10/6/2022 (21 days) the western-most portion of Area A bounded by a line from Conimicut Point to Ogden Avenue in Warwick was closed due to this SSO sewage spill.

All conditionally approved stations in the growing area met NSSP criteria while in the open status during 2022 (Table 2). Water quality in the prohibited zone near the mouth of Buckeye Brook and Mill Cove (stations 1-8C, 1-8L) showed improvements over 2021 results, but still had occasional elevation in fecal coliform during dry weather. The City of Warwick is in the process of extending municipal sewer service to the Bayside neighborhood adjacent to Buckeye Brook and Mill Cove. DEM shellfish staff will continue to monitor the Mill Cove area to see if the expansion of sewer service results in improved water quality and potential for an upgrade in classification.

Station 1-1C, located in Smith Cove in Barrington, was added in 2021 to assess microbial water quality in the cove. Samples collected thus far (n = 13) indicate acceptable fecal coliform levels in Smith Cove while the area is in the open status (Table 2). In addition, sampling thus far (n = 13 paired samples) indicated that fecal coliform levels at station 1-1C were not statistically different than those at nearby station 1-1 (ANOVA, $F(1, 24) = 0.5159$, $p = 0.4795$) when the growing area was in the open status. The OWR shellfish program will continue to monitor station 1-1C in Smith Cove.

The 2022 statistical review demonstrated that all conditionally approved stations in Upper Bay Area A (GA1-1A) met NSSP fecal coliform water quality criteria while the area was in the open status and that the area is properly classified as conditionally approved.

Area 1B: Upgrades of wastewater treatment and storm water facilities in the Providence area resulted in improved fecal coliform water quality and a change in the classification of the southern portion of the Upper Bay (Upper Bay Area B, GA1-1B) from conditionally approved to approved in May 2017. Subsequent sampling of the four stations (1-2, 1-3C, 1-13, 1-14) in the southern portion of the Upper Bay followed the systematic random sampling protocol recommended by the NSSP for approved areas.

The southern portion of the Upper Bay (Area 1B) was sampled eight times (2 wet weather and 6 dry weather) during 2022, exceeding minimum sampling requirements for approved areas. Seven of the 2022 samples were collected while the area was open, and one set of samples was collected while the areas was in the closed status. There was one emergency closure of Area B during 2022. An intense rainstorm dropped up to 8.33" (at NBC Fields Point gauge) of rain on the area on the afternoon of 9/5/2022. An emergency closure of Upper Bay Area B was put into effect on 9/6/2022 at noon. Water samples collected several days after the spill demonstrated that the area had returned to acceptable water quality by 9/9/2022 and the area was returned to the open status on 9/12/2022 (a 5.5 day closure of Area B).

Fecal coliform results for 2022 showed improvement over those of 2021. All stations in Area B met NSSP criteria during 2022 (Table 3). 27 of 30 (90%) samples collected in Area B during 2022 had fecal coliform results of 2 cfu/100 ml or less and all samples collected in Area B during 2022 had results of 8 cfu/100 ml or less. A single set of moderately elevated fecal coliform

results is in the recent 30 samples used to evaluate NSSP criteria. Samples collected on 7/14/2021 (5 days after 2.05" rain) had moderately elevated fecal coliform. These samples resulted in the 90th percentile variability statistic being moderately elevated, but still well below NSSP variability criteria at stations 1-2 and 1-13. Samples collected in Area B have demonstrated acceptable fecal coliform water quality after heavy rainfall. Water samples collected 3-5 days after five separate rainstorms of 2.3 to 3.3 inches during 2018-2022 have shown acceptable water quality in Area B.

The southern portion of Upper Narragansett Bay (Area 1B or 'Area B') has met criteria for approved waters since 2017 (2017 – 2022). The 2022 statistical summary demonstrated that the southern portion of the Upper Bay (Area B) is properly classified as Approved.

RECOMMENDATIONS

* All conditionally approved stations in compliance and conformance when open.
* All approved stations in compliance.
* Continue monitoring Buckeye Brook to quantify changes in water quality in response to increased number of homes connected to municipal sewage treatment in the Bayside neighborhood.
* When possible, continue optional wet weather sampling to track fecal coliform concentration response and to monitor effects of upgrades in wastewater and storm water treatment on Upper Bay water quality.

Table 2: Upper Narragansett Bay Conditional Area (GA1) fecal coliform compliance statistics for Upper Bay Area 1A when open (4/28/2021 to 11/30/2022; all dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
1-1	CA	15	4.4	0.0
1-1C	CA	13*	4.4	0.0
1-4	CA	15	3.4	0.0
1-7	CA	15	2.9	0.0
1-10	CA	15	2.8	6.7
1-12	CA	15	2.8	0.0
1-11A	CA	15	3.4	6.7
1-5C	CA	15	3.1	0.0
1-6A	CA	15	2.0	0.0
1-8A	CA	15	2.4	0.0
1-8C	P	15	2.5	6.7
1-8F	CA	15	2.2	0.0
1-8G	CA	15	3.3	0.0
1-8L	P	15	3.4	6.7

Table 3: Upper Narragansett Bay fecal coliform compliance statistics for the approved waters of GA1B or 'Area B'; the southern half of the Upper Bay growing area. Samples collected during 3/5/2019 to 11/1/2022 (10 wet weather, 20 dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
1-2	A	30	3.4	11.8
1-3C	A	30	2.7	8.3
1-13	A	30	2.9	11.3
1-14	A	30	2.7	8.8

5. Summary and Recommendations

The 2022 annual re-evaluation of Upper Narragansett Bay shellfish Growing Area 1 (GA1) demonstrated that shoreline sources are not negatively impacting the microbiological water quality of the growing area when this conditionally approved area is in the open status for shellfish harvest. In addition, the WWTF potentially impacting the growing area were shown to be operating in an efficient manner that consistently resulted in effluent flow and fecal coliform concentration being well below permitted discharge levels. A statistical review of water column fecal coliform collected while the conditionally approved area was in the open status indicated that all conditionally approved stations in sub-area 1A and that all Approved stations in sub-area 1B met NSSP criteria and that these areas of the Upper Narragansett Bay Growing Area (GA1) are in program compliance and is properly classified.

The northern portion of GA1, known as 'Area A', is conditionally approved and impacted by precipitation events and also potentially impacted by discharge from sewage treatment facilities. Therefore, the RIDEM Shellfish Program monitors Growing Area 1 in accordance with the guidelines set forth in the Upper Narragansett Bay Conditional Area Management Plan (CAMP) amended in 2017 (amendment #3) and 2021 (amendment #4). The Upper Bay (Growing Area 1) CAMP was re-evaluated during this review and the monitoring and management actions were consistent with the management plan (CAMP).

No classification changes are recommended for Upper Bay Area 1A or 1B.

GA 2
Barrington, Palmer and Warren Rivers
2022 Annual Update

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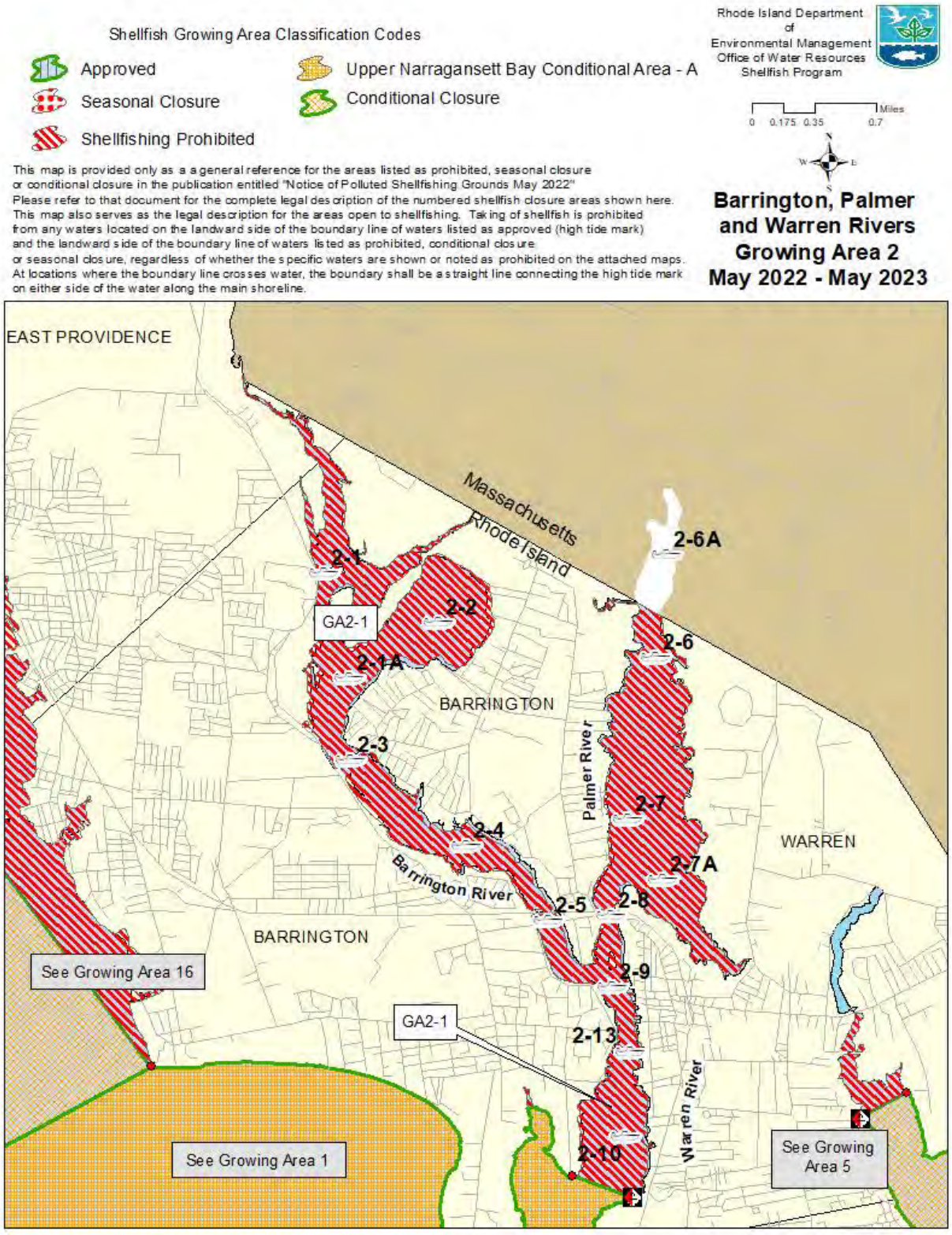
1. Introduction

All waters of the Barrington, Palmer and Warren Rivers, Growing Area 2 (Figure 1), are currently classified as prohibited to shellfishing. Sampling of this area has been limited due to the prohibited classification. However, DEM OWR shellfish staff sample the area as program resources allow. The area was sampled two (2) times during 2017 (both during wet weather), (5) times during 2018 (1 dry weather, 4 wet weather), twice (2 times) during 2019 (one dry, one wet), and once during 2021 (dry weather sample). Results from recent sampling and statistical evaluation (based on the most recent 30 samples collected under all weather conditions; an 'Approved' status scenario) indicate that seven (7) of fourteen (14) stations (~50%) are in compliance. Under a 'Conditionally Approved' scenario with a 0.5" rainfall closure trigger, seven (7) of fourteen (14) stations (50%) comply with NSSP criteria for harvest of molluscan shellfish for direct human consumption. There is no consistent, predictable regional pattern of compliance in the up-river segments of this growing area. Stations that are in compliance during dry weather (i.e., stations 2-2, 2-4 in the Barrington River and station 2-8 in the Palmer River) are adjacent to or surrounded by stations that are out of compliance during dry weather. A change from 'Prohibited' status will not be possible until fecal coliform concentrations decline and there is a consistent and predictable regional pattern of stations meeting NSSP criteria in the Barrington and Palmer River portions of Growing Area 2.

Figure 1. 2022-2023 Shellfish Classification Map of GA 2 with Routine Monitoring Stations



A bi-state monitoring effort of the lower Palmer River watershed in Massachusetts, was begun in 2012 and three dry weather surveys of the entire Palmer River watershed were conducted in 2012 and 2013. More recent sampling led by RIDEM and MADEP has targeted specific areas with elevated bacteria concentrations. This included several canoe trips on the lower Palmer

River below Shad Factory Pond and targeted sampling along both the main stem lower Palmer River, Torrey Creek, and Rocky Run. In 2015, multiple samples were taken at different tides at eight stations in this target area. While these monitoring efforts have helped to identify specific reaches of the river and its tributaries associated with elevated bacteria levels, they have not been helpful in identifying specific sources. In December 2015, EPA coordinated a meeting between MADEP, RIDEM, EPA, and MA office of NRCS to update organizations on the project and to plan next steps to identify bacteria sources. 2016 field work focused on identifying agriculturally related source areas of nutrients and bacteria to help target the NWQI (National Water Quality Initiative) outreach efforts. In the Upper reaches of this growing area extensive study and focus has been initiated, and further work by RIDEM in cooperation with EPA and NRCS still needs to be done to address the impacts noted in the bi-state TMDLs with regards to non-point discharges and agricultural BMPs.

The above-mentioned efforts have resulted in completion of several agricultural BMPs in the upstream watershed. These mitigation efforts should help to reduce bacteria loadings to the watershed and result in improved water quality. However, a recent analysis concluded that multiple bacteria sources contribute to degraded water quality of the shellfish growing area and that it will take a considerable effort to remediate these sources such that water quality can support safe shellfish harvest (Save the Bay, 2021). Efforts will be made to sample the growing area more frequently to document changes in water quality.

2. Waste Water Treatment Facilities

The receiving waters of the Warren Wastewater Treatment Facility are within Growing Area 2. An analysis to determine the necessary dilution zone for compliance with the NSSP MO is contained in the program's permanent files. EPA's PLUMES model was utilized in determining the extent of impacts of the WWTF discharge in the event of an upset in treatment at the plant should it occur. Performance records of plant treatment quality and records of any unusual events at the plant that would cause a discharge of partially treated sewage are maintained by the department's operations and maintenance division and reported immediately to shellfish staff should such an unlikely event occur. There were no reports of permit violations warranting re-evaluation of the prohibited zone during 2022.

Upgrades to the Warren WWTF are outlined in the towns Consent Agreement with the state in 2011, which will bring the facility into compliance with its new discharge permit. Construction has been completed and the RI DEM RIPDES program is tentatively waiting for a "substantially complete" date from the Town of Warren. Reevaluation of the dilution analysis previously establishing the prohibited zone for this plant discharge will be completed using any newly permitted design parameters.

In addition to the Warren WWTF there are numerous marinas and mooring fields located within the confines of GA-2, mostly concentrated in the lower reaches of the Warren and Barrington Rivers. As you travel north beyond the bridges of Route 103 water depths and access heights limit the accessibility of larger vessels in the Palmer River and the large shallower coves of the Barrington River. Numerous day use vessels are docked or moored along the riparian shorelines of both rivers. The potential impacts from the existing commercial docks and marinas have been evaluated and waters adjacent to these facilities are within the closed prohibited zones providing adequate protection in the case of any accidental discharges associated with marine vessels. Details of this analysis can be found in the program document entitled "Evaluation of Waters

Adjacent to Marinas – Marine Dilution Analysis, 2021." All waters within GA2 are designated as a "No Discharge Zone".

3. Water Quality Studies / Annual Statistical Analysis

HIGHLIGHTS

* Growing Area 2 was not sampled in 2022.
* The area was last sampled during 2021.
* Area is currently classified as prohibited; statistics calculated for informational purposes only, not for compliance.
* Statistics calculated for Approved scenario: recent 30 combined wet and dry weather data 8/13/2010 to 8/17/2021, 16 wet weather and 14 dry weather samples; 8 MPN and 22 mTEC samples (variability criteria = 35 mpn/100 ml).
* Statistics also calculated for Conditionally Approved scenario: recent 15 samples collected during dry weather only (<0.5" rain in prior 7 days) during (8/13/2010 to 8/17/2021); 3 mpn and 12 mTEC (variability criteria = 34 mpn/100 ml).
* Data run 12/21/2021.

COMMENTARY

Areas of the Barrington River (stations 1-5) and the Palmer River (stations 6-8) were downgraded from conditionally approved to prohibited in May of 1998 due to declining water quality. A TMDL study of the area was completed in 2002, with a recommendation to monitor shellfish growing waters to track changes in water quality. The Barrington, Palmer and Warren Rivers (Growing Area 2) were sampled once during 2021 during dry weather (12 days after 2.73" rain at TF Green Airport). Although this area is prohibited for the harvest of shellfish, compliance statistics were run under two scenarios: approved (recent 30 observations under all weather conditions) and conditionally approved (recent 15 observations during dry weather of <0.5" rain 7-days prior to sampling).

Approved scenario: Seven stations (stations 2-2, 2-4, 2-5, 2-8, 2-9, 2-10, 2-13) of 14 met criteria under the approved scenario. Most of the stations that met NSSP criteria are located in the southern-most Barrington River and in the Warren River in marina areas or are adjacent to the Warren WWTF outfall which keeps the area classified as prohibited to shellfish harvest. Station 2-2 in Hundred Acre Cove met criteria but is bounded up- and down-river by areas that do not meet criteria.

Conditionally Approved scenario: Under dry weather conditions (less than 0.5" rain in prior 7 days), seven of fourteen stations (stations 2-2, 2-4, 2-5, 2-8, 2-9, 2-10, 2-13) of 14 met criteria. As with the Approved scenario (above), the stations that met NSSP criteria are predominantly located in the southern-most Barrington River and in the Warren River in marina areas or are adjacent to a WWTF outfall which keeps the area classified as prohibited to shellfish harvest. Station 2-2 in Hundred Acre Cove met criteria but is surrounded by adjacent waters that do not meet NSSP criteria during dry weather. TMDL work in RI and MA portions of the watershed continues in an effort to improve water quality. Given current water quality and the unpredictable fecal coliform response after rainfall, the area is properly classified as Prohibited.

RECOMMENDATIONS

* Maintain closure of the Barrington River and Hundred Acre Cove.
* Maintain closure of the Palmer River.
* As resources allow, complete six (6) systematic random sampling trips per year to support TMDL efforts and to track water quality changes.

Table 1: Fecal coliform summary statistics under Approved scenario based on recent 30 samples collected under all weather conditions (8/13/2010 to 8/17/2021; 16 wet and 14 dry weather; 8 MPN / 22 mTEC). Area is classified as Prohibited, statistics for informational purposes only, not for compliance.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
2-1	P	30	43.0	391.9
2-1A	P	30	12.5	110.4
2-2	P	30	5.1	22.9
2-3	P	30	7.9	38.2
2-4	P	30	5.3	24.7
2-5	P	30	5.5	24.0
2-6	P	30	59.1	660.6
2-6A	P	30	163.6	1753.0
2-7	P	30	9.3	67.5
2-7A	P	30	9.8	70.4
2-8	P	30	5.5	20.8
2-9	P	30	4.8	18.1
2-10	P	30	4.3	16.3
2-13	P	30	4.3	14.6

Table 2: Fecal coliform summary statistics under Conditionally Approved scenario based on recent 15 samples collected during dry weather (<0.5" rain prior 7 days) during 8/13/2010 to 8/17/2021; 12 mTec, 3 mpn). Area is classified as Prohibited, statistics for informational purposes only, not for compliance.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 34 cfu/100 ml
2-1	P	15	33.7	60.0
2-1A	P	15	10.5	33.3
2-2	P	15	4.3	6.7
2-3	P	15	6.8	13.3
2-4	P	15	4.7	6.7
2-5	P	15	4.9	6.7
2-6	P	15	36.7	46.7
2-6A	P	15	116.2	86.7
2-7	P	15	7.0	13.3
2-7A	P	15	7.4	13.3
2-8	P	15	5.9	0.0
2-9	P	15	3.9	0.0
2-10	P	15	3.9	0.0
2-13	P	15	4.7	0.0

4. Summary and Conclusions:

All waters of the Barrington, Palmer and Warren Rivers, Growing Area 2 (Figure 1), are currently classified as prohibited to shellfishing. Monitoring of prohibited areas is not required, but as resources allow DEM Shellfish staff will continue to complete limited monitoring of the growing area. The 2021 review and calculation of compliance statistics indicated that the waters of the Barrington, Palmer and Warren Rivers (Growing Area 2) do not reliably meet NSSP fecal coliform criteria for safe harvest and consumption of molluscan shellfish. The growing area is properly classified as prohibited.

Efforts should be made to complete sampling of the growing area during 2023, as resources allow.

5. Literature Cited:

Save the Bay, 2021. A comprehensive plan to restore water quality in Hundred Acre Cove. 29 pages. Available at: https://www.savebay.org/wp-content/uploads/HAC-Report_FINAL_8-16-2021_ForWeb.pdf.

East Middle Bay

Growing Area 3

12 Year Sanitary Shoreline Survey

Calendar Year 2022

Sandy Point – Prudence Island - Lighthouse Friends

Rhode Island Department of Environmental Management
Office of Water Resources
Shellfish Monitoring Program

This 12-year sanitary shoreline survey was compiled with guidance of the National Shellfish Sanitation Program (NSSP) Guide for the Control of Molluscan Shellfish 2019 Revision.

David Borkman
Sanitary Survey Officer
RI Department of Environmental Management

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Acronyms and Terms

BMP:	Best Management Practice
CSO:	Combined Sewer overflow
FDA:	Food and Drug Administration
I & I:	Inflow and Infiltration
ISSC:	Interstate Shellfish Sanitation Conference
MPN:	Most Probable Number
NOAA:	National Oceanographic and Atmospheric Administration
NSSP:	National Shellfish Sanitation Program
OWTS:	On-site Wastewater Treatment Systems (Formerly ISDS, Individual Sewage Disposal Systems)
RIDEM:	Rhode Island Department of Environmental Management
RIPDES:	Rhode Island Pollutant Discharge Elimination System
SGAM:	Shellfish Growing Area Monitoring
SSCA:	State Shellfish Control Authority
SWMPP:	Storm Water Management Program Plan
TMDL:	Total maximum Daily Load
WWTF:	Waste Water Treatment Facility

A Executive Summary

A comprehensive 12-year shoreline survey of the East Middle Bay shellfish Growing Area 3 (GA3) was conducted during the summer and fall of 2022 by staff from RIDEM's Office of Water Resources Shellfish Program. The survey involved a shoreline reconnaissance of the entire study area to locate and evaluate pollution sources and collect bacteriological samples from all sources actively flowing into the survey area. This survey was conducted following the guidance of the 2019 NSSP Model Ordinance.

The primary objective of the shoreline survey was to identify and characterize sources of pollution potentially impacting the shellfish in the growing area, to reevaluate point and non-point sources identified during previous surveys, and to update information regarding the sampling of previously identified sources. This report updates previous surveys and includes recent shoreline survey results and a statistical summary of recent shellfish growing area fecal coliform results for comparison with NSSP compliance criteria for safe harvest of molluscan shellfish.

The 2022 shoreline survey investigated 70 shoreline pollution sources that could potentially deliver fecal coliform pollution to the growing area. Analysis of water samples demonstrated that none of these sources compromise the microbial water quality of the shellfish growing area. A review of growing area fecal coliform data indicated that the conditionally approved and approved portions of the growing area meet NSSP criteria for safe shellfish harvest. All monitoring stations in the area were in program compliance. A review indicated that the growing area sampling schedule, and sampling station locations support the current classification of the growing area. The findings of the shoreline survey support the current classification and legal description of the growing area.

Changes in land use in some areas adjacent to the growing area since the last 12-year survey, namely conversion of the abandoned Weyerhaeuser Lumber industrial site in Portsmouth to residences, and improved water quality in adjacent Mt. Hope Bay support an upgrade of GA3-3 (477 acres) from its current Prohibited classification to an Approved classification.

B Description of the Growing Area

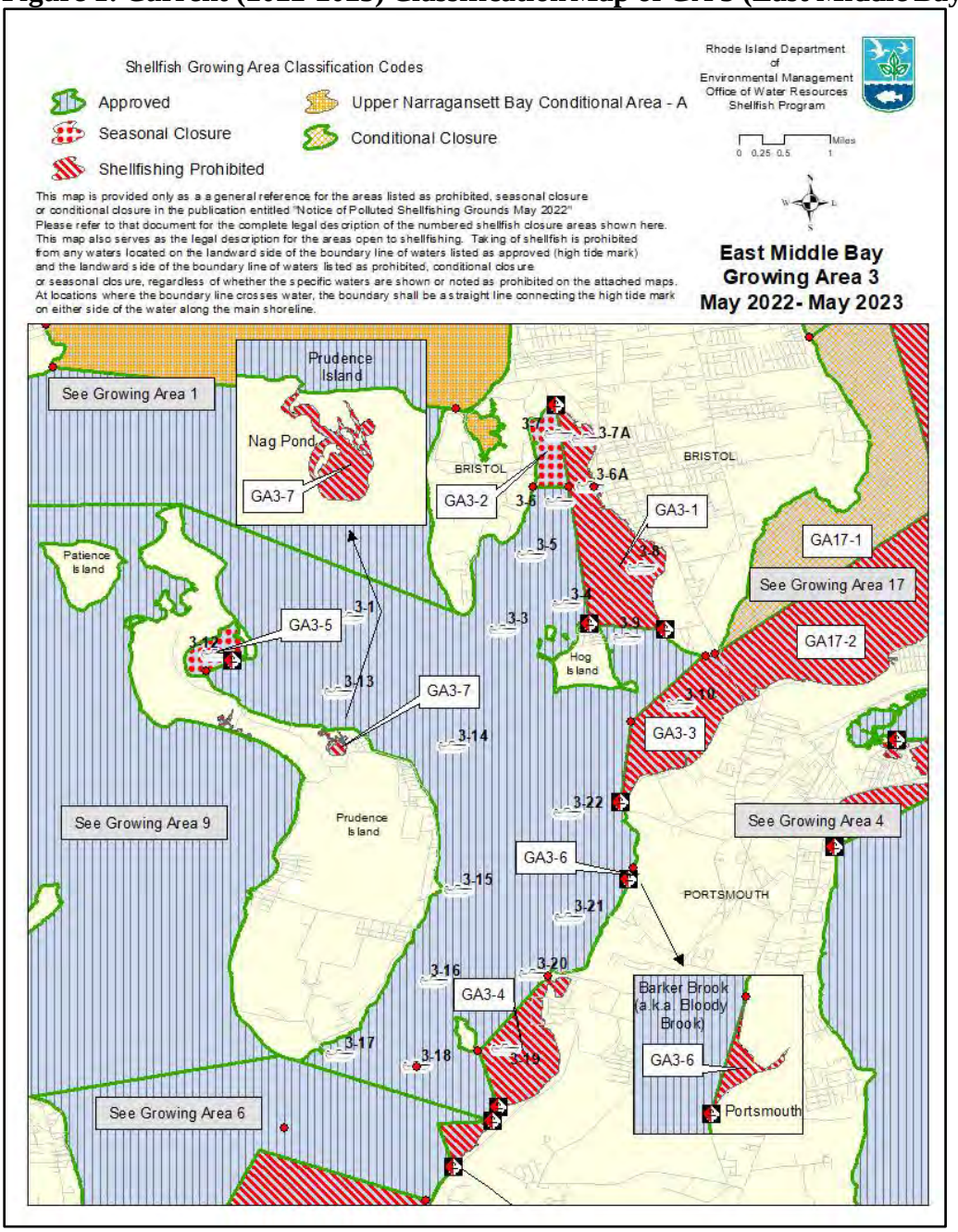
A shoreline survey of East Middle Bay was conducted during the summer of 2022 by staff from RIDEM's Office of Water Resources. The survey involved a shoreline reconnaissance of the entire study area to locate and catalog pollution sources and collect bacteriological samples from all sources actively flowing into the survey area.

The primary objective of the shoreline survey was to identify and characterize any new sources of pollution impacting the growing area, to reevaluate point and non-point sources identified during previous surveys, and to update information regarding the sampling of previously identified sources.

1. Location

East Middle Bay (GA3) is identified as the area of water bounded on the north side by a line from Providence Point on Prudence Island to the tip of Poppasquash Point in Bristol, north and east along the Bristol shoreline and the Mt. Hope Bridge; bounded to the east by the Portsmouth and Middletown shoreline from the Mt. Hope Bridge south to Carr Point; and bounded to the west and south sides by the shoreline of Prudence Island (Figure 1). The growing area includes the seasonally approved waters of Bristol Harbor and Potter Cove.

Figure 1: Current (2022-2023) Classification Map of GA 3 (East Middle Bay)



2. Description of the Area

i. Physical Description

East Middle Bay is the northern half of what is commonly referred to as the East Passage of Narragansett Bay. Shellfish growing areas 1 (Upper Narragansett Bay) and 17 (Mt. Hope Bay) are to the north and growing area 6 (East Passage) is to the south of growing area 3 (GA3). In addition to wild harvest shellfish resources, there are five shellfish aquaculture leases located in GA3 as of 2023 (CRMC). The East Passage is considered the deep-water gateway from the Atlantic Ocean to Narragansett Bay *via* Newport and is a major shipping channel for large commercial vessels sailing to the Ports of Providence, RI and Fall River, MA. The East Passage also receives heavy usage from all sorts of pleasure craft, along with a bounty of sports and commercial fishermen. Within the East Middle Bay there are two islands, Hog Island a small residential enclave and Dyer Island owned by the State of Rode Island and managed by RI DEM. There are approximately 120 residences on Hog Island while Dyer Island is uninhabited; both islands are fairly isolated from the mainland and accessible only by boat.

The deep gorge of the East Passage was formed by glacial action. The deepest portion of the passage is located to the south of this growing area in the Castle Hill Newport area, but depths of 100 feet are found all the way north to the Sandy Point area off Prudence Island (NOAA Navigation Chart 13223) which is approximately in the center of GA3.

East Middle Bay consists of approximately 9,500 acres (38.4 km^2) of marine waters, of which:

- 7,820 acres are Approved
- 1,441 acres are Prohibited
- 233 acres are Seasonally Approved

Figure 2 is the current classification map for the 2022 – 2023 season. Captioned areas refer to their legal descriptions located in the document entitled "Notice of Polluted Shellfishing Grounds May 2022".

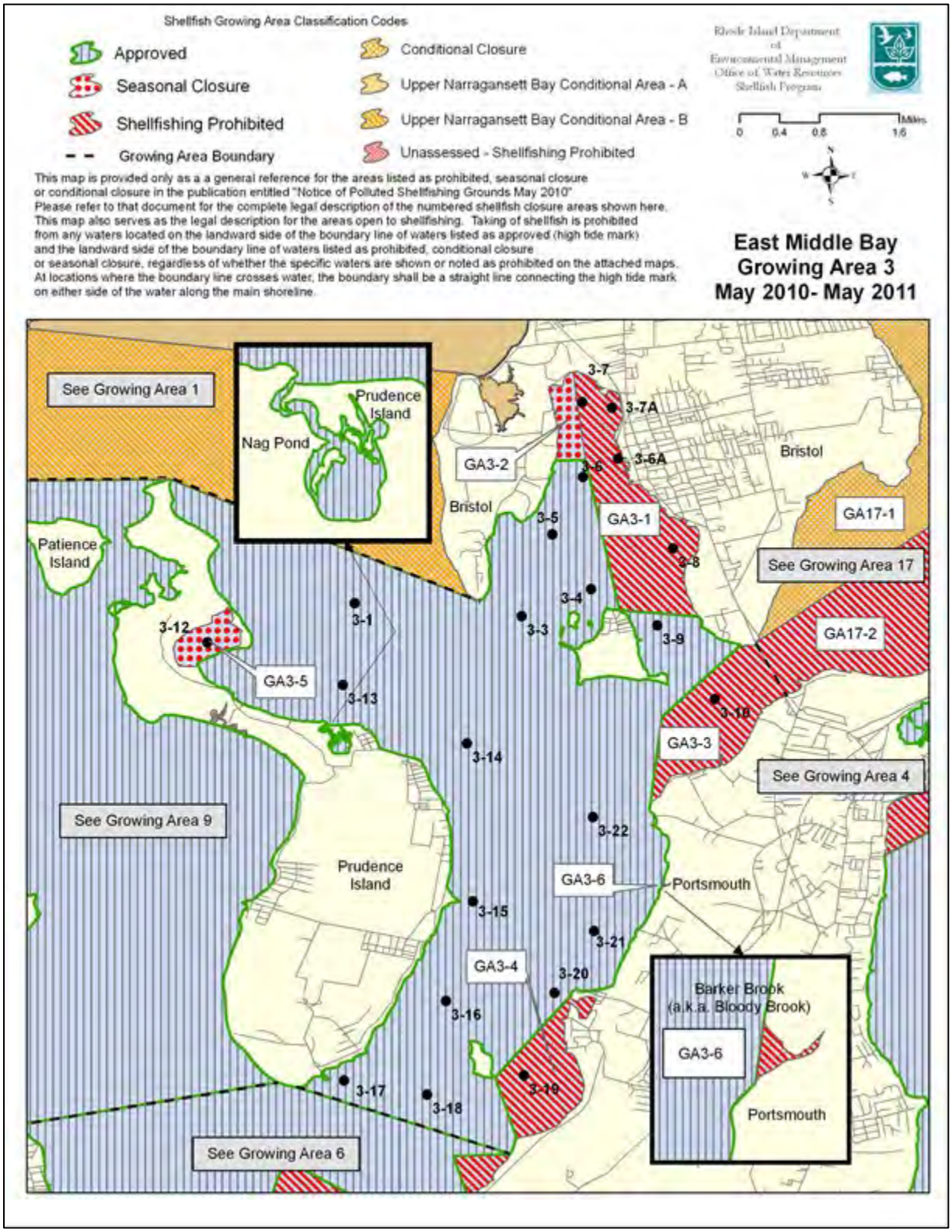
ii. Latest Survey

Prior to this 2022 shoreline survey, RIDEM's Office of Water Resources personnel last conducted a 12-year shoreline survey of GA3 in 2010. Triennial surveys were completed in 2013, 2016 and 2019 with annual updates completed in each intervening year. The 2022 survey included all shorelines of the growing area regardless of the classification.

iii. Previous Classification Maps

The 2010 classification map (Figure 2) does not vary from the current map, except that Nag's Pond, on Prudence Island was reclassified as Prohibited to shellfishing in 2014.

Figure 2: 2010 Classification Map of GA3 (East Middle Bay)



iv. Current Classification Map

The most recent (May 2022-May 2023) classification map of GA3 is shown in Figure 1. The legal description of each area as follows:

Shellfishing Prohibited

Growing Area 3 – East Middle Bay
Bristol Harbor

GA3-1 Bristol Harbor, east of a line from the range marker located on pole # 20 Poppasquash Road at the northernmost indentation of Bristol Harbor to the Rhode Island Department of Environmental Management range marker located on the northern extremity of Hog Island, and north of a line from the northern extremity of Hog Island to the range marker located at the western extension of Low Lane on Bristol Neck.

(see also: the seasonal closures GA3-2 under Bristol Harbor and GA3-5 under Potter Cove)

East Middle Bay, Mount Hope Bay and Vicinity

GA3-3 Mount Hope Bay and vicinity south and west of the Rhode Island-Massachusetts state line to a line from the range marker located on the shoreline of Touisset Point to the range marker on Common Fence point that intersects with a line from Bristol Point to the Buoy R4 channel marker located on the southerly side of the Mount Hope Bay channel, including the waters north and east of a line from Bristol Point to the Hog Island Shoal Light, to the southwestern extremity of Arnold Point in Portsmouth, where a Rhode Island Department of Environmental Management range marker has been established, and north of a line in the Sakonnet River at the centerline of the Sakonnet Bridge in Portsmouth and Tiverton

GA3-4 The waters in the vicinity of Melville east of a line from Coggeshall Point southwesterly to the southeastern most point of Dyer Island and the area east of a line from the Rhode Island Department of Environmental Management range marker at Carr Point northwesterly to the southeastern most point of Dyer Island Portsmouth.

GA3-6 All waters of Barker Brook (a.k.a. Bloody Brook) in Portsmouth east of a line from the most southeastern landward corner of the Carnegie Abbey dock located to the north of the mouth and the Rhode Island Department of Environmental Management range marker located approximately 250 feet south of the mouth of the brook.

GA 3-7 All waters of Nag Pond on Prudence Island.

Seasonal Closures

Seasonal Closures begin at sunrise of the Saturday immediately prior to Memorial Day and ends at sunrise of the Tuesday immediately following Columbus Day **Except as Noted**.

Growing Area 3 – East Middle Bay

Bristol Harbor

GA3-2 Bristol Harbor, west of a line from the Rhode Island Department of Environmental Management range marker located on pole # 20 Poppasquash Rd. at the northernmost indentation of Bristol Harbor to the Rhode Island Department of Environmental Management range marker located at the northernmost extremity of Hog Island and north of a line from the CRMC Permitted Dock # 419 located at 163 Poppasquash Road to the most north-western corner of the Rockwell Pier municipal parking lot in Bristol Harbor.

Potter Cove (Prudence Island)

GA3-5 Potter Cove, northerly and westerly of a line from the Rhode Island Department of Environmental Management range marker established at the southwesterly extremity of Gull Point on Prudence Island through nun buoy 6 at the entrance to Potter Cove to the east shore of Prudence Island.

C Pollution Source Survey

1. Personnel

Steve Rogers, Steve Engborg and Anthony Crudale, Biologists, of the RIDEM Office of Water Resources coordinated and conducted a shoreline reconnaissance of East Middle Bay Growing Area 3 with the assistance of other staff members at RIDEM Office of Water Resources.

The survey took place on five days during July through November of 2022: . July 5, July 6, July 7, August 9, October 6, and October 20 of 2022.

2. Survey Procedures

Special attention was given to all types of pipes, drainage ditches, culverts, and streams in order to classify them as a direct (discharges directly to the growing area), indirect (does not discharge directly to the growing area but may contribute to pollution), actual (discharging at the time of the survey), or potential (not actively discharging at the time of the survey but considered a possible source of pollution). Bacteriological samples were collected in sterile, four-ounce (125 mL) Nalgene bottles from all sources that were actively flowing at the time of the field study. Samples were stored on ice in a portable cooler and transported to the Rhode Island Department of Health Laboratory at the end of each field day following DOH time-temperature guidance. The mTEC method, as described in Standard Methods for the Examination of Water and Wastewater, was used for analysis of fecal coliform in water samples.

3. Summary of Sources and Locations

A total of seventy (70) actual or potential sources, excluding marinas, were identified during this shoreline survey. Thirty-seven (37) of these sources were not actively flowing at the time of the shoreline survey, and thirteen (13) previously identified sources could not be located. The remaining twenty (20) sources were flowing and were sampled. All actual and potential sources of pollution to the East Middle Bay growing area that were identified as part of the 2022 12-year survey were mapped (Figure 3). Fecal coliform results for sources that were flowing are listed in Table 1.

Figure 3: Pollution sources investigated during the 2022 12 Year Sanitary Shoreline Survey of GA3.

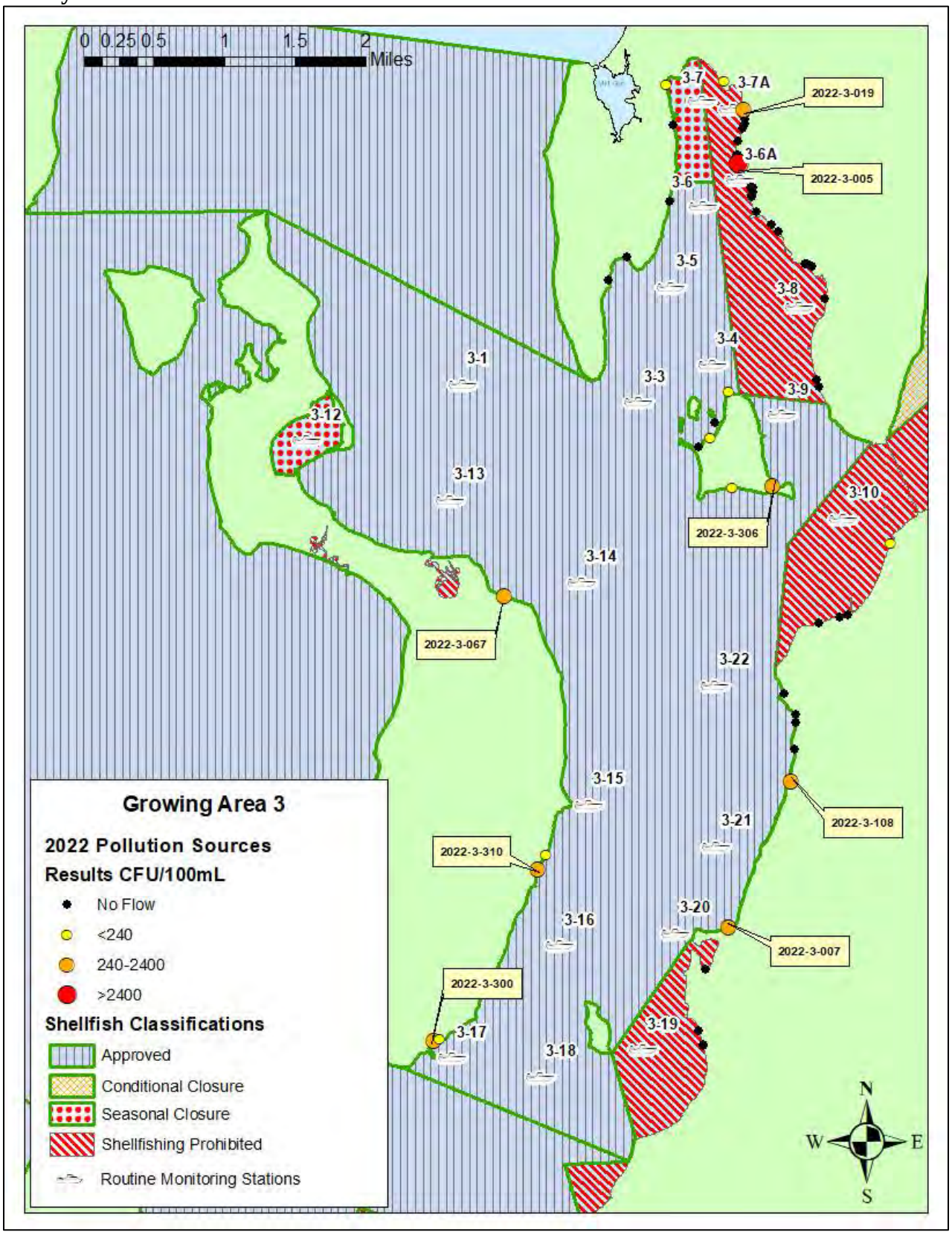


Table 1: Fecal coliform results for pollution sources investigated in the 2022 survey of GA 3.

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-001	41.67385	-71.27998	Boat launching area manhole and 12" Black PVC	Prohibited	P	D		NF
2022-3-002	41.67385	-71.27988	20" CMP from storm drain in boat launch parking area	Prohibited	P	D		NF
2022-3-003	41.6725	-71.28005	4" PVC pipe from side of Quitos restaurant	Prohibited	CNL			
2022-3-004	41.67248	-71.27987	18" Corrugated PVC storm drain in rip rap wall	Prohibited	P	D		NF
2022-3-005	41.67161	-71.2798	36" Dia RCP storm drain from under condo building	Prohibited	A	D	13000 N 70 S 14	0.003
2022-3-007	41.59298	-71.2814	Stream north of Melville shipyard	Approved	A	D	300 E 2 W 1.9	0.56
2022-3-008	41.66916	-71.27811	(3) 8" dia. PVC pipes in bulkhead at Rockwell Pier Marina	Prohibited	P	D		NF
2022-3-009	41.66868	-71.2779	8" Dia PVC in bulkhead at southern end of Rockwell Pier Marina	Prohibited	P	D		NF
2022-3-010	41.66829	-71.27801	30" CMP in bulkhead at end of Church St ROW	Prohibited	P	D		NF
2022-3-011	41.66818	-71.27798	8" PVC in bulkhead at end of ROW Church St	Prohibited	CNL			

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-012A	41.66665	-71.27739	12" Dia Cast Iron pipe at end of Constitution St	Prohibited	P	D		NF
2022-3-012B	41.66665	-71.27739	24" Dia RCP pipe at end of Constitution St	Prohibited	P	D		NF
2022-3-012C	41.66665	-71.27739	24" Dia RCP at end of Constitution St	Prohibited	P	D		NF
2022-3-013	41.66527	-71.27529	24" Dia. Clay storm drain at end of ROW Union St	Prohibited	P	I		NF
2022-3-014A	41.66456	-71.27438	12" RCP in bulkhead	Prohibited	P	I		NF
2022-3-014B	41.66456	-71.27438	6" RCP in bulkhead	Prohibited	P	I		NF
2022-3-015	41.67518	-71.27919	24" Dia RCP outfall 3/4 full of silt	Prohibited	P	I		NF
2022-3-016	41.67572	-71.27901	18" RCP outfall in rip rap wall from storm drain on Thames St	Prohibited	P	D		NF
2022-3-017	41.6762	-71.27899	18" RCP outfall in rip rap wall from storm drain	Prohibited	P	D		NF
2022-3-018	41.67652	-71.279	18" RCP outfall in rip rap wall from storm drain	Prohibited	P	D		NF
2022-3-019	41.67706	-71.2791	Culvert under bike path Silver Creek	Prohibited	A	D	640 N 120 S < 2	3.5
2022-3-020	41.68013	-71.2818	20' culvert under road draining tidal pond	Prohibited	A	D	<2 IS <2	8.5
2022-3-021	41.67975	-71.28977	3' long stone culvert/bridge draining tidal pond	Prohibited	A	D	99 N 2 S 4	0.319

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-030	41.6611	-71.2707	cast iron roof drain from lobster pot restaurant	Prohibited			CNL	
2022-3-031	41.6612	-71.2704	15" RCP storm drain at end of High St	Prohibited	P	D		NF
2022-3-032	41.661	-71.2698	15" RCP storm drain at in seawall opposite pole # 172	Prohibited	P	D		NF
2022-3-033	41.6576	-71.2681	Broken 24" RCP	Prohibited				NF
2022-3-034	41.6493	-71.2692	H2O pipes under dock	Prohibited				NF
2022-3-035	41.6486	-71.2688	12" PVC set back in seawall full of shells evidence of no flow	Prohibited				NF
2022-3-036	41.6482	-71.2687	15" VC pipe in seawall	Prohibited			CNL	
2022-3-037	41.6474	-71.2682	12" broken clay pipe just south of dock	Prohibited			CNL	
2022-3-038	41.65961	-71.29769	18" RCP storm drain Reliance Drive	Prohibited				NF
2022-3-039	41.66195	-71.29524	Stream draining wetland	Approved				
2022-3-040	41.66768	-71.28931	Dry stream channel Portside Dr	Approved	P	I		NF
2022-3-041	41.67552	-71.28876	6" dia Vitrified clay pipe in seawall NE corner just south of Poppasquash	Conditionally Approved	P	D		NF

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-060	41.63827	-71.2809	Stream draining saltwater marsh on south side of Hog Island	Approved	A	D	100 E 9 W4	0.944
2022-3-067	41.62712	-71.3122	Culvert under road draining large upland wetland complex	Approved	A	D	400 E 8 W <2	0.12
2022-3-100	41.63243	-71.25901	Outlet from tidal marsh eastern Portsmouth shoreline south of Mt Hope Bridge	Prohibited	A	D	99 N 62 S 6	1.02
2022-3-101	41.62516	-71.26505	8" PVC at south end of brick building at Werheauser Pier	Prohibited				NF
2022-3-102	41.6249	-71.26603	Damned pond outlet	Prohibited				NF
2022-3-103	41.62426	-71.269	ASSF at beach access from neighborhood	Prohibited				NF
2022-3-104	41.61706	-71.27375	30" RCP outfall at Carnegie Abby marina	Approved				NF
2022-3-105	41.61484	-71.27222	Outlet channel from created marshland tidally influences	Approved				NF
2022-3-106	41.61405	-71.27213	Outlet channel from drainage basin into channel to beach	Approved	P	D		NF

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-107	41.61129	-71.2723	Stream at Carnegie golf course	Approved	P	D		NF
2022-3-108	41.60794	-71.27279	Bloody (Barker Brook) Brook	Approved	A	D	360 N 2 S 1.9	0.243
2022-3-200	41.57167	-71.29167	Dry stream bed / drainage swale just north of ball field	Prohibited			CNL/DNE	
2022-3-201	41.57333	-71.2881	Stream at R/R trestle Burma (Defense Dr) Road.	Approved	P	D	Does not reach receiving water	NF
2022-3-202	41.5808	-71.28494	Stagnant stream bed	Prohibited	P	D		NF
2022-3-203	41.58094	-71.28502	Manhole structure with 10" dia Cast Iron pipe below low tide	Prohibited	P	D		NF
2022-3-204	41.58237	-71.28561	Dry stream bed stagnant	Prohibited	P	D		NF
2022-3-205	41.58868	-71.2847	(4)12" Cast Iron pipe in rip rap at old fuel depot in boat basin	Prohibited	P	D		NF
2022-3-206	41.5915	-71.28281	12" dia cast iron pipe in corner of rip rap wall and steel bulkhead in boat basin	Prohibited			CNL	
2022-3-207	41.59158	-71.28512	12" RCP in riprap from parking lot	Prohibited			CNL	
2022-3-208	41.59268	-71.28309	12" dia cast iron pipe in corner of rip rap wall	Approved			CNL	

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-209	41.59298	-71.28131	Stream from upland pond. In 2017, stream ended ~50' from shore.	Approved			CNL	
2022-3-210	41.59789	41.59789	Dry stream bed	Approved			CNL	
2022-3-300	41.58139	-71.32201	Stream just north of pier 48" RCP	Approved	A	D	1200 N 8 S 6	0.17
2022-3-301	41.58155	-71.3211	24" dia RCP 50 yards north of #301	Approved	A	I	100 N 2 S 14	0.018
2022-3-302	41.64244	-71.28537	Stream draining upland marsh, drains into cove near aquaculture site	Approved			CNL	
2022-3-303	41.64336	-71.28388	Stream draining upland marsh receiving waters near aquaculture farm	Approved	A	D	100 N 1.9 S 11	0.053
2022-3-304	41.64812	-71.28128	Groundwater seep coming from marsh	Approved	A	D	90 IS 8	
2022-3-306	41.63841	-71.27521	Stream draining upland marsh	Approved	A	D	300 E 18 W 4	0.68
2022-3-307	41.64495	-71.28319	Mouth of Foul cove	Approved			CNL	
Nag-1	41.6295	-71.32022	Nag Creek, inside pond to east, tide flowing in	Prohibited	A	D	8 IS 4	tidal

Source #	Latitude	Longitude	Description	Rec. Waters Classification	Actual / Potential	Direct / Indirect	Results (cfu/100mL)	Flow (cfs)
2022-3-310	41.598965	-71.307657	Run off through rocks	Approved	A	I	700 N 4 S 54	Trickle
2022-3-311	41.60056	-71.30648	Stream from upland, under road	Approved	A	I	160 N <2 S 160	Trickle
2022-3-008B	41.66916	-71.2779	36” PVC Round in bulkhead at Rockwell pier	Prohibited	P	D	Too little to sample	

4. Identification and Evaluation of Pollution Sources

The DEM shellfish program uses the following criteria for categorizing shoreline pollution sources:

- > 2,400 cfu/100 ml fecal coliform and greater than a trickle flow: Investigation and at least annual resampling.
- 240 to 2,400 cfu/100 ml fecal coliform and greater than trickle flow: Resample each triennial survey.
- < 240 cfu/100 ml fecal coliform: Resample each 12-year survey.

Of the twenty (20) sources that were flowing to the growing area and were sampled, only one (1) had results that exceeded 2,400 cfu/100mL (source 3-005; highlighted in red in Table 3). Source 3-005 flows into Prohibited waters of GA3. Seven (7) sources had fecal coliform levels of greater than 240 but less than 2,400 cfu/100mL (highlighted in yellow in Table 3). These eight (8) sources that had fecal coliform of greater than 240 cfu/100 ml are discussed in detail below.

Sources with fecal coliform >2,400 cfu/100 ml:

Source 3-005 was the only source that had an elevated coliform bacteria count of greater than 2,400 cfu/100mL during the 2022 survey. Source 3-005 is a 36" diameter concrete pipe flowing under an apartment complex and draining into the prohibited waters of GA 3 in Bristol Harbor (Figure 4). A fecal coliform result of 13,000 cfu/100mL and a flow rate of .003 cfs was recoded on 7/5/2022 (8 days after 0.65" rain and 3 days after 0.24" rain at TF Green Airport, approximately 8 miles west of the growing area). Companion instream samples of 70 and 13 cfu/100 mL indicate a rapid dilution in the receiving waters. In addition, this source flows into the northern end of an approximately 617 acre prohibited area and the source is at minimum 0.3 miles from approved or seasonally approved waters. Given the low flow rate and the expansive prohibited area, this source does not negatively impact the microbial water quality of the approved or seasonally approved waters of the growing area.

Figure 4: Source 2022-3-005, a 36" diameter pipe conveying stormwater to Bristol Harbor (prohibited waters).

Sources with fecal coliform of 240 to 2,400 cfu/100 ml:
Seven (7) sources had fecal coliform levels of greater than 240 but less than 2,400 cfu/100mL (highlighted in yellow in Table 3). These sources are described below:

Source 3-007 is a small, intermittent stream draining a wetland to the north of the Melville Boat Basin. This source had a fecal coliform level of 300 cfu/100 ml and a flow rate of 0.56 cfs on 10/20/2022. A review of previous observations indicated that the 2022 result was lower than the fecal coliform levels recorded in 2007 (930 cfu/100 ml) and 2009 (1,100 cfu/100 ml). The source was not flowing at the time of the last 12-year survey (2010). Source 3-007 flows into approved waters. Companion in-steam samples yielded results of 2 cfu/100 ml and 1.9 cfu/100 ml in the receiving waters approximately 25 feet to the east and west of where source 3-007 enters the waters of GA3. Given the demonstrated rapid dilution in the receiving waters and the intermittent nature of this small stream, source 3-007 has little impact on the microbial water quality of the growing area. Source 3-007 will be revisited in the next triennial survey.

Source 3-019 is Silver Creek, a stream that flows from a wetland, under a small bridge, and into the prohibited waters of Bristol Harbor (Figure 5). Source 3-019 had a fecal coliform result of 640 cfu/100 ml and a flow rate of 3.5 cfs on (7/5/2022). In stream samples collected approximately where the stream enters the receiving waters yielded results of 120 cfu/100 ml to the north and 1.9 cfu/100 ml to the south. Given that this stream flows into the extensive (617 acres; GA3-1) Bristol Harbor prohibited zone, this source is not a threat to the water quality of the approved waters of the growing area.

Figure 5: Source 3-019 Silver Creek flowing into the prohibited waters of Bristol Harbor.

Source 3-067 is a small stream (known locally as Mill Creek) flowing from a wetland on the north shore of Prudence Island. The stream flows into approved waters of GA3. Source 3-067 had a fecal coliform level of 400 cfu/100 ml on 7/6/2022 (7 days after 0.65" rain and 2 days after 0.24" rain at TF Green Airport, approximately 8 miles west). However, in-stream samples

collected in the receiving waters had fecal coliform values of 8 cfu/100 ml (to the east) and 1.9 cfu/100 ml (= below detection) to the west of the stream mouth. The low instream fecal coliform results demonstrate rapid dilution and indicate that source 3-067 is not heavily impacting the microbial water quality of GA3.

Source 3-108 is Bloody (or Barker) Brook; named after a Revolutionary War battle ('The Battle of Rhode Island') that occurred near this brook during August 1778. Bloody Brook flows through Portsmouth RI and enters approved waters of GA3 along the shore just north of the Portsmouth Abbey School. The previous 12-year survey (in 2010) had shown fecal coliform levels of 43 cfu/100 ml at this source. This source had a fecal coliform result of 360 cfu/100 ml and a flow rate of 0.24 cfs on 8/9/2022 (23 days after 0.17" rain at TF Green Airport). However, companion in-stream samples collected in the receiving waters showed fecal coliform levels of 2 cfu/100 ml (to the north) and 1.9 cfu/100 ml (= below detection) to the south indicating rapid dilution and demonstrating that this source is not causing degradation of the water quality in the growing area. Given the recent (2022) increase over 240 cfu/100 ml, this source will be resampled in the next triennial survey.

Source 2022-3-300 (Figure 6) is a 48" diameter reinforced concrete pipe draining a substantial upland wetland and joining the approved waters of GA3 just north of the T-Wharf on Prudence Island. This source had a fecal coliform of 1,200 cfu/100 ml and a flow rate of 0.17 cfs on 7/6/2022. In-stream samples demonstrated rapid dilution in the receiving waters, with instream results of 8 cfu/100 ml (north) and 6 cfu/100 ml (south). The upland area of the island is part of the Narragansett Bay Estuarine Reserve (NBERR) and is uninhabited (no homes in the area) suggesting a non-human fecal coliform source of fecal coliform bacteria. The low flow rate of this source and the demonstrated rapid dilution in the receiving waters indicate that this source is not causing degradation of the water quality in the growing area. This source will be resampled in the next triennial survey.

Figure 6: Source 3-300, a 48" concrete pipe draining an upland wetland on Prudence Island, just north of the T-Wharf.

Source 3-306 is a small stream flowing from a wetland to the approved waters of GA3 near the southeast corner of Hog Island (Figure 3). This source was flowing at a rate of 0.68 cfs and had a fecal coliform level of 300 cfu/100 ml during wet weather (sample collected on 10/6/2022; 1 day after 1.17" rain at TF Green Airport). However, companion instream samples collected near where this small stream flows into the receiving waters had fecal coliform levels of 18 cfu/100 ml (to the east) and 4 cfu/100 ml (to the west) demonstrating rapid dilution in the receiving waters. Given the rapid dilution and low flow even during wet weather, this source has little negative impact on the microbial water quality of GA3.

Source 3-310 is a small stream in a drainage swale flowing from under a road on the east side of Prudence Island (Figure 7). This source yielded a fecal coliform result of 700 cfu/100 mL and a flow rate of only a trickle on 7/6/2022. Instream samples several feet north and south of the source had fecal coliform results of 4 cfu/100 mL and 54 cfu/100 mL demonstrate rapid dilution in the receiving waters. The low flow rate (trickle) and relatively low in-stream fecal coliform levels indicate that this source is not having a negative impact on the water quality of the receiving waters.

Figure 7: Source 3-310 a small stream on the east side of Prudence Island.

5. Other Potential Sources of Pollution

i. Domestic Wastes / Industrial Wastes

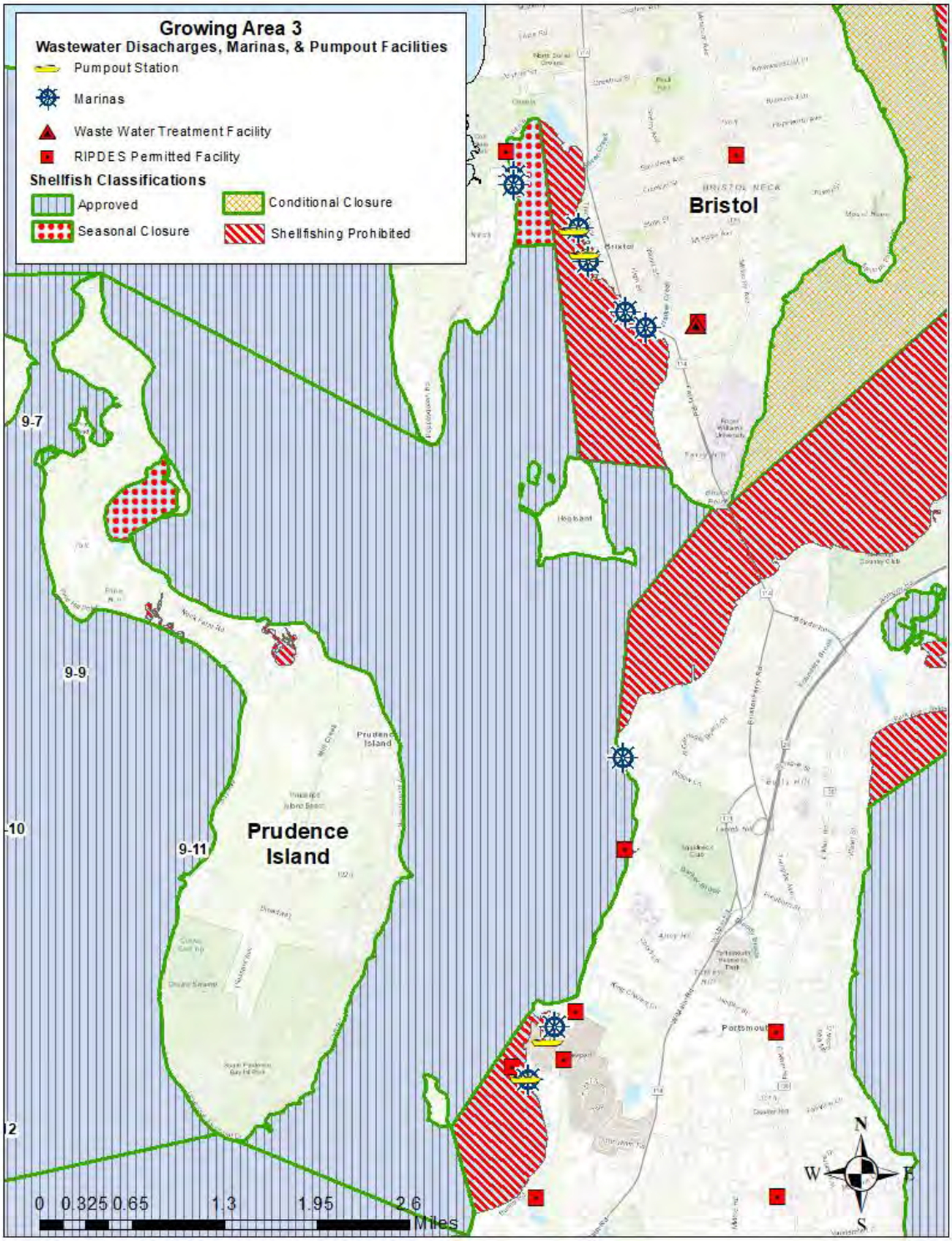
Portions of the watershed to the East Middle Bay growing area are serviced by a mix of sanitary sewers and OWTS (On-site Wastewater Treatment Systems). The town of Bristol is primarily served by municipal sewers except for the dwellings located on Poppasquash Point. These large estate lots are serviced by OWTS. The town of Portsmouth which includes the islands of Hog and Prudence are entirely dependent on OWTS. Reviewing the department's Office of Compliance and Inspections open complaint files for the towns of Bristol and Portsmouth indicates that there were no complaints logged for this area during 2022.

The Town of Bristol has the only permitted WWTF discharge into the growing area. The town's wastewater facility discharges into a 617 acre Prohibited safety zone that includes all of Walker Cove and the eastern half of Bristol Harbor (see GA3-1 in Figure 1). The Bristol WWTF was constructed in 1935 as a primary treatment plant and has received numerous upgrades since then. The most recent major upgrade was in 1989 when rotating biological contactors were added to provide secondary treatment. In addition, processing technology was added in 1996 to reduce total residual chlorine in the effluent to a maximum of 0.364 mg/L. In addition, the Bristol WWTF has undergone several upgrades to replace aging infrastructure and equipment including upgrades to the facility's disinfection equipment. Additional upgrades are under way to improve the facility's solids handling equipment that will further improve facility operations and improve effluent quality. The Town has also made progress in its program to reduce inflow and infiltration (I&I) in the collection system which has significantly reduced sanitary sewer overflows that historically have occurred during heavy rain events. The Bristol WWTF serves approximately 21,000 people and has a RIPDES (permit # RI100005) permitted discharge of 3.79 MGD.

A review of the Bristol WWTF RIPDES permit indicated three minor permit violations during 2022. All three violations were exceedances of the average daily flow (3.79 MGD) through the facility. In March 2022 the Bristol WWTF had a monthly average flow of 5.45 MGD which was in excess of the 3.79 MGD permitted flow. March of 2022 was slightly drier than usual, with 3.6" of rain in March 2022 compared to a long-term mean of 4.8". While flow was exceeded in March of 2022, fecal coliform levels remained low in the treated effluent, with a maximum of 6.3 cfu/100 ml and a geometric mean fecal coliform of 1.6 cfu/100 ml in Bristol WWTF treated effluent during March 2022. A mean monthly flow rate of 4.71 MGD was recorded during April 2022 compared to a permitted 3.79 MGD for the Bristol WWTF. As with March 2022, rainfall in the region was slightly less (0.93") than normal during April 2022. Effluent fecal coliform levels remained low during April 2022, with a maximum value of 11 cfu/100 ml and a geometric mean of 4.3 cfu/100 ml, despite the elevated flow rate. The Bristol WWTF also had a monthly mean flow rate violation in May of 2022. Flow averaged 3.94 MGD in May 2022 which was slightly (~4%) greater than the permitted flow of 3.79 MGD. As in the previous months with elevated flow, fecal coliform levels in the treated effluent remained low. May 2022 effluent had a maximum fecal coliform of 10.9 cfu/100 ml and a monthly averaged geometric mean of 2.2 cfu/100 ml at the Bristol WWTF. Other than the three flow exceedances noted in spring of 2022, no other violations occurred at the Bristol WWTF during

2022 indicating that this facility is well-run and operating under permitted effluent discharge conditions.

Figure 8: Locations of WWTF, marinas and RIPDES permitted dischargers adjacent to GA3 at the time of the 2022 shoreline survey.



ii. Stormwater

Other than downtown Bristol, which is adjacent to the prohibited waters of Bristol Harbor, most of the land adjacent to GA3 is rural to suburban with impervious cover levels of less than 20%. (RIGIS, 2020) Prudence Island and Hog Island are more sparsely developed and have less than 4% impervious surfaces. In addition, there are no large rivers that flow directly to the shellfish waters of GA3. As a result, stormwater has little impact on the fecal coliform water quality of East Middle Bay (GA3) and there are no conditionally approved waters in GA3 that have a rainfall closure threshold.

Extreme rain events in excess of typical rainfall patterns occur infrequently. These extreme events may impact the water quality of shellfish growing areas and may require emergency closures to safeguard public health. A retrospective analysis of the effects of extreme rain events on the microbial water quality of RI shellfish growing areas was completed by RI DEM Shellfish staff. These analyses are described in the document "Determination of Excess Rain Closures for RI Shellfish Growing Areas" available in the shellfish programs permanent files. The analyses identified that fecal coliform levels exceed NSSP criteria after excess rainfall levels of 3" in a 24-hour period. Accordingly, GA3 is managed with a 3" rain, 7-day emergency rainfall closure.

Wet weather sampling has demonstrated that fecal coliform water quality in the approved waters of GA3 remains acceptable after rainfall amounts of up to the emergency closure level (3" in 24-hour period; Table 2). For example, samples collected on 12/4/2020 (3.5 days after 3.45" rain) and samples collected on 9/11/2012 (6 days after 3.45" rain) had fecal coliform levels of near 2-3 cfu/100 ml (Table 2). Similarly, fecal coliform results after rain of approximately 2.0" to 2.8" showed acceptable fecal coliform water quality (Table 2). While Table 2 summarizes geometric mean fecal coliform results, a review of the 375 individual wet weather fecal coliform results taken one to seven days after rain of approximately 1" to 2.8" showed that 368 of 375 (98%) of these wet weather samples had fecal coliform of less than the variability standard of 31 cfu/100 ml. In addition, 341 of these 375 wet weather samples (91%) had fecal coliform values of 2 cfu/100 ml or less, demonstrating that stormwater, up to the 3" emergency closure rainfall, has a minor effect on the fecal coliform water quality of the approved waters of GA3.

Table 2: Fecal coliform levels at approved stations in GA3 during wet weather (1 to 7 days after rainfall of greater than 1") sorted by rainfall amount. Only data since the 2012 transition to the MTEC analysis method included. Note that GA3 has a 3" rain emergency closure and the growing area was in the closed status for samples collected after rain >3".

Date	Rain (")	Days since rain	Fecal Coliform geometric mean (cfu/100 ml)	n	Status
9/9/2022	8.33	3.0	4.9	2	**Closed**
9/11/2012	3.45	6.0	2.0	15	**Closed**
12/4/2020	3.45	3.5	2.7	15	**Closed**
1/16/2018	3.34	3.0	13.6	15	**Closed**
12/12/2014	3.08	2.0	10.7	15	**Closed**
7/11/2014	2.80	7.0	2.3	15	Open
3/6/2018	2.55	3.5	3.6	3	Open
11/3/2017	2.36	5.0	4.1	4	Open
10/31/2017	2.34	1.0	9.0	7	Open
1/29/2019	2.33	5.0	2.4	15	Open
6/30/2015	2.07	2.0	2.1	15	Open
1/26/2017	1.95	1.5	2.4	15	Open
4/29/2019	1.91	2.0	6.7	15	Open
4/3/2017	1.88	2.0	2.3	14	Open
1/30/2023	1.84	4.0	3.3	15	Open
11/3/2021	1.74	3.0	3.8	15	Open
11/4/2015	1.57	6.0	2.1	15	Open
6/2/2016	1.50	3.0	2.2	15	Open
10/3/2018	1.46	1.0	4.6	14	Open
10/11/2018	1.46	8.0	4.0	1	Open
2/9/2022	1.35	2.0	1.9	15	Open
5/17/2012	1.35	1.0	4.4	14	Open
6/14/2022	1.31	1.0	2.6	15	Open
9/18/2015	1.21	5.0	2.2	15	Open
5/20/2019	1.14	7.0	1.9	15	Open
9/29/2022	1.12	7.0	1.9	15	Open
10/15/2020	1.11	2.0	2.1	15	Open
6/29/2021	1.05	7.0	2.1	15	Open
5/18/2017	1.01	4.0	2.0	15	Open
5/13/2021	1.01	3.0	1.9	15	Open
10/15/2019	0.98	6.0	1.9	15	Open
11/21/2011	0.97	3.0	3.4	15	Open
4/22/2015	0.96	1.0	2.5	15	Open

iii. Marinas

Consistent with NSSP guidance (Section II. Chapter IV @.01C (3) a (iii) of the 2019 revision of the NSSP Guide), the OWR Shellfish program completes required analysis of the microbial water quality of waters adjacent to marinas and mooring fields. Details of these analyses are in the document "Evaluation of Waters Adjacent to Marinas and Mooring Areas, November 2022 update" available in the programs permanent files.

There are thirteen marinas within the East Middle Bay growing area, with shellfish harvest prohibited at all thirteen marinas. Ten marinas are in prohibited waters of Bristol Harbor and the prohibited zone near Coggeshall Point in Portsmouth. Two marina are located in the seasonally prohibited waters on the western side of Bristol Harbor. A single marina, the small marina at Carnegie Abbey is located in approved waters of GA3. This small marina has a seasonal shellfish closure zone extending 25 feet beyond the footprint of the marina. .

There are four (3 fixed, 1 mobile) pump-out facilities within the growing area servicing the boating population. Rhode Island coastal waters are federally designated as "No Discharge" mandating that the discharge of *treated* and *untreated* boat sewage is prohibited (not including greywater or sink water) in these designated areas. These designated areas encompass the entire East Middle Bay growing area

iv. Agricultural Waste

The East Middle Bay watershed is a significantly developed watershed comprised of primarily residential, commercial and industrial development. Agricultural land use is approximately 16% of the total watershed area. A review of RI DEM Division of Agriculture data indicated that there were no animal agriculture operations in the area immediately adjacent to the waters of Growing Area 3.

v. Wildlife

A variety of terrestrial wildlife such as birds, raccoons, fox, deer, muskrat, and rodents that inhabit the open space lands, as well as urban and suburban lands, adjacent to the East Middle Bay, may contribute pathogens through stormwater runoff or direct deposition. No accurate information as to the magnitude and geographic dispersion of the waste source is available.

Marine birds and mammals are also present in the East Middle Bay. Because of the great variety, complex distribution and dispersal patterns, and fluctuating populations of waterfowl it is difficult to assess their impact on water quality. Shoreline sources such as streams and culverts that may potentially convey wild animal fecal coliform contamination to the growing area are routinely assessed as part of the shoreline survey.

D Hydrographic and Meteorological Characteristics

1. Tides

Tides in Rhode Island are semi-diurnal with a period or cycle of approximately one-half day (12.84 hrs.) characterized by two similar high waters and two similar low waters each tidal day. Narragansett Bay has strong semi-diurnal tides, with an average tidal range of 1.16 meters at Conimicut Point (Spaulding and Swanson, 2008). Similarly, NOAA operates a real-time tide gauge at Conimicut Light near the mouth of the Providence River where the mean tidal range is 1.27 meters (4.17 feet; NOAA 2020). Tidal range during spring tides at Conimicut Point averages 1.43 meters (4.69 feet; Spaulding and Swanson. 2008). Similar tidal ranges are found in GA3 which is approximately 6 miles south east of the tide gauge at Conimicut Point.

The shoreline survey was scheduled to coincide with ebb and/or low tide, which is the most opportune time for observing stormwater outfalls that may otherwise be hidden by tidal water. Additionally, potential pollution effects such as runoff are generally more noticeable during low tide. Sampling of streams and pipes during low tides should represent actual stream flows rather than the retreating tidal waters that they may receive.

2. Rainfall

The East Middle Bay growing area (GA3) is approximately nine miles southeast of the NOAA/ National Weather Service meteorology station at TF Green Airport. The rainfall patterns at this NOAA weather station (KPVD) are summarized below. There is no strong seasonal pattern in rainfall in theGA3 region (Table 3). Rainfall is fairly evenly distributed in each month of the year, although spring months of March – April and the autumn months of November – December tend to have increased rainfall (Table 3).

Table 3: Average monthly rain and wind in the GA3 area (1904-2018 averages from NOAA KPVD weather station at TF Green Airport). The KPVD weather station is located approximately 9 miles northwest of GA3.

Month	Avg Rainfall (inches)	Minimum Rainfall (inches & year)	Maximum Rainfall (inches & year)	Avg. Windspeed (mph)	Prevailing Wind Direction
January	3.79	0.51 (1970)	11.66 (1979)	11.2	NW
February	3.32	0.39 (1987)	7.2 (1984)	11.5	NNW
March	4.06	0.07 (1915)	16.34 (2010)	12.1	WNW
April	3.86	0.72 (1942)	12.74 (1983)	12.2	SW
May	3.33	0.57 (1939)	10.58 (1948)	10.8	SW
June	3.25	0.05 (1949)	11.08 (1982)	9.9	SW
July	3.11	0.32 (1952)	10.52 (2009)	9.5	SW
August	3.67	0.71 (1984)	12.24 (1946)	9.3	SSW
September	3.58	0.48 (1914)	10.99 (2008)	9.4	SW
October	3.41	0.15 (1924)	15.38 (2005)	9.7	NW
November	3.92	0.31 (1917)	11.01 (1983)	10.6	SW
December	3.97	0.58 (1955)	10.75 (1969)	10.9	WNW
Annual total (rain)					
Annual avg (wind)	43.25	25.44 (1965)	67.52 (1983)	10.6	SW

Storms that occur between October and May are primarily extra-tropical cyclones. The most famous are the "nor-easters:" low-pressure systems that typically develop off the North and South Carolina coasts and move northeast along the Atlantic seaboard, occasionally colliding with colder and drier air (from Canada) in the New England region. This results in the development of heavy rain and/or snow. These storms are more widespread in their range. The second type of storm, occurring between June and October, are primarily tropical cyclones. The biggest storms are hurricanes, which have hit Rhode Island 71 times during the last 350 years. In the summer, most precipitation results from thunderstorms and smaller convective systems. These typically produce short-duration high-intensity precipitation events and are more localized than regional nor-easters.

The shoreline survey dates for the East Middle Bay were July 5th,6th, and 7th, August 9th, October 6th, and 20th of 2022.

Rainfall observed at the NOAA weather station located at T.F. Green Airport in Warwick prior to shoreline survey dates are shown below (Table 4). Sampling days are highlighted in yellow.

Table 4: July 2022 Weather Conditions

Date	Max Temp	Min Temp	Precip. (inches)
7/1/2022	89	64	0
7/2/2022	87	72	0.24
7/3/2022	85	70	0
7/4/2022	84	64	0
7/5/2022	78	64	T
7/6/2022	86	64	T
7/7/2022	80	61	0
7/8/2022	86	60	0
7/9/2022	83	65	0
7/10/2022	81	60	0
7/11/2022	84	58	0
7/12/2022	84	65	T
7/13/2022	90	70	0
7/14/2022	85	69	0.02
7/15/2022	85	65	0
7/16/2022	83	62	T
7/17/2022	88	69	T
7/18/2022	83	69	0.17
7/19/2022	93	74	T
7/20/2022	96	70	0
7/21/2022	93	73	0
7/22/2022	95	73	0
7/23/2022	97	72	0
7/24/2022	98	71	0
7/25/2022	88	75	0
7/26/2022	84	66	0
7/27/2022	89	62	0
7/28/2022	86	67	0.01
7/29/2022	94	71	0.02
7/30/2022	88	71	T
7/31/2022	86	64	0

Table 4: August 2022 Weather Conditions

Date	Max Temp.	Min Temp.	Precip. (inches)
8/1/2022	79	68	0.11
8/2/2022	91	70	0
8/3/2022	89	71	0
8/4/2022	95	66	0
8/5/2022	96	73	0
8/6/2022	95	72	0
8/7/2022	95	77	0
8/8/2022	95	78	0
8/9/2022	98	70	0.16
8/10/2022	82	67	T
8/11/2022	77	69	0.14
8/12/2022	86	68	0
8/13/2022	81	63	0
8/14/2022	85	57	0
8/15/2022	84	63	0
8/16/2022	83	60	0.02
8/17/2022	80	63	0.03
8/18/2022	86	64	0
8/19/2022	93	65	0
8/20/2022	88	67	0
8/21/2022	83	66	0
8/22/2022	75	68	0.33
8/23/2022	82	67	0.63
8/24/2022	88	65	0
8/25/2022	89	70	0
8/26/2022	88	68	0.05
8/27/2022	85	67	0
8/28/2022	82	65	0
8/29/2022	87	62	0
8/30/2022	88	72	0
8/31/2022	85	63	0.22

Table 4: October 2022 Weather Conditions

Date	Max temp	Min temp	Precip. (inches)
10/1/2022	57	51	0.6
10/2/2022	58	50	0
10/3/2022	55	50	T
10/4/2022	57	52	0.48
10/5/2022	60	55	0.69
10/6/2022	76	55	0.01
10/7/2022	77	52	0
10/8/2022	61	44	0.1
10/9/2022	62	38	0
10/10/2022	66	42	0
10/11/2022	68	45	0
10/12/2022	73	50	0
10/13/2022	67	52	0.88
10/14/2022	73	50	0.75
10/15/2022	71	47	0
10/16/2022	70	46	0
10/17/2022	65	47	0.21
10/18/2022	66	43	0.14
10/19/2022	55	38	0
10/20/2022	58	38	0
10/21/2022	65	37	0
10/22/2022	66	39	0
10/23/2022	60	47	0.07
10/24/2022	59	52	0.84
10/25/2022	70	57	0.91
10/26/2022	74	63	0.17
10/27/2022	69	47	0
10/28/2022	56	40	0
10/29/2022	62	37	0
10/30/2022	64	32	0
10/31/2022	63	39	T

3. Winds/Climate

Rhode Island has a strong seasonal temperature cycle, with mean air temperatures varying from below freezing during January and February to greater than 70 °F during July and August (Table 5). These observations are based on observations made at TF Green Airport (located approximately 9 miles northwest of Growing Area 3). Within the general temperature pattern there is considerable variability in that any season can have much colder or warmer mean temperatures than usual in a given year. For example, in the past twenty years mean air temperature during February varied from a low of 18.4 °F during 2015 to a maximum of 39.6 °F during 2006 – a 21.2 °F difference. Similarly, summer air temperatures can vary by 9 °F between a cool summer (July 2001, 69.8 °F) and a warm summer (July 2013, 78.4 °F). Overall, the mean air temperature in the region is 51.7 °F.

Table 5: Mean, maximum and minimum monthly air temperature at TF Green Airport (NOAA station KPVD) during 2000 to 2019. The KPVD weather station is located approximately 9 miles northwest of GA3.

	Air Temperature (F)				
Month	**Mean**	**Max**	**Year**	**Min**	**Year**
Jan	30.0	37.2	2006	21.4	2004
Feb	31.9	39.6	2018	18.4	2015
Mar	39.1	46.3	2012	32.7	2015
Apr	49.3	53.8	2010	45.4	2003
May	59.0	63.0	2018	53.4	2005
Jun	68.0	71.3	2008	64.4	2009
Jul	74.4	78.4	2013	69.8	2001
Aug	73.3	77.0	2018	70.2	2000
Sep	66.2	69.1	2015	63.0	2009
Oct	54.8	61.2	2017	51.7	2003
Nov	44.6	49.2	2006	40.5	2019
Dec	35.4	46.0	2015	28.9	2000
Annual mean	**51.7**	**53.8**		**43.6**	

Water temperature Narragansett Bay also has a strong seasonal pattern and considerable annual variability (Figure 9). The NOAA PORTS system maintains a real-time water temperature sensor at the Conimicut Point lighthouse located approximately 8 miles NW of Growing Area 3. Data from this sensor were compiled to illustrate the range of water temperature in the growing area during recent years. As with air temperature, there is a strong seasonal variation in water temperature, with an approximately 50 °F range in winter versus summer water temperature (Figure 11). Winter water temperature can vary annually from years having prolonged periods of <32 °F water with formation of sea ice in the growing area, as was seen during 2015, to warm winters such as 2019 in which the water temperature never dropped below 35 °F. Similarly, maximum summer water temperature at Conimicut Point can vary from approximately 76 °F during a cool summer to up to 80.7 °F during a warm summer (Figure 11). Annual average water temperature at Conimicut Point during recent years (2015-2019) was 54.8 °F.

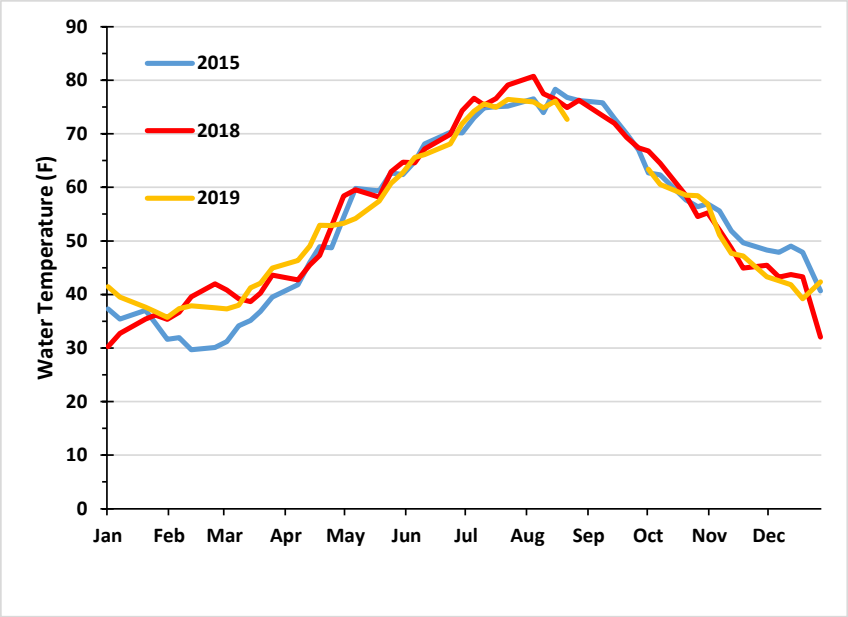


Figure 9: Surface water temperature (F) at Conimicut Point Lighthouse during 2015 (a cold winter), 2018 (warm winter) and during 2019. Temperatures taken every 6 minutes at NOAA PORTS station 8452944 Conimicut Light, RI.

Winds: Winds in the region follow a seasonal shift from winds predominantly from the northwest during winter and southwest winds dominant during spring and summer (April through September; Table 3 in section 4B). Summer winds tend to be calmer, but occasional tropical storms or hurricanes can bring elevated wind speeds during summer and early autumn.

4. River Discharges

There are no significant direct river discharges to the East Middle Bay growing area. There are several named and unnamed 1st and 2nd order streams that contribute fresh water directly to the East Middle Bay. This growing area is indirectly affected by freshwater inputs that arrive in the bay via its connection to the Upper Bay and Mt Hope Bay. Wet weather sampling (see Table 3 in section 3 E ii, above) has demonstrated that these indirect riverine sources are sufficiently diluted before reaching the approved waters of GA3.

E Water Quality Studies

1. Overview

The RIDEM Shellfish Program maintains a Shellfish Growing Area Monitoring (SGAM) program as part of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) as described in the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island conducts regular bacteriological monitoring of shellfish harvesting waters.

Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1995) for the standard fecal coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012 and/or the multiple tube fermentation test (sm01 MPN) method utilized prior to August 2012. All samples in the current statistical evaluation were analyzed by the mTEC method. The procedure for water sample holding times and temperature control for the sm48 and sm01 methods are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedures (copy in the Program's permanent file).

Below is a summary of 2022 fecal coliform monitoring compliance statistics for Upper Narragansett Bay Growing Area 3.

2. RI DEM Fecal Coliform Monitoring 2022 Review and Statistical Summary

HIGHLIGHTS

* Sampled 6X during 2022 season with 5 wet weather and 1 dry weather set of samples.
* Statistics represent recent 30 combined wet (n=18) and dry (n=12) weather data 9/25/2017 or 1/16/2018 to 11/28/2022 for approved stations (Table 6).
* Statistics represent recent 15 combined wet (n=11) and dry (n=4) weather data when the area was open 5/16/2018 to 11/28/2022 for seasonally approved stations (Table 7).
* All approved and conditionally/seasonally approved stations in compliance and conformance.
* All samples analyzed by mTEC method (90th percentile criteria= 31 cfu / 100 ml).
* Data run 12/5/2022

Table 6: Fecal coliform compliance statistics for Approved stations in GA3. Recent 30 samples collected 9/25/2017 or 1/16/2018 to 11/28/2022, all mTEC, 18 wet and 12 dry weather samples. Station locations shown in Figure 1.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
3-1	A	30	2.3	5.1
3-3	A	30	2.5	5.7
3-4	A	30	2.2	4.7
3-5	A	30	2.8	10.9
3-6	A	30	2.8	9.0
3-6A	P	30	4.1	21.7
3-7	SA	30	3.0	8.4
3-7A	P	30	4.0	19.5
3-8	P	30	3.0	8.2
3-9	A	30	3.4	13.1
3-10	P	30	3.3	10.3
3-12	SA	30	2.5	6.0
3-13	A	30	2.3	4.7
3-14	A	30	2.5	7.3
3-15	A	30	2.4	5.8
3-16	A	30	2.2	3.9
3-17	A	30	2.4	5.5
3-18	A	30	2.3	4.9
3-19	P	30	2.3	4.8
3-20	A	30	2.5	4.9
3-21	A	30	2.0	2.3
3-22	A	30	2.7	7.6

Table 7: Fecal coliform compliance statistics for conditionally approved (seasonal closure) stations in GA3. Recent 15 samples collected when the station was in the open status (5/16/2018 to 11/28/2022all mTEC, 18 wet and 12 dry weather). Station locations shown in Figure 1.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
3-7	SA	15	2.5	0.0
3-12	SA	15	2.2	0.0

Statistics represent recent 15 combined wet (n=11) and dry (n=4) weather data when the area was open 5/16/2018 to 11/28/2022 for seasonally approved stations (Table

COMMENTARY

All stations in Growing Area 3 (East Middle Bay) were sampled 6 times during the 2022 season, in compliance with systematic random sampling monitoring requirements for approved waters. The 2022 statistical evaluation includes the most recent 30 samples collected during both wet and dry weather (18 wet weather, 12 dry weather) since 9/25/2017. Two stations in GA3 (3-7 and 3-12) are classified as seasonally approved. The statistical analysis for these seasonally approved stations includes the most recent 15 samples collected during wet and dry weather (11 wet and 4 dry weather) since 5/16/2018.

All approved stations met criteria during the 2022 evaluation. Results of the 2022 statistical evaluation also indicated that all conditionally approved / seasonally approved stations in Growing Area 3 are in compliance and that the area is properly classified. Conditionally approved stations 3-7 (in western Bristol Harbor) and 3-12 (in Potter Cove on Prudence Island) are located in mooring areas that are seasonally closed during boating season. Note that both of these stations also meet NSSP criteria when evaluated as approved, indicating acceptable fecal coliform levels during the precautionary seasonal closure of these mooring areas. This is consistent with RI DEM's long-standing observation of compliance with the state's no discharge regulations.

Long-term changes in adjacent land use and in GA3 water quality were documented as part of the 2022 12-years survey. Historically, Weyerhaeuser Timber Company operated a lumber milling and storage facility on the Portsmouth shore on the east side of GA3 just south of the Mt. Hope Bridge. This facility commenced operation in the 1920's (likely 1926; RI Historic Preservation Commission, 1979) on an upland site that included buildings for sawing, milling and storing up to 10 million board-feet of lumber. The facility included a large pier that was used to land raw timber shipped to the site. The pier, which formerly extended 600 feet into GA3, received weekly to monthly deliveries of raw timber which was unloaded at the pier and then processed at the 100-plus acre upland site. The Weyerhaeuser Lumber operation ceased operation at the Portsmouth, RI site in the mid-1980s. The 600-foot pier continued to be used for berthing a few large commercial vessels through the early 2000s. However, the pier gradually fell into disrepair and was removed, except for the concrete bulkhead and a small

fishing pier, in 2012. The brownfield at the former upland site of the Weyerhaeuser Lumber industrial operation has been cleared and redeveloped (New York Times 8/31/2005) and is now residential housing including the 125-acre 'Newport Beach Club' condominium complex that includes a large open-space parcel (Providence Business News, May 6, 2021). The adjacent land to the east of GA3-3 has had a dramatic change in use from an industrial operation in the 1980s to open-space and residential housing in 2022.

Simultaneous with the change in land use in GA3-3 to the south of the Mt. Hope Bridge, there have been declines in fecal coliform loading to Mt. Hope Bay (GA17) just to the north of the Bridge and contiguous with GA3-3. In the 1980s, untreated stormwater from the highly developed urban areas of Fall River, MA and north Tiverton, RI flowed through CSOs to the Bay and this wet-weather discharge was the primary source of bacterial contamination to Mt. Hope Bay (Rippey and Watkins, 1987). The City of Fall River has recently made significant reductions in CSO discharge to Mt. Hope Bay (described by Force, 2013). Prior to CSO abatement activity in the 1990s, there were 19 CSO outfalls in the Fall River system; seven (7) of the CSOs and the Fall River WWTF outfall discharged directly to Mt. Hope Bay. Five (5) Fall River CSOs discharged to the Taunton River, five (5) CSOs discharge to the Quequechan River and two (2) CSO were inactive. Court-ordered CSO abatement began in 1997. CSO upgrades included construction of a 38-million-gallon CSO storage tunnel (completed in 2005), construction of pumping stations and nine CSO drop shafts (completed in 2015) to convey stormwater to the tunnel and an increase in the Fall River WWTF wet weather capacity from 50 MGD to 106 MGD (completed in 1998). Together, these improvements in stormwater management have resulted in a significant reduction in CSO discharges to Mt. Hope Bay (MA Federal Court Order update, dated 4-4-2018). Design specifications of the upgraded CSO abatement project have resulted in reduction in CSO discharge for rainfall of less than a 3-month storm (1.76" of rain in a 12-hour period; see Force, 2013).

These upgrades have resulted in a significant decline in fecal coliform loading and concentration in Mt. Hope Bay, especially during wet weather. For example, RI DEM monitoring station 17-4 which is located in Prohibited waters approximately 0.5 miles offshore of the Fall River WWTF outfall showed a dramatic decline from a wet weather geometric mean fecal coliform of 31.7 cfu/100 ml (n = 30 wet weather samples) during 1984 to 1997 compared to a wet weather geometric mean of 4.8 cfu/100 ml (n = 14 wet weather samples) during the post 1998 period of improved waste water control and treatment. Details of Fall River WWTF upgrades and concomitant improvements in Mt. Hope Bay water quality are further documented in the Mt. Hope Bay Conditional Area Management Plan, 2021 update on file in the program's permanent files. In addition, a dye study has indicated that the waters of GA3-3 have sufficient dilution (greater than 1,000:1 dilution) of treated Fall River WWTF effluent even under maximum wet weather flow through the Fall River facility (FDA, 2018).

GA3-3 was historically classified as prohibited due to 1) industrial activity at the Weyerhaeuser site and 2) potential for fecal coliform contamination from the Fall River area of Mt. Hope Bay. Both of these situations have changed considerably at the time of the 2022 12-year survey of GA3. The former industrial site is now residential housing and open space; stormwater (CSO) remediation and Fall River WWTF upgrades have resulted in reductions in fecal coliform loading to the waters of Mt. Hope Bay adjacent to GA3-3. These changes are evident as a long-

term decline in the fecal coliform concentration at station 3-10 located the approximate center of the prohibited waters of GA3-3 (Figure 10).

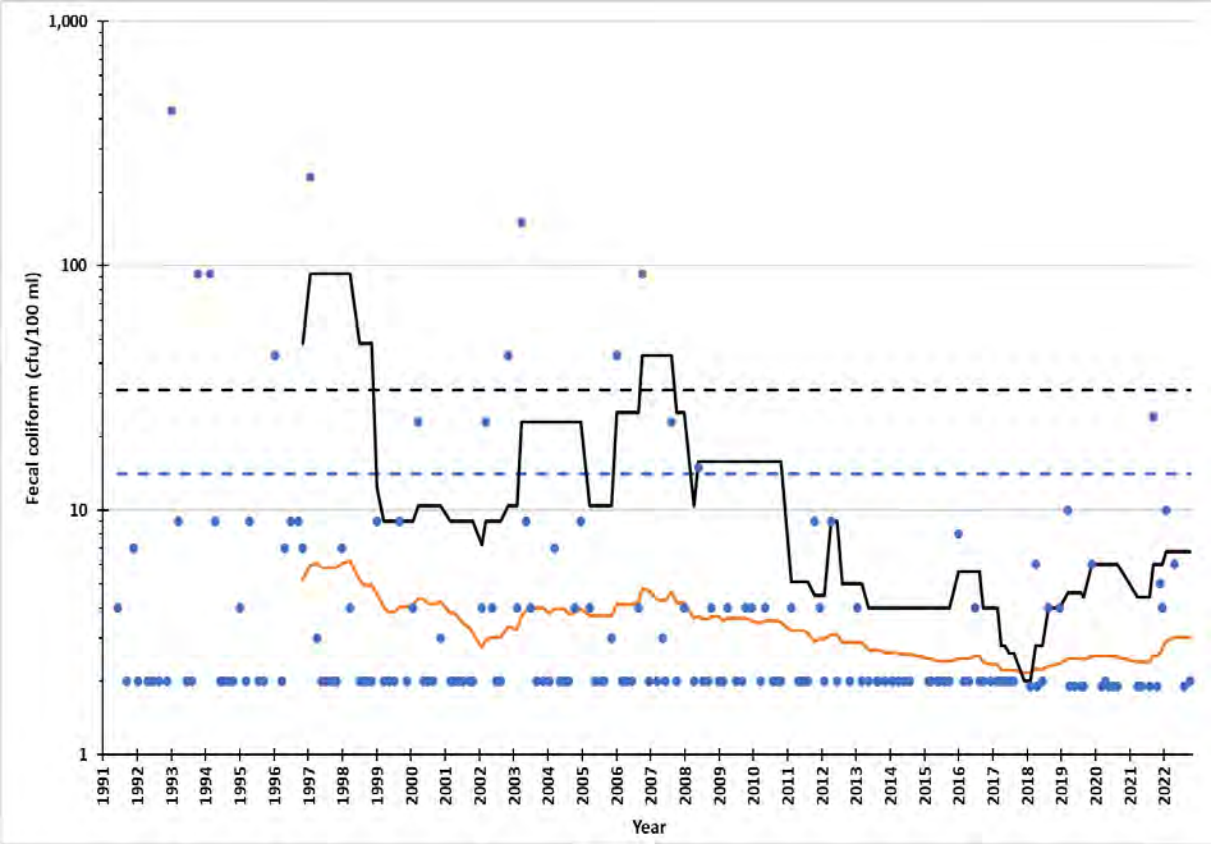


Figure 10: Fecal coliform concentration at station 3-10, located in the prohibited waters of GA3-3, during 1991 to 2022. Blue dots are individual observations, orange line is the 30 sample geometric mean, black line is the 30 sample 90th percentile. Horizontal lines are the NSSP geometric mean standard of 14 cfu/100 ml and the NSSP variability standard of 31 cfu/100 ml. Note that station 3-10 has meet NSSP fecal coliform criteria for approved waters continuously since 2011.

The microbial water quality of the prohibited waters of GA3-3 have shown remarkable improvements since the upgrades in CSO and wastewater treatment at the Fall River WWTF. Note that 177 of 186 (95%) fecal coliform observations taken during 1991 to 2022 were less than 31 cfu/100 ml and that no fecal coliform observations taken when the area was in the open status have exceeded the NSSP variability criteria of 31 cfu/100 ml since 2006. Further, 46 of 60 or 77% of the fecal coliform observations made at station 3-10 during the past ten years have been values of 2 cfu/100 ml or less (Figure 10). Fecal coliform in GA3-3 exceeded NSSP criteria during 1991 to 2010 but has continuously met NSSP criteria for approved waters since 2011 (Figure 10).

Shellfish Tissue Analyses: Quahog tissue samples were collected from the area on 4/5/2023 (5 days after 2.49" rain at TF Green Airport) and analyzed for indicator pathogens and heavy metals (Table 8). Fecal coliform levels were below detection in the composite quahog tissue sample (Table 8). Note that these quahogs were harvested during wet weather (5 days after

2.49" rain). The absence of fecal coliform in the shellfish tissue immediately after a relatively large rainfall supports that the waters of GA3-3 south of the Mt. Hope Bridge near Mussel Bed Shoals are not subject to microbial contamination from shoreline freshwater sources or adjacent Mt. Hope Bay during wet weather. Similarly, heavy metals were well below the 2007 standards, supporting that shellfish harvest is appropriate for this currently prohibited area (Table 8).

		Lat, Long---->	41.635, -71.259
Analyte	**FDA (2007) Standard**	**Units**	**GA3-3 PORTSMOUTH**
METALS			
ARSENIC	**86.0**	**mg/kg**	4.02
CADMIUM	**4.0**	**mg/kg**	ND
CHROMIUM	**13.0**	**mg/kg**	0.17
COPPER	**N/A**	**mg/kg**	3.22
IRON	**N/A**	**mg/kg**	24.7
LEAD	**1.7**	**mg/kg**	0.24
MERCURY	**1.0**	**mg/kg**	ND
NICKEL	**80.0**	**mg/kg**	0.27
ZINC	**N/A**		14.7
Indicator Pathogens			
FECAL COLIFORM	**230.0**	**MPN/100 g**	ND
MALE SPECIFIC BACTERIOPHAGE	**50 (or established background levels)**	**PFU/100 g**	120

Table 8: Heavy metal and indicator pathogen results for a composite quahog tissue samples collected in the prohibited waters south of the Mt. Hope Bridge near Mussel Bed Shoals on 4/5/2023 (5 days after 2.49" rain at TF Green Airport).

RECOMMENDATIONS

Because of the changes in adjacent land use and the demonstrated improvement in fecal coliform water quality, it is recommended that GA3-3 be upgraded in its classification from prohibited to approved waters. GA3-3 is bounded on the south and west side by the approved waters of GA3, is bounded by conditionally approved waters showing improved water quality to the north and by the Portsmouth shoreline to the east. The 2022 shoreline survey did not identify any elevated fecal coliform sources on the adjacent Portsmouth shore. Out of an abundance of caution, DEM OWR has collected quahog meat samples from the waters of GA3-3 to be analyzed for metals, fecal coliform and MSC. These analyses demonstrated acceptable microbial and heavy metal levels in shellfish tissue in the currently prohibited waters of GAS3-3. Pending coordination with DEM Division of Marine Fisheries about shellfish restoration projects in the area, it is recommended that that GA3-3 be upgraded in its classification from prohibited to approved waters.

The 2022 12-year survey has demonstrated that the classification of all other areas of GA3 is appropriate and that all stations in approved and conditionally approved waters meet NSSP criteria. No other classification changes are recommended for GA3.

3. Sampling Plan and Justification

i. Frequency of Monitoring

The east Middle Bay (GA3) growing area is predominantly classified as approved, with two small conditionally approved areas (seasonal closures of mooring fields in NW Bristol Harbor and Potter Cove on Prudence Island). The minimum sampling frequency for approved waters is six (6) sets of samples collected annually while the area is in the open status (NSSP MO Section II. Chapter IV @.03(3)(b)(iv)). The sampling schedule is set by the systematically random sampling strategy with sampling dates pre-selected at the beginning of each calendar year.

ii. Monitoring Stations

There are twenty-two (22) fecal coliform monitoring stations in the East Middle Bay Growing Area (GA3). Fifteen (15) stations are in approved waters, two (2) stations are in conditionally approved (seasonal) waters and five (5) stations are located in prohibited waters in Bristol Harbor, within the Bristol WWTF outfall closure zone and in small, prohibited zones on the Portsmouth shore (Figure 1). Fecal coliform water quality monitoring station locations (Figure 1) and number of stations were selected to be representative of all conditions in the growing area.

There are also two (2) routine HAB phytoplankton monitoring stations located in GA3 (see the RI HAB Monitoring and Contingency Plan, November 2021 for details).

4. RIDEM TMDL Studies

The East Middle Bay shellfish growing area (GA3) contains eight WBID waterbody segments. Six of these WBID segments are fully supporting all aquatic uses and therefore do not require a TMDL plan. The prohibited waters of Nag Pond on Prudence Island (WBID RI0007029E-04) have insufficient data to fully assess this WBID compliance with the Clean Water Act. The waters of Potter Cove on Prudence Island (WBID RI0007029E-03) are listed as impaired due to low dissolved oxygen levels. A TMDL study is scheduled for 2029 in which the need for a TMDL will be evaluated after recent upgrades to Providence-area WWTF.

F Interpretation of Data

1. Effects of Meteorological and Hydrographic Conditions

There are no conditionally approved waters in GA3 that are managed in response to meteorological or hydrographic events. As described above (section 3, E, ii), no large rivers flow directly into GA3 and the majority of land adjacent to GA3 (with the exception of downtown Bristol) is suburban or rural and has less than 20% impervious surfaces. Accordingly, typical rain storms do not negatively impact the water quality of approved waters in GA3. Wet weather sampling has demonstrated that fecal coliform water quality in the approved waters of GA3 remains acceptable after rainfall amounts of up to approximately 3" in a 24-hour period (Table 2).

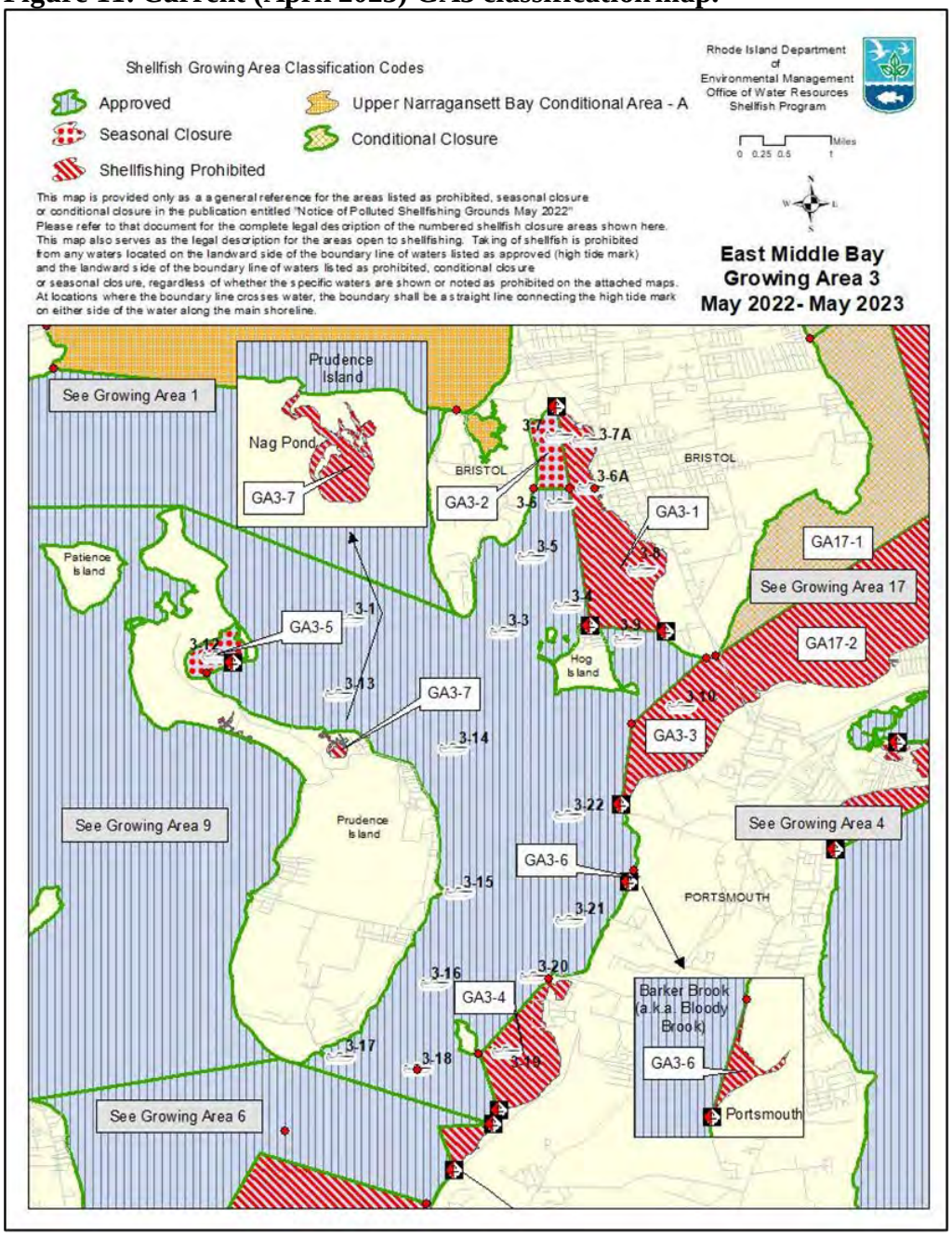
A review of GA3 fecal coliform indicated increased variability and increases above 31 cfu/100 ml in some samples collected after large rainstorms. This analysis suggested that fecal coliform levels may temporarily increase to greater than NSSP standards after unusually large rain storms. The study identified rainfall of greater than 3" rain in a 24-hour period as the level that negatively affected GA3 microbial water quality. Accordingly, GA3 is managed with a 3" emergency rain closure as described in the report "Determination of Excess Rain Closures for RI Shellfish Growing Areas, June 2021" available in the program's permanent files.

G Conclusions

1. Classification Map

The current classification map is shown in Figure 11. Given changes in land use and demonstrated declines in fecal coliform levels, it is recommended that the waters of GA3-3 be reclassified from Prohibited to Approved. ***As of May 2023 the recommended classification change is in review with other divisions of RI DEM.***

Figure 11: Current (April 2023) GA3 classification map.



2. Legal Description

Based on regular RIDEM Shellfish Program monitoring data and the data acquired during this 12-year shoreline survey, ***it is recommended that the current legal description of the growing area be modified to reflect a reclassification of GA3-3 from prohibited to approved.***

The May 2022 legal description of GA3 includes five prohibited areas (GA3-1, GA3-3, GA3-4, GA3-6, GA3-7) and two conditionally (seasonally) approved areas (GA3-2, GA3-5) as described below: Recommended changes to the legal description of are also shown for GA3-3.

GA3 Prohibited Waters of GA3:

GA3-1 Bristol Harbor, east of a line from the Rhode Island Department of Environmental Management range marker located on pole # 20 Poppasquash Road at the northernmost indentation of Bristol Harbor to the Rhode Island Department of Environmental Management range marker located on the northern extremity of Hog Island, and north of a line from the northern extremity of Hog Island to the Rhode Island Department of Environmental Management range marker located at the western extension of Low Lane on Bristol Neck.

(See also: the seasonal closures GA3-2 under Bristol Harbor and GA3-5 under Potter Cove)

~~GA3-3 Mount Hope Bay and vicinity south and west of the Rhode Island-Massachusetts state line to a line from the Rhode Island Department of Environmental Management range marker located on the shoreline of Touisset Point in Warren to the Rhode Island Department of Environmental Management range marker on Common Fence point that intersects with a line from the east side of the Mt Hope Bridge abutment at Bristol Point to the Buoy R4 channel marker located on the southerly side of the Mount Hope Bay channel, including the waters north and east of a line from the landward end of the rock jetty at Bristol Point to the Hog Island Shoal Light, to the southwestern extremity of Arnold Point in Portsmouth, where a Rhode Island Department of Environmental Management range marker has been established, and north of a line in the Sakonnet River at the centerline of the Sakonnet Bridge in Portsmouth and Tiverton.~~ [Note: the legal description of Mt. Hope Bay (GA17) will be revised to reflect conditionally approved waters of GA17 extend to southward limit bounded by the southern side of the Mt. Hope Bridge.]

GA3-4 The waters in the vicinity of Melville east of a line from Coggeshall Point southwesterly to the southeastern most point of Dyer Island and the area east of a line from the Rhode Island Department of Environmental Management range marker at Carr Point northwesterly to the southeastern most point of Dyer Island Portsmouth.

GA3-6 All waters of Barker Brook (a.k.a. Bloody Brook) in Portsmouth east of a line from the most southeastern landward corner of the Carnegie Abbey dock located to the north of the mouth and the Rhode Island Department of Environmental Management range marker located approximately 250 feet south of the mouth of the brook.

GA3-7 All waters of Nag Pond on Prudence Island.

Conditionally (seasonally) Closured Waters of GA3:

GA3-2 Bristol Harbor, west of a line from the Rhode Island Department of Environmental Management range marker located on pole # 20 Poppasquash Rd. at the northernmost indentation of Bristol Harbor to the Rhode Island Department of Environmental Management range marker located at the northernmost extremity of Hog Island and north of a line from the CRMC Permitted Dock # 419 located at 163 Poppasquash Road to the most north-western corner of the Rockwell Pier municipal parking lot in Bristol Harbor.

GA3-5 Potter Cove, northerly and westerly of a line from the Rhode Island Department of Environmental Management range marker established at the southwesterly extremity of Gull Point on Prudence Island to the southeast landward corner of the State of Rhode Island dock at the southern entrance to Potter Cove on the east shore of Prudence Island.

3. Conditionally Approved Management Plan (CAMP)

There are no conditionally approved waters requiring a management plan in GA3. The only conditionally approved waters are seasonally closed waters of mooring areas in Bristol Harbor (GA3-2) and Potter Cove (GA3-5). GA3 is managed following the program's standard operating procedures described in the "RI DEM Shellfish Program Growing Area Monitoring Standard Operating Procedures, updated August 2021" available in the program's permanent files.

4. Recommendations for Sanitary Survey Improvement

i. Monitoring Schedule

The current monitoring schedule is adequate for maintaining the current classification. As resources allow, the program will complete optional wet weather sampling to characterize changes in water quality in response to WWTF upgrades in adjacent Mt. Hope Bay.

ii. Monitoring Stations

Monitoring station locations were originally established with assistance from the FDA and are believed to be adequate in distribution and location to represent the overall water quality of the growing area. As needed, "emergency" or additional stations are added on a temporary basis should situations arise due to unexpected or newly identified pollution sources.

H Literature Cited

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Sakonnet River
Growing Area 4
Triennial Re-Evaluation
2022

Sakonnet Harbor, Little Compton, RI
Photo Courtesy of Alexey Sergeev

Rhode Island Department of Environmental Management

Office of Water Resources

Shellfish Monitoring Program

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A Introduction

The last 12-year comprehensive shoreline sanitary survey of the Sakonnet River (GA4) was conducted during the summer of 2013 by staff from RIDEM's Office of Water Resources Shellfish Program. The survey involved a shoreline reconnaissance of the study area to locate and evaluate pollution sources and collect bacteriological samples from all sources actively flowing into the survey area. A triennial shoreline survey of the area was completed during 2019 with annual updates during each intervening year.

The 2022 triennial shoreline survey was conducted as a re-evaluation of this growing area. As such the survey involved review of previous shoreline surveys, including bacteriological sampling of actual pollution sources noted in previous surveys that were found to be equal to or greater than 240 FC/100ml and identification of any new sources of pollution if applicable. These previously identified pollution sources were re-evaluated to determine their bacteriological impacts on the Sakonnet River.

B Description of Growing Area

Hydrographic Characteristics

Total area of the Sakonnet River Growing Area 4	12, 954 Acres
Widest Reach	2.8 miles
Deepest Point	66 feet

The Sakonnet River is not actually a river, but the eastern most opening of Narragansett Bay and an inlet of the Atlantic Ocean. This 14-mile-long saltwater strait separates Aquidneck Island on the west from the mainland of eastern Rhode Island (Tiverton and Little Compton) on the east. The communities of Tiverton and Little Compton on the mainland and Portsmouth and Middletown on Aquidneck Island abut the Sakonnet River.

Growing Area 4 is presently comprised of sections classified as either approved, seasonally approved, or prohibited for shellfishing (Figure 1). There are several distinct portions of this growing area that are prohibited to shellfishing. The first is the northern boundary of the growing area adjacent to Portsmouth Park, Island Park, and the Hummocks in Portsmouth and encompasses the marina areas along the shore of Tiverton and Portsmouth south of the Sakonnet River Bridge. The second area is an inlet to Nanaquaket Pond known as the "Gut." The third area, referred to as Almy Brook, flows out of Nonquit Pond at the border between Tiverton and Little Compton. Finally, Sakonnet Harbor in Little Compton is classified as seasonally approved. It is closed during the summer months due to the large number of recreational and commercial fishing vessels.

Figure 1: 2022-2023 GA4 Sakonnet River (North) Classification Map with Routine Monitoring Stations

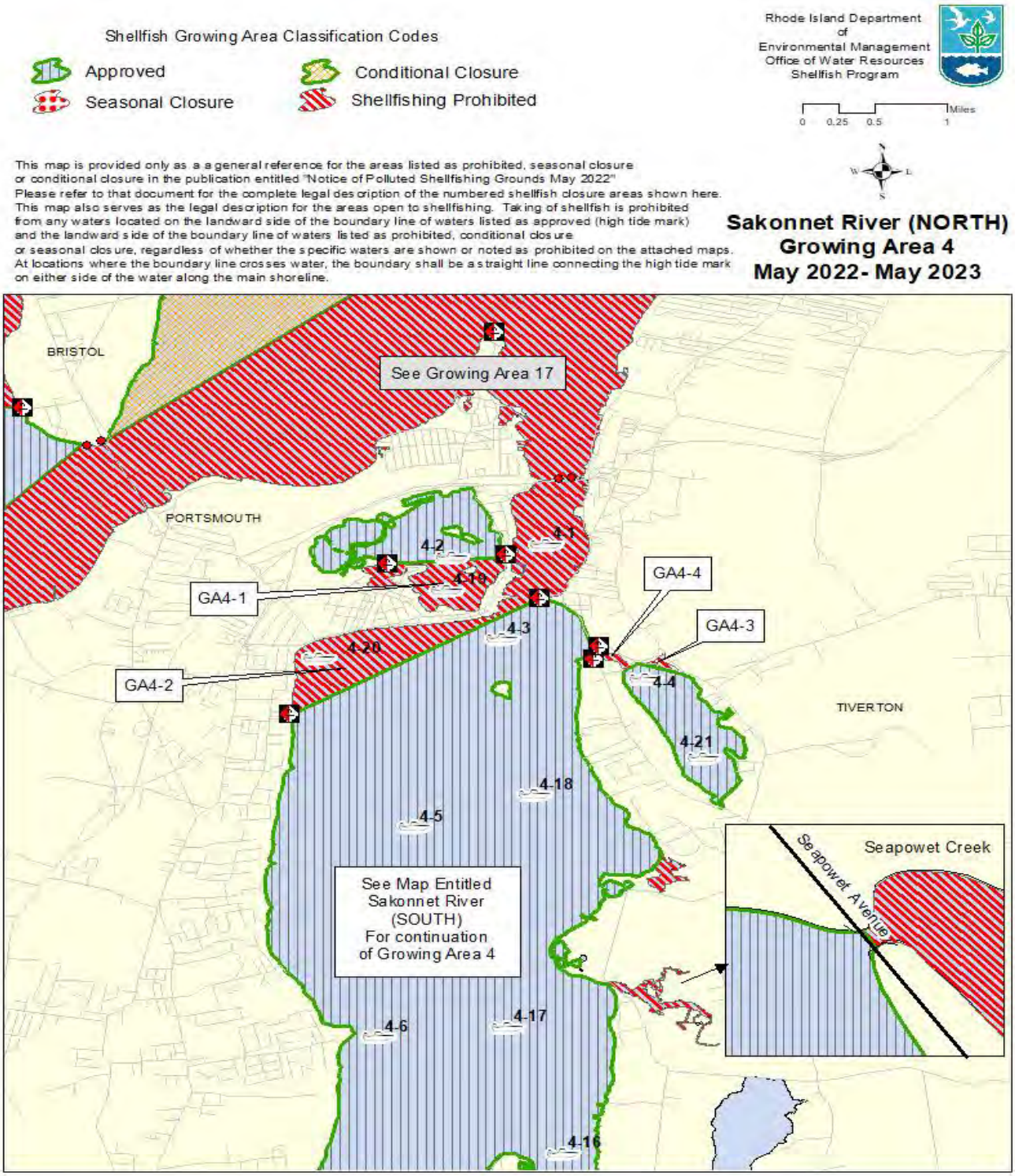
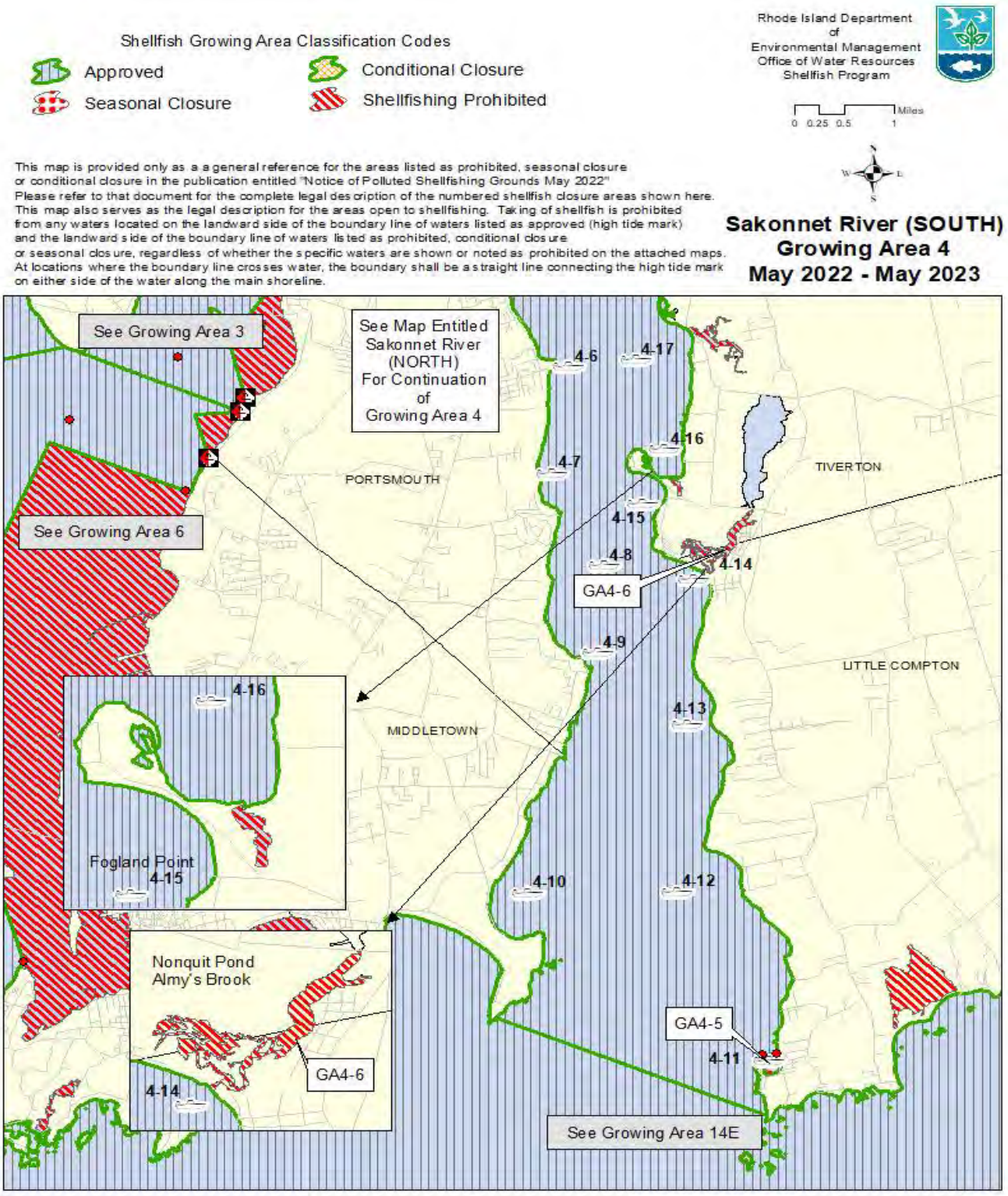


Figure 2: 2022-2023 GA4 Sakonnet River (South) Classification Map with Routine Monitoring Stations



C Pollution Source Surveys

The previous 12-yr shoreline sanitary survey was conducted in 2013, with a triennial survey being completed in 2019. A triennial survey was completed in the Summer of 2022 by biologists Anthony Crudale, Steve Rogers and Steve Engborg of RIDEM Office of Water Resources Shellfish Program.

During the 2022 field surveys, sampling was conducted for all sources which had fecal coliform counts that exceeded the 240 FC/100 ml threshold identified in previous surveys. Bacteriological samples were collected from all sources that were actively flowing at the time of the survey. The samples were collected in sterile 125ml Nalgene bottles, stored on ice in a portable cooler and delivered within 6 hours to the Rhode Island Department of Health Laboratory for analysis. The mTEC membrane filtration method, as outlined in *Standard Methods for the Examination of Water and Wastewater* (APHA, 1999), was used to evaluate all water samples.

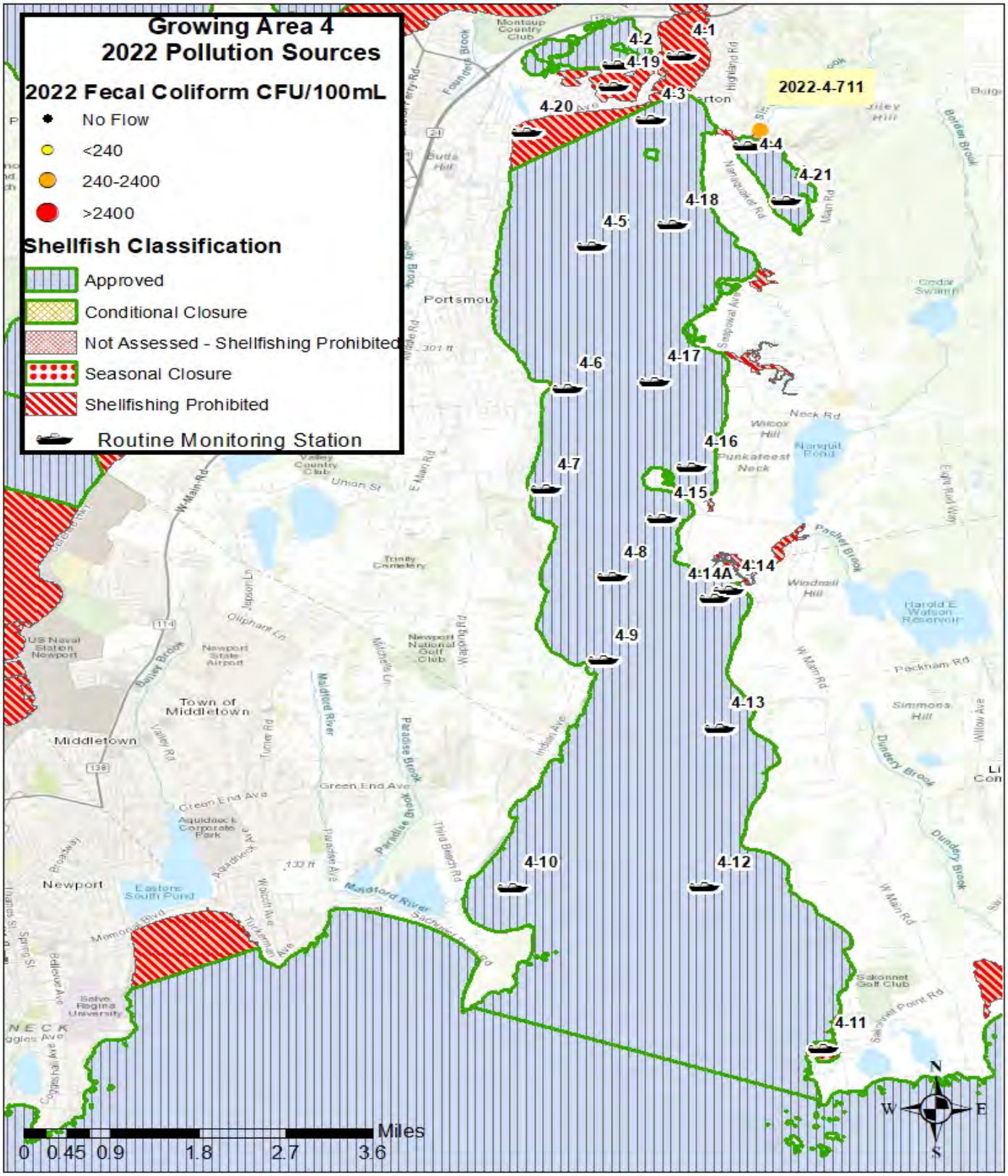
Most elevated sources from the previous 12 year were either flowing into prohibited waters or had a trickle/minimal flow within recent sampling. Sources sampled during this triennial were mostly sources that were not elevated >2,400 cfu/100 ml during the previous 12 year survey but were elevated > 240 cfu/100ml threshold in recent triennial surveys. A total of four (4) sources were revisited and sampled if flow was present in this year's triennial survey. Of the four sources sampled this year, 1 of which was found to have been flowing and samples were taken, and three (3) sources (2022-4-701, 2022-4-710, 2022-4-2000) had no flow at the time of sampling (Table 1).

Table 1: 2022 Summary of Pollution Sources in GA4

*Highlighted sources >240 CFU/100ml. NF= No flow

Source ID	Date Visited	Latitude	Longitude	Description	Receiving waters classification	Actual / Potential	Direct / Indirect	2021 Results mTEC cfu/100ml	2022 Results mTEC cfu/100ml	2022 Volumetric Flow (cfs)
2022-4-711	10/19/2021	41.61925	-71.2033	Sin and Flesh Brook	Prohibited	A	I	1400	1000	0.00353
2022-4-701		41.60188	-71.1978	Stream at south end of pond at Nanaquaket Road	Approved	P	D	-	NS	NF
2022-4-710		41.61236	-71.1959	White Wine Brook at road crossing 24" dia CMP	Prohibited	P	I	1500	NS	NF
2022-4-2000		41.61236	-71.1959	Small Steam south of Morningside Lane	Approved	P	D	-	NS	NF

Figure 3: 2022 Pollution Sources and Routine Monitoring Stations in GA4



Source 2022-4-711 Of the sources sampled in 2022, only one had been observed to be flowing. Source 2022-4-711 which is Sin & Flesh Brook flows into prohibited waters of the "Gut" before flowing into approved waters of Nanaquaket Pond. This source had a fecal coliform result of 1,000 CFU/100ml on 10/3/2022. However, this sample was collected during wet weather. Two (2) days prior to shoreline sampling, this growing area received .81" of rain and the flow rate of this source was 0.00353 cfs. A companion instream sample had a result of 160 cfu/100 ml. In addition to the 2022 shoreline survey, Sin & Flesh Brook is now regularly monitored through a monthly land run survey to better understand the source and its impact on the growing area.

East Bay Land Run

In April of 2022, the Rhode Island DEM Shellfish Team, resumed regular sampling of elevated East Bay sources via the 'East Bay Land Run'. A list was compiled of 10 stations, 8 of which are in GA4, to collect data sets on sources known to have the potential to negatively impact the growing area. Through the samples collected, the team is able to closely monitor these pollution sources and the impact they have on the growing area.

The relationship between land run stations 4-711 and 4-712 has been monitored in the past months with source 4-711, Sin & Flesh Brook, being a source of concern for the growing area. Station 4-712 is the culvert in which water from the prohibited area known as "The Gut" enters the approved waters of Nanaquacket Pond. As these data sets grow, they will help to better understand the relationship between these 2 stations and the overall impact that Sin & Flesh Brook has on the nearby growing area. Data collected thus far demonstrates considerable dilution (up to 120-fold on 8/18/2022) between the brook and the outflow to Nanaquaket Pond.

Figure 4: Land Run Station 4-711 Sin & Flesh Brook upstream of "The Gut" and station 4-712 where water flowing from "The Gut" enters approved waters of Nanaquaket Pond.

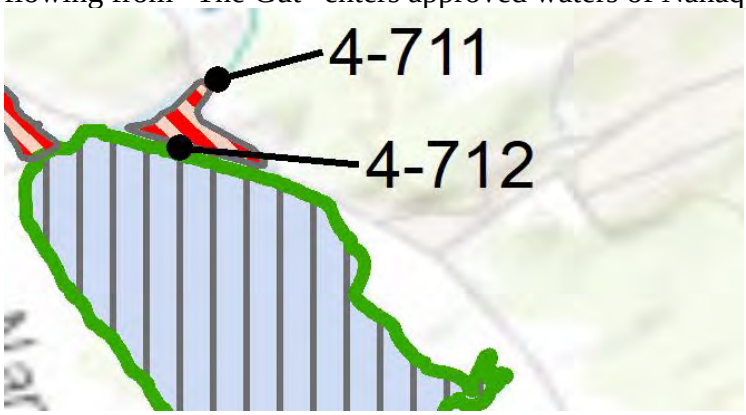


Table 2: Land Run Data Comparison between Land Run Stations 4-711 (Sin and Flesh Brook) and 4-712 (location of in-stream where water enter Nanaquacket Pond from "The Gut")

Date Sampled	4-711 (Sin & Flesh Brook)	4-712 (Culvert entering from "The Gut")	Rain Total within 7 days (inches)
4/11/2022	18	16	1.24"
5/2/2022	70	8	.72"
6/27/2022	960	720	.85"
8/18/2022	240	2	.19"
10/3/2022	1000	160	.9"
11/17/2022	520	54	1.34"

D Mooring Fields and Marinas

There are several boating areas that have the potential to negatively impact the waters of the Sakonnet River (Figure 2). The waters north of the Old Stone Bridge are classified as Prohibited. The Sakonnet Harbor (GA4-5) in Little Compton is seasonally approved for shellfishing.

In 1998 the State of Rhode Island designated all their coastal waters as a No Discharge Zone (NDZ). The Rhode Island waters include territorial seas within three miles of shore, including all of Narragansett Bay. A No Discharge Zone is a designated body of water in which the discharge of *treated* and *untreated* boat sewage is prohibited (this does not include greywater or sink water). There are currently three pump out facilities located within Sakonnet River: Brewers Sakonnet Marina, Pirate Cove Marina, and Standish Boat Yard. All are stationary pumpout stations. For additional information refer to the most recent RIDEM Pump-out Facilities Report which evaluates the area's compliance with Rhode Island's "No Discharge" policies.

To account for illicit discharges, dilution calculations were completed for all marinas and destination mooring fields in the growing area. *Determination of Marina Buffer Zones using Simple Mixing and Transport Models* (VIMS, 1989) was used as the basis for determining the dilution necessary to be protective in the case of discharge from MSDs (Marine Sanitation Devices). Seven marinas are located within the prohibited waters of the growing area, in which the closure areas are more than adequate to account for the fecal coliform level resulting from these potential discharges. Two marinas are located in the seasonally approved area of Sakonnet Harbor, which also provides adequate dilution for the summer boating season. Finally, there is one marina within the approved Nanaquaket Pond portion of the growing area. No slips are used for long-term dockage; the marina is a land based marina used only for day use, loading, and unloading for service or deliveries. Based on this marina type, no dilution area is required. For details on these calculated dilution areas and the rationale for assumptions made to complete these calculations, refer to the RIDEM Office of Water Resources Shellfish Program document entitled *Marina Dilution Analysis Background* (November 2022).

E Wastewater Treatment Facilities (WWTF)

The majority of the Growing Area 4 shoreline consists of single-family homes most of which use On-site Wastewater Treatment Systems (OWTS) to dispose of wastewater. Public sewers currently service a portion of Middletown near the Sachuest Point area as well as some of Tiverton, primarily in the northern area of the town. The treatment facility for Middletown does not discharge into this growing area but rather into the West Passage of Narragansett Bay (Growing Area 6). Tiverton's sewer waste is treated by the Fall River Municipal Wastewater Treatment Facility just north of the Tiverton town line which ultimately discharges into Mount Hope Bay (Growing Area 17). The potential impacts from a treatment failure at this WWTF does not extend into the Sakonnet River growing area however the associated protective prohibited safety zone does extend into the northern portion where it merges with the marina closure north of the old stone bridge in Tiverton.

It should be noted that the portion of the growing area adjacent to Island Park and Portsmouth Park are classified as prohibited due to the high-density residential development and the direct evidence (high fecal coliform counts in dry weather stormwater flows) of failing and marginal septic systems and contaminated groundwater in the area. The majority of OWTS complaints for the Sakonnet River are in the Island Park area. A review of Onsite Wastewater Treatment System (OWTS) complaints and failures was conducted for

the 2022 triennial update. There were four complaints within 200 ft of the shoreline of waters in the growing area with the potential to affect the receiving waters (Table 3). All complaints had follow-up inspections and all four complaints are either resolved or under resolution (Table 3).

Table 3: 2022 OWTS Complaints in Approved Waters of GA4

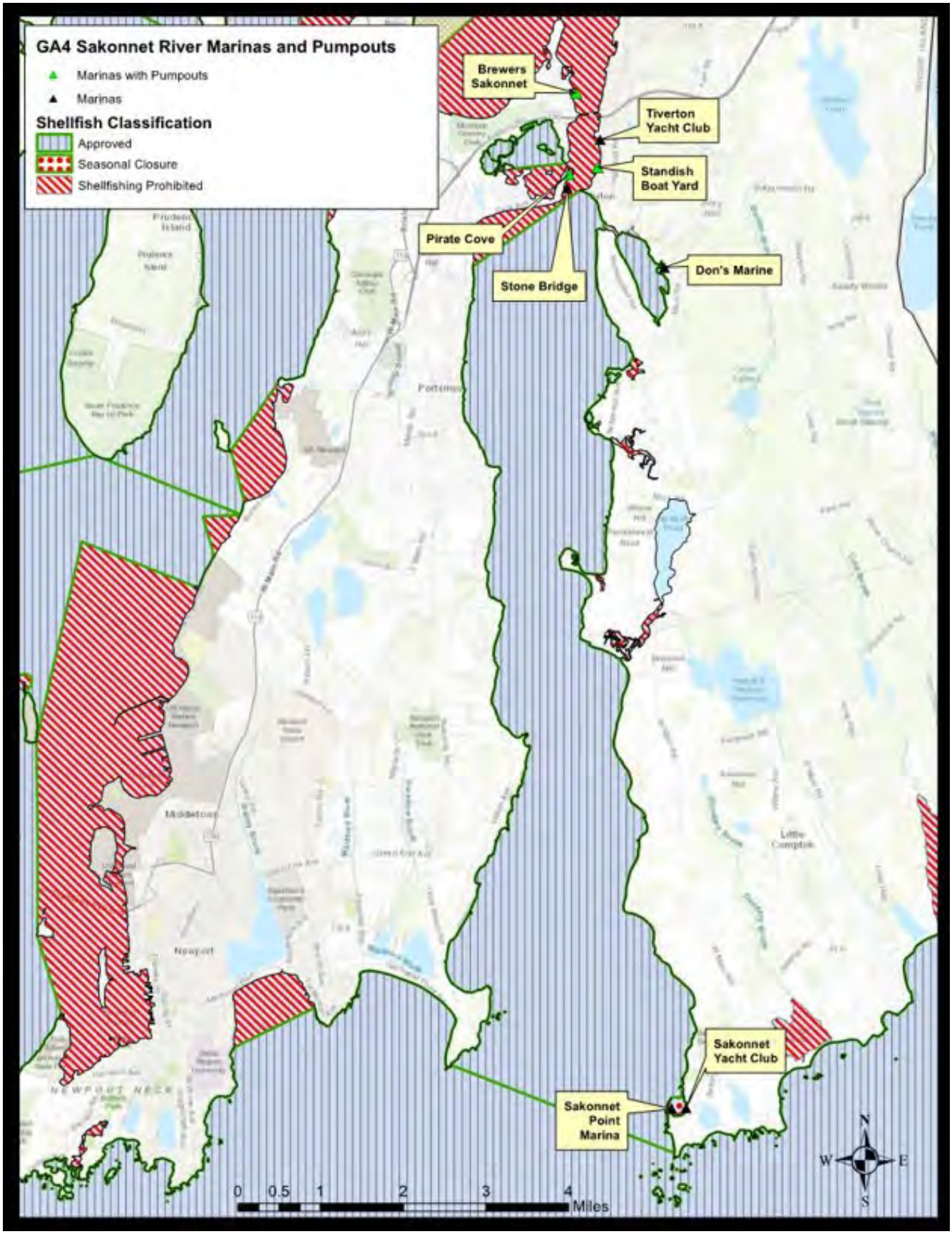
Town	Address	Complaint type	Resolution underway?	Comments
TIVERTON	757 East Road	Failed cesspool	Yes	OC & I inspected and reported non issue
TIVERTON	36 Peckham Lane	Failed Cesspool	Yes	OC & I inspected and reported non issue
Tiverton	4547 Main Road	Failed Cesspool	Yes	OC & I inspected and reported non issue

The Rhode Island Cesspool act of 2007 requires that any home that is within 200ft of the shoreline of any tidal waters and serviced by a cesspool must have a certified OWTS installed or be connected to the municipality's sewer system by January 1, 2014 (RI Cesspool Act of 2007, section 19.15-6). Three complaints were filed that could potentially flow into Growing Area 4 (Sakonnet River). All OWTS complaints adjacent to GA4 have been inspected by staff in the Office of Compliance and Inspection and determined that they were a non-issue and no further action is required (Table 3).

The majority of the OWTS complaints near prohibited waters were in the Island Park area of Portsmouth. As previously stated, this is a high-density residential area with an ongoing problem of failing septic systems and illicit discharges. This is an issue that the town of Portsmouth is currently working to address. The RI DEM has developed, and the EPA has approved a TMDL for the Portsmouth Park and Island Park area that addresses the bacteria contamination problems in the area. The TMDL study is entitled "FINAL Total Maximum Daily Load, The Sakonnet River –Portsmouth Park and The Cove – Island Park, March 2005. As part of the TMDL recommendations, the town of Portsmouth Wastewater Management Plan and the Wastewater Ordinance were passed by the Portsmouth Town Council in September 2015. Maintenance inspections of systems in the Island Park and Portsmouth Park areas are the town's first priority in battling these issues, were due to be completed by July 1, 2017. Septic systems for the entire town are scheduled to be completed by 2022. In addition, all cesspools will be removed by 2025, with those within 50 feet of a storm drain removed by January 2020. Mandates from RI DEM and the recent effort by the town of Portsmouth via the Wastewater Management Plan will work to resolve these ongoing OWTS problems in the Portsmouth Park/Island Park areas. Until the town and property owners in these two areas have met the conditions of the NOV/Consent decree these areas will remain classified as prohibited. A complete vetting of the improvements will be performed prior to any reclassification of these two areas.

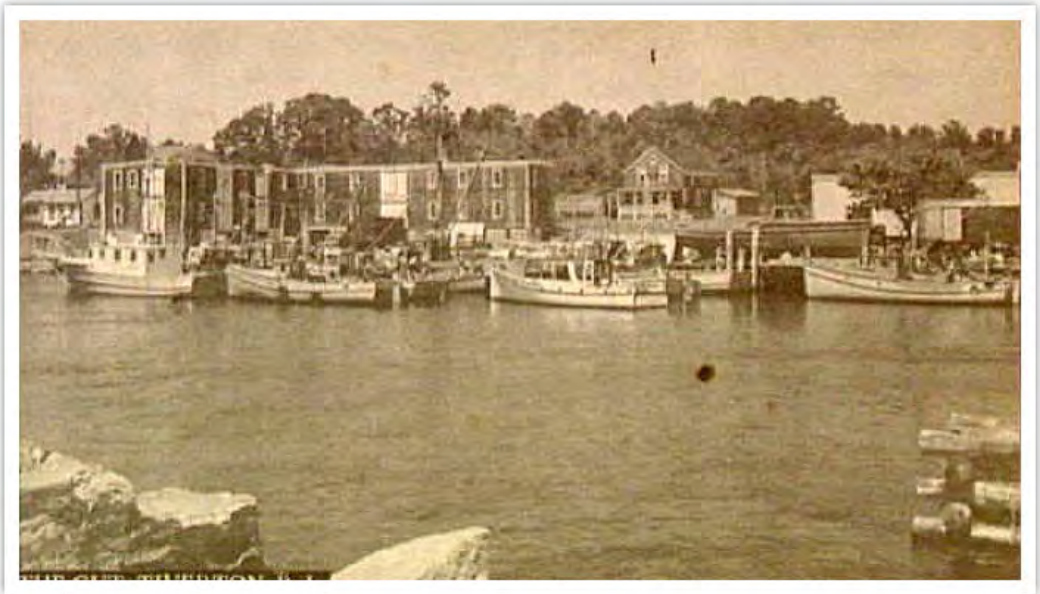
Non-sanitary RIPDES discharges: There is currently one RIPDES non-sanitary permit allowing discharge of process water from desalinization into Growing Area 4

Figure 5: GA4 Wastewater Discharges, Marinas, and Pumpout Facilities



In the past, a seafood processing operation, Manchester Seafood, was located at approximately 2139 Main Road in Tiverton, RI which is immediately adjacent to the growing area near the entrance to Nanaquaket Pond (Figure 5). Potential for bacteria-enriched runoff from the seafood processing operation and the regular presence of commercial vessels at the facility led to creation of a 6.5 acre Prohibited zone (GA4-4; see Figure 1) adjacent to the former seafood processing facility. This seafood processing operation ceased operation sometime in the late 1980s or early 1990s. The former seafood processing facility is currently empty (for decades) and in the process of being converted to residential housing. Recent observations by DEM staff indicate that there have been four or less boats tied up at the bulkhead on every sampling run made in this area over the past five years. In addition, a survey of aerial images (Living Atlas ArcGIS (https://livingatlas.arcgis.com/wayback) indicated presence of one to four vessels at the bulkhead in all images reviewed for the years 2008 through 2020. Fishing vessels present at the bulkhead are not landing seafood; vessels are only tied up at this location as a 'parking lot' and there are no people living onboard the vessels.

These changes in land-use adjacent to the growing area (elimination of seafood processing and the decline in the number of vessels regularly present in the area) have eliminated potential threats to the microbial water quality of the growing area and a will allow a classification upgrade from Prohibited to Approved. Fecal coliform samples collected in the area and in adjacent areas demonstrate compliance with NSSP criteria for Approved waters. In addition, the shoreline of the area was surveyed in March 2023 and no elevated fecal coliform sources were observed. ***Accordingly, it is recommended that GA4-4 be eliminated and that the waters of GA4-4 be reclassified as approved.***



Quahog Draggers
| Tiverton-based Quahog draggers can be seen here, tied up behind the Bridgeport Block. | **Date**: 1950

Figure 6: Photo of Manchester Seafood facility (large, shingled building) in 1950. The former seafood processing facility is now unoccupied and is in the process of being converted to housing. (image courtesy of Tiverton Historical Society).

F Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters as a source of shellfish for direct human consumption in order to maintain certification.

Water samples are collected at 21 monitoring stations throughout the growing area. Three of these stations are in prohibited areas, one is in a seasonally approved area in Sakonnet Harbor, and the remaining 17 are in the approved portions of the growing area.

Samples are collected 1-2 feet below the water surface (using 124 ml sterile Nalgene bottles) after which they are stored in a cooler packed with ice. They are then transported to the Rhode Island Department of Health Laboratories for analysis. Since June 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics for GA4 were analyzed by the mTec method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data is analyzed and compliance statistics are calculated annually. A summary of these compliance statistics and related commentary is below.

HIGHLIGHTS

* Sampled 6X during 2022 season (3 wet weather, 3 dry weather).
* Statistics represent recent 30 samples collected 2/8/2018 to 1/11/2023 during wet (n = 16) and dry (n = 14) weather for approved stations; all samples analyzed by mTEC method.
* Statistics represent recent 15 samples (7 wet weather, 8 dry weather) collected 4/30/2018 to 1/11/2023 when seasonally approved station 4-11 (Sakonnet Harbor) was in the open status; all samples analyzed by mTEC method.
* All approved and seasonally approved stations were in compliance and conformance.
* Data run 1/17/2023.

COMMENTARY

The Sakonnet River (Growing Area 4) was sampled six times during the 2022 sampling season (one set of samples was collected on 1/11/2023) which meets minimum systematic random sampling requirements for approved areas. The statistical evaluation of approved areas includes the recent 30 samples collected since 2/8/2018 during both wet (n=16) and dry (n=14) weather conditions. All approved stations are in program compliance and properly classified (Table 4).

Fecal coliform levels observed in GA4 during 2022 were low, with a maximum of 14 cfu/100 ml observed for the 132 samples collected during 2022. The low fecal coliform values from 2022 lowered the variability standard at stations which had moderately elevated variability for the 2021 review. Station 4-4 located in the northern end of Nanaquaket Pond (station 4-4; south of Nanaquaket Bridge) had experienced elevated fecal coliform during 2017 to 2021, resulting in an acceptable, but elevated variability standard for that station. 2022 fecal coliform observations in the Nanaquaket Pond area were low and station 4-4 had a decline in fecal coliform variability from 29.1 cfu/100 ml for 2021 to 18.6 cfu/100 ml during for 2022. Similarly, station 4-14, near the mouth of Almy Brook, had a decline in the variability standard from 25.0

cfu/100 ml for 2021 to 18.0 cfu/100 ml during for 2022. RI DEM established a new monitoring station (4-14A) further offshore from Almy Brook to characterize the extent of Almy Brook fecal coliform influence in the growing area. In addition, the program has increased the frequency of ' East Bay Land Run' sampling to better characterize the fecal coliform levels in GA4 sources including Almy Brook.

Classification of station 4-11 in Sakonnet Harbor was upgraded from prohibited to seasonally approved, with the area closed during the May to October boating season, in 2016 due to improvements in water quality. The 2022 update indicated that seasonally approved station 4-11 was in compliance during the open season and that the area is properly classified (Table 5).

Table 4: Fecal coliform statistical summary of 30 recent samples collected during 2/8/2018 to 1/11/2023; all mTEC analysis, 16 wet and 14 dry weather. See Figures 1 & 2 for station locations.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
4-1	P	30	2.3	3.6
4-2	A	30	2.2	3.3
4-3	A	30	2.2	3.6
4-4	A	30	4.1	18.6
4-5	A	30	2.2	3.8
4-6	A	30	2.2	4.2
4-7	A	30	2.1	3.5
4-8	A	30	2.0	2.8
4-9	A	30	2.2	3.5
4-10	A	30	2.3	4.4
4-11	SA	30	2.3	4.1
4-12	A	30	1.9	1.9
4-13	A	30	2.2	3.5
4-14	A	30	3.9	18.2
4-14A	A	6	2.7	8.0
4-15	A	30	2.0	2.7
4-16	A	30	2.0	2.5
4-17	A	30	2.2	3.8
4-18	A	30	2.2	3.4
4-19	P	30	2.3	3.9
4-20	P	30	2.4	6.4
4-21	A	30	3.1	11.0

Table 5: Fecal coliform statistical summary for seasonally approved station 4-11 in Sakonnet Harbor based on 15 recent samples collected during 4/30/2018 to 1/11/2023; all mTEC, 7 wet and 8 dry weather

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
4-11	SA	15	1.9	0.0

RECOMMENDATIONS

* Maintain Sakonnet Harbor (station 4-11) seasonal closure.
* While stations in Nanaquaket Pond (station 4-4) and near Almy Brook (station 4-14) showed improved water quality during 2022, continue to investigate upland sources that may be contributing to increased fecal coliform in those areas.
* Upgrade classification of GA4-4 (6.5 acres) from prohibited to approved due to changes in use in adjacent land (removal of potential microbial contamination from seafood processing discharge).

G Conclusions and Recommendations

The 2022 Triennial Evaluation of the Sakonnet River shellfish growing area (GA4) demonstrated that shoreline sources are not negatively impacting the microbiological water quality of the growing area's Approved waters or the Seasonally Approved waters when they are in the Open status. A statistical review of water column fecal coliform data collected while the area was in the open status indicated that all Approved and Conditionally Approved stations met NSSP criteria and that the Sakonnet River Growing Area (GA4) is in program compliance and is in properly classified. One recommended classification change was identified during the 2022 triennial review.

It is recommended that GA4-4 (6.5 acres) be upgraded in classification from prohibited to approved. GA4-4 was classified as prohibited as a precaution due to potential microbial contamination from a seafood processing facility adjacent to the growing area. That facility has been out of operation for decades, effectively removing the need for a prohibited classification in GA4-4. A shoreline survey of the area and water column fecal coliform monitoring in the area indicate acceptable water quality to meet the approved classification.

H Literature Cited

American Public Health Association. 1999. *Standard Methods for the Examination of Water and Wastewater*, 20th ed. 1999. American Public Health Association, American Water Works Association, Water Pollution Control Federation. Washington D.C.

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NOAA. June 2016. *Nautical Chart 13221*. National Oceanic and Atmospheric Association, National Ocean Service, Office of Coast Survey. Silver Spring, Maryland.

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VIMS. June 1989. *Determination of Marina Buffer Zones using Simple Mixing and Transport Models.* Virginia Institute of Marine Science, College of William and Mary. Gloucester Point, Virginia.

GA5
Kickemuit River
2022 Annual Update

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Figures

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1. Introduction

Initial shoreline surveys of the Kickemuit River (GA5; Figure 1) were performed in 1994 and 1997. Comprehensive 12-year shoreline surveys of the Kickemuit River (conditionally approved Growing Area 5) were conducted during the summer of 2008 and most recently during 2020 by staff from RIDEM's Office of Water Resources Shellfish Program. Triennial surveys of the growing area were completed in 2011, 2014, and 2017 with annual updates completed in the intervening years.

This report is an annual update of growing area GA5 completed in 2022. Sampling was conducted for all known GA5 pollution sources found to have fecal coliform results exceeding 2,400 cfu/100ml in the 2020 12-year survey. Sources 2022-5-001, 2022-5-007, and 2022-5-008 were visited on multiple occasions for sampling. When visited, the mentioned sources were found to be no flows, due to dryer than usual summer as well as disrupted flow in preparation of dam construction. A final visit was made to the source 2022-5-001 on March 6, 2023 when the source was flowing a source sample and corresponding in stream samples were taken.

2. Pollution Source Survey

Three shoreline sources were sampled during the 2022 annual update. All three sources sampled as part of the 2022 annual update flow into prohibited waters in the northern end of GA5. Sources 2022-5-001, 2022-5-007, and 2022-5-008 were visited on multiple occasions for sampling, August 24, 2022 and October 5, 2022. When visited, the mentioned sources were found to be no flows, due to dryer than usual summer as well as disrupted flow at the dam just upstream. A final visit was made to source 2022-5-001 on March 6, 2023 where flow was observed and samples were collected (Table 1).

Figure 1: Current 2022-2023 Kickemuit River (GA5) shellfish classification map.

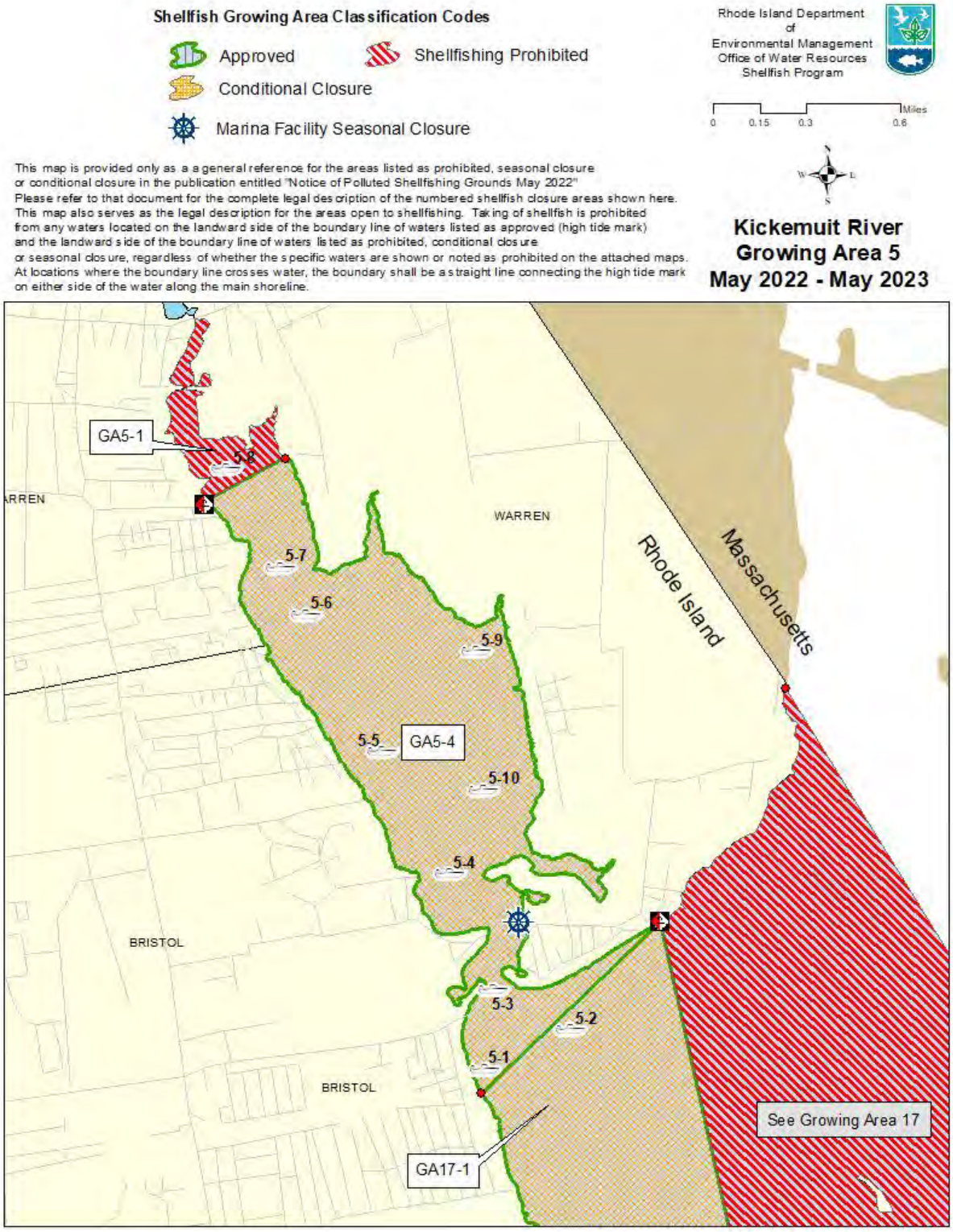

Figure 2: Location of pollution sources in GA5 . Growing area monitoring stations indicated by boat symbols.

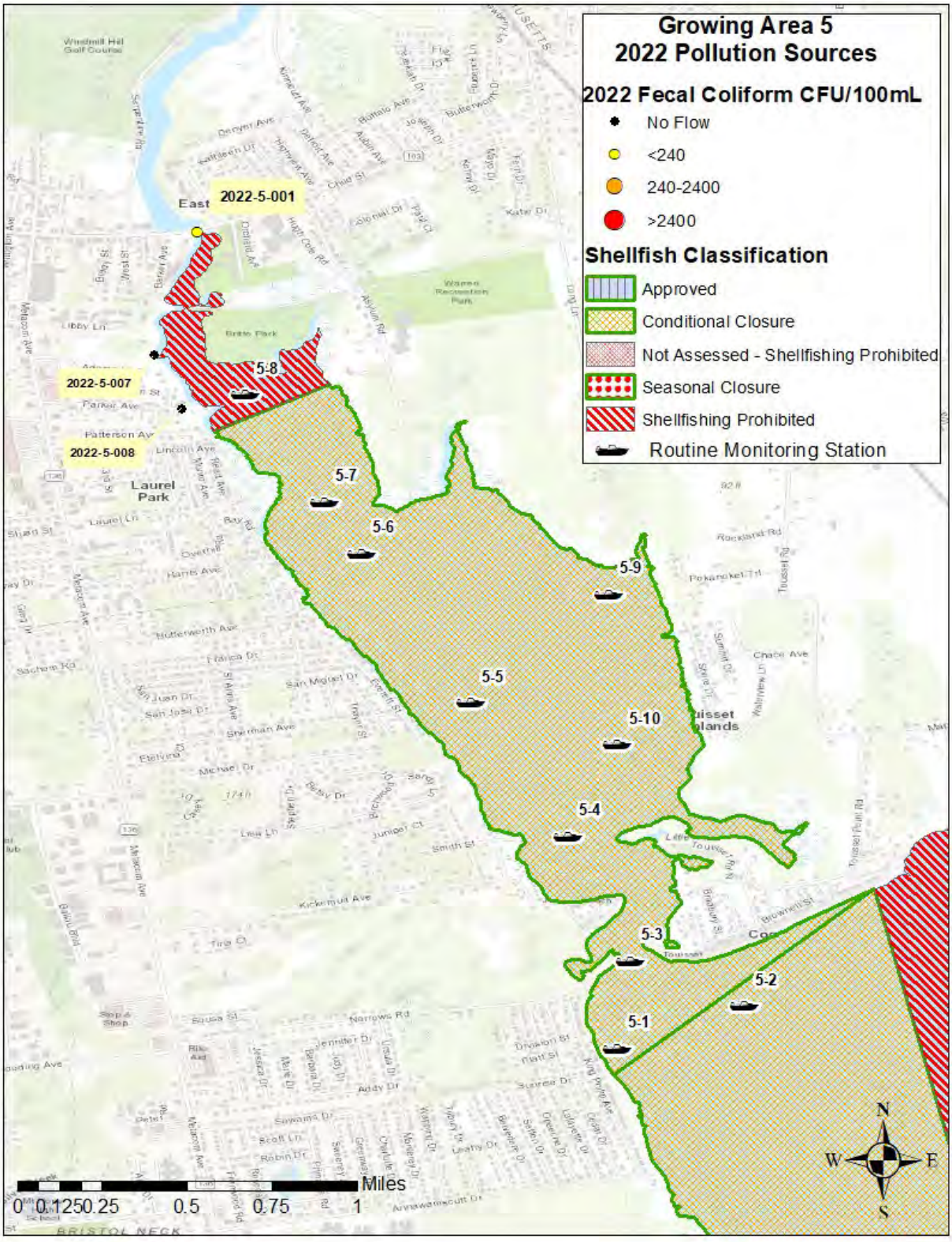

Table 1: 2022 summary of pollution sources in GA5

Source ID	Date Visited	Latitude	Longitude	Description	Receiving waters classification	Actual / Potential	Direct / Indirect	2020 Results mTEC cfu/100ml	2021 Results mTEC cfu/100ml	2022 Results
2022-5-001	3/6/2023	41.7294	-71.26271	Kickemuit River freshwater source @ dam	Prohibited	Potential	Indirect	6000	100 E 160 W 100	100 IS 40
2022-5-007	**8/24/2022**	**41.7241**	**-71.26457**	**Small stream from dammed pond at cow farm**	**Prohibited**	**Potential**	**Indirect**	**1100**	**800 N 940 S 500**	**No Flow**
2022-5-008	8/24/2022	41.7218	-71.2634	(2) discharges at end of Parker St (1) not flowing	Prohibited	Potential	Indirect	1400	100 N 260 S 120	**No Flow**

Source 2022-5-001 (Figure 3) is the outfall of the Kickemuit River Dam at Child Street in Warren, RI. The dam separates the freshwater upper reaches of the Kickemuit River and the Warren Reservoir from the tidal waters of the Kickemuit River shellfish growing area. The Kickemuit Dam is scheduled to be removed in the next several years and prep-work for dam removal has begun. When visited in 2020 the source yielded a result of 6,000 cfu/100 mL with a low flow rate of approximately 0.04 cfs at the outflow of the Warren Reservoir dam to the Kickemuit River. In 2022 the source was visited 3 times. On 8/24/2022 and 10/5/2022 the source was observed to have no flow due to a dryer than usual summer and disrupted flow due to work the dam up stream of the station. On 3/6/2023 the source was visited and a sample was collected with results of 100 cfu/100 ml with a flow rate of 0.9792 cfs and in-stream result of 40 cfu/100ml.

Source 5-001 (Figure 3) is located approximately 3,500 feet (1.07 km) upstream from the conditionally approved waters of Growing Area 5. The waters between source 5-001 at the Child Street dam and the Conditionally Approved waters of the area are classified as Prohibited (GA5-1, approximately 45 acres). This 45-acre prohibited area acts as a dilution zone before the freshwater input of the Kickemuit River enters Conditionally Approved waters. The low flow rate and the large Prohibited zone provide adequate dilution of potential fecal coliform contamination from source 5-001 as evidenced by sentinel station 5-8 (Prohibited classification) which met NSSP criteria for conditionally approved waters during 2022 (Table 2). A plan to remove this dam is currently under review by RI DEM. DEM shellfish staff will monitor changes in the microbial water quality of the growing area during and after dam removal.

Figure 3: Source 5-001, flow over the Kickemuit Reservoir dam at Child Street in Warren, RI..

Source 2022-5-007 (Figure 4) is a small stream that drains a pond within a cow grazing pasture located on the northwestern shore of the growing area. The stream discharges to prohibited waters. The stream splits the property line between the pasture located at the end of Adams Lane in Warren, RI and a 3-acre property of 113 Libby Lane in Warren, RI. The water flows from the pond into a concrete trench before exiting out through a stone retaining wall and flowing across a marshy shoreline before entering the prohibited waters of the growing area. Source 5-007 had a low (trickle) flow and a fecal coliform concentration of 1,100 cfu/100 mL during the 2020 shoreline survey. The source was visited on August, 24 2022 and observed to be stagnant with no flow.

This source flows into Prohibited waters approximately 1,300 feet (0.4 km) from the northern-most Conditionally Approved waters of the growing area. The low flow rates observed for this source and the dilution provided within the Prohibited zone this source discharges to are protective of the microbiological water quality of the Conditionally Approved waters of the growing area. As discussed above, monitoring station 5-8 in prohibited waters adjacent to this source met NSSP criteria for conditionally approved waters during 2022. Given the proximity of livestock to the growing area, this source will be monitored regularly to ensure that there continues to be no impact on the fecal coliform water quality of the growing area.

Figure 4: Source 5-007, a small stream flowing through a field and Phragmites marsh

Source 2021-5-008 (Figure 5) is a set of two drainpipes at the extension of Parker Avenue in Warren, RI that drain into prohibited waters. In 2012 this source had fecal coliform concentrations of 1,400 cfu/100 ml. In 2021 the source yielded fecal coliform results of 100 cfu/100ml with a trickle flow on 7/22/2021 (1 day after 0.11" rain at Taunton Airport). Companion in-stream samples in the prohibited waters had fecal coliform concentration of 260 cfu/100ml (to the north) and 120 cfu/100 ml (to the south). The source was visited on August 24, 2022 and was observed to have no flow. This source flows into prohibited waters which provide sufficient dilution to protect the fecal coliform water quality of the conditionally approved waters of the growing area.

Figure 5: Source 5-008, drainpipes at the extension of Parker Avenue in Warren RI.

3. Marinas and Mooring Areas

The Kickemuit River growing area has one marina and several mooring fields as detailed in the shellfish program's document entitled "Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background November 2022". Waters adjacent to this marina have a seasonal closure (May to October) to be protective of shellfish waters should an accidental discharge from a vessel occur. All waters in Rhode Island are designated as No Discharge Zones which prohibits the discharge of any sewage from any vessel within any waters of the state. Information regarding the enforcement and inspection procedures for vessels operating in RI waters can be found at:
http://www.dem.ri.gov/programs/water/shellfish/marine-pumpouts.php

4. Waste Water Treatment Facilities

There are currently no wastewater treatment facilities that discharge directly to the Kickemuit River (GA5). This conditionally approved growing area is managed with precipitation based closure of the growing area as outlined in the area's Conditional Area Management Plan (CAMP). As is the case of all areas that may have sewer systems or infrastructure within their watersheds a notification of any sewage overflow that may impact these waters could require an emergency closure.

A review of Onsite Wastewater Treatment System (OWTS) complaints and failures was conducted as part of the shoreline survey. There are currently no open complaints within 200 ft of the Kickemuit River growing area. In February 2017, DEM investigated a complaint at 82 King Philip Ave in Bristol (on the western shoreline just south of Bristol Narrows) in which over time, the structure settled and the septic connection at the foundation separated from the discharge line, causing a chronic failure. The system was immediately reconnected to the septic system and a new septic pump installed as a short-term solution. The property has since been connected to the public sewer system and is no longer dependent on an OWTS.

In January 2018, a break in a sewer line caused by work on a water main in the general vicinity resulted in 265,000 gallons of untreated sewage to enter a stream and discharge into the

conditionally approved Mt. Hope Bay (GA17) receiving waters just south of the Kickemuit River growing area. The discharge was discovered by town officials and DEM was notified immediately and the necessary repairs to the sewer line were made on January 25. The Kickemuit River growing area was closed throughout the overflow event due to its seasonal January closure. An extension to the closure was made until February 15 (resulting in a full 21-day closure from the end of the SSO event on January 24, 2018). The RI Department of Health verified that no shellfish product from these waters entered the market during the closure period.

5. Poisonous and Deleterious Substances

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted.

There were no indications that any of the sources identified during this survey have the potential to impact the conditionally approved waters of the Kickemuit River (Growing Area 5) due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

6. Water Quality Studies

A. RIDEM Shellfish Program

The Shellfish Growing Area Monitoring program is part of the state of Rhode Island's agreement with the United States Food and Drug Administration's National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harvesting waters of the state in order to maintain certification of these waters for shellfish harvesting for direct human consumption.

Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the

RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1995) for the standard fecal coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012 and/or the multiple tube fermentation test (sm01 MPN) method utilized prior to August 2012. All samples in the current statistical evaluation were analyzed by the mTEC method. The procedure for water sample holding times and temperature control for the sm48 and sm01 methods are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedures (copy in the Program's permanent file).

Water samples for fecal coliform monitoring are collected at ten (10) monitoring stations throughout the growing area. Nine (9) of the stations are in Conditionally Approved waters and one (1) station is located in prohibited waters. GA5 is monitored in conjunction with GA17 (Mt. Hope Bay) at a once per month frequency which exceeds the NSSP requirements for conditionally approved waters not impacted by point source pollution. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data is analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

B. Statistical summary and review of GA5 fecal coliform data

HIGHLIGHTS

* Sampled 10X during 2022 season.
* Statistics represent recent 15 dry-weather samples collected 3/11/2021 to 11/15/2022 when the Kickemuit conditional area was open.
* All samples analyzed by the mTEC method.
* All conditionally approved stations are in compliance and program conformance.
* Data run 2/4/2022.

COMMENTARY

The conditionally approved Kickemuit River (Growing Area 5) was sampled ten (10) times during 2022, eight times while the area was in the open status and twice while the area was in the closed status. Samples were not collected during January, April and May of 2022 due to mechanical problems with the monitoring boat engine. However, a new outboard engine was purchased in May of 2022 and double sampling (twice per month) was completed in June and November 2022 to compensate for the months in which sampling did not occur. September 2022 was extremely wet in the Providence, RI area, with 5.95" of rain falling at TF Green Airport compared to a long-term means September rainfall of 4.26". This wet weather kept the Kickemuit growing area in the closed status for 26 of 30 days (87%) and 19 of 22 weekdays (87%) and prevented sampling during September 2022. Other than the wet month of September 2022, sampling of the Kickemuit has been completed every month since the May 2022 replacement of the monitoring boat engine.

Previously (2016 through 2020) there was a January closure of the Kickemuit River (GA5) due to fecal coliform water quality exceeding the NSSP fecal coliform variability criteria during that month. Improved January fecal coliform water quality results were documented during January 2017 through January 2020 such that this seasonal (January) closure was removed in the May 2020 reclassification. January results were therefore included in calculation of the current compliance statistics. The 2022 statistical review demonstrated that all conditionally approved stations in the growing area are in program compliance. The single Prohibited station (station 5-

8) located near the dominant freshwater source to the Kickemuit River also had acceptable water quality during dry weather. DEM OWR Shellfish staff continue to monitor the progress of the planned Kickemuit Dam removal.

The 2022 statistical review demonstrated that the Kickemuit River growing area is properly classified and that all conditionally approved stations are in program compliance.

RECOMMENDATIONS

* All stations are in program compliance and conformance.
* Water quality continues to meet NSSP criteria during January since the removal of the seasonal (January) closure in 2020.
* Monitor Kickemuit Dam removal
* No other recommendations based on the 2022 review of monitoring data.

Table 2: Statistical summary of GA5 fecal coliform observations. Statistics based on recent 15 observations collected while the area was in the open status, all dry weather, samples collected during 3/11/2020 to 11/15/2022. All samples analyzed by mTEC method.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
5-1	CA	15	4.0	6.7
5-2	CA	15	3.9	0.0
5-3	CA	15	3.5	6.7
5-4	CA	15	2.7	0.0
5-5	CA	15	3.1	0.0
5-6	CA	15	3.5	6.7
5-7	CA	15	4.7	6.7
5-8	P	15	4.4	6.7
5-9	CA	15	4.2	6.7
5-10	CA	15	3.4	0.0

7. Conclusions and Recommendations

The 2022 annual update demonstrated that all monitoring stations in the growing area meet NSSP criteria while in the open status. The 2022 review also documented that there are no shoreline pollution sources that are negatively impacting the fecal coliform water quality of the growing area. A review of the current GA5 Conditional Area Management Plan (CAMP) was conducted and the management plan was found to account for meteorological and hydrological influences on the water quality of the growing area. The current CAMP was updated in December 2021 and provides shellfish growing area management guidance and procedures to safeguard public health. The review also showed that the GA5 CAMP was adhered to during 2022.

Removal of the Kickemuit Dam is currently in the permitting stage. DEM Shellfish staff will monitor GA5 fecal coliform data in the event that dam removal alters the flushing time and fecal coliform loading of the growing area, perhaps requiring changes in the conditional area management plan.

The 2022 annual update has demonstrated that the area is properly classified. No changes in classification are recommended.

Growing Area 6
East Passage of Narragansett Bay
2022 Annual Update

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Figures

Tables

1. Introduction

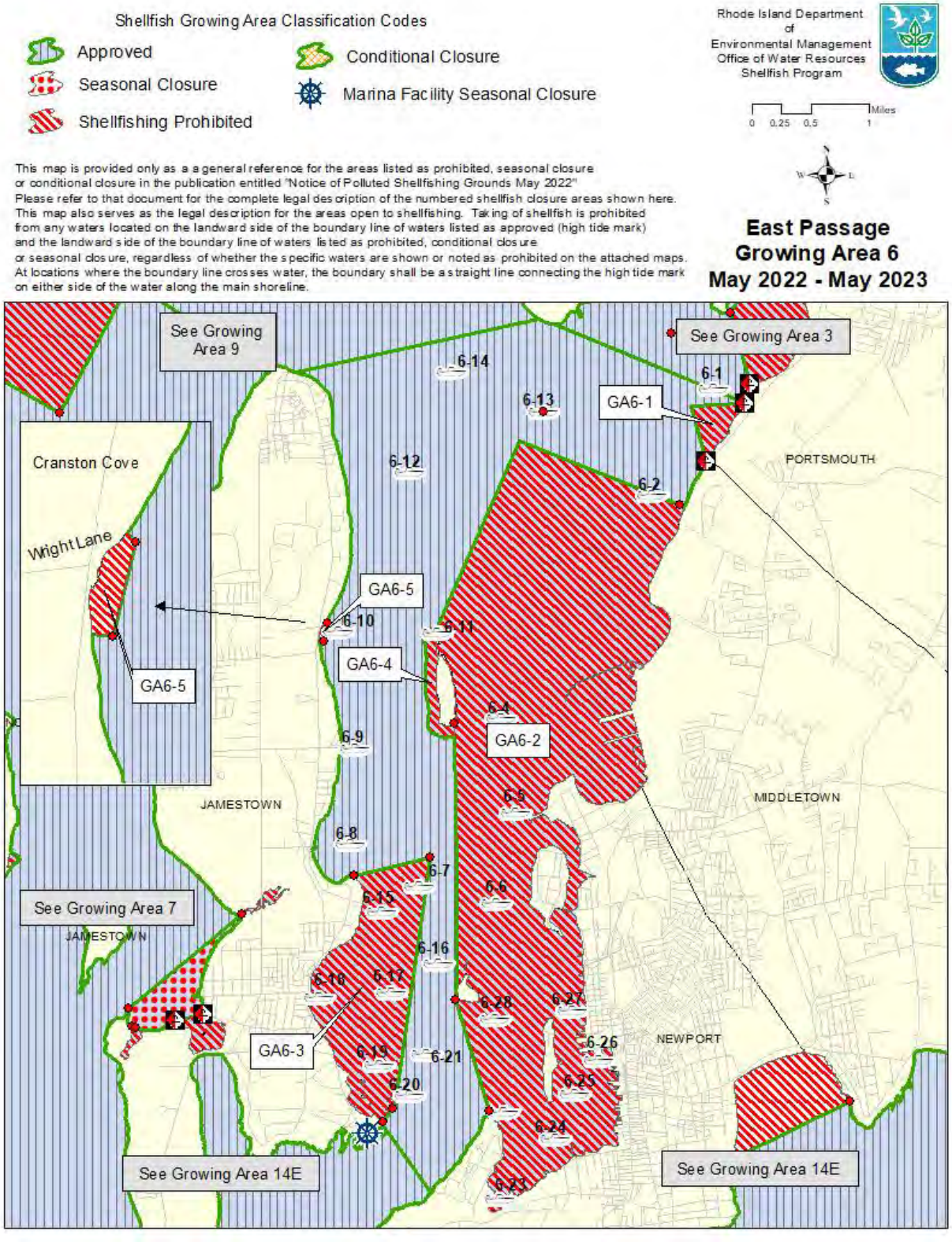
An annual update survey of the East Passage (GA6) was completed during 2022. A twelve (12) year sanitary shoreline survey of the East Passage Growing Area 6 (Figure 1) was last conducted in 2015. Triennial surveys were completed in 2018 and 2021 with annual updates being completed in the intervening years.

The 2015 12-year survey identified seventy-two (72) actual or potential sources. Fifty-four (54) of the sources were not actively flowing at the time of the shoreline survey with the remaining eighteen (18) having flows warranting sampling. In 2015 six (6) sources had bacteria counts greater than 2,400 cfu/100ml warranting follow-up sampling. Three (3) of those sources discharge to prohibited classification waters and were not re-sampled as part of the 2016 annual update. None of the three (3) sources requiring a follow-up were flowing during the 2016 annual update survey. Sources (6-001 and 6- 003), which discharge into the Prohibited area near Cranston Cove in Jamestown (GA6-5 closure) were re-inspected in 2016. These two (2) sources showed no flow during 2016 which was a drier than normal year.

In 2017, a follow-up visit was made to ten (10) of the eighteen (18) sources that were measured during the 2015 twelve (12) year sanitary shoreline survey. The 2017 annual follow-ups were determined by bacteria sample results > 2400 cfu/100ml from the 2015 survey requiring a site visit during 2017 (Table 1). Of the ten (10) sources visited during the 2017 shoreline survey, eight (8) of them had no flow. The two (2) sources (2017-6-001 and 2017-6-500) with flow had bacterial levels < 2,400 cfu/100ml, which did not require additional follow-up sampling.

Source 6-001, a small stream crossing the beach and flowing into Cranston Cove on the northeastern shore of Jamestown, has historically had elevated bacteria levels and has a small, prohibited area in the receiving waters (GA6-5) to provide sufficient dilution before reaching approved growing waters. Source 6-001 was sampled several times during 2022 (Table 1) to better characterize this pollution source.

Figure 1: 2022-2023 Shellfish Classification Map of GA6 with Routine Monitoring Stations



2. 2022 Pollution Source Survey

No follow up source sampling was required to complete the 2022 annual update because sources sampled during the 2018 12-year survey were either not flowing or had low fecal coliform results (Table 2). Of the six (6) sources that had bacteria results >2,400 CFU/100 mL during the 2015 12-year sanitary survey, three (3) were found to have no flow in 2018, and the remaining three (3) could not be located or no longer exist. Those sources that were previously found to have been flowing had results well below the 2,400 CFU/100 mL threshold (Table 2). With no required follow-ups in the growing area, source 6-001 was investigated several times during 2022.

Source 6-001 is a stream that enters into a small, prohibited zone near Cranston Cove in Jamestown, RI. It was visited 3 separate times for shoreline sampling to monitor fecal coliform levels within the source and in stream samples. On June 13, 2022, the source was sampled during wet weather, one day after 1.31" of rainfall. The source had high fecal coliform levels of 10,100 cfu/mL and in stream samples of 23,000 cfu/100mL (North) and 120 cfu/100mL (South) It is also to be noted that there was a heavy presence of birds roosting in the area (Figure 2). When the source was revisited on August 23, 2022, during a drier than usual summer season, there was no flow observed. Lastly the source was visited on December 13, 2022 yielding a result of 91 cfu/100mL with in-streams both showing no detection.

Initial results suggest that shorebirds may be a significant source of fecal coliform pollution in Cranston Cove (source 6-001). Moving forward this source will be monitored on an approximately monthly basis through an on-going "land run" designed to monitor specific sources that are of concern or are not accessible for routine sampling by boat.

Figure 2: Birds congregating at source 6-001, a small stream crossing the beach and flowing into the Prohibited waters of Cranston Cove in Jamestown, RI. Image taken June 13, 2022.

Figure 3: Location of Shoreline Source 6-001 at Cranston Cove.

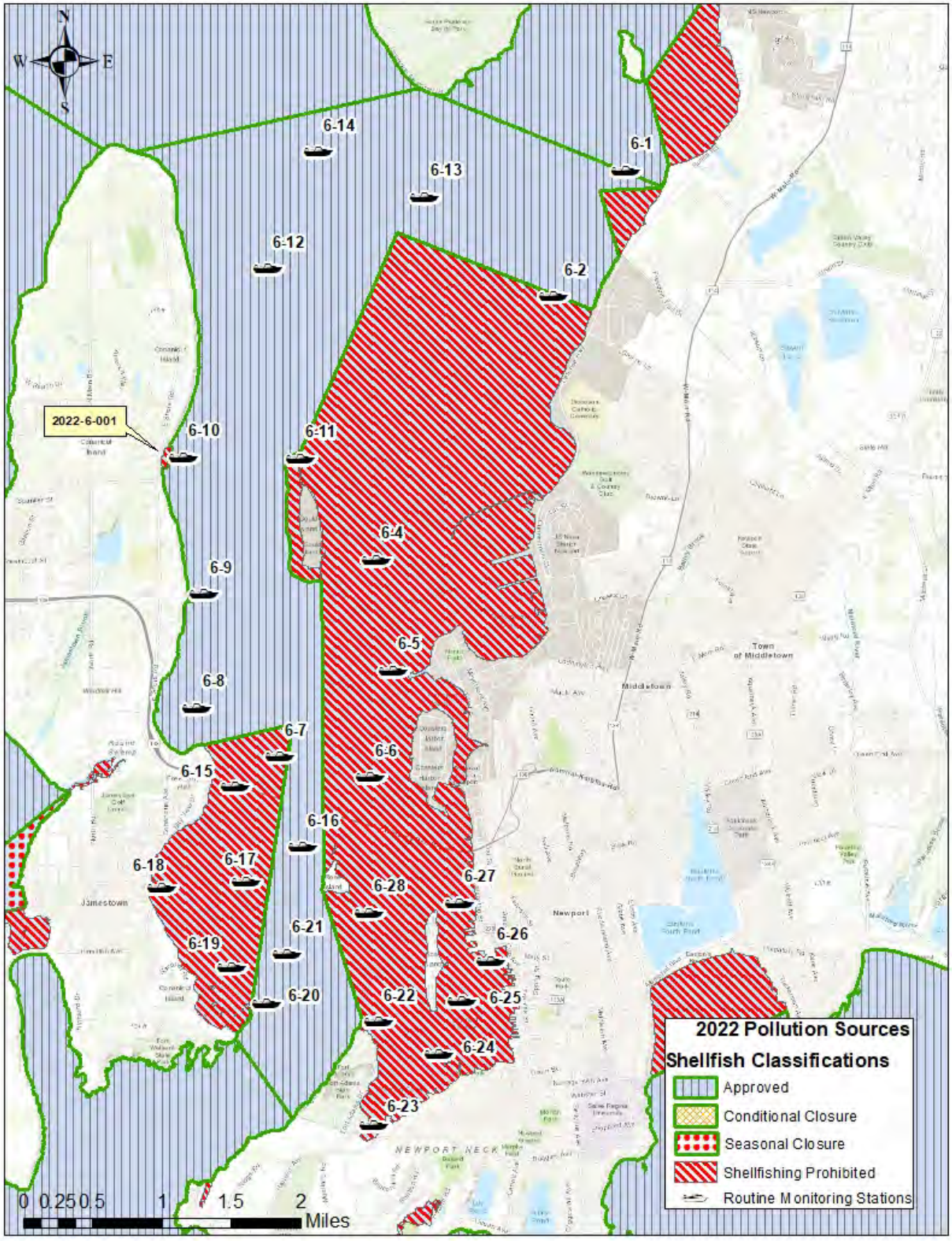


Table 1: Sampling results from three (3) visits to source 6-001

Source ID	Date Visited	Latitude	Longitude	Description	Receiving Waters Classification	Actual / Potential	Direct / Indirect	Result
2022-6-001	6/13/2022	41.54162	-71.36502	Stream north of Wright Lane	Prohibited	Actual	Indirect	10,100
	8/23/2022					Potential	Indirect	NF
	12/13/2022					Actual	Indirect	91

Table 2: GA6 Sources sampled during the 2018 12-year survey. No follow-up sampling was required for the 2022 update.

Source ID	Latitude	Longitude	Description and Location	Act/ Pot	Dir/ Indir	2015 Results	2017 Results	2018 Results	Volumetric Flow cfs	Date Visited/ Sampled
6-001	41.54162	-71.365	Stream north of Wright Lane	A	D	800	454	320	0.042	7/11/2018
6-001IS			In stream	A	D			200		7/11/2018
6-003	41.54297	-71.3635	Stream thru woods	A	D	2700	NS	Could not find	NF	7/11/2018
6-102	41.53825	-71.3649	Small stream over rocks from uplands	A	D	1100	NS	NS	NF	
6-103	41.53822	-71.3649	Small stream maybe split of source #102 south of #102	A	D	800	NS	NS	NF	
6-106	41.53295	-71.3628	Very small stream from upland woods heavy iron bacteria	A	D	1430	NS	Could not find	NF	7/11/2018
6-107	41.53127	-71.3624	Small stream thru woods	A	D	662	0	Could not find	NF	
6-109	41.52988	-71.3621	Groundwater seepage fades out above tide line	A	I	685	NS	Could not find	NF	
6-209	41.51197	-71.3656	Outfall from retention pond at base of Newport Bridge can't	P	D	2600	0	NS	NF	7/11/2018
6-210	41.51173	-71.3653	Stone headwall w/ standing water most likely from retention	A	D	8000	0	NS	NF	7/11/2018
6-301	41.49587	-71.3667	24" dia CMP storm drain at corner of concrete seawall	P	D	7700	0	NS	NF	7/11/2018
6-311	41.49025	-71.3637	8" dia clay/iron pipe put in water took sample from drip	A	D	2120	NS	NS	NF	7/11/2018
6-500	41.48854	-71.363	24" Dia RCP before broken seawall	A	D	2400	99	DNE	NF	7/11/2018
6-500B	41.48506	-71.3606	24" RCP at private beach	A	D			DNE	NF	7/11/2018
6-505	41.49372	-71.3664	"Unknown source" for original description. Upon surveying, only visible potantial source was an old broken iron pipe, half buried in sand. No evidence of recent flows.	A	D	4600	0	Could not find	NF	7/11/2018
6-606	41.52806	-71.3617	Multiple GW seeps	A	D	1720	NS	Could not find	NF	
6-850	41.56528	-71.3629	GW Seep @ brick abutment north of Broad St	P	D	300	NS	100	Stagnant	7/11/2018
6-852	41.56724	-71.363	Large stream north of Broad St	P	D	560	NS	60	0.021	7/11/2018
6-900			4" dia PVC pipe in cement seawall			10	NS	<2	Trickle	7/11/2018
6-901	41.49587	-71.3667	GW stream coming from base of rock wall below 6-301	A	D		NS	<2	0.042	7/11/2018

NS = no sample, DNE = does not exist / could not find

3. Marinas and Mooring Areas

There are thirty-five (35) marinas with more than 1,700 slips and moorings located within the waters of the East Passage growing area, the majority of which are within the Newport and Jamestown harbor areas. All waters surrounding the marina proper are classified as prohibited with sufficient dilution in adjoining water to be protective of shellfish harvest.

Calculations to determine adequacy of this closure zone are contained in the program's permanent files in the report entitled "Evaluation of Waters Adjacent to Marinas: Marina Dilution Analysis Background, June 2017, RIDEM" (Updated in November 2022) and is available for review. Mooring areas were noted and where adjacent to existing marinas such as in Newport and Jamestown harbors they are included in the boat counts. Individual moorings were evaluated for their potential to impact approved shellfish waters.

4. Waste Water Treatment Facilities

Public sewers service the majority of the Newport shoreline and a small portion of the Jamestown harbor area. All other areas of the watershed are serviced by onsite waste water treatment systems (OWTS). There are currently two municipal WWTFs that discharge to Growing Area 6: The City of Newport and the Town of Jamestown.

The review of the City of Newport's WWTF performance data report for 2022 indicated that the average flow from the treatment plant was 6.96 MGD well under the 16 MGD permitted level. The Newport facility had no effluent fecal coliform exceedances during 2022. The Newport WWTF has recently increased their permitted flows from 19.7 to 30 MGD and is in the process of completing major upgrades to their equipment. These upgrades include, new grit removal equipment, a new primary clarifier, reconfiguration of the aeration basins, larger chlorine contact tanks and other processing upgrades along with other system improvements to remove/reduce CSOs. The plant is under a judicial consent agreement to complete these improvements by 2019 with the CSO system work to be completed by 2032.

The Jamestown WWTF discharges to the deep waters of the East Passage (GA6) near the Newport Bridge. A review of DMR data for the Town of Jamestown WWTF showed that there were no reported violations of monthly average flow during 2022. The average monthly flow was 0.29 MGD well within the permitted flow of 0.73 MGD.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of the East Passage due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

5. Water Quality Studies

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters in order to maintain interstate shellfish shipper certification.

Water samples are collected at twenty-seven (27) monitoring stations throughout the growing area. Ten (10) of the stations are in Approved waters and seventeen (17) stations are located in prohibited waters. The stations in prohibited waters are predominantly in the extensive marina and mooring areas of Newport Harbor and Jamestown Harbor. Water samples are collected and handled following the Programs SOP (available in the Program's permanent files). Briefly, samples are collected 0.5 m (1.5 feet) below the water surface (using 4-ounce sterile Nalgene bottles) after which they are stored in a cooler packed with ice. Samples are then transported to the Rhode Island Department of Health Laboratories for analysis. Since June 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics were analyzed by the mTec method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually.

A summary of these statistics and related commentary is below.

A Annual Statistical Summary

HIGHLIGHTS

* Sampled 6X during 2022 (6 wet weather, 0 dry weather).
* Statistics represent recent 30 samples collected during wet (n = 15) and dry (n = 15) conditions during 8/22/2017 to 12/21/2022.
* All samples analyzed by the mTEC method.
* All approved stations are in compliance.
* Data run 1/10/2022.

COMMENTARY

The East Passage (Growing Area 6) was sampled six times during 2022, complying with minimum systematic random sampling criteria. The recent 30 samples used in the evaluation were collected during both wet (greater than 0.5" rain during prior 7 days; n=15) and dry (n=15) weather conditions. All approved stations met NSSP criteria.

In addition, 10 of 11 stations located in Newport Harbor which are classified as prohibited met criteria. This improvement in Newport Harbor fecal coliform water quality likely reflects recent CSO and stormwater control upgrades completed by the City of Newport. These improvements in Newport Harbor water quality have been consistently noted during 2020-2022 and consideration of reclassifying portions of outer Newport Harbor to seasonally approved may be warranted.

Results of the 2022 statistical evaluation indicate that all approved stations are in program compliance and that the area is properly classified.

RECOMMENDATIONS

* Continue to collect and evaluate Newport Harbor fecal coliform data for potential reclassification of outer Newport Harbor.
* No other recommendations based on the 2022 review of monitoring data.

Table 3: GA6 Fecal coliform compliance statistics for 2022 based on recent 30 samples collected during 8/22/2017 to 12/21/2022, all mTEC analysis, 15 wet and 15 dry weather samples.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
6-1	A	30	2.4	5.4
6-2	P	30	2.4	5.2
6-4	P	30	2.4	6.3
6-5	P	30	2.5	5.7
6-6	P	30	2.4	5.0
6-7	P	30	2.2	3.9
6-8	A	30	2.0	2.6
6-9	A	30	2.5	6.8
6-10	A	30	2.3	4.9
6-11	P	30	2.1	3.7
6-12	A	30	2.3	4.7
6-13	A	30	2.2	3.5
6-14	A	30	2.0	2.5
6-15	P	30	2.6	7.7
6-16	A	30	2.4	6.2
6-17	P	30	2.3	4.5
6-18	P	30	2.4	7.1
6-19	P	30	2.4	6.2
6-20	A	30	2.3	5.2
6-21	A	30	2.1	3.2
6-22	P	30	2.5	5.0
6-23	P	30	3.2	11.2
6-24	P	30	3.4	12.5
6-25	P	30	4.3	25.3
6-26	P	30	8.8	63.9
6-27	P	30	3.0	10.0
6-28	P	30	2.2	3.8

6. Conclusions and Recommendations

The 2022 annual update demonstrated that all monitoring stations in the growing area meet NSSP criteria while in the open status. The 2022 review also documented that there are no shoreline pollution sources that are negatively impacting the fecal coliform water quality of the growing area. Fecal coliform water quality in outer Newport Harbor has shown improvements in recent years, likely in response to upgrades in CSO and stormwater control made by the City of Newport. Continued monitoring will help to establish whether improvements in Newport Harbor water quality will continue to the point of a possible reclassification of outer Newport Harbor from prohibited to conditionally / seasonally approved.

Changes to the classification of GA6 were made in 2020 to accommodate a contiguous closure (GA6-2) of former Naval facilities and Newport Harbor. This closure was due to new data on the presence of PAHs and PCBs at the site of a former Naval facility on Gould Island. Closure 6-2 resulted in a contiguous ~4,860 acre Prohibited zone encompassing the former naval-industrial operation on both the eastern (closure 6-2) and western side of Gould Island portions of GA6. This reconfiguration and reclassification remain in effect as of the 2022 annual update.

West Passage of Narragansett Bay
Growing Area 7
Triennial Re-Evaluation
2022

Jamestown Bridge West Passage Juan Carlos Cruz

Rhode Island Department of Environmental Management
Office of Water Resources
Shellfish Monitoring Program

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Introduction

A triennial re-evaluation shoreline survey of the West Passage of Narragansett Bay (Growing Area 7) was conducted in order to comply with National Shellfish Sanitation Program (NSSP) requirements for shellfish growing area classification. The primary objective of this shoreline survey is to identify and characterize sources of pollution affecting the area and re-evaluate point and non-point sources previously identified during prior surveys. Comprehensive 12-year shoreline surveys of the area were completed in 2005 and 2016. Triennial updates of the area were completed in 2008, 2011, 2014 and 2019. The 2022 report is a triennial re-valuation of the growing area.

This triennial update of Area 7 (Figure 1) was conducted during the summer of 2022. The survey involved follow-up sampling of previously identified sources that had fecal coliform counts exceeding 240 MPN / 100ml. These sources were evaluated to determine the bacteriological impact on the shellfish growing area. The survey area encompasses all the shoreline south of Quonset Point including the shorelines of North Kingstown and Narragansett to Bonnet Shores on the western side of the area and the Jamestown shoreline from Conanicut Point to Beavertail Point (Figure 1).

1. Description of Growing Area

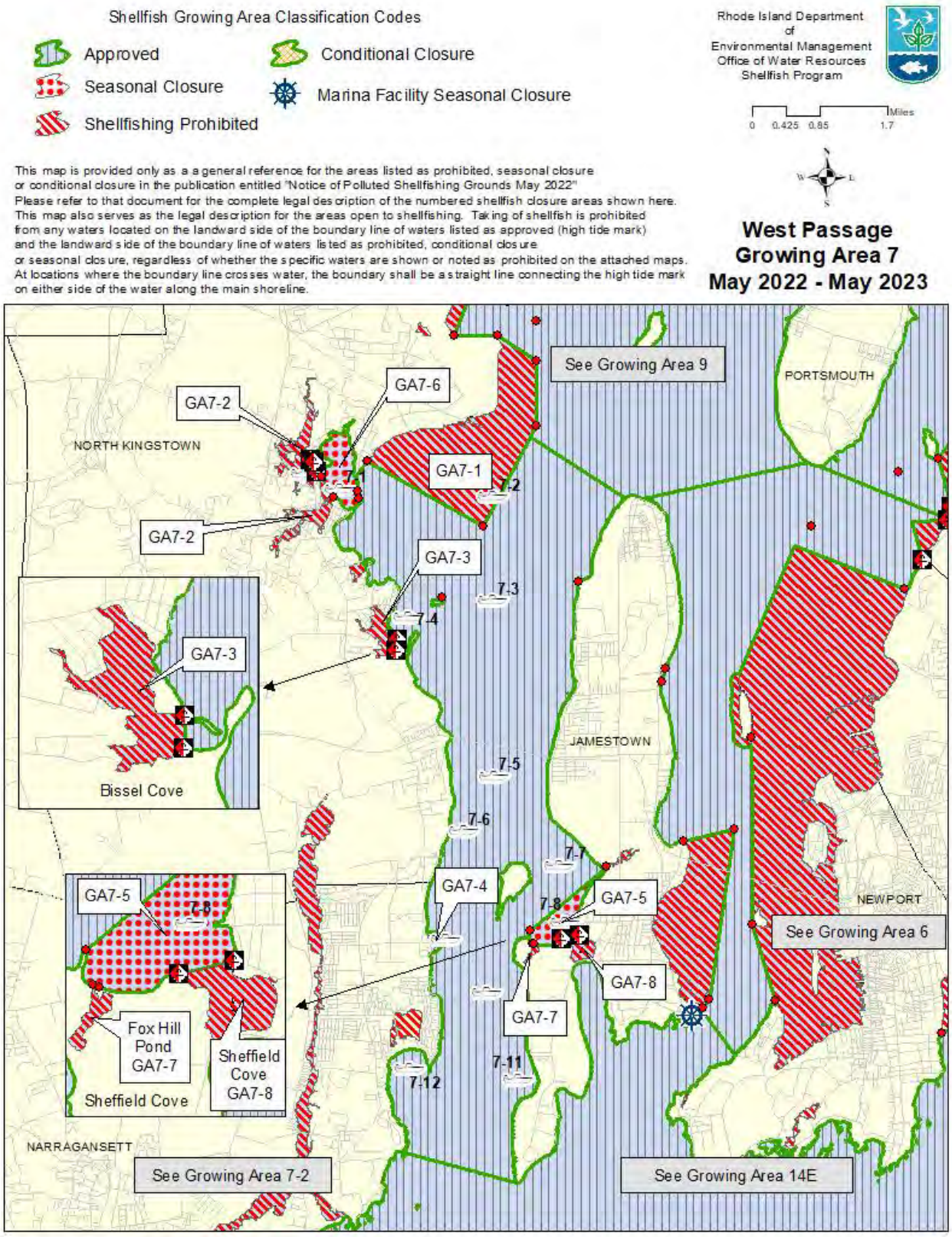
Growing Area 7 is presently comprised of sections classified as approved, seasonal, and prohibited for shellfishing (Figure 1). Five distinct areas of this growing area are prohibited to shellfishing. They are Wickford Cove, Bissel Cove, a portion of the upper West Passage abutting the Quonset Point area, Sheffield Cove in Jamestown, and the area around the docks at the University of Rhode Island's Bay Campus. Outer Wickford Harbor in N. Kingstown and Dutch Harbor on Jamestown are operated as conditionally approved / seasonally approved areas with seasonal closures in effect between Memorial Day weekend and Columbus Day weekend due to the large number of recreational boats and transient moorings in these two areas during peak summer months. There are several aquaculture operations in the area south of Wickford Harbor (station 7-4) and on the west side of Jamestown (near station 7-7).

Hydrographic Characteristics

Total area of the West Passage Growing Area 7	Approximately 12,000 Acres
Widest Reach	Approximately 4.3 miles
Deepest Point	85 feet
Average Depth	30 -50 feet

The West Passage Growing area encompasses approximately 12,000 acres of Narragansett Bay waters. Much of the shoreline within the West Passage consists of medium to high-density developments with onsite waste water treatment systems (OWTSs). The southern portion of Jamestown and Dutch Island and the area near Rome Point and Casey Farm in North Kingstown have large tracts of open space. This open space includes several parks and tracts of conservation land adjacent to this growing area: Fort Getty Park (approx. 40 acres), Beaver Tail State Park (approx. 150 acres), Dutch Island (approx. 100 acres), Watson Farm (265 acres). Rome Point (approx. 250 acres) and Casey Farm (approx. 300 acres). No large rivers flow directly into GA7.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA7



2. Pollution Source Survey

Anthony Crudale, Biologist from the Department of Environmental Management Division of Water Resources conducted the review for the triennial update of the shoreline of the West Passage. This review involved follow-up sampling on all previously identified sources in which bacterial results from sampling exceeded the 240 CFU/100 ml threshold established in the shellfish programs standard operating procedures. In 2022, four (4) sources warranted follow-up sampling. They are identified and described in Table 1. Figure 2 is a map depicting the location of these sources within the growing area.

Figure 2: 2022 Pollution Sources in GA7 with Routine Monitoring Stations

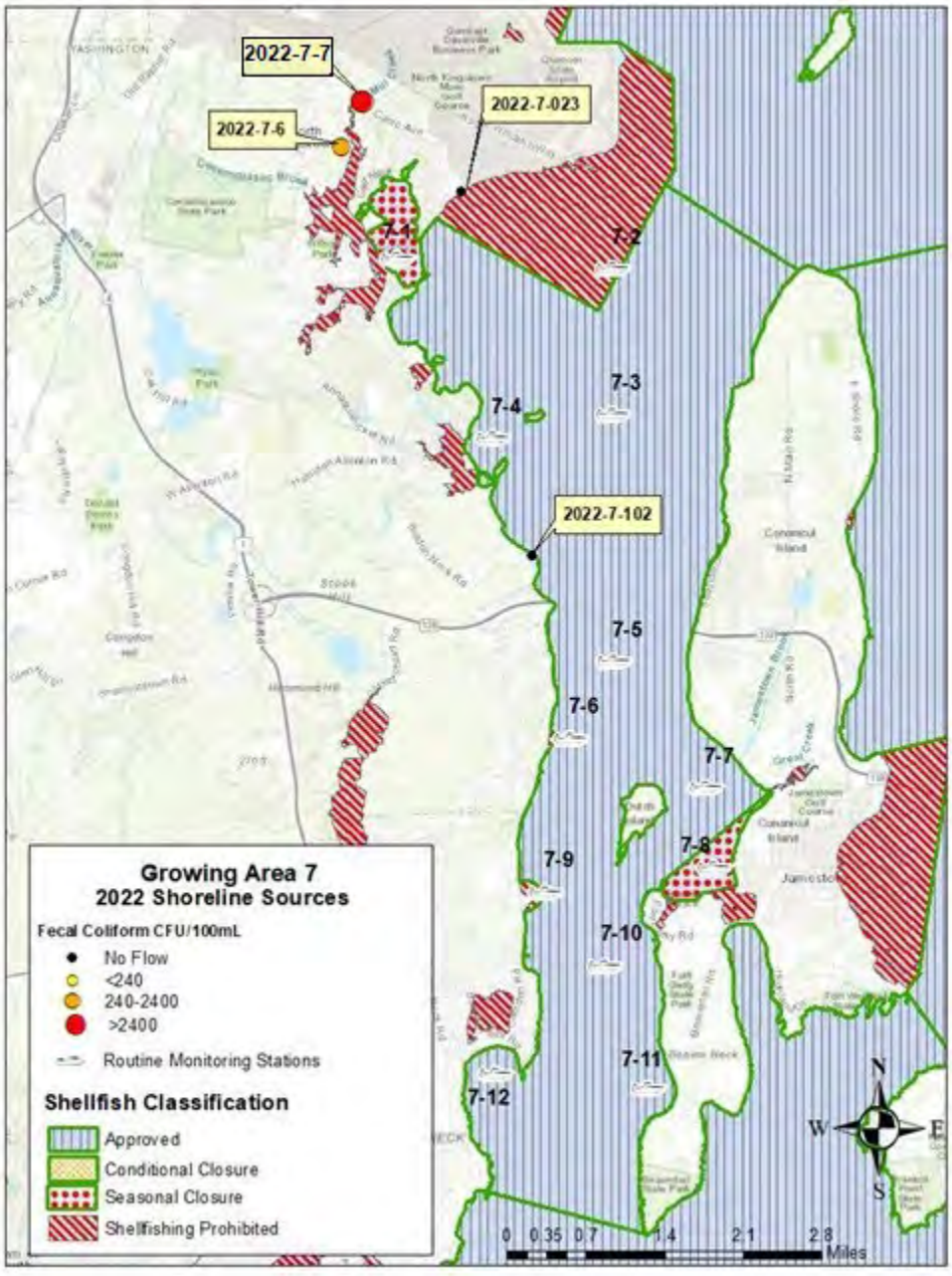


Table 1: 2022 Summary of Pollution Sources in GA7

Source ID	Date Visited	Latitude	Longitude	Description	Receiving waters classification	Actual / Potential	Direct / Indirect	2019 Results mTEC cfu/100ml	2022 Results mTEC cfu/100ml	2022 Volumetric Flow
2022-7-6	8/23/22	41.589	-71.45164	Stream at #15 Walnut Street	Prohibited	A	D	640	1600	25mL/sec
2022-7-7	8/23/22	41.595	-71.44799	Stream at Camp Ave Mill Creek Box culvert	Prohibited	A	D	1100	2900	50mL/sec
2022-7-023	8/23/22	41.5832	-71.4311	Small outlet from upland marsh at north end of beach access from Shore Acres	Prohibited	A	D	>1600	NS	NF
2022-7-102	8/23/22	41.5362	-71.41897	Outlet from upland tidal pond - fades into sand above high tide	Approved	A	D	1500	NS	NF

Highlighted sources >240 CFU/100ml IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate

Sources 7-6 and 7-7 are both small streams that flow into the receiving waters of Mill Cove (classified as Prohibited) in inner Wickford Harbor, North Kingstown, RI. Source 7-6 is a stream near #15 Walnut Street that flows into the prohibited waters of Mill Cove in the northwest corner of inner Wickford Harbor. This source (7-6) had a fecal coliform concentration of 640 cfu/100 ml sampled on July 1, 2019, warranting follow up sampling in 2022. When visited on August 23rd, 2022, this source had a flow of 25mL per second and a result of 1,600 CFU/100mL and an instream result of 220 CFU/100mL. This freshwater stream enters prohibited waters approximately 1.2 miles inland of the seasonally approved waters of outer Wickford Harbor.

Source 7-7 had a fecal coliform concentration of 1,100 cfu/100 ml in 2019 and a result of 2,900 CFU/100mL in 2023. The distance (1.2 to 1.5 miles) from these sources through a prohibited zone to the seasonally approved waters of outer Wickford Harbor provides sufficient dilution to reduce bacteria levels prior to reaching shellfish harvest waters. This is supported by results at DEM Shellfish monitoring station 7-1, located in seasonally approved waters of outer Wickford Harbor which had a fecal coliform geometric mean of 2.6 cfu/100 ml with 0% of the recent 15 observations exceeding 31 cfu/100 ml while the area was in the open (seasonal) status for shellfish harvest. Both sources will be sampled again the following year given their high results.

Source 7-023 is in the Shore Acres area of North Kingstown and is a small stream that flows from an upland marsh across a beach into the prohibited waters surrounding Quonset Point. This source had a fecal coliform result of >1,600 cfu/100 ml when sampled for the 2019 sanitary survey however was not flowing when visited in August of 2022 therefore no sample was taken.

Source 7-102 is the outlet of an upland tidal pond that had a result of 1,500 CFU/100mL in 2019 and this source was reinvestigated during 2022. This source was not flowing at the time of the 2022 investigation so no samples were taken.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved or seasonally approved waters of Growing Area 7 (West Passage) due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

3. Wastewater Treatment Facilities (WWTF)

Public sewers service several areas adjacent to the growing areas of the West Passage including the Bonnet Shores neighborhood of Narragansett, east of the Narrow River and a 752-acre area just east of Dutch Harbor and Sheffield Cove in Jamestown. These areas are serviced by WWTF that discharge outside growing area 7. The area surrounding Quonset Point is also serviced by municipal sewers and a WWTF that discharges into a closed safety zone (prohibited area) in Growing Area 9. All other areas of the watershed are serviced by Onsite Wastewater Treatment Systems (OWTS).

There are currently thirteen RIPDES permits within close proximity to receiving waters of the growing area (Table 2). Twelve of the thirteen RIPDES permitted discharges flow into prohibited waters with Fox Island being the only permitted source releasing into approved waters. Fox island is a small island on the western side of the growing area. The Fox Island permit is for discharge from a reverse osmosis system used by the single residence on the island due to the lack of freshwater on the island.

The Quonset WWTF discharges treated effluent into adjacent waters of Growing Area 9, just north of GA7. A review of Quonset Point WWTF performance data (echo.epa.gov) indicates that there were no fecal coliform violations during 2022. The facility did report one *Enterococci* daily max violation in January of 2022. The daily maximum value per their permit is 276 CFU/100mL and they reported an instance of 560 CFU/100mL. Per NSSP Model Ordinance requirements a prohibited safety zone is established around this outfall. The PLUMES model analysis used to establish the size of the closed safety zone is available for review in the program's permanent files.

The RIPDES permitted discharge is a non-sanitary water release pipe from the Jamestown Water Treatment Facility that discharges into Jamestown Brook which then ultimately discharges into the east shore of Jamestown at the northern end of Dutch Island Harbor. This discharge (identified as source 7-1000) has historically had low fecal coliform values (2018 result was below detection of 2.0 cfu/100 ml) and the source has little impact on the microbial water quality of the receiving waters.

Table 2: RIPDES permits within Growing Area

Name	Permit ID	Receiving Waters Classification
Quonset WWTF	RI0100404	Prohibited
Senesco Marine, LLC	RIR50R010	Prohibited
J. Goodison Company	RIR50R017	Prohibited
General Dynamics Electric Boat Corp.	RIR50R008	Prohibited
Pleasant Street Wharf	RIR50Q016	Prohibited
Northwick Boatyard	RIR50Q021	Prohibited
Wickford Shipyard	RIR50Q031	Prohibited
U.S. EPA	RI0000949	Prohibited
Fox Island	RI0023736	Approved
Army Aviation	RIR50S006	Prohibited
RI Airport/ Quonset Airport	RIR50S002	Prohibited
RI Air National Guard	RI0021555	Prohibited
Jamestown Water Treatment Facility	RI0001619	Prohibited

4. Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain certification.

Water samples are collected at thirteen (13) monitoring stations throughout the growing area. Two (2) of the stations are in Conditionally Approved / Seasonally Approved waters and three (3) stations are in Prohibited waters. The remaining eight (8) stations are in Approved waters.

Samples are collected 0.5 m below the water surface (using 125 ml sterile Nalgene bottles) after which they are stored in a cooler packed with ice. They are then transported to the Rhode Island Department of Health Laboratories for analysis. Since June 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics for GA4 were analyzed by the mTEC method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

A 2022 Review and Statistical Summary of Growing Area 7

HIGHLIGHTS

* Sampled 6X during 2022 season (4 wet weather, 2 dry weather).
* For approved stations, statistics represent recent 30 samples collected during wet (n = 17) and dry (n = 13) conditions during 8/21/2017 or 11/28/2017 to 12/5/2022.
* For seasonally approved stations 7-1 and 7-8, statistics represent recent 15 samples collected 11/28/2017 to 12/5/2022 (12 wet, 3 dry) when these seasonally approved stations were open.
* All approved stations are in compliance.
* All seasonally approved stations are in compliance.
* All samples analyzed by the mTEC method.
* Data run 12/9/2022.

COMMENTARY

The West Passage (Growing Area 7) was sampled six times during 2022, meeting minimum sampling requirements for approved waters. The recent 30 samples used in the 2022 statistical evaluation of approved stations were collected since 8/21/2017 or 11/28/2017 and included samples collected during wet (n=17) and dry (n=13) weather conditions. Statistics for seasonally approved stations 7-1 and 7-8 were calculated based on the recent 15 samples (9 wet, 6 dry) collected when the station was in the open status.

Results of the 2022 statistical evaluation demonstrated that all approved stations are in program compliance (Table 3). 2022 compliance statistics for seasonally approved stations 7-1 (Wickford Harbor) and 7-8 (Sheffield Cove) also demonstrated that these stations are in compliance and that the seasonal closures in these areas are effective (Table 4). During 2018 a new station (station 7-1A) was established in the prohibited area in Mill Cove (inner Wickford Harbor) to assess the water quality of Mill Cove (prohibited classification) and to measure the impacts of municipal sewer service upgrades in parts of the adjacent watershed on Mill Cove fecal coliform water quality. Thus far, station 7-1A (prohibited waters of inner Wickford Harbor) has had fecal coliform levels that are similar to those of outer Wickford Harbor (seasonally approved waters, station 7-1) during the seasonal open season.

Station 7-4, located outside Bissel Cove, continues to show mildly elevated fecal coliform levels as compared to other approved stations in GA7. This likely is a result of water from contiguous Bissel Cove (prohibited waters) flowing into approved waters on outgoing tides. In 2022 DEM-OWR shellfish began a program of regularly sampling the two freshwater streams that flow into Bissel Cove to characterize these potential fecal coliform sources and their effects on the microbial water quality of the growing area.

RECOMMENDATIONS

* No actions required based on 2022 ambient monitoring results.
* Continue monitoring station 7-1A to track water quality changes in inner Wickford Harbor.
* Continue monitoring freshwater streams flowing into Bissel Cove (prohibited waters).

Table 3: GA7 Fecal coliform statistical summary for approved stations based on recent 30 samples collected under all weather conditions during 8/21/2017 or 11/28/2017 to 12/5/2022 (all mTEC, 17 wet, 13 dry weather samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
7-1	SA	30	3.9	16.3
7-1A**	P	26	15.6	115.4
7-2	P	30	2.0	2.6
7-3	A	30	2.3	5.5
7-4	A	30	3.2	10.5
7-5	A	30	2.0	2.8
7-6	A	30	1.9	2.0
7-7	A	30	2.0	2.6
7-8	SA	30	2.0	2.6
7-9	P	30	2.0	2.3
7-10	A	30	2.0	2.6
7-11	A	30	2.0	2.3
7-12	A	30	2.2	5.0

** new station 7-1A added at Mill Cove, Wickford inner harbor in 2018. Number of observations is low (n=26); data shown for informational purposes, not compliance.

Table 4: GA7 Fecal coliform statistical summary for seasonally approved stations based on recent 15 samples collected when the area was in the open status during 11/28/2017 to 12/5/2022 (all mTEC, 12 wet, 3 dry weather samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
7-1	SA	15	2.6	0.0
7-1A**	P	9	5.1	0.0
7-8	SA	15	1.9	0.0

** new station 7-1A added at Mill Cove, Wickford inner harbor in 2018. Number of observations is low (n=9 when seasonal areas open); data shown for informational purposes, not compliance.

5. Conclusions and Recommendations

The 2022 triennial update of Growing Area 7 (West Passage of Narragansett Bay) demonstrated that all Approved and Conditionally / Seasonally Approved monitoring stations in the growing area meet NSSP criteria while in the open status. The 2022 review also documented that there are no shoreline pollution sources that are negatively impacting the fecal coliform water quality of the growing area.

The 2022 update has demonstrated that the area is properly classified. No changes in classification are recommended.

GA 7-2 Annual Update: Narrow (Pettaquamscutt) River

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1. Introduction

Due to elevated fecal coliform concentration, portions of the Narrow River (Growing Area 7-2) have been classified as prohibited to shellfishing since August 28, 1979. This partial closure was followed by the current classification of the entire Narrow River as prohibited which began on July 15, 1986. Because the area has been classified as prohibited to shellfishing for decades, a shoreline survey of the growing area has not been completed since 1979. However, during July 2018 DEM Shellfish staff completed a comprehensive shoreline survey of the southernmost section of GA7-2, the area south of Sprague Bridge to the confluence of the Narrow River with the open waters of Rhode Island Sound (GA14). In addition, DEM Shellfish staff regularly sample five stations in the Narrow River to track changes in fecal coliform concentration. Follow up source sampling was completed as part of the area's shoreline survey update in 2019, 2020, 2021.

2. Shoreline Survey of Lower River

A shoreline survey of the southernmost portion of the Narrow River (GA 7-2) covers approximately 4,500 feet of tidal river length extending from the crossing of Route 1 at Sprague Bridge south to where the Narrow River joins RI Sound (Figure 1). The area surveyed comprises approximately 39 acres of Narrow River tidal waters currently classified as prohibited to shellfish harvest. The area is a popular recreational site visited by small boats (kayaks, skiffs) during the warmer months of the year. The tidal waters are surrounded by a fringing *Spartina*-dominated saltmarsh and upland forest with some

residential housing. There are approximately twenty (20) private residences and two (2) beach clubs within 1,500 feet of the surveyed area of the Narrow River downstream of Sprague Bridge.

No sources were investigated in GA7-2 during 2022 as the entire area is classified as prohibited. A survey of the lower portion of GA7-2, south of Sprague Bridge, was completed in 2018. Twenty-seven (27) potential sources were identified with seven (7) sources found to be dry during the 2018 survey. No large-flow sources were identified, with most potential sources having only a trickle of flow on the survey dates. Nineteen (19) of the twenty (20) sources found to have some flow, had fecal coliform results of less than 240 cfu/100 ml. Source 7-2-028 was the only source resampled in 2019, 2020 and 2021. Source 7-2-028 has continuously had a minimal flow when sampling and historic instream sampling has shown results of less than 20 cfu/100mL, therefore was not visited this year. The source flows into prohibited waters with a strong tidal current allowing rapid dilution upon entering the receiving waters.

3. Water Quality Monitoring

The Shellfish Growing Area Monitoring program is part of the state of Rhode Island's agreement with the United States Food and Drug Administration's National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harvesting waters of the state in order to maintain certification of these waters for shellfish harvesting for direct human consumption.

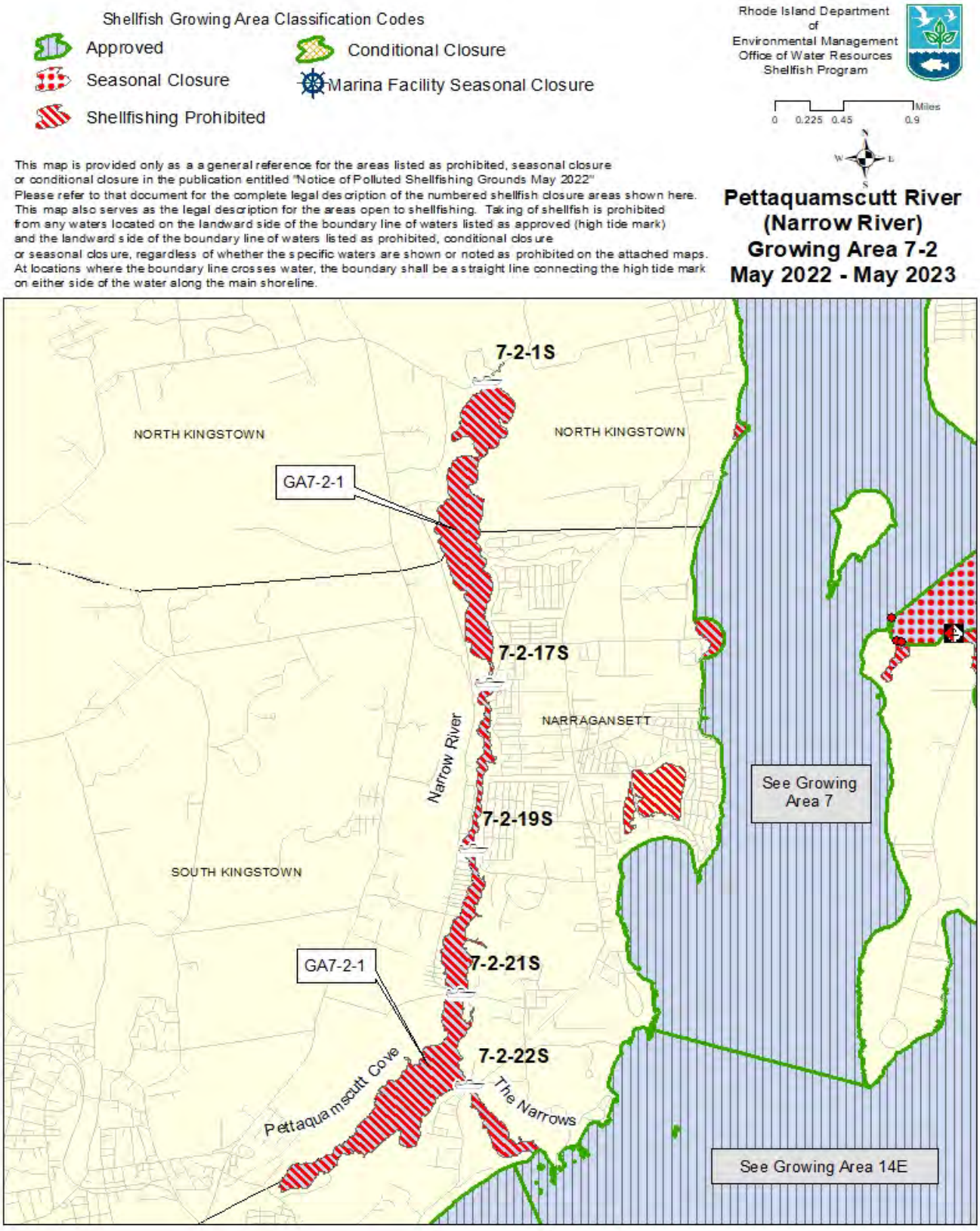
Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1999) for the standard fecal coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012. The procedures for water sample holding times and temperature control are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedures, August 2021 update (copy in the Program's permanent file).

The results of all bacteriological monitoring – whether collected as part of the routine bacteriological monitoring program or sanitary survey program – are evaluated by RIDEM Shellfish staff as they are received from the RIDOH. Any unusual or exceptionally elevated values are immediately evaluated to determine the need for additional sampling and/or investigation

4. Marinas and Mooring Fields

There are two marinas located within the waters of this growing area. Both marinas have mainly small vessels because the waters of the river are shallow and low bridges limit the size of boats capable of navigating to these marinas. The waters of the entire river are currently classified as prohibited which includes the marina proper and further provide more than ample dilution to be protective of shellfishing in adjacent approved waters at the confluence of the river with open waters of Rhode Island Sound approximately a mile and a half to the southeast. Refer to the report entitled RIDEM "Evaluation of Waters Adjacent to Marinas: Marina Dilution Analysis Background, November 2022" which is located in the program's permanent files for further details and the relative dilution calculations.

Figure 1: 2022-2023 classification map and routine monitoring stations.



5. Annual Statistical Summary

A Growing Area 7-2, Pettaquamscutt River (Narrow River)

HIGHLIGHTS

* Sampled 11X during 2022.
* Shellfishing is prohibited in growing area 7-2. Statistics were calculated for informational purposes of tracking water quality changes.
* Statistics represent recent 30 samples collected during wet (n= 17) and dry (n= 13) weather 8/26/2019 to 12/13/2022.
* Statistics also calculated under conditionally approved scenario (less than 0.5" rain in prior 7 days) for recent 15 samples collected 3/29/2018 to 7/27/2022.
* All samples analyzed by the mTEC method.
* Data run 1/11/2022.

COMMENTARY

The Pettaquamscutt River (Growing Area 7-2) was sampled 11 times from shore-access stations during 2022. The area in its entirety has been classified as prohibited to shellfishing since 1986 so there is no minimum sampling requirement. The 2022 statistical evaluation for the Pettaquamscutt River includes an approved scenario (recent 30 samples collected under all weather conditions) and a conditionally approved scenario (recent 15 samples collected during dry weather). The area has been closed to shellfish harvest for direct human consumption since 1986 due to unpredictable and elevated fecal coliform levels. A TMDL was completed for the area in 2002, with recommendations for monitoring to follow long-term changes in fecal coliform water quality.

Approved scenario: The recent 30 samples collected under all weather conditions were from 8/26/2019 to 12/13/2022 with 17 samples collected under wet (greater than 0.5" rain in prior 7 days) weather conditions and 13 collected during dry weather. The review of 2022 observations demonstrated that fecal coliform levels were greater than NSSP criteria for safe harvest of filter-feeding molluscan shellfish at all Narrow River stations (Table 2).

Conditionally Approved scenario (0.5", 7-day closure): Evaluation of the recent 15 samples collected during dry weather conditions (< 0.5" rain in 7-days prior to sampling) demonstrated that fecal coliform levels in the Narrow River exceed NSSP criteria for safe shellfish harvest during dry weather (Table 3).

Although fecal coliform levels are lower than those observed decades ago, the 2022 update showed that all stations in the Narrow River exceeded NSSP fecal coliform criteria under both approved and conditionally approved scenarios. The 2022 evaluation demonstrated that the Narrow River continues to exceed fecal coliform levels that support safe harvest of molluscan shellfish. The area is properly classified a Prohibited. DEM Shellfish Program staff will continue to monitor the fecal coliform water quality of the Narrow River growing area to track any potential improvements in water quality.

RECOMMENDATIONS

* Continue approximately monthly shore-based sampling under all weather conditions to track water quality changes and to support TMDL efforts in the watershed.
* No other action recommended.

Table 1: GA7-2 fecal coliform summary statistics calculated under an Approved scenario – for informational purposes only. Recent 30 samples collected in all weather (8/26/2019 to 12/13/2022; all mTEC, 17 wet and 13 dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
7-2-1S	P	12	21.8	222.5
7-2-17S	P	30	34.7	341.5
7-2-19S	P	30	39.9	450.0
7-2-21S	P	30	26.5	265.2
7-2-22S	P	30	21.9	143.9

** Station 7-2-1S (Gilbert Stuart Brook) added in 2021, has low sample count (n=12).

Table 2: GA7-2 fecal coliform summary statistics calculated under a Conditionally Approved scenario – for informational purposes only. Recent 15 samples collected during dry weather (<0.5" rain in previous 7 days; 3/29/2018 to 7/27/2022; all mTEC, 15 dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
7-2-1S	P	3	20.0	0.0
7-2-17S	P	15	47.7	46.7
7-2-19S	P	15	30.4	60.0
7-2-21S	P	15	25.5	46.7
7-2-22S	P	15	23.0	26.7

** Station 7-2-1S (Gilbert Stuart Brook) added in 2021, has low sample count (n=3 dry weather samples).

6. Summary and Conclusions

The 2022 update demonstrated that fecal coliform water quality in Growing Area 7-2 (Pettaquamscutt or Narrow River) does not meet NSSP criteria under either an Approved or a Conditionally Approved (0.5", 7-day rain closure) scenario. The 2022 update has demonstrated that the area is properly classified as Prohibited. No changes in classification are recommended.

GA8 Annual Update: Greenwich Bay

2022

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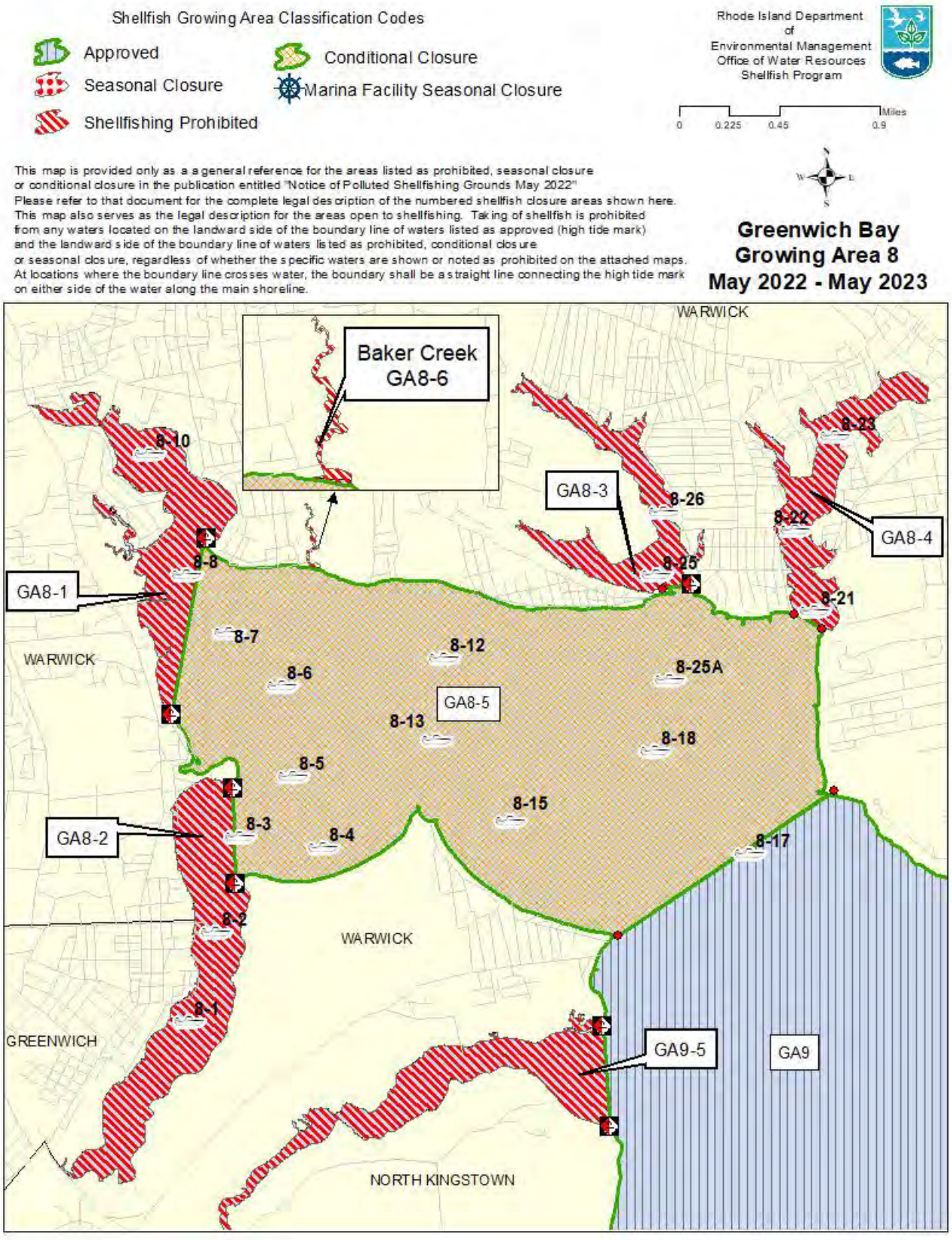
1. Introduction

12-year shoreline surveys of the Greenwich Bay Growing Area 8 (Figure 1) were completed in 2005 and 2017. Triennial updates were completed during 2008, 2011, 2014, 2017 and 2020 while annual updates were completed during each intervening year. A total of 206 potential or actual sources were identified during the 2017 shoreline survey. Eighty-four (84) of these sources had flows while the remaining one hundred twenty-two (122) were not flowing at the time of the 2017 survey. None of the flowing sources had results greater than 2,400 MPN /100 ml therefore did not warrant follow-up as per the program's standard operating procedures for this annual review. Although no source was identified that exceeded the 2,400 MPN/100 ml criteria for follow-up sampling, out of an abundance of caution several sources that had previously elevated counts were re-sampled in 2022.

Figure 1: 2022-2023 GA 8 Shellfish Classification Map



2. 2022 Shoreline Survey

Five (5) sources that had shown elevated fecal coliform levels were investigated in 2022 to verify previous results indicating that they were not impacting the growing area (Table 1). Four of the five sources were flowing at the time of 2022 inspection and therefore were sampled. All sources were sampled on 11/22/2022 (same day received 0.52" rain at TF Green Airport, KPVD).

Source 8-2-213 (Figure 2) is a 30" concrete pipe located below the deck of the waterfront restaurant Blu On The Water. The restaurant is located between two marinas in East Greenwich Cove which has a permanent closure (classified as prohibited) due to the outfall of the East Greenwich WWTF. Source 8-2-213 had an extremely high result of 50,000 cfu/100mL when sampled in 2021. When visited in 2022, this source had a result of 640 CFU/100mL. The pipe enters a small area of water that is almost entirely enclosed in by a sandbar, making it difficult to flush out. However, instream sample results of 4 CFU/100mL show rapid dilution before entering the prohibited waters of the growing area. The source is approximately 2,500 feet from the conditionally approved water of the growing area, providing adequate dilution.

Figure 2: Source 8-2-213, 30" concrete pipe below Blu On The Water

Source 8-4-400 is Hardig Brook at the headwaters of Apponaug Cove. This source had a fecal coliform result of 1,200 cfu/100ml during the 2017 12-year survey. When this source was followed up in 2022, it had a fecal coliform level of 300 cfu/100 ml, still elevated above the 240 cfu/100mL threshold. This source flows into prohibited waters of Apponaug Cove (GA8-1), approximately 1.2 miles upstream of the conditionally approved waters of the growing area. There is ample dilution prior to entering the conditionally approved waters as demonstrated by the fecal coliform levels at sentinel station 8-6 which meets NSSP fecal coliform criteria while in the open status.

Source 8-5-504 is a 4 ft wide canal draining a wetland area that is adjacent to a heavily developed residential area, when visited this year this source was not flowing therefore no sample was taken.

Source 8-6-602 is a stream that flows through Warwick City Park and enters the prohibited waters of Buttonwoods Cove (GA8-3). This source had a result of 100cfu/100 mL and a trickle flow during the 2022 inspection.

Source 8-6-672 is a 36" pipe at the end of Shand Ave. Both of these sources had results of 300 cfu/100mL and had minimal flow (25mL/ sec) when sampled during 2022. Both sources flow into prohibited waters which provide adequate dilution to be protective of the water quality of the conditionally approved waters of GA8.

Figure 3: 2022 Shoreline survey pollution sources in GA 8. Routine monitoring stations indicated by boat symbols.

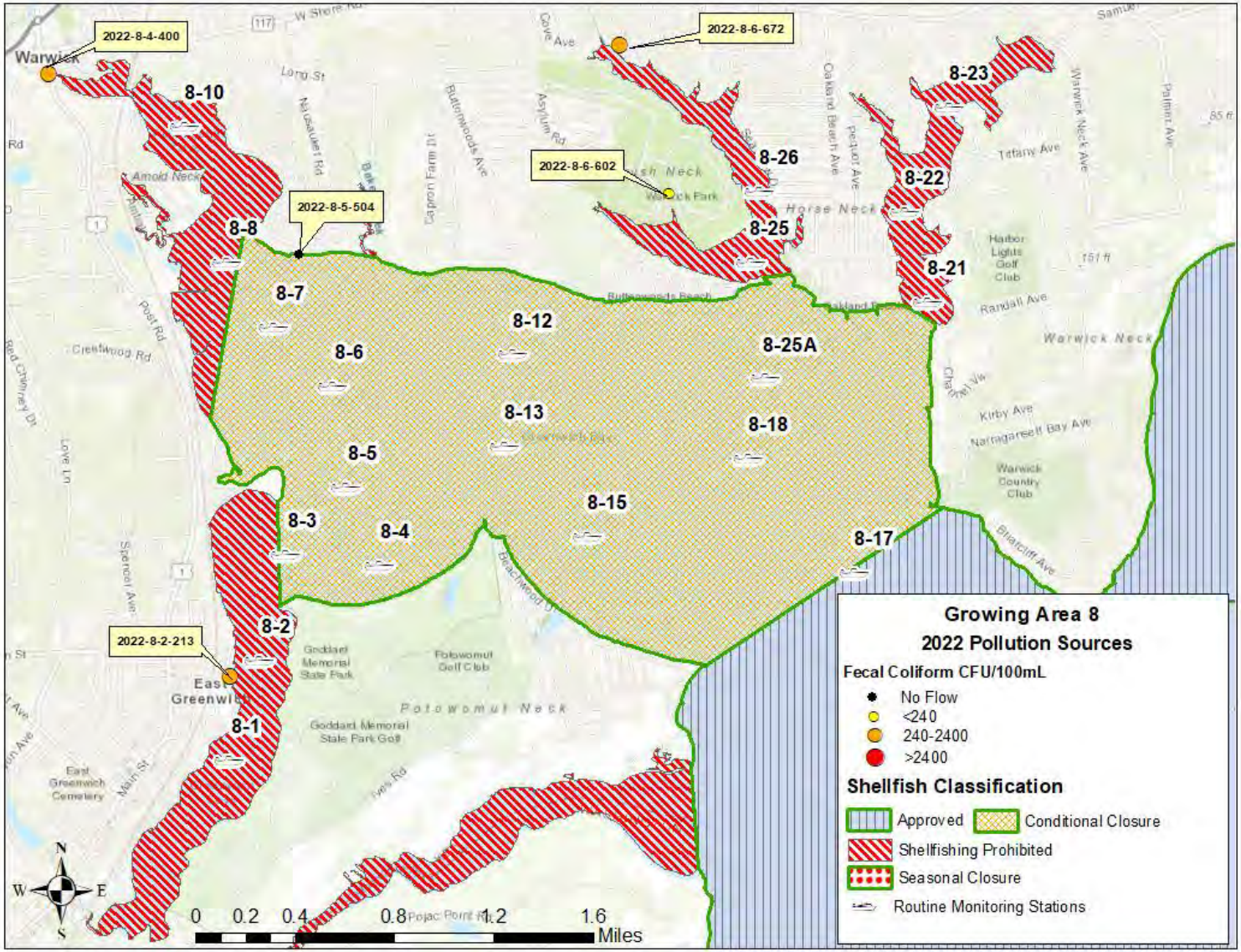


Table 1: 2022 Summary of Pollution Sources in GA 8

Source ID	Date Visited	Latitude	Longitude	Description	Receiving waters classification	Actual / Potential	Direct / Indirect	2017 Results mTEC cfu/100ml	2022 Results mTEC cfu/100 ml	Volumetric Flow
8-2-213	11/22/ 2022	41.6623	-71.445267	30" concrete pipe under south end of 20 Water St deck. Visited at low tide and water was still up to and slightly flooding pipe.	Prohibited	Actual	Direct	1200	640	Trickle
8-4-400	11/22/ 2022	41.697467	-71.459383	Hardig Brook at Rt 1	Prohibited	Actual	Indirect	1200	300	13.6
8-5-504	11/22/ 2022	41.686967	-71.43985	4' wide concrete canal draining upstream wetlands	Prohibited	Potential	Direct	1120	NS	NF
8-6-602	11/22/ 2022	41.690483	-71.411133	Stream upstream of culvert under bike path at Warwick City Park	Prohibited	Potential	Indirect	420	100	Trickle
8-6-672	11/22/ 2022	41.699117	-71.414933	36" concrete pipe at end of Shand Ave	Prohibited	Actual	Direct	1270	300	2mL/Sec

*Red highlighted sources >2400 cfu/100ml; Yellow highlighted sources > 240 cfu/100ml NF = No flow, NS = No source

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Greenwich Bay (Growing Area 8) due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

3. Marinas and Moorings

Greenwich Bay is home to fifteen (15) marinas with over forty-four hundred (4,400) slips and moorings available to boaters. These marinas vary in size and capacity from the small private yacht club in Brushneck Cove with less than 10 slips to the large, full-service marina such as Safe Harbor Greenwich Bay. All of these marinas are located in prohibited waters and dilution calculations have been performed to ensure that the prohibited zone is of sufficient size to provide ample dilution zones to be protective of water quality in the adjacent waters. These calculations can be found in the programs permanent file and are tabulated in the document entitled "Marina Dilution Analysis, November 2022". All the marinas have sufficient dilution waters for the slip counts and usage rates currently existing. Additional pump out facilities that are privately owned may be available and would complement the public facilities.

There are currently 10 pump-out facilities and 2 mobile pump-out boats in the Greenwich Bay area to service the boating public. An inventory of pump-out facilities (both private and CVA-funded) is available for review in the Program's permanent files.

4. Wastewater Treatment Facilities (WWTF)

There are thirteen RIPDES permits within the Greenwich Bay growing area, a majority of which are issued to the marinas that encompass this area. Two are issued to municipalities, one being the City of Warwick (RIR040031) located at the end of Apponaug Cove for stormwater discharge. The only sanitary discharge permitted in the growing area is for the East Greenwich WWTF.

The East Greenwich WWTF is a modern "Rotating Biological Contactors" secondary treatment plant that was converted to UV disinfection in February of 2004. Additional construction was completed in 2006 to meet a seasonal Total Nitrogen limit of 5 mg/l. A recent upgrade (in 2017) was the new UV system control panel. They are currently replacing their RBC (Rotating Biological Contactors) units and rehabbing their secondary clarifiers. Plant operators immediately report any permit violations or failure events to RIDEM's Office of Operations and Maintenance (or DLE after hours) which is then conveyed directly to the shellfish program for any necessary actions according to the CAMP. The plant has a design flow of 1.7 MGD and serves approximately 6,000 customers. The plant currently has a RIPDES permitted discharge (RI0100030) that discharges into Greenwich Cove.

The facility is permitted to discharge a maximum daily of 1.70 MGD (million gallons/day) of treated effluent. The average flow for 2022 was 0.82 MGD, well within the permit limits. While fecal coliform is not a permit criterion, it is monitored, and average monthly geometric mean fecal coliform was 2.7 cfu/100 ml during 2022. There were 2 *Enterococci* violations in 2022, the monthly geomean for January exceeded the 35 cfu/100mL permit limit, with a reported 50 cfu/100mL. The second violation was also in January for a daily max *Enterococci* reporting 300 cfu/100mL exceeding the permit limit of 276 cfu/100mL. This review of the East Greenwich WWTF indicated that the facility is well-run and was operating well-below permitted fecal coliform discharge levels during 2022.

A dye study was completed in Greenwich Cove in 1986 to determine the travel time and dilution of effluent from the wastewater treatment facility. The flow rate of the effluent from the plant was 0.8-1.05 MGD. Results of the study concluded that it takes approximately 14.5 hours for the effluent from the plant to exit Greenwich Cove (Turner 1986). This portion of the growing area is classified as prohibited, and so it takes that amount of time for the discharge from the plant to enter the conditionally approved section of Greenwich Bay. In addition, prior to reaching the current defined edge of the prohibited area, the effluent is diluted by a factor of 1,700, meeting the NSSP requirements that a dilution ratio of 1,000:1 be reached within the prohibited zone.

The flow rate of effluent has not changed significantly since the completion of the dye study (2018 average flow of 0.98 MGD and past years' flows generally between 0.8 and 1.0 MGD), and therefore, these dilution values would still apply. However, significant improvements have been made to the plant over the years, such as the installation of RBCs in 1989 and a UV disinfection system in 2004, which ultimately reduce viral loads and more efficiently eliminate pathogens in the effluent.

Finally, in the event of a wastewater treatment facility failure, the plant operator is required to inform DEM immediately so that appropriate action can be taken. This allows shellfish staff to close the conditionally approved area within 12 hours (within the 14.5-hour travel time of the effluent) and reopen when conditions have returned to normal. Per NSSP requirements if an extended failure to treat event outside of these design parameters should occur at the plant, the conditionally approved area would be closed for 21 days or until shellfish samples collected after 7 days are tested and show male-specific coliphage levels below 50 PFU/100 grams.

5. Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) as codified in the National Shellfish Sanitation Program (NSSP). The purpose of these programs is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states management programs and to enforce and maintain an industry standard. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain certification.

Water samples are collected at eighteen (18) monitoring stations throughout the growing area. Ten (10) of the stations are in Conditionally Approved waters and eight (8) stations are located in Prohibited waters.

Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All

samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1999) for the standard fecal coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012. The procedures for water sample holding times and temperature control are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedures, August 2021 update (copy in the Program's permanent file).

Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

A Annual Statistical Summary: GA8 (Greenwich Bay)

HIGHLIGHTS

* Sampled 10X during 2022.
* Statistics represent recent 15 samples collected between 11/22/2020 or 1/7/2021 and 11/2/2022 for most stations.
* Statistics represent recent 15 samples collected between 3/9/2020 or 5/20/2020 and 8/2/2022 for stations 8-25 and 8-26 which are in shallow coves that cannot be sampled at low tide.
* All samples analyzed by the MTEC method.
* All conditionally approved stations are in compliance.
* Data run 1/25/2023.

COMMENTARY

Greenwich Bay (GA8) was sampled ten times during 2022 with seven samples collected while the area was in the open status and three samples collected while the area was in the closed status. Samples were not collected during January, March, April and October 2022. Samples were not collected during January, March, April 2022 due to mechanical problems with the monitoring boat outboard engine. The boat engine was replaced in May 2022 which will aide in completing sampling requirements in the future. Sampling of Greenwich Bay was not completed in October 2022 due to wet weather; with 5.85 inches of rain falling at TF Green Airport (NOAA KPVD station) compared to a long-term October average rainfall of 4.60". This rain kept the Greenwich Bay conditional shellfish area (GA8) closed for 25 of 31 days (81%) and the area was open on only two weekdays that the DOH Lab could receive and analyze samples during October 2022. Double sampling (two sample runs per month) was completed in June and December 2022 to offset some missed monthly samples.

Note that the classification of a 180 acre area near the mouth of Apponaug Cove was upgraded from prohibited to conditionally approved in September 2022. This classification upgrade was based on reduced fecal coliform loading in the Apponaug area due to expansion of municipal sewer service and concomitant improvements in fecal coliform water quality. Monitoring station 8-7, formerly classified as prohibited; now classified as conditionally approved, had met NSSP criteria for approved waters since 2011. Details of this reclassification are in the report "Documentation of Change in Apponaug Cove Shellfish Closure Line (GA8-1), August 2022" amended to the GA8 CAMP.

The 2022 statistical evaluation showed that all conditionally approved stations in Greenwich Bay were in compliance with NSSP criteria. 'Sentinel stations' located in prohibited areas of Greenwich Cove (station 8-3), Apponaug Cove (station 8-8) and Warwick Cove (station 8-21) adjacent to conditionally approved areas also met criteria for conditionally approved waters. This indicated that the Prohibited areas of Greenwich Bay provide adequate dilution from potential fecal coliform sources and are protective of public health.

Wet weather samples were collected during on three dates during 2022 to evaluate microbial water quality after greater than 0.5" inches of rainfall. Samples collected on 6/30/2022 (3 days after 0.65" rain), and on 12/6/2022 (3 days after 0.51" rain) showed acceptable results at all conditionally approved stations. Samples collected on 12/22/2022 (6 days after 1.46" rain) showed elevated fecal coliform at prohibited stations, but acceptable fecal coliform (<14 cfu/100 ml) at all conditionally approved stations. This wet weather sampling demonstrates that that the current 0.5" rain, 7-day closure continues to be appropriate for the growing area. As resources allow wet weather sampling after storms of 0.5 to 1" rainfall will be completed to evaluate GA8 conditional rain closure thresholds.

The 2022 statistical review demonstrated that the Greenwich Bay Conditionally Approved shellfish area (GA8) is in program compliance and is properly classified.

RECOMMENDATIONS

* Maintain Greenwich Bay as conditionally approved year-round (December seasonal closure ended in May 2017).
* Continue to sample prohibited areas in Greenwich, Apponaug, Buttonwood, Brushneck and Warwick Coves to track water quality changes in support of TMDL work in the watershed.
* As resources allow, conduct wet weather sampling to collect data on fecal coliform response after greater than 0.5" rain (current closure rain) storms.

Table 2: Fecal coliform summary statistics for GA8 (Greenwich Bay) conditionally approved stations based on recent 15 samples collected when the area was in the open status (all dry weather; 11/22/2020 or 1/7/2021 to 11/2/2022; all mTEC)

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
8-1	P	15	6.7	6.7
8-2	P	15	4.5	6.7
8-3	P	15	4.1	0.0
8-4	CA	15	3.0	0.0
8-5	CA	15	3.9	6.7
8-6	CA	15	3.9	6.7
8-7	CA	15	4.8	0.0
8-8	P	15	7.0	20.0
8-10	P	15	15.8	46.7
8-12	CA	15	3.5	0.0
8-13	CA	15	3.0	0.0
8-15	CA	15	3.0	0.0
8-17	CA	15	2.8	0.0
8-18	CA	15	2.4	0.0
8-21	P	15	3.7	0.0
8-22	P	15	6.3	13.3
8-23	P	15	8.3	20.0
8-25A	CA	15	2.5	0.0

Table 3: Fecal coliform summary statistics for GA8 (Greenwich Bay) stations 8-25 and 8-26 based on recent 15 samples collected during dry weather (3/9/2020 or 5/20/2020 to 8/2/2022; all mTEC).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
8-25	P	15	9.9	13.3
8-26	P	15	10.4	26.7

6. Summary and Conclusions

The 2022 annual update of Greenwich Bay (GA8) demonstrated that no shoreline sources are negatively impacting the microbiological water quality of the growing area when this conditionally approved area is in the open status for shellfish harvest. In addition, the single WWTF in the growing area was shown to be operating in an efficient manner that consistently resulted in effluent flow and fecal coliform concentration being well below permitted discharge levels. A statistical review of water column fecal coliform collected while the conditionally approved area was in the open status indicated that the Greenwich Bay (Growing Area 8) is in program compliance and is properly classified.

Growing Area 8 is a conditionally approved growing area, impacted by precipitation events, and also containing a discharge from a sewage treatment facility. Therefore, the RIDEM Shellfish Program manages Growing Area 8 in accordance with the guidelines set forth in the Greenwich Bay Conditional Area Management Plan (CAMP). This CAMP was initiated in January 1996 and was updated in 2003. In 2019 a major revision was made to the GA8 CAMP to incorporate recommendations made during the 2017 FDA PEER review. The GA8 was updated in 2021 to reflect changes (addition of a listserve notification) in the conditional area closure process. An amendment to the GA8 CAMP was made in September 2022 to reflect the reclassification (prohibited to conditionally approved) of a 180 acre area near Apponaug Cove. The CAMP for Greenwich Bay Growing Area 8 was re-evaluated as part of the 2022 annual review and the monitoring and management of GA8 were consistent with the current conditional area management plan.

No classification changes are recommended for GA8 at this time.

West Middle Bay
Growing Area 9
Triennial Re-Evaluation
2022

Allen Harbor Inlet, North Kingstown, RI

Rhode Island
Department of Environmental Management
Office of Water Resources
Shellfish Program

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A. Introduction

A triennial re-evaluation of the West Middle Bay shellfish growing area (GA9) was conducted in accord with the National Shellfish Sanitation Program (NSSP) requirements for shellfish growing area classification. The primary objective of this survey is to identify and characterize sources of pollution affecting the area and re-evaluate point and non-point sources previously identified during prior surveys. This triennial update of GA9 was conducted in the summer of 2022. The survey involved follow-up sampling of previously identified sources that resulted in fecal coliform counts exceeding 240 CFU/100ml. These sources were reevaluated to determine the bacteriological impact on the growing area.

The survey area for this review encompasses the approved waters of the West Middle Bay from Sandy Point on Potowomut Neck south to Quonset Point, including the Potowomut River and the waters of the west side of Prudence Island from Providence Point to the “T-wharf” at the southern end of Prudence Island. GA9 includes the shoreline of Patience Island, Hope Island, Despair Island, and the west-southwest shoreline of Prudence Island. GA9 is bounded by shoreline of the towns of Warwick, and North Kingstown to the west and Portsmouth (Prudence Island) to the north and east. GA9 is adjacent to GA1 to the north, GA8 to the west, GA6 and GA7 to the south.

B. Description of Growing Area

The West Middle Bay growing area encompasses approximately 13,772 acres. The shoreline immediately adjacent to the growing area consists of a mixture of primarily developed/urban lands, forest, and brush-lands. This is marked by drastic variance between the virtually undeveloped shoreline of Patience and Prudence Island and the commercial ports (Quonset Point) and developed landscape along the western shoreline. The adjoining towns primarily rely upon On-site Wastewater Treatment Systems (OWTS) for wastewater treatment. A single municipal WWTF discharges to GA9: the Quonset Development Corporation operates a WWTF that serves approximately 10,000 residents in the Quonset Point area. The Quonset WWTF discharges treated effluent to the from their wastewater treatment facility to southwestern-most GA9 near the border with GA7 (see section 5 – Wastewater Treatment Facilities and Figure 2).

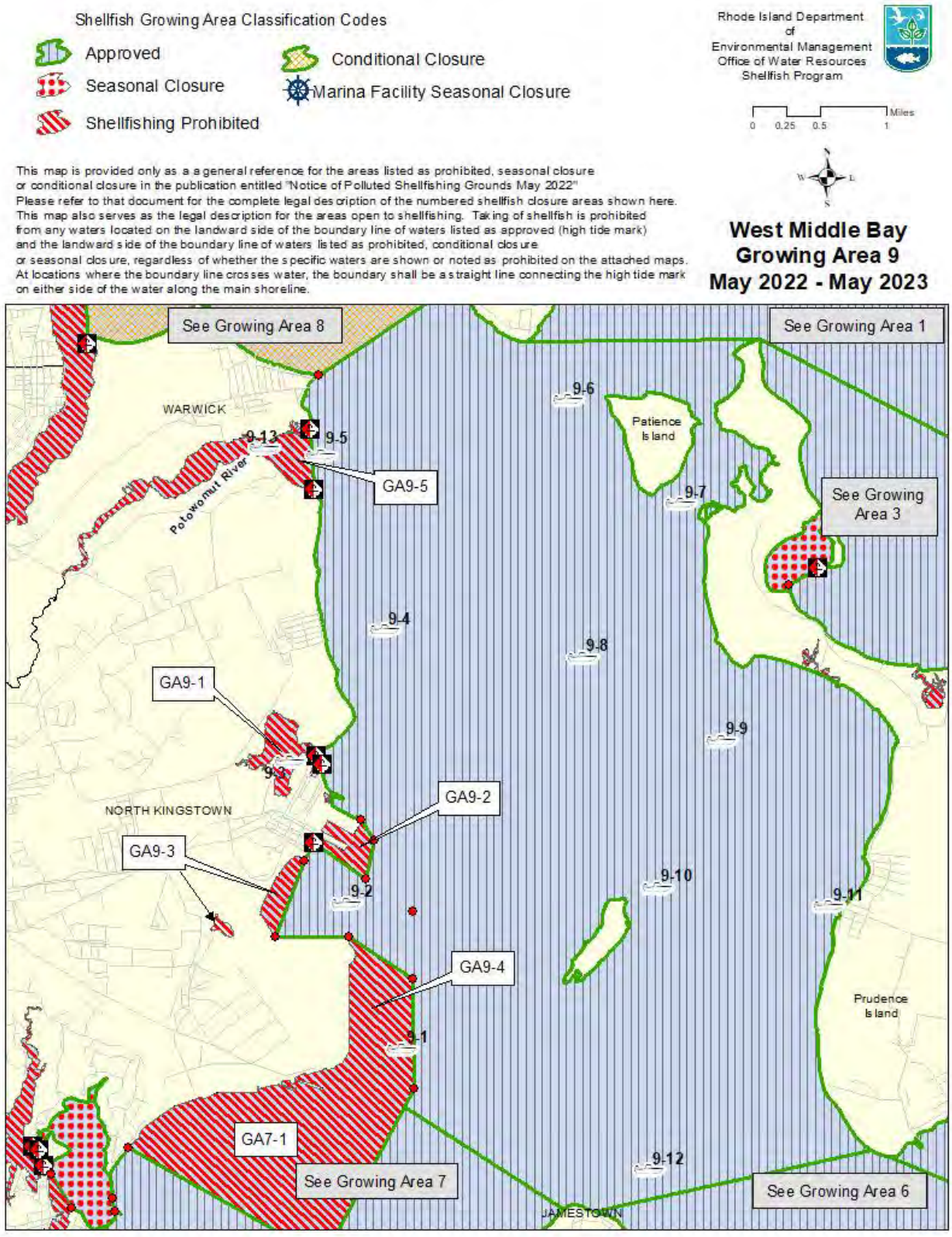
Growing Area 9 is presently comprised of sections classified as approved and prohibited for shellfishing (Figure 1). Five areas of this growing area are currently classified as prohibited: 8.5 acres of Frys Pond and 52 acres of Frys Cove are prohibited to shellfishing; the waters of the Greene or Potowomut River are also closed in their entirety (199 acres); Allen Harbor (83-acres) is classified as prohibited due to the high density of recreational boats as well as the presence of an abandoned Navy landfall and superfund site adjacent to the harbor. There is also a 66-acre closure area in the Davisville area due to commercial shipyard activities. Finally, a 1,320-acre closure surrounds the bulkhead and docks in the vicinity of Quonset Point (the Quonset Point closure extends southward into Area 7 – the West Passage). This is due to the location of the Quonset Point Wastewater Treatment Facility discharge as well as the presence of commercial shipyards. All other sections of the West Middle Bay growing area are classified as approved for shellfish harvesting. There are no conditionally approved waters in GA9.

1 Hydrographic Characteristics

Total area of the West Middle Bay Growing Area	13, 772 Acres
Widest Reach	4.3 Miles
Deepest Point	50 Feet

The majority of the west side of Prudence Island is protected open space with limited development, resulting in virtually no human impacts upon the surrounding ambient water quality. This includes 750 acres of the northern end and 1,645 acres of the southern end of the island, as well as most of the western shoreline. More development is present along the western boundary of the growing area, including the Quonset Point Port and Commerce Park, the Davisville and Allen Harbor areas, and some higher density residential areas near Sandy Point, in North Kingstown, and a small residential community on Prudence Island.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA9 with Routine Monitoring Stations



C. Pollution Source Survey

A comprehensive 12-year sanitary survey of GA9 was completed in 2019. Sixty-one (61) actual or potential pollution sources were identified during the 2019 shoreline survey. Thirty-nine (39) of these sources were not actively flowing at the time of the shoreline survey with the remaining 22 having flows warranting sampling. Seven (7) sources met or exceeded the 240 CFU/100ml criteria warranting follow-up sampling for this triennial update, however only one source (9-011) is in approved waters, and this source was not flowing at the time of the 2022 investigation. Special attention will be given to the seven moderately elevated (greater than 240, but less than 2,400 cfu/100 ml) sources in the next triennial update of GA9.

Table 1. Pollution Sources in GA 9

Source ID	Latitude	Longitude	Description	Receiving Waters Classification	Direct/ Indirect	Potential/ Actual	2019 FC Results (CFU/100ML)	2019 Flow Rate (cu. Ft./sec)	2022 FC Results (CFU/100ML)
2019-9-009	41.649672	-71.428889	Seep near old Concrete / Iron slab	Prohibited	D	A	360	0.0067	Not Sampled
2019-9-602	41.5934	-71.3369	Small stream flowing over rock ledge	Approved	D	A	300	0.18298	NF
2019-9-706	41.60826	-71.32981	Stream bed north of Prudence park jetty, potential for heavy flows	Approved	D	A	500	0.8850625	NF
2019-9-721	41.648288	-71.348626	Small groundwater seep between 9-704 and 9-705	Approved	D	A	3600	0.06375	NF
2019-9-729	41.656151	-71.354861	Stream draining marsh on W side of Patience Island	Approved	D	A	400	0.7867222	Not Sampled
2019-9-800	41.6265	-71.41557	24" Culvert draining marsh	Prohibited	D	A	300	1.275	Not Sampled

D. Mooring Fields and Marinas

There are five marinas/mooring fields located within the waters of the West Middle Bay growing area (Figure 1). All are within the prohibited waters of Allen Harbor in North Kingstown.

In 1998, the State of Rhode Island designated all of their coastal waters as a No Discharge Area (NDA). Rhode Island waters include all of Narragansett Bay as well as territorial seas within three miles of shore. An NDA is a designated body of water in which the discharge of *treated* and *untreated* boat sewage is prohibited (this does not include grey water or sink water). There are two pumpout facilities within the growing area (all within Allen Harbor): Allen Harbor Marina, and the Quonset Davisville

Navy Yacht Club. This area is currently permanently closed to shellfish harvesting due to the adjacent former Navy industrial disposal dumpsite as well as the presence of seasonal boating impacts.

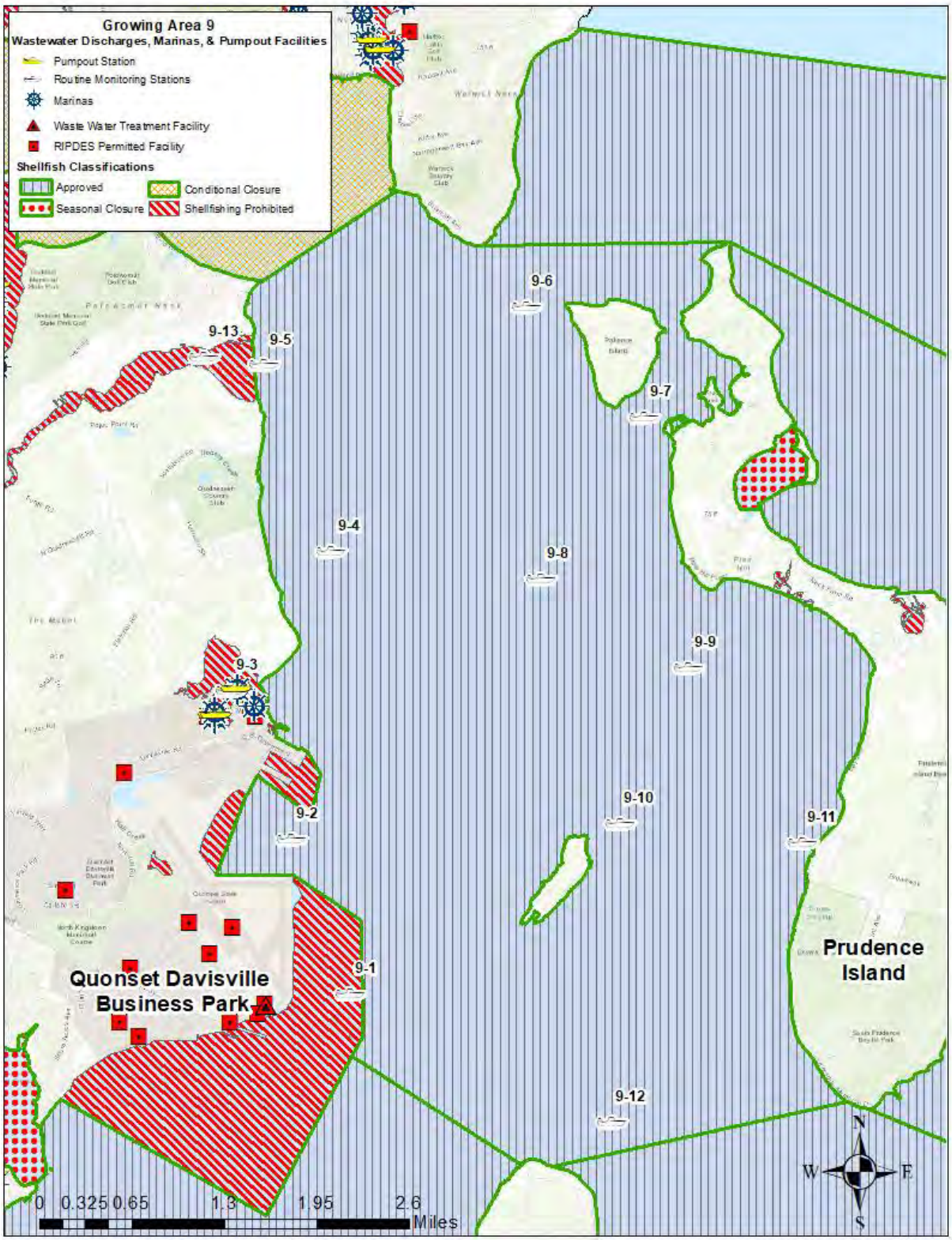
To account for illicit discharges, dilution calculations were completed for all marinas and destination mooring fields in the growing area. *Determination of Marina Buffer Zones using Simple Mixing and Transport Models* (VIMS, 1989) was used as the basis for determining the dilution necessary to be protective in the case of discharge from MSDs (Marine Sanitation Devices). It is predicted that there is an occupancy rate of 50% of all slips in a given marina and boats will discharge at a rate of 5% with the FDA/VIMS assumed vessel occupancy of two persons. All nine marinas are located within the prohibited waters of Allen Harbor, in which the closure area is more than adequate to account for the FC level resulting from these potential discharges. For details on these calculated dilution areas and the rationale for assumptions made to complete these calculations, refer to the RIDEM Office of Water Resources Shellfish Program document entitled *Evaluation of Waters Adjacent to Marinas and Mooring Areas* (December 2022).

E. Wastewater Treatment Facilities (WWTF)

There is one major sanitary discharge and two non-sanitary discharges permitted by the Rhode Island Pollutant Discharge Elimination System (RIPDES) within this growing area (Figure 2). The Quonset Point wastewater treatment facility located on Quonset Point is operated by the RI Economic Development Corporation and discharges treated effluent to the waters of GA9 near the line separating GA9 and GA7 to the south. The facility is permitted to discharge 1.78 MGD of treated effluent. The average flow for 2022 was 0.54 MGD, well within the permit limits. The fecal coliform discharge average for 2022 was 13.5 MPN/100ml, which is also well below the permit level of 200 MPN/100ml.

The Quonset point WWTF services the Quonset Point and Davisville Depot areas. The remaining areas adjacent to the West Middle Bay Growing Area rely on OWTS. A review of Office of Compliance and Inspection data showed no open OWTS complaints for residences immediately adjacent to GA9.

Figure 2: Wastewater Discharges, Marinas, and Pumpout Facilities in GA 9



F. Water Quality Studies

The Shellfish Growing Area program is based on Rhode Island's agreement with the US Food and Drug Administration (FDA) as described in the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfish industry. The NSSP is designed to oversee the shellfish producing state's management program and to enforce and maintain an industry standard. As part of this agreement, the State of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harboring waters in order to maintain certification of said waters for the harvest of shellfish for direct human consumption.

Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds, visible algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1995) for the standard fecal coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012. The procedure for water sample holding times and temperature control for the sm48 and sm01 methods are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedures (copy in the Program's permanent file).

There are 13 monitoring stations (10 in approved waters, 3 in prohibited waters) in the growing area (Figure 1). A summary of the growing area's recent NSSP compliance statistics is below.

1 GA9 Annual Statistical Evaluation

HIGHLIGHTS

* Sampled 6X during 2022 (3 wet weather, 3 dry weather).
* Statistics represent recent 30 samples collected during wet (n = 15) and dry (n = 15) conditions during 7/27/2017 or 11/3/2017 to 12/5/2022.
* All samples analyzed by the mTEC method.
* All approved stations are in compliance.
* Data run 12/9/2022.

COMMENTARY

The West Middle Bay (Growing Area 9) was sampled 6 times during 2022 meeting minimum sampling requirements for approved waters. The recent 30 samples used in the evaluation were collected during both wet (greater than 0.5" rain during prior 7 days; n=15) and dry (n=15) weather conditions. All ten (10) approved stations met NSSP criteria (Table 2). In addition, the three (3) monitoring stations in prohibited waters also meet NSSP fecal coliform criteria for approved waters. Prohibited stations 9-1 and 9-3 are precautionarily closed to shellfish harvest due to industrial activity and marina activity rather than being closed for bacterial pollution.

The Potowomut River (stations 9-13 and 9-5) has elevated fecal coliform levels during wet weather. A TMDL study for fecal coliform impairment in the growing area was scheduled for 2023. Station 9-13 near the freshwater end of the Potowomut River was established in 2007 to evaluate whether that area of was suitable for approved harvest of shellfish. The 2022 statistical evaluation indicated that the freshwater end of

the Potowomut River (station 9-13; precautionarily classified as prohibited) met, but nearly exceeded the 90th percentile variability criteria and that shellfish harvest should remain prohibited for that region. 'Sentinel station' 9-5 at the mouth of the Potowomut River and at the transition from prohibited to approved waters continues to meet criteria for approved waters indicating that the current prohibited zone at the mouth of the Potowomut River is appropriate and protective of public health. Several elevated fecal coliform values collected at station 9-5 during wet weather in 2017 are included in the 2022 evaluation resulting in elevated, but still acceptable, variation statistics for that station. These elevated wet weather 2017 observations will 'roll out' of the 5-year statistical window for the 2023 evaluation. DEM OWR Shellfish staff began a program of regularly (approximately monthly) monitoring the freshwater input flowing over the Potowomut Dam into GA9 near station 9-13 to quantify this source of fecal coliform pollution to the growing area.

The 2022 statistical review indicated that all approved stations in the growing area were in program compliance and that the area is properly classified.

RECOMMENDATIONS

* Maintain closure of upper Potowomut River.
* Continue to monitor Potowomut River (stations 9-13 and 9-5) to follow changes in water quality.
* Continue evaluating sources of fecal coliform pollution to the Potowomut River.
* No other actions recommended based on ambient monitoring results.

Table 2: Fecal coliform summary statistics for GA9 based on recent 30 samples collected under all weather conditions 7/27/2017 or 11/3/2017 to 12/5/2022 (all mTEC, 15 wet and 15 dry weather sets of samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
9-1	P	30	2.1	3.0
9-2	A	30	2.1	2.9
9-3	P	30	3.2	10.7
9-4	A	30	2.9	8.5
9-5	A	30	4.4	25.4
9-6	A	30	2.7	6.2
9-7	A	30	2.3	4.2
9-8	A	30	2.0	2.3
9-9	A	30	2.0	2.8
9-10	A	30	2.2	3.5
9-11	A	30	2.0	2.6
9-12	A	30	2.1	2.9
9-13	P	30	6.6	27.1

G. Conclusions and Recommendations

The 2022 Triennial Evaluation of the West Middle Bay shellfish growing area (GA9) demonstrated that shoreline sources are not negatively impacting the microbiological water quality of the growing area's Approved waters. A statistical review of water column fecal coliform data collected while the area was in the open status indicated that all Approved stations met NSSP criteria and that the West Middle Bay shellfish growing area (GA9) is in program compliance and is in properly classified.

No changes in shellfish classification are recommended.

H. Literature Cited:

American Public Health Association. 1999. *Standard Methods for the Examination of Water and Wastewater*, 20th ed. 1999. American Public Health Association, American Water Works Association, Water Pollution Control Federation. Washington D.C.

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RIDEM. June 2017 (updated December 2022). *Marina Dilution Analysis Background.* Rhode Island Department of Environmental Management, Office of Water Resources, Shellfish Monitoring Program. Providence, Rhode Island.

VIMS. June 1989. *Determination of Marina Buffer Zones using Simple Mixing and Transport Models.* Virginia Institute of Marine Science, College of William and Mary. Gloucester Point, Virginia.

GA10
Point Judith & Potters Pond
2022 Annual Update

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Figures

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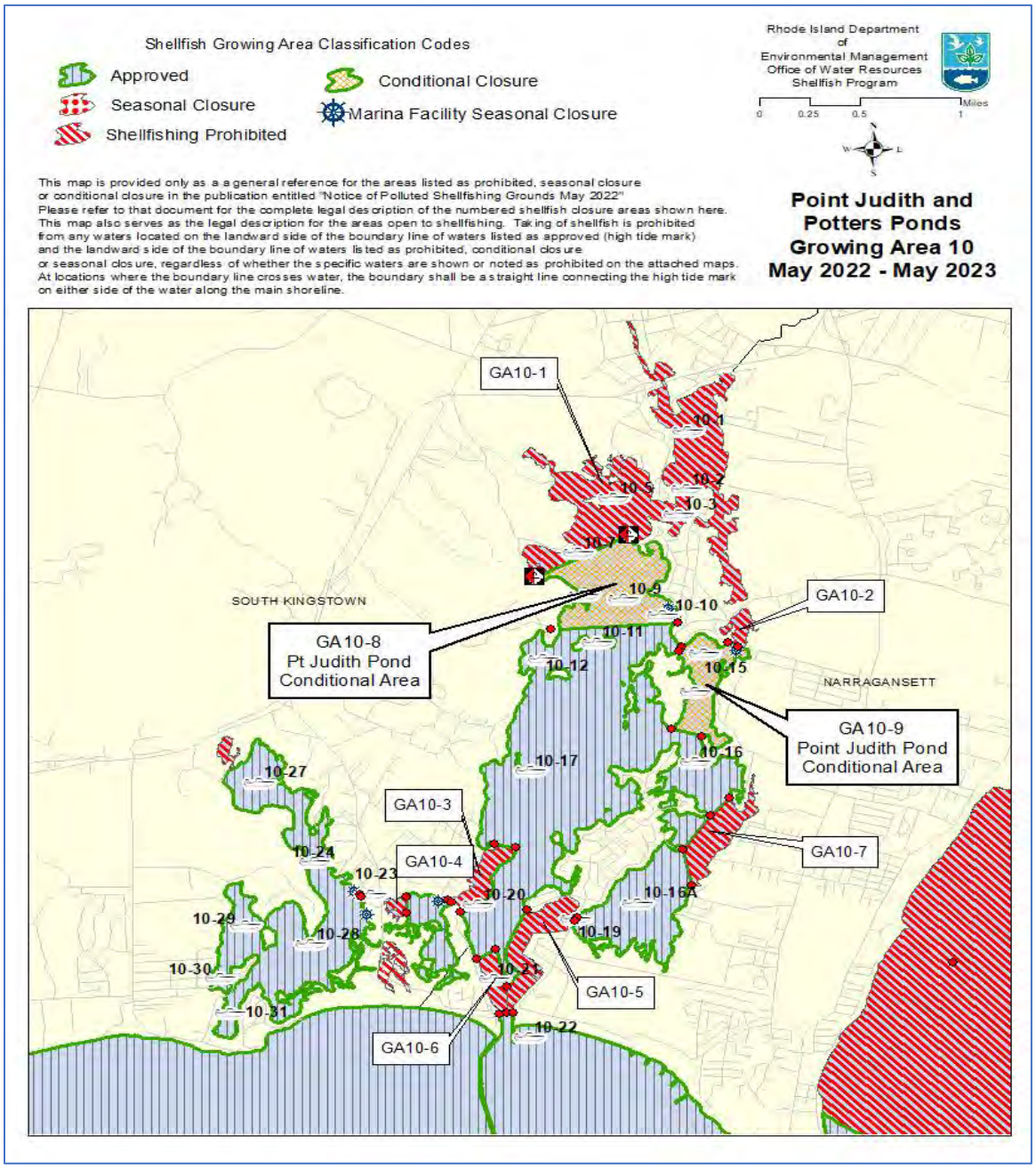
1. Introduction

12-year sanitary shoreline surveys of the Point Judith Pond and Potters Pond Growing Area (GA10; Figure 1) were completed in 2002 and 2011. Triennial surveys were completed in 2005, 2008, 2014, 2017, and 2020. During the 2011 12-year survey a total of ninety-seven (97) actual or potential sources were identified. A total of forty-seven (47) were not actively flowing at the time of the shoreline survey with the remaining fifty (50) having flows warranting sampling. All sources in which flow was observed were sampled. During the 2020 triennial survey ten (10) potential pollution sources were sampled. The 2022 survey of this growing area was an annual update. A comprehensive 12-year survey is planned for 2023.

Figure 1: 2022-2023 Shellfish Classification Map of GA10



2. 2022 Shoreline Survey

The 2022 shoreline survey annual update of GA10 was conducted by DEM Shellfish Program staff. In 2021 three (3) sources were re-visited, two of which have potential to flow into receiving waters currently classified as Conditionally Approved, while the third source flows into Prohibited waters. A review of the 2021 shoreline survey resulted in no sources needing follow up sampling in 2022.

Table 1: 2021 Summary of Pollution Sources in GA 10

Source ID	Latitude	Longitude	Description	Receiving waters classification	Actual / Potential	Direct / Indirect	2021 Results mTEC cfu/100ml	2021 Volumetric Flow (cfs)
2021-10-011	41.410233	-71.497317	RCP outfall-near Cedar Island, Harbor Island, Narragansett	Conditionally Approved	Potential	Indirect	NF	N/A
2021-10-026A	41.39645	-71.49015	Rye Cove, In stream sample	Prohibited	Actual	Direct	<2	1.42
2021-10-200	41.400088	-71.494024	Culvert draining pond at Kenyon Farm	Conditionally Approved	Actual	Direct	100	<.001

IS = In stream sample NS = Not sampled NF = No flow CNL = Could not locate NA = Measurements not taken

A. Description of Sources

i. Pt. Judith Pond

No sources sampled during the 2020, 2021 or 2022 surveys exceeded 240 cfu/100 ml (Table 1). A brief description of the lone source visited is below.

Source 10-200 is a culvert draining a pond at Kenyon Farm in Narragansett, RI and discharging into the Conditionally Approved waters of Upper Pt. Judith Pond. The 2020 survey was conducted during wet weather (1 day after 1.54" rain) and the Conditionally Approved receiving waters were in the closed status. During the 2020 survey source 10-200 had a fecal coliform result of 1,600 cfu / 100 ml and a flow rate of only 0.094 cfs. An in-stream bacteria result of 960 cfu / 100 ml indicated some dilution during wet weather. The 2021 observation of this source took place during dry weather (12 days since 1.83" rain) and yielded a much lower fecal coliform result of 100 cfu/100 ml. ***When investigated during 2022 this source was not flowing and therefore no sample was taken.***

ii. Potter Pond

A shoreline survey update was completed for the Potter Pond portion of GA10 during September 2021. This shoreline survey update was in response to an illness outbreak due to *Campylobacter*-contaminated shellfish harvested at an aquaculture lease in Potter Pond. Details and documentation of the RI shellfish program (DEM, DOH, CRMC) response to the illness outbreak are in the report "Illness Outbreak Summary and Growing Area Evaluation of Rhode Island Shellfish Growing Area 10 PP (Potter Pond) Completed in Response to a *Campylobacter*-related Illness Outbreak, dated December 2021" and available in the Program's permanent files. No shoreline sources exceeding 240 cfu/100 ml were identified during the 2021 survey. ***Given the low fecal coliform results obtained for sources in 2021, no follow-up source sampling was required for the 2022 annual update.***

B. Poisonous and Deleterious Substances

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources

identified during this survey have the potential to impact the approved waters of Growing Area 10 (Pt. Judith and Potter Ponds) due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

3. Marinas and Moorings

There are numerous recreational boating facilities within the growing area that have the potential to have negative impacts upon water quality. Closed safety zones have been established around these marinas. As of 2022 there are four pumpout facilities servicing the numerous marinas, two at the head of Point Judith Pond at Ram Point and the other two located in the Snug Harbor area near the channel between the two ponds. Both ponds are within the states no-discharge zone, making the discharge of marine sanitation devices illegal.

The Port of Galilee in the Town of Narragansett is the major commercial fishing center in Rhode Island. The port is located on the eastern side of Point Judith Pond immediately north of the breachway. There are also commercial fishing boats harbored in Snug Harbor immediately south of High Point in South Kingstown. The areas immediately surround these ports are closed to shellfishing. The potential impacts from the existing commercial docks and marinas have been evaluated and waters adjacent to these facilities are within the closed prohibited zones providing adequate protection in the case of any discharges associated with marine vessels. Details of this analysis can be found in the program document entitled “Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background June 2017” (& December 2022 update).

4. Wastewater Treatment Facilities

There are no wastewater treatment facilities that discharge directly into either Point Judith Pond or Potters Pond. There are nine (9) RIPDES permitted discharges into the harbor area in Galilee. Eight of the nine are water release pipes associated with fish processing and distribution plants and discharge into waters that are currently classified as prohibited providing sufficient dilution prior to mixing with adjacent approved shellfish waters. The last permit is issued as stormwater runoff for the Town of South Kingstown.

5. Water Quality Studies

The Shellfish Growing Area Monitoring program is part of the state of Rhode Island’s agreement with the United States Food and Drug Administration’s National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harvesting waters of the state to maintain certification of these waters for shellfish harvesting for direct human consumption.

Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in “Standard Methods for the Examination of Water and Wastewater” (APHA, 1995) for the standard fecal

coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012. The procedure for water sample holding times and temperature control for the sm48 and sm01 methods are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedure, August 2021 (copy in the Program's permanent file).

The results of all bacteriological monitoring – whether collected as part of the routine bacteriological monitoring program or sanitary survey program – are evaluated by RIDEM Shellfish staff as they are received from the RI DOH. Any unusual or exceptionally elevated values are immediately evaluated to determine the need for additional sampling and/or investigation.

The fecal coliform water quality in Pt. Judith and Potter Ponds (GA10) is monitored at 24 stations in the growing area (Figure 1). The growing area is sampled six times per year under a systematic random sampling strategy following NSSP guidance for growing areas not affected by point sources. A statistical summary and commentary on recent fecal coliform data for the growing area is below.

A GROWING AREA 10PJ – PT. JUDITH POND

HIGHLIGHTS

* Sampled 6X (2 wet weather, 4 dry weather) during 2022 while the area was in the open status.
* For Approved stations, statistics represent recent 30 samples collected when the area was open during both wet (n= 17) and dry (n= 13) weather during 10/12/2017 to 10/17/2022.
* For Conditionally Approved stations, statistics represent recent 15 samples collected when the Conditional area was in the open status during 5/5/2020 or 6/2/2020 to 9/28/2022 (8 wet weather and 7 dry weather).
* GA10 management changes were put into effect in 2020:
    - All stations: emergency rain closure (3", 7-day closure)
    - Northern Pt. Judith Pond (stations 10-9, 10-10, 10-15): reclassified as Conditionally Approved with 1.4" rain, 7-day closure.
* All samples analyzed by the mTEC method.
* All approved stations in compliance.
* Data run 11/16/2022.

COMMENTARY

Approved waters: The Pt. Judith Pond shellfish growing area (GA10PJ) was sampled six times (2 wet weather: 4 dry weather) during 2022, meeting sampling requirements for approved waters. For approved stations, the recent 30 samples used for calculation of compliance with NSSP criteria were collected during 10/12/2017 to 10/17/2022 (17 wet weather; 13 dry weather samples). Fecal coliform levels observed in Pt Judith Pond declined during 2022 compared to the previous several years, especially 2019 which had moderately elevated fecal coliform during wet weather. No fecal coliform values of greater than 31 cfu/100 ml have been observed at approved stations in Pt. Judith Pond since May of 2020. Note that the recent 30 samples included five sets of samples collected two to four days after rainfall of 1.5" to 1.8", demonstrating acceptable water quality in approved waters during wet weather conditions.

All approved stations in Pt. Judith Pond (GA10PJ) met NSSP fecal coliform criteria and are in program compliance for 2022. Station 10PJ-16 located in Bluff Hill Cove had a 90th percentile

variability statistics of 24.9 cfu/100 ml which is approaching the NSSP variability criteria of 31 cfu/100 ml. Investigation of shoreline fecal coliform sources contributing to elevated fecal coliform in Bluff Hill Cove will continue during the 12-year survey to be completed in 2023.

Conditionally approved waters: The conditionally approved waters of Pt. Judith Pond are managed with a 1.4", 7-day rain closure (Pt. Judith Pond (GA10PJ) Conditional Area Management Plan). The GA10PJ conditional area was sampled six times (5 when open, 1 when closed) during 2022. The recent 15 samples included eight wet weather and 7 dry weather samples collected during 5/5/2020 or 6/2/2020 to 9/28/22 when the conditional area was in the open status.

All conditionally approved station in Pt. Judith Pond (10PJ-9, 10PJ-10, 10PJ-15) met NSSP criteria when in the open status. Note that station 10PJ-15 did not meet criteria under an Approved classification scenario, demonstrating the continued necessity for the Conditionally Approved classification in Upper Pt. Judith Pond. The 2022 statistical evaluation demonstrated that all Approved and Conditionally Approved areas of Pt. Judith Pond meet NSSP criteria, and that the area is properly classified.

RECOMMENDATIONS.

***** Maintain 3" rain emergency closure for entire growing area.
* Maintain 1.4" rain conditional closure in upper Pt. Judith Pond conditional area.
* When practical, continue wet-weather sampling to further refine extent of conditional closure areas and closure rainfall amounts.
* Continue work to identify fecal coliform sources contributing to increased fecal coliform concentration in the Saugatucket River and Bluff Hill Cove areas of the growing area.

Table 1: Fecal coliform summary statistics for Pt. Judith Pond (GA10PJ) approved waters based on recent 30 samples collected when the area was in the open status 10/12/2017 to 10/17/2022; 17 wet and 13 dry weather); all mTEC analysis. Conditionally Approved stations shown for informational purposes only, not for compliance.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
10PJ-1	P	30	95.9	824.8
10PJ-2	P	30	43.5	322.2
10PJ-3	P	30	30.1	212.9
10PJ-5	P	30	13.1	88.4
10PJ-7	P	30	9.2	53.1
10PJ-9	CA	30	5.8	28.6
10PJ-10	CA	30	4.3	21.5
10PJ-11	A	30	4.1	14.7
10PJ-12	A	30	3.8	12.1
10PJ-15	CA	30	5.7	42.0
10PJ-16	A	30	4.5	24.9
10PJ-16A	A	30	5.3	19.4
10PJ-17	A	30	3.7	11.0
10PJ-19	P	30	6.8	29.5
10PJ-20	P	30	4.2	12.2
10PJ-21	P	30	4.4	13.8
10PJ-22	A	30	2.6	5.6

Table 2: Fecal coliform summary statistics for Pt. Judith Pond (GA10PJ) conditionally approved stations. Statistics based on recent 15 samples collected when area was in the open status (1.4" Conditional Approved area rain closure; 5/5/2020 or 6/2/2020 to 9/28/2022; all mTEC, 8 wet and 7 dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
10PJ-7A	CA	15	5.3	0.0
10PJ-9	CA	15	4.3	0.0
10PJ-10	CA	15	3.3	6.7
10PJ-15	CA	15	4.2	0.0
10PJ-15A	CA	15	2.7	0.0

B GROWING AREA 10PP –POTTER POND

HIGHLIGHTS

* Sampled 6X during 2022 (2 wet weather, 4 dry weather).
* * GA10 management changes were put into effect on 2/1/2020:
    - All stations: emergency rain closure (3", 7-day closure)
* For Approved stations, statistics represent recent 30 samples collected when the area was open during both wet (n= 17) and dry (n= 13) weather during 8/1/2017 to 10/17/2022.
* All samples analyzed by the MTEC method.
* All approved stations in compliance.
* Data run 11/16/2022.

COMMENTARY

Potter Pond (GA10PP) was sampled six times (2 wet weather, 4 dry weather) during 2022 meeting minimum sampling requirements for approved areas. All samples were taken while the area was in the open status. All approved stations in Potter Pond met NSSP fecal coliform criteria during 2022.

Fecal coliform levels in the northern region of Potter Pond, stations 10-24 and 10-27, have been increasing over the past several years. Shoreline surveys conducted in 2020 and 2021 did not identify any significant surface water shoreline sources of fecal coliform contamination. Part of the recent fecal coliform increase may be related to frequent wet weather experienced in the area during two of the last five years. Both 2018 (53.0" annual rain total) and 2019 (59.1" annual rain total) received greater than long-term average annual rainfall of 42.5" as recorded at the NWS Westerly Airport station KWST. Rainfall during 2020, 2021, 2022 was slightly below long-term levels and fecal coliform levels appear to reflect that. Only two of 76 (2.6%) fecal coliform values exceeded the 31 cfu/100 ml variability criteria during 2021 and 2022 monitoring. As a result,.2022 fecal coliform compliance statistics for Potter Pond are improved compared to 2021 results. Fecal coliform compliance statistics declined at six of seven stations in Potter Pond for 2022 compared to 2021. Station 10-24 is the only station in Potter Pond with fecal coliform variability approaching the NSSP criterion of 31 cfu/100 ml. In the past (1998) the 'narrows' portion of Potter Pond near station 10-24 has been closed to shellfishing due to water quality exceeding NSSP criteria for Approved waters. While all stations in Potter Pond meet NSSP criteria, station 10-24 monitoring data will be reviewed during 2023 to ensure fecal coliform levels do not exceed NSSP criteria.

RECOMMENDATIONS.

* Maintain 3" rain emergency closure for entire growing area.
* Continue work to identify wet weather fecal coliform sources.

Table 3: Fecal coliform summary statistics for Potter Pond (GA10PP) based on recent 30 samples collected while the area was in the open status (8/1/2019 to 10/17/2022; 17 wet and 13 dry weather); all mTEC analysis.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
10PP-23	P	30	5.2	19.8
10PP-24	A	30	6.2	27.4
10PP-27	A	30	5.2	24.9
10PP-28	A	30	3.8	14.1
10PP-29	A	30	3.6	12.3
10PP-30	A	30	4.2	16.7
10PP-31	A	30	4.4	20.4

6. Summary and Conclusions

The 2022 annual evaluation of Pt. Judith Pond and Potter Pond growing areas (GA10) demonstrated that shoreline sources are not negatively impacting the microbiological water quality of the growing area's Approved waters or Conditionally Approved waters when they are in the Open status. A statistical review of water column fecal coliform data collected while the area was in the open status indicated that all Approved and Conditionally Approved stations met NSSP criteria and that the Pt. Judith and Potter Pond Growing Area (GA10) is in program compliance and is properly classified.

Growing Area 10 has conditionally approved areas in upper Pt. Judith Pond that are negatively impacted by precipitation and wet weather discharge of the Saugatucket River. Therefore, the RIDEM Shellfish Program manages Growing Area 10 in accordance with the guidelines set forth in the Pt. Judith Pond Conditional Area Management Plan (CAMP) revised in August 2021. A review indicated that management of the GA10 conditional area was consistent with the CAMP during 2022.

The 2022 annual revaluation has demonstrated that all approved and conditionally approved waters are in current compliance with NSSP criteria. While 2022 fecal coliform compliance statistics improved when compared to 2021, areas of eastern Pt. Judith Pond (near station 10PJ-16) and northern Potter Pond (near stations 10PP-24) have fecal coliform variability statistics that are approaching the NSSP standard of 31 cfu/100 ml. Should the pattern of elevated fecal coliform variation continue, these areas may require a classification downgrade.

No classification changes are recommended for the Pt. Judith and Potter Pond growing area (GA10) at this time.

Growing Area 11 NG
Ninigret and Green Hill Ponds
2022 Annual Update

Contents

Figures

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1. Introduction

During 2022 an annual update shoreline survey was completed for the Ninigret Pond and Green Hill Pond shellfish growing area (GA11NG; Figure 1). Previous shoreline surveys of this area included comprehensive 12-year surveys completed in 2002 and 2012 and triennial surveys completed during 2005, 2008, 2015, 2018, and 2021. The 2022 annual re-evaluation shoreline survey was conducted to comply with National Shellfish Sanitation Program (NSSP) requirements for shellfish growing area classification. The primary objective of this shoreline survey was to identify and characterize sources of pollution affecting the area and re-evaluate point and non-point sources previously identified during prior surveys.

The Ninigret Pond and Green Hill Pond - Growing Area 11NG (Figure 1) presently has two classifications: Prohibited and Approved. The entirety of Green Hill Pond and the easterly section of Ninigret Pond adjoining Green Hill Pond are presently classified as prohibited to shellfishing due to elevated bacteria levels. The remainder of the growing area is in Ninigret Pond and is classified as Approved. There are twenty-three monitoring stations that are routinely sampled to characterize the water quality of the growing area.

A 12-year shoreline survey of this growing area was last conducted in 2012. A total of ten actual or potential sources were identified during the 2012 shoreline survey. All sources were sampled in 2012, only two of which had bacteria counts that exceeded the 240 cfu/100 ml benchmark used for follow-up sampling. The two sources having greater than 240 cfu/100 ml results in 2012 were identified as 11GH-01 (Factory Brook) and 11GH-04 (an RCP outfall into Allen Cove). Both of these sources discharge into the prohibited area of Green Hill Pond and have no impact on the approved waters of Ninigret Pond.

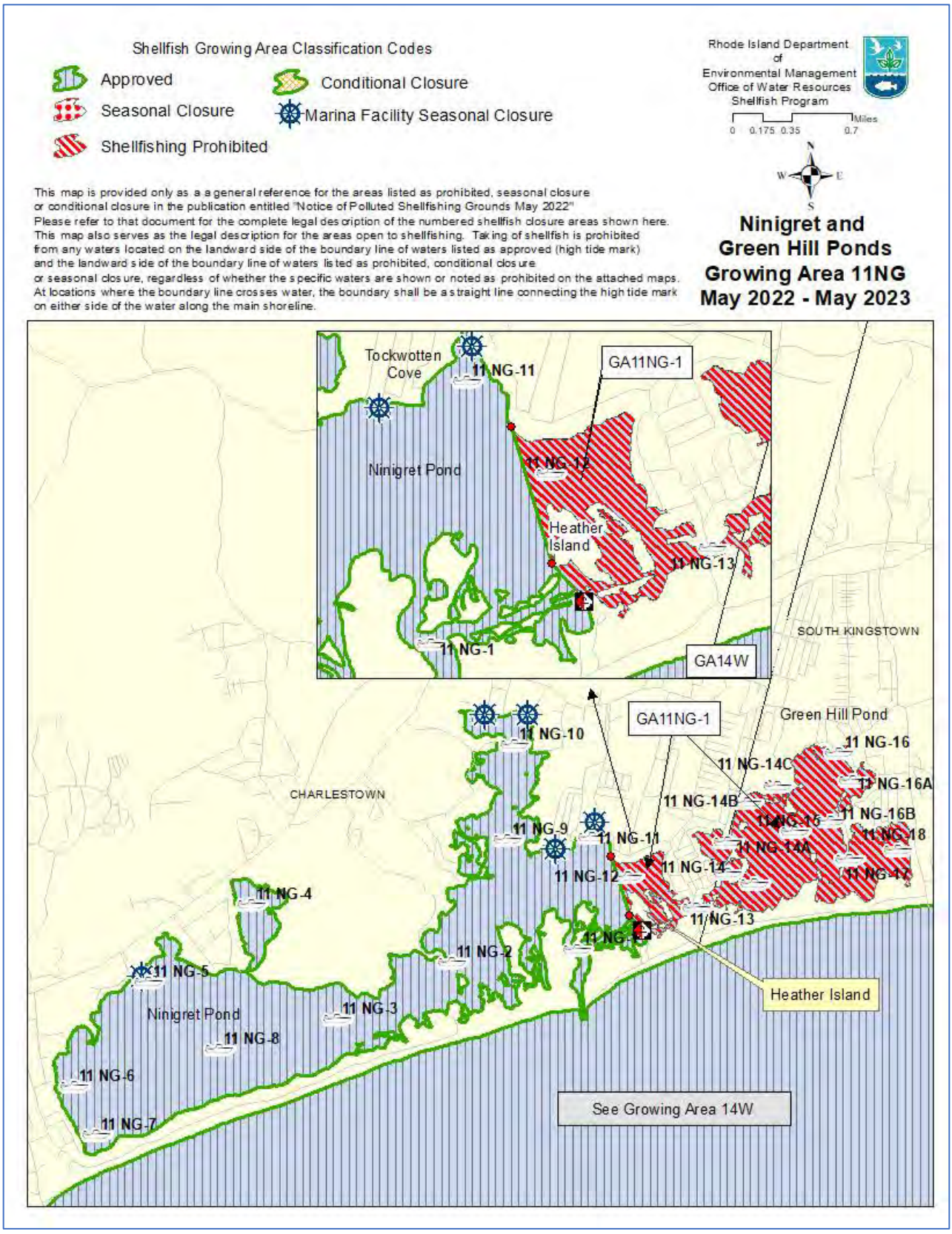
2. 2022 Shoreline Survey

In 2022 no shoreline survey sources were sampled because bacteria counts were low in previous years. The 2022 annual update included a review of marinas and mooring areas in the growing area, a review of OWTS complaints in the area and a review and statistical summary of growing area fecal coliform monitoring data.

Friends of Green Hill Pond

In August of 2022, an environmental conservation organization, known as “Friends of Green Hill Pond”, released a newsletter announcing the findings from a stormwater assessment. The group has expressed concern that runoff from nearby Route 1 was a significant contributor to the pond’s bacteria levels. After a private contractor conducted a stormwater assessment, the Route 1 catchment area was identified as a probable source of bacteria loading. Following the assessment, the group collected field samples from the outfall as well as downstream. The samples were submitted to URI’s Watershed Watch for analysis. The results for the outfall were 61,310 MPN/100mL. After reporting the findings, RIDOT has since launched an investigation into the high bacteria levels and updates will be provided as the investigation moves forward. Note that the Route 1 highway drainage outfall is approximately 1 mile north of the growing area and the small stream that flows from the highway enters the prohibited waters of Green Hill Pond approximately 1.75 miles east of the nearest approved shellfish waters.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA 11NG with Routine Monitoring Stations



3. Marinas and Mooring Areas

There are eleven recreational boating facilities, marinas or dockage areas located in Ninigret and Green Hill Ponds. Two are located in prohibited waters of Green Hill Pond and four are located within the prohibited areas of Ninigret Pond. The remaining five marinas located in approved waters (Table 1), have seasonal shellfish closures surrounding them.

Table 1: Ninigret Pond Marinas.

Marina Facility Name (As Currently Known)	Number of Boats	Town	Latitude	Longitude
Lavin's	70	Charlestown	41° 21.51'	-71° 41.31'
Ocean House Marina	95	Charlestown	41° 22.85'	-71° 38.70'
Fort Neck Association	25 (est.)	Charlestown	41° 22.85'	-71° 38.99'
Tockwotten Cove Assn	25 (est.)	Charlestown	41° 22.30'	-71° 38.24'
Pond Shore	15 (est.)	Charlestown	41° 22.17'	-71° 38.51'

Due to the shallow depth of the salt ponds, most of the boats in the growing area are small (less than 25' long) fishing and recreational day boats. There is a Seasonal Marina Closure area described as that area within 25 feet of any in water structure for docking vessels around each of the five marinas listed (Figure 1). Ocean House Marine, the largest marina in the growing area, operates a dock side marine pump out facility that is available to all boats operating in these waters. Details of these marinas can be found in the shellfish program's document entitled "Evaluation of Waters Adjacent to Marinas – Marine Dilution Analysis Background June 2017" (updated in December 2022). Waters of the marina proper and waters adjacent to marinas have either a year-round prohibited area or a seasonal closure to be protective of shellfish waters should an accidental discharge from a vessel occur. All waters in Rhode Island are designated as No Discharge Zones which prohibits the discharge of any sewage from any vessel within any waters of the state. Information regarding the enforcement and inspection procedures for vessels operating in RI waters can be found on our website: http://www.dem.ri.gov/programs/water/shellfish/marine-pumpouts.php

4. Wastewater Treatment Facilities / Domestic wastes

There are no wastewater treatment facilities (WWTF), or any permitted RI Pollution Discharge Elimination (RIPDES) discharges that discharge to Growing Area 11NG. The Ninigret and Greenhill Pond watershed consists of mainly residential homes with very little commercial and no industrial land developments. The entire watershed is served by onsite wastewater treatment systems (OWTS). OWTS complaints and filings in the immediate watershed of the growing area were reviewed as part of the 2022 update and no significant violations of OWTS were recorded.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands.

Prohibited areas were established based on land use within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM revised November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas were visually inspected for indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation was conducted during watershed background research. Follow-up sampling or further field work and evaluation was conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Ninigret or Green Hill Ponds due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

5. Water Quality Studies

The Shellfish Growing Area Monitoring program is part of the state of Rhode Island's agreement with the United States Food and Drug Administration's National Shellfish Sanitation Program (NSSP). The purpose of this program is to maintain national health standards by regulating the interstate shellfish industry. As part of this agreement, the state of Rhode Island is required to conduct continuous bacteriological monitoring of the shellfish harvesting waters of the state to maintain certification of these waters for shellfish harvesting for direct human consumption. Surface water samples are collected by the RIDEM OWR Shellfish Program staff. A description of field conditions is recorded, which includes overall tidal stage, wind direction and speed, number of days since last rain and the rainfall total, the status of conditional areas (open or closed), any important observations such as flocks of birds or algae blooms, and water temperature and collection time at each sampling station. All samples are analyzed by the RIDOH Water Microbiology Laboratory for the presence of fecal coliform bacteria. RIDOH uses the procedures as prescribed by the American Public Health Association in "Standard Methods for the Examination of Water and Wastewater" (APHA, 1995) for the standard fecal coliform membrane filtration method (sm48 mTEC) utilized exclusively since August 2012. The procedure for water sample holding times and temperature control for the sm48 and sm01 methods are described in the RI DEM Shellfish Growing Area Monitoring Program Standard Operating Procedure, August 2021 (copy in the Program's permanent file).

The results of all bacteriological monitoring – whether collected as part of the routine bacteriological monitoring program or sanitary survey program – are evaluated by RIDEM Shellfish staff as they are received from the RI DOH. Any unusual or exceptionally elevated values are immediately evaluated to determine the need for additional sampling and/or investigation. Fecal coliform water quality is monitored at twenty-five (25) monitoring stations: thirteen (13) stations in Ninigret Pond and twelve (12) stations in Green Hill Pond. The growing area is sampled six times per year under a systematic random sampling strategy following NSSP guidance for growing areas not affected by point sources.

A statistical summary and commentary on recent fecal coliform data for the growing area is below.

A. GROWING AREA 10N – Ninigret Pond

HIGHLIGHTS

* Sampled 6X during 2022 (4 wet weather, 2 dry weather).
* Statistics represent recent 30 samples collected under both wet (n= 18) and dry (n= 12) weather conditions during 11/8/2017 to 10/27/2022.
* All approved stations in compliance.
* All samples analyzed by the mTEC method.
* Data run 11/16/2022.

COMMENTARY

Ninigret Pond (Growing Area 11NG) was sampled six times (4X dry weather and 2X wet weather) during 2022, consistent with the minimum systematic random sampling monitoring requirements for approved areas. The recent 30 sample results are representative of both wet (n= 18) and dry (n= 12) weather conditions.

The 2022 statistical review demonstrated that all approved stations in Ninigret Pond met criteria for shellfish harvest for direct human consumption. The recent 30 samples used to calculate compliance were collected during 11/8/2017 through 10/27/2022. These samples included 18 'wet weather' samples collected within 7 days of rainfall of 0.5" or more. Fecal coliform levels were generally low in Ninigret Pond during 2022, likely due to dry weather experienced in summer 2022. For example, 90 of 92 samples (98%) collected in Ninigret Pond during 2022 were below the NSSP variability standard of 31 cfu/100 ml and 86 of 92 (94%) samples collected in both approved and prohibited waters of Ninigret Pond during 2022 were below 14 cfu/100 ml.

All approved stations in Ninigret Pond met NSSP criteria during 2022. However, stations 11NG-4 (Foster Cove, approved waters) continues in a pattern of elevated, but still acceptable, fecal coliform variability statistics. This pattern has been present for 2020, 2021, and 2022. The 'sentinel station' 11NG-12 (classified as prohibited) that marks the transition from approved waters in the western side of Ninigret Pond to prohibited waters at the far eastern end of Ninigret Pond and Green Hill Pond exceeded NSSP variability criteria in 2019 through 2022 evaluations. Continued monitoring of this station is required to determine if there is westward expansion of reduced water quality from eastern Ninigret and Green Hill Pond. In 2022 a new station (station 11NG-11A) was established to the west of station 11NG-11 to quantify fecal coliform water quality in the transition region from prohibited waters to approved waters near station 11NG-11.

Table 2: Fecal coliform summary statistics for Ninigret Pond based on recent 30 samples collected during all weather conditions (11/8/2017 to 10/27/2022; all mTEC, 18 wet and 12 dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
11NG-1	A	30	4.3	22.2
11NG-2	A	30	3.1	8.7
11NG-3	A	30	2.7	6.3
11NG-4	A	30	5.8	26.6
11NG-5	A	30	2.2	3.7
11NG-6	A	30	2.4	4.9
11NG-7	A	30	2.5	6.0
11NG-8	A	29	2.4	4.7
11NG-9	A	30	5.1	19.2
11NG-10	A	30	4.7	21.0
11NG-11	A	30	3.3	9.5
11NG-11A	P	2	1.9	1.9
11NG-12	P	30	5.5	45.2

**11NG-11A is a new station added in 2022; number of observations is low (n= 2) and insufficient data to calculate representative statistics for compliance.

B. GROWING AREA 10GH – Green Hill Pond

HIGHLIGHTS

* Sampled 6X during 2022 (4 wet weather, 2 dry weather).
* Statistics represent recent 30 samples collected under both wet (n= 18) and dry (n= 12) weather conditions during 9/7/2017 to 10/27/2022.
* All samples analyzed by the mTEC method.
* All stations classified as prohibited, statistics for information only, not compliance.
* Data run 11/16/2022.

COMMENTARY

Shellfishing has been prohibited in the entirety of Green Hill Pond since May 28, 1994, due to elevated and unpredictable fecal coliform concentration. A TMDL study of Green Hill Pond was completed in 2006. The TMDL study identified freshwater streams in the north-northeast side of Green Hill Pond and groundwater as sources of fecal coliform. 2022 ambient monitoring results are consistent with this, indicating elevated fecal coliform levels exceeding NSSP standards for shellfish harvest at stations along the northern side of Green Hill Pond. In addition, highway runoff from Route 1 to the north of the Pond may be contributing to elevated fecal coliform (see Section 2, above). Stations on the south side of Green Hill Pond continue to display lower but highly variable (90^{th} percentile statistic above NSSP threshold) and unpredictable fecal coliform levels.

The 2022 statistical evaluation demonstrated that all twelve (12) monitoring stations located in Green Hill Pond exceeded NSSP variability criteria (90^{th} percentile of 31 cfu/100 ml) for harvest of

shellfish. Future monitoring will continue in Green Hill Pond to track and support TMDL and other water quality improvement efforts in the watershed.

Table 3: Fecal coliform summary statistics for Green Hill Pond based on recent 30 samples collected during all weather conditions (9/7/2017 to 10/27/2022; all mTEC, 18 wet and 12 dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
11NG-13	P	30	7.4	50.9
11NG-14	P	30	10.1	70.4
11NG-15	P	30	7.5	41.4
11NG-16	P	30	29.9	268.4
11NG-17	P	30	7.6	67.1
11NG-18	P	30	7.3	50.6
11NG-14A	P	30	11.3	64.9
11NG-14B	P	30	8.9	56.2
11NG-14C	P	30	19.1	202.4
11NG-16A	P	30	13.8	146.5
11NG-16B	P	30	10.1	71.5
11NG-19G	P	25	5.2	32.7

**11NG-19G is a new station added in 2017; number of observations is low (n= 13) and insufficient data to calculate representative statistics for compliance.

All approved stations in the growing area are in program compliance and the GA11NG growing area (Ninigret and Green Hill Pond) is properly classified.

RECOMMENDATIONS

* 3" rain emergency closure required to maintain compliance with NSSP criteria.
* Carefully review future results for stations 11NG-1 (Foster Cove) and sentinel station 11NG-12. These stations have an increasing fecal coliform variability trend in recent years.
* Continue sampling in shellfishing-prohibited Green Hill Pond to support TMDL study and to track changes in fecal coliform concentration.

6. Conclusions and Recommendations

The 2022 annual update of the Ninigret Pond and Green Hill Pond growing area (GA11NG) demonstrated that shoreline sources are not negatively impacting the microbiological water quality of approved waters in the growing area. A statistical review of water column fecal coliform samples collected in the growing area demonstrated that all Approved stations met NSSP criteria and that GA11NG is in program compliance and is properly classified. Station 11NG-4 in Foster Cove (approved waters) had elevated fecal coliform variability statistics that are approaching the NSSP standard of 31 cfu/100 ml. This station will be watched for exceedance of NSSP criteria that may require a classification downgrade. Waters in Green Hill Pond and eastern Ninigret Pond continue to exceed NSSP criteria for safe shellfish harvest.

The 2022 evaluation demonstrated that all approved waters met NSSP criteria and are in program compliance. No classification changes are recommended for the Ninigret Pond and Green Hill Pond growing area (GA11NG) at this time.

7. Literature Cited

Friends of Green Hill Pond Newsletter. August 2022. Volume 03. Issue 4.

RI DEM, 2006. TMDL Analysis for Green Hill Pond, Ninigret Pond, Factory Pond Stream and Teal Pond Stream. 65 pages. Available at: http://www.dem.ri.gov/programs/benviron/water/quality/rest/pdfs/ghptmdl.pdf

Growing Area 11QW
Quonochontaug and Winnapaug Ponds
2022 Annual Update

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1. Introduction

An annual re-evaluation survey of the Quonochontaug Pond and Winnapaug Pond shellfish growing area (GA11QW) was conducted during 2022 in order to comply with National Shellfish Sanitation Program (NSSP) requirements for shellfish growing area classification. The primary objective of this shoreline survey was to identify and characterize sources of pollution potentially affecting the area and re-evaluate point and non-point sources previously identified during prior surveys.

Comprehensive 12-year shoreline surveys of Quonochontaug and Winnapaug Ponds (Growing Area 11QW; Figure 1) were conducted in 2002 and 2012, and triennial updates were completed in 2005, 2008, 2011, 2015, 2018, and 2021. The last 12-year shoreline survey, completed in 2012, identified a total of twenty-six (26) actual or potential sources, seventeen (17) in Quonochontaug Pond and nine (9) in Winnapaug Pond. In the 2021 triennial update a total of two (2) sources were visited, both flowing and sampled at the time of the survey.

2. 2022 Survey

A triennial update of growing area 11QW was conducted in 2021. No sources located in this growing area were visited in 2022. There was one source greater than 2,400 cfu/100mL in the previous 12-year survey (conducted in 2012). There were few sources higher than 240 cfu/100mL and those sources were monitored in the 2021 triennial survey. Given the low fecal coliform results observed at these sources in 2021 (triennial survey), no source follow ups were necessary in 2022.

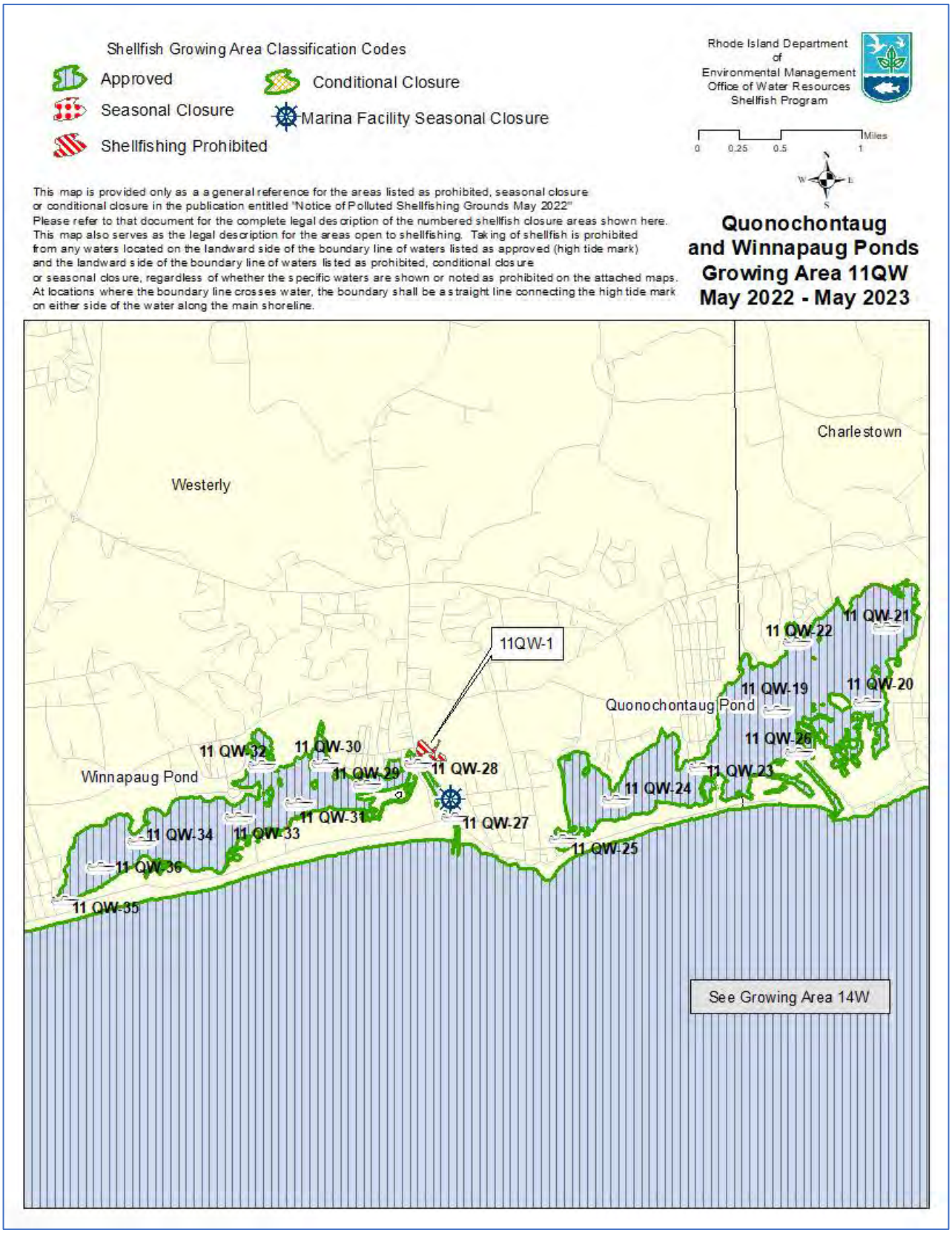
Two (2) actual or potential fecal coliform sources were sampled during the 2018 shoreline survey of GA11QW and fecal coliform concentration in flowing sources ranged from 100 to 400 cfu/100mL. Only a single (1) source, source 11QW-40 exceeded the 2,400 cfu/100 ml threshold in the 2012 survey. Source 11QW-40 and nearby source 11QW-41 were resampled as part of the 2020 annual update. These sources drain a stormwater detention structure on the barrier beach (Misquamicut Beach) separating Winnapaug Pond from the Atlantic Ocean. The detention structure was heavily damaged and partially filled by sediment in 2012 during Hurricane Sandy

resulting in reduced capacity of the system. 2020 survey results indicated that fecal coliform in these sources was low (< 100 cfu/100 ml). Companion in-stream samples demonstrated rapid dilution of fecal coliform to < 2 cfu/100 ml within 8 m (25 feet) of the sources. In addition, monitoring station 11QW-36, located approximately 200 meters (656 feet) west of source 11QW-40, has acceptable fecal coliform levels (Table 2) indicating that this source does not negatively impact the fecal coliform water quality of the growing area.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, *in situ* water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Quonochontaug or Winnapaug Ponds due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA11QW with Routine Monitoring Stations



3. Marina and Mooring Areas

There are two marinas identified in the growing area, one in each pond. The Weekapaug Yacht Club located in a cove on the southwestern corner of Quonochontaug Pond is a small day-sailing school that operates only during the summer months. It has no permanent docks and all boats are either moored or stored on the beach. The facility has a land-based sanitary service and the boats used here do not have MSDs. The Weekapaug Fire District has a series of docks located along the Weekapaug Breachway in Winnapaug Pond. There is a seasonal (summer only) closure associated with these docks. Marina closures are sized so that there is sufficient dilution to be protective during the seasonal operation of marina facilities. The dilution analysis supporting marina closures is in the document entitled "RIDEM Marina Dilution Analysis – June 2017 (with December 2022 update)" which is maintained in the program's permanent files.

4. Wastewater Treatment Facilities / Domestic Waste

There are no wastewater treatment facilities (WWTF), or any permitted RI Pollution Discharge Elimination (RIPDES) discharges that discharge to either pond in GA11QW.

The entire watersheds of Quonochontaug and Winnapaug Ponds are served by On-Site Wastewater Treatment systems (OWTS). There is a mix of types of systems ranging from cesspools, conventional and innovative and advanced systems located in the towns of Charlestown and Westerly (bordering communities). Since 2011 legislation has required that all cesspools located within the critical resource area boundary and within 200 ft of the inland edge of coastal shoreline feature bordering a tidal water area must be replaced and upgraded with a new onsite wastewater treatment system or connected to available municipal sewer lines by January 2014.

5. Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate

shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain interstate shipping certification.

Water samples are collected at eighteen (18) monitoring stations throughout the growing area (Figure 1). Eight (8) stations are located in Quonochontaug Pond and ten (10) stations are located in Winnapaug Pond. All water quality monitoring stations in GA11QW are in Approved waters.

Samples are collected and processed according to the DEM Shellfish Program's standard operating procedure as documented in the Program's permanent files (Shellfish Growing Area Monitoring Program SOP, updated August 2021). Briefly, water samples are collected 0.5 m (1-2 feet) below the water surface using 125 ml (4-ounce) sterile Nalgene bottles which are then stored in a cooler packed with ice. Samples are transported to the Rhode Island Department of Health Laboratories for analysis. Since June 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics were analyzed by the mTec method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

A. 2022 Review and Statistical Summary of Growing Area 11QW:

HIGHLIGHTS

* Sampled 6X when open (2 wet weather, 4 dry weather) during 2022.
* Compliance statistics calculated for recent 30 samples when area was in the open status (11/9/2017 to 10/25/2022, 14 wet weather and 16 dry weather samples).
* All approved stations meet NSSP criteria.
* All samples analyzed by the mTEC method.
* Data run 11/16/2022.

COMMENTARY

Winnapaug and Quonochontaug Ponds (Growing Area 11QW) were sampled six times during 2022; twice during wet weather and four times during dry weather (<0.5" in prior 7 days). Extreme rainfall during summer of 2019 led to elevated fecal coliform and an excessive rain closure of the growing area in 2019. Due to this observation of elevated fecal coliform after extreme rain, an extreme rain closure following rain of greater than 3" in 24 hours (measured at Westerly Airport) was instituted for this growing area.

Rainfall levels have returned to more typical patterns since 2019 and during 2022 fecal coliform levels were at relatively low levels typical of GA11QW. All fecal coliform observations made in GA11QW during 2022 were less than the NSSP variability standard of 31 cfu/100 ml and 104 of 107 (97%) of fecal coliform values were less than 14 cfu/100 ml during 2022. Further, 74 of 17 observations (69%) made during 2022 had fecal coliform values of 2 cfu/100 ml or less. 2022 compliance statistics indicated that all Approved stations in the growing area met NSSP fecal coliform water quality criteria.

One station in Quonochontaug Pond, station 11QW-25, met criteria but had 90th percentile variability statistic (29.4 cfu/100 ml) that approached NSSP criteria of 31 cfu/100 ml. A review of the recent 30 samples for station 11QW-25 indicated that elevated variability at this stations was primarily due to two elevated fecal coliform samples from the wet summer of 2019. Nineteen (19) observations made at station 11QW-25 since September 2019 have been less than 31 cfu/100 ml and 18 of 19 (95%) observations made since September 2019 have been less than 14 cfu/100 ml. DEM OWR staff will continue to carefully monitor station 11QW-25 to verify that the pattern of improving water quality since 2019 continues.

The 2022 evaluation demonstrated that the Quonochontaug Pond and Winnapaug Pond growing area (GA11QW) is in program compliance and the area is properly classified.

RECOMMENDATIONS

* 3" excessive rain closure required to maintain compliance with NSSP criteria.

* Watch station 11QW-25 for changes in fecal coliform water quality,

Table 1: Fecal coliform summary statistics for Quonochontaug Pond based on recent 30 samples collected under all weather conditions 11/9/2017 to 10/25/2022 (all mTEC, 14 wet and 16 dry weather sets of samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
11QW-19	A	30	2.3	5.5
11QW-20	A	30	2.5	5.5
11QW-21	A	30	2.5	4.7
11QW-22	A	30	3.2	12.9
11QW-23	A	30	2.9	9.5
11QW-24	A	30	2.9	6.9
11QW-25	A	30	5.2	29.4
11QW-26	A	30	2.7	7.1

Table 2: Fecal coliform summary statistics for Winnapaug Pond based on recent 30 samples collected under all weather conditions 11/9/2017 to 10/25/2022 (all mTEC, 14 wet and 16 dry weather sets of samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
11QW-27	A	30	2.7	5.3
11QW-28	A	30	2.8	5.8
11QW-29	A	30	3.9	10.1
11QW-30	A	30	5.8	22.5
11QW-31	A	30	2.8	6.3
11QW-32	A	30	4.3	15.6
11QW-33	A	30	3.5	10.4
11QW-34	A	30	3.0	9.1
11QW-35	A	30	3.6	15.3
11QW-36	A	30	3.2	10.8

6. Summary and Conclusions

The 2022 annual review of Quonochontaug and Winnapaug Ponds (GA11QW) documented that there are no shoreline pollution sources that are negatively impacting the fecal coliform water quality of the growing area. The 2022 review of fecal coliform water quality data indicated that an excessive rain closure for rain amounts of greater than 3” is required for this growing area to maintain compliance with NSSP standards. With application of the 3” excess rain closure, the 2022 annual update demonstrated that all monitoring stations in the growing area meet NSSP criteria while in the open status.

The 2022 update has demonstrated that the area is properly classified. No changes in classification are recommended.

Growing Area 12:
Little Narragansett Bay and Pawcatuck River
2022 Annual Update

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Introduction

Little Narragansett Bay is an embayment located at the mouth of the Pawcatuck River, behind the barrier beach of Napatree Point. Little Narragansett Bay is located in the southwestern corner of Rhode Island adjacent to the Rhode Island – Connecticut state line. All waters of Little Narragansett Bay (Growing Area 12, Figure 1) are currently prohibited to shellfishing due to elevated fecal coliform concentration. A fecal coliform loading TMDL study of Little Narragansett Bay was approved by EPA in December of 2010. The TMDL-recommended implementation activities that focused on stormwater control, wastewater treatment, and waterfowl management (RI DEM, 2010). As part of that ongoing effort sampling has been conducted in the past several years by RI DEM TMDL and Shellfish staff in partnership with Save the Bay. The collaborative sampling effort with Save the Bay has resulted in more frequent sampling of this growing area (two to six times per year) for the past several years. This recent data is more representative of current conditions in Little Narragansett Bay and the Pawcatuck River compared

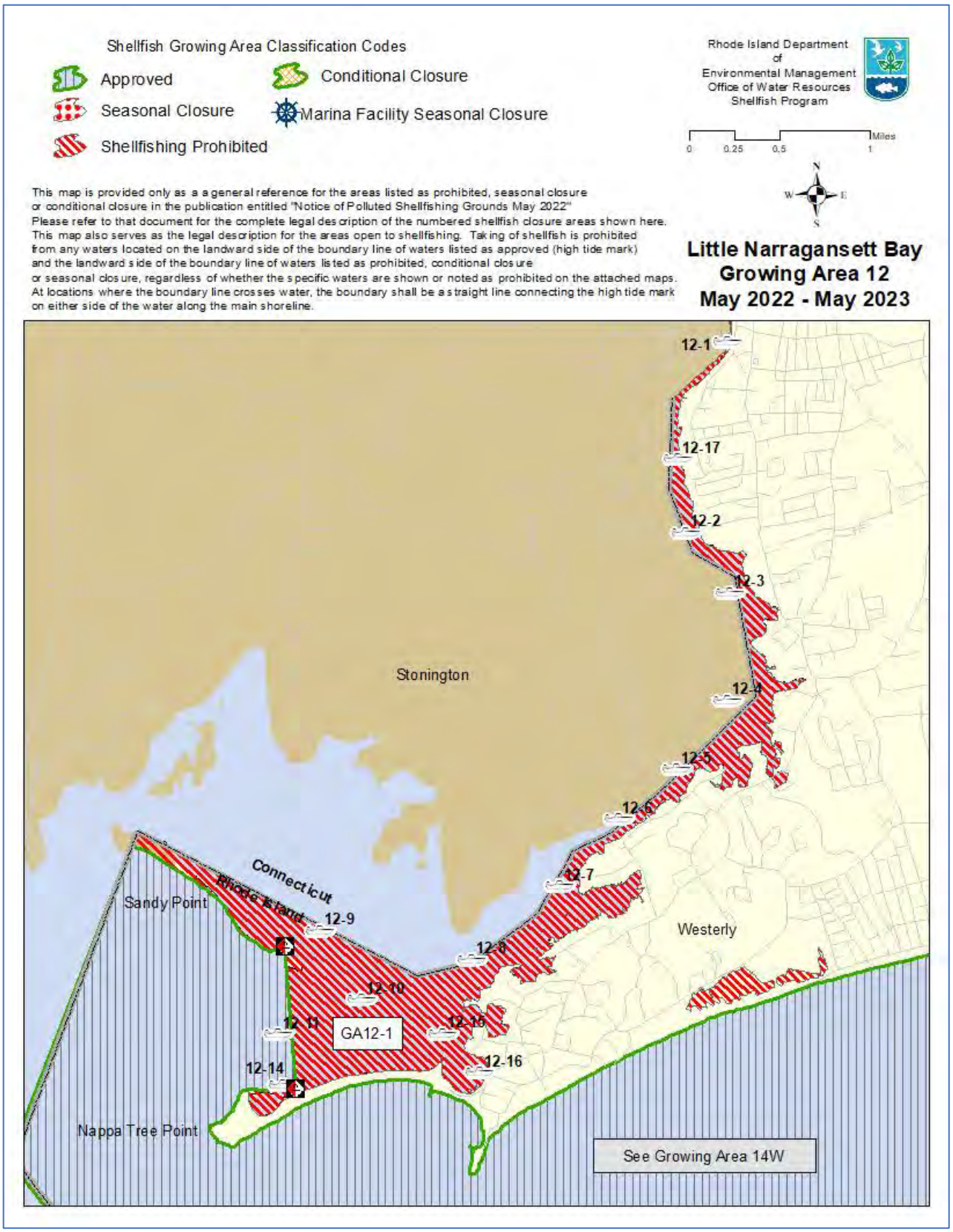
to more sporadic historic sampling that had been done prior to the collaboration with Save the Bay.

In addition to closures due to unacceptable fecal coliform water quality, there are approximately a dozen commercial marinas and mooring fields within these prohibited waters. All waters of Little Narragansett Bay within and adjacent to these marinas are currently classified as prohibited. By calculation there is sufficient dilution within these prohibited waters to be protective of adjacent waters that are open for shellfish harvest. These calculations and marina details can be found in the document entitled “Marina Dilution Analysis – June 2017, &December 2022 Update” located in the program’s permanent files.

2022 Survey

The entirety of the Rhode Island portions of Little Narragansett Bay is classified as Prohibited (Figure 1), therefore there has not been a comprehensive shoreline survey of the area by the shellfish program staff. This 2022 update summarizes recent fecal coliform water quality data in the growing area in support of TMDL efforts and to track potential changes in fecal coliform water quality.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA 12 with Routine Monitoring Stations.



Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain interstate shipping certification.

Water samples are collected at fifteen (15) monitoring stations throughout the growing area (Figure 1). Fourteen stations are in Prohibited waters with station 12-11 (classified as Approved) as a 'sentinel station' on the closure line adjacent to Approved waters of GA14.

Water samples are collected and handled according to the DEM Shellfish Programs Standard Operating Procedure (Updated August 2021 and available in the Program's permanent files). Briefly, samples are collected 0.5 m(1-2 feet) below the water surface using sterile 125 ml (4 ounce) Nalgene bottles and stored on ice. They are transported to the Rhode Island Department of Health Laboratories for analysis via the mTEC method (APHA, 1999). The results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. The growing area fecal coliform monitoring data are annually analyzed and evaluated for compliance with NSSP criteria for safe shellfish harvest. The most recent annual statistical report and commentary is below.

A. 2022 Review and Statistical Summary of Growing Area 12:

HIGHLIGHTS

* Sampled 3X during 2022 (all dry weather).
* The area is classified as prohibited, sentinel station 12-11 is located on the line between approved and prohibited waters.
* For approved station 12-11, statistics represent recent 30 samples collected under both wet (n= 13) and dry (n= 17) weather conditions during 9/27/2016 to 7/21/2022.
* Statistics for prohibited stations calculated for information purposes only, not for compliance.
* Informational statistics calculated for Approved and Conditionally Approved (7-day closure after greater than 0.5" rain) management scenarios.
* Approved station 12-11 is in compliance.
* All samples analyzed by the mTEC method.
* Data run 1/20/2023.

COMMENTARY

Little Narragansett Bay (Growing Area 12) was sampled three times during 2022 through a cooperative partnership between DEM Office of Water Resources and Save the Bay. All samples collected during 2022 were collected during dry weather (< 0.5" rain prior 7 days). The area is classified as Prohibited, so there is no minimum sampling requirement. For more than ~20 years the area has been closed to shellfish harvest for direct human consumption due to elevated and unpredictable fecal coliform levels during wet weather. A TMDL study of the area was completed in 2010, with a focus on improving stormwater and wastewater management and reducing waterfowl impacts in the Pawcatuck River watershed.

The 2022 statistical review indicated that Little Narragansett Bay would not meet NSSP water quality criteria for shellfish harvest under either Approved or Conditionally Approved (with 0.5", 7-day rain closure) management scenarios. Fecal coliform levels remain unpredictable and elevated, especially during wet weather. The sentinel station (12-11) on the line between approved and prohibited waters was in compliance for 2022, demonstrating that the current closure line is appropriate. Under an Approved scenario, only stations 12-11 and 12-14 located in the western edge of the growing area adjacent to Approved waters, met fecal coliform criteria. Under a Conditionally Approved management scenario, with a 0.5", 7-day rain closure only those same two stations (12-11, 12-14) would meet NSSP criteria during dry weather.

The elevated and unpredictable fecal coliform response to rainfall indicates that the area is currently properly classified as Prohibited for shellfish harvest.

RECOMMENDATIONS

* Continue cooperative sampling effort with Save the Bay to monitor water quality and to support TMDL work in the watershed.

Table 1: Fecal coliform summary statistics for GA12 (Little Narragansett Bay and Pawcatuck River) under an Approved classification scenario. Statistics based on recent 30 samples collected under all weather conditions during 9/27/2019 to 7/21/2022, 13 wet and 17 dry weather samples. Statistics shown for informational purposes only, not for compliance.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
12-1	P	30	179.1	765.3
12-2	P	30	185.9	834.2
12-3	P	30	192.5	777.8
12-4	P	30	95.6	552.5
12-5	P	30	77.7	614.2
12-6	P	30	54.3	437.3
12-7	P	30	27.7	179.2
12-8	P	30	17.5	163.0
12-9	P	30	8.3	61.4
12-10	P	30	10.7	94.3
12-11	A	30	6.4	19.8
12-14	P	30	4.9	28.9
12-15	P	30	11.0	80.7
12-16	P	30	22.5	146.9
12-17	P	30	90.7	361.4

Table 2: Fecal coliform summary statistics for GA12 (Little Narragansett Bay and Pawcatuck River) under a Conditionally Approved classification scenario of a 0.5", 7-day closure. Recent 15 samples collected during 5/22/2018 to 7/21/2022, all mTEC, all dry weather of <0.5" in prior 7 days. Statistics shown for informational purposes only, not for compliance.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
12-1	P	15	108.1	100.0
12-2	P	15	116.8	93.3
12-3	P	15	116.9	93.3
12-4	P	15	57.3	66.7
12-5	P	15	48.3	46.7
12-6	P	15	35.9	46.7
12-7	P	15	19.0	26.7
12-8	P	15	8.9	20.0
12-9	P	15	4.4	13.3
12-10	P	15	7.7	20.0
12-11	A	15	5.9	6.7
12-14	P	15	3.0	0.0
12-15	P	15	7.8	20.0
12-16	P	15	15.5	33.3
12-17	P	15	67.9	73.3

Summary and Conclusions

The 2022 review of fecal coliform water quality data indicated that fecal coliform water quality in GA12 (Little Narragansett Bay) does not reliably meet NSSP standards under all weather conditions (Approved scenario) or under a Conditionally Approved scenario with a 0.5", 7-day rain closure. Only sentinel stations on the far western edge of the growing area adjacent to the Approved waters of GA14 met NSSP criteria under any scenario. The fecal coliform water quality of GA12 is too variable, primarily due to wet weather elevations, to meet NSSP criteria for safe shellfish harvest.

The 2022 update has demonstrated that the area is properly classified as Prohibited. No changes in classification are recommended.

Literature Cited:

RI DEM, 2010. Total maximum daily load (TMDL) analysis for the Pawcatuck River and Little Narragansett Bay bacteria impairments. 83 pages. Available at: http://www.dem.ri.gov/programs/benviron/water/quality/rest/pdfs/lnbwdrft.pdf

Growing Area 13

Great Salt Pond at Block Island

2022 Annual Update

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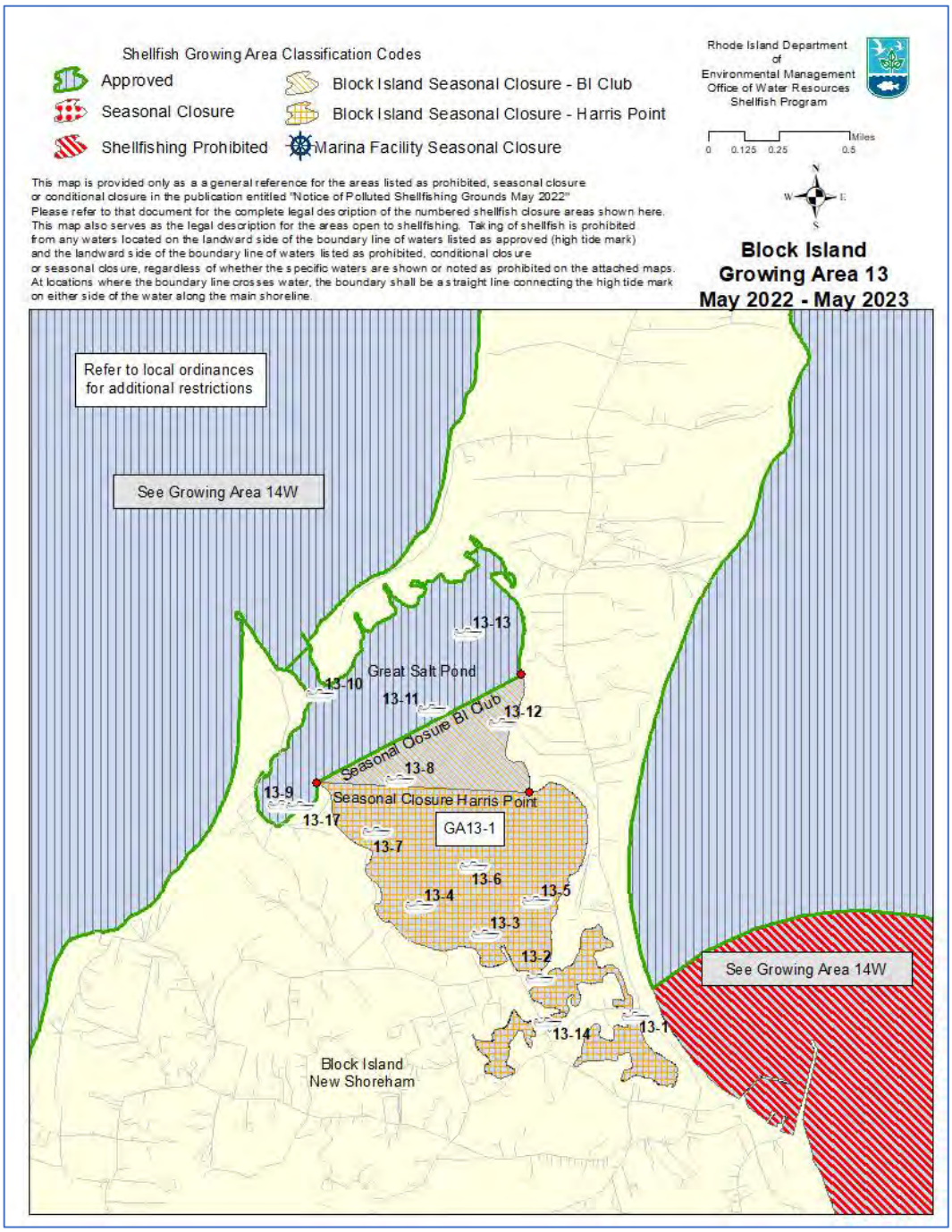
1. Introduction

A comprehensive 12-year sanitary survey of Great Salt Pond, Harbor Pond and Trims Pond on Block Island (Growing Area 13) was last conducted in 2018. The 2018 comprehensive survey involved a shoreline reconnaissance of the growing area to locate and catalog pollution sources and collect bacteriological samples from all sources actively flowing into the study area. All

locations within the growing area were surveyed regardless of their classification. The primary objective of the sanitary survey was to identify and characterize sources of pollution potentially impacting the growing area, to reevaluate point and nonpoint sources identified during previous surveys, and to update information regarding the sampling of previously identified sources.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA13 with Routine Monitoring Stations



2. 2022 Survey

No sources sampled during the 2018 survey surpassed the 2,400 cfu/100 mL threshold for resampling as part of the 2022 annual update. The 2022 update of GA13 included a review of OWTS complaints adjacent to the growing area and a review of fecal coliform data collected at monitoring stations in the growing area. One source (2022-13-001) was inspected by a RI DEM summer intern during their inspection of the pumpout facilities on the island.

Source 2022-13-001 is a tributary to Upper Harbor Pond, that crosses under Ocean Avenue adjacent to the parking lot of Kimberly's Restaurant. This source has a minimal flow and is difficult to access as it approaches the main portion of the pond. Dense *Phragmites* and vegetation, as well as soft sod banks and a muddy bottom make it difficult for staff to collect an instream sample. When sampled on 8/23/2022 (same day as 0.43" rain at Block Island Airport station KBID), this source had a result of 36,000 cfu/100mL and no flow (stagnant pool). The 2022 result was drastically higher than any sample taken at this source historically. In 2021 this source had a result of 300 cfu/100mL. The likely explanation for the elevated 2022 result is stagnant water (no flow) warmed by the summer sun which promoted bacterial survival and growth. This source is at the farthest inland end of the growing area. GA13 has an extensive seasonal (summer) closure and source 13-001 enters the receiving waters approximately 1.7 miles away from any shellfish waters that are in the open status during summer. This source will be resampled in 2023.

Table 1: Source 2022-13-001

Source ID	Date	Latitude	Longitude	Description	2021 Results (CFU/100mL)	2022 Results (CFU/100mL)	2022 Flow
2022-13-001	8/23/22	41.17522	-71.5634	Tributary upper Harbor Pond	300	36,000	none

During the 2018 comprehensive survey all actual and potential pollution sources discharging or

having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. Possible sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, *in situ* water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of GA13 due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

3. Marinas and Mooring Areas

Great Salt Pond on Block Island is a destination harbor that sees a dramatic increase in number of visiting boats during the summer months. There are six (6) commercial marinas that have nearly 450 slips and moorings available to the boating public in Great Salt Pond. Two staggered seasonal closures go into effect beginning in May and expanding in June, which encompasses almost three quarters of the pond. These seasonal closures last through the recreational boating season and end in October. Sampling of the growing area is completed approximately monthly, year-round in a cooperative effort with the Block Island Harbor Master's office. A marina dilution calculation was performed and is detailed in the summary report entitled "Marina Dilution Analysis – June 2017 & December 2022 Update" in the program's permanent files. By calculations there is sufficient dilution within these seasonal closures to be protective of adjacent shellfishing waters. The Town of New Shoreham operates five (5) pump out boats that operate in the Great Salt Pond to service the docked and moored vessels present in GA13. In addition the Town operates a seasonal fixed

pumpout station in Old Harbor in the contiguous waters of GA14.

4. Wastewater Treatment Facilities

No WWTF discharge to GA13. New Shoreham has a centralized 0.5 MGD wastewater treatment facility that serves approximately 50% of the population during winter and approximately 20% of the population during summer (New Shoreham Comprehensive Plan, 2016). The New Shoreham WWTP discharges treated effluent to Block Island Sound (GA14). The New Shoreham WWTF discharged a monthly average of 0.12 MGD during 2022, well-below the permitted flow of 0.5 MGD and the New Shoreham WWTF had no permit violations during 2022. The southern portion of the Great Salt Pond (GA13) watershed, namely the densely populated region from Champlin's Marine east to Old Harbor is serviced by municipal sewer. The remainder of the watershed is served by on-site wastewater treatment systems (OWTS). Block Island has implemented increased inspection of the island's OWTS recently and 272 (of 1,674) OWTS systems have previously been identified as sub-standard and have been repaired or upgraded since 2015 (New Shoreham Comprehensive Plan, 2016).

5. Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain interstate shellfish shipping certification.

Water samples are collected at fifteen (15) monitoring stations located throughout Growing Area 13 (Figure 1). Four (4) stations have the Approved classification, ten (10) stations are in Conditionally (Seasonal) Approved waters and one (1) station is located in Prohibited waters.

Water samples are collected at monitoring stations throughout the growing area (Figure1). Water samples are collected and handled according to the DEM Shellfish Programs Standard Operating Procedure (updated August 2021 and available in the Program's permanent files). Briefly, samples are collected 0.5 m (1-2 feet) below the water surface using sterile 125 ml (4 ounce) Nalgene bottles and stored on ice at 4 C. They are transported to the Rhode Island Department of Health Laboratories for analysis via the mTEC method (APHA, 1999). The results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. The growing area fecal coliform monitoring data are annually analyzed and evaluated for compliance with NSSP criteria for safe shellfish harvest. The most recent annual statistical report and commentary is below.

A. Review and Statistical Summary of Growing Area 13:

HIGHLIGHTS

*** Sampled 9X during 2022.**

*** For approved stations, statistics represent recent 30 samples collected under both wet (n= 14) and dry (n= 16) weather conditions during 12/4/2019 or 1/28/2020 to 10/19/2022.**

*** For seasonally approved stations, statistics represent recent 15 samples when area was open 10/27/2020 to 10/19/2022 during both wet (n= 7) and dry (n= 8) conditions.**

*** All approved stations in compliance.**

*** All seasonally approved stations in compliance.**

*** All samples analyzed by the mTEC method.**

*** Data run 1/30/2023.**

COMMENTARY

Growing Area 13, the Great Salt Pond at Block Island, was sampled nine (9) times during 2022, exceeding NSSP systematic random sampling requirements. Monitoring of Block Island shellfish growing waters was done through a cooperative agreement between the Town of New Shoreham Harbor Master's Office and DEM Water Resources. Following NSSP guidelines, statistics calculated for approved areas are based on the recent 30 samples and are representative of both wet and dry weather, with 14 wet weather and 16 dry weather samples. Similarly, statistics for seasonally approved areas are representative of both wet (n= 7) and dry (n= 8) weather conditions collected when the area was in open status. The 2022 statistical review demonstrated that all approved and conditionally approved stations in GA13 (Block Island Great Salt Pond) are in

program compliance.

Comparison of results at the conditionally (seasonal) approved stations also demonstrated that seasonal closures during the peak boating season are effective and that acceptable water quality was maintained while GA13 seasonal areas were in the open status. The continued need for a seasonal (summer) closure is especially evident for stations 13-1, 13-2 and 13-14 (located in the innermost area of Great Salt Pond furthest from the breachway) and stations 13-3 and 13-4 (located in an extensive seasonal marina and mooring area). Comparison of compliance statistics at these stations show exceedance or near exceedance of NSSP standards under an approved management scenario, but compliance with NSSP standards under the conditionally approved (seasonally approved; closed during peak boating season) management strategy used for GA13.

The 2022 statistical evaluation demonstrated that all Approved and Seasonally Approved stations in Block Island's Great Salt Pond met NSSP fecal coliform criteria and are in program compliance. The area is properly classified.

RECOMMENDATIONS

*** Continue cooperative agreement with Block Island Harbor Master to monitor Block Island shellfish growing areas.**

*** Continue seasonal closures due to elevated fecal coliform levels during the summer season.**

*** No other actions recommended.**

Table 2: Fecal coliform summary statistics for approved stations in Block Island's Great Salt Pond (GA13) based on recent 30 samples collected under all weather conditions 12/4/2019 or 1/28/2020 to 10/19/2022 (all mTEC, 14 wet and 16 dry weather sets of samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
13-9	A	30	3.1	7.4
13-10	A	30	2.5	5.0
13-11	A	30	3.0	9.1
13-13	A	30	2.6	8.3

Table 3: Fecal coliform summary statistics for all observations at seasonally approved and prohibited stations *shown for reference only and not for compliance*. Recent 30 samples collected under all weather conditions and while stations were in both open and closed status 12/4/2019 or 1/28/2020 to 10/19/2022 (all mTEC, 14 wet and 16 dry weather sets of samples). .

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
13-1	SA	30	10.5	80.9
13-2	SA	30	8.4	69.3
13-3	SA	30	6.3	59.9
13-4	SA	30	4.3	28.1
13-5	SA	30	3.3	12.0
13-6	SA	30	3.0	8.6
13-7	SA	30	3.7	19.6
13-8	SA	30	3.2	17.3
13-12	SA	30	2.7	6.8
13-14	SA	30	7.9	47.4

Table 4: Fecal coliform summary statistics for seasonally approved stations (closures A&C) in Block Island's Great Salt Pond (GA13) based on recent 15 samples collected while the area was in the open status (10/24/2020 to 10/19/2022, all mTEC, 7 wet and 8 dry weather sets of samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
13-1	SA	15	4.9	0.0
13-2	SA	15	3.4	6.7
13-3	SA	15	2.2	0.0
13-4	SA	15	2.1	0.0
13-5	SA	15	1.9	0.0
13-6	SA	15	2.0	0.0
13-7	SA	15	1.9	0.0
13-14	SA	15	3.6	0.0

Table 5: : Fecal coliform summary statistics for seasonally approved stations (closure B) in Block Island's Great Salt Pond (GA13) based on recent 15 samples collected while the area was in the open status (2/24/2021 to 10/19/2022, all mTEC, 8 wet and 7 dry weather sets of samples).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
13-8	SA	15	1.9	0.0
13-12	SA	15	2.1	0.0

6. Summary and Conclusions

The 2022 review documented that there are no pollution sources that are negatively impacting the fecal coliform water quality of the growing area while the area is in the open status. The 2022 review of fecal coliform water quality data indicated that all stations in Growing Area 13 met NSSP criteria while in the open status are in program compliance. The area is properly classified and no changes in classification are recommended.

Growing Area 14E and 14W

RI Offshore Waters

2022 Annual Update

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Tables

1. Introduction

Growing Area 14 is the waters off the southern cost of Rhode Island out to the 3-mile state waters limit including the waters within three miles of the Block Island coast. The growing area is broken into an eastern section, GA14E (Figure 1) and a western section (GA14W, Figure 2) which includes the offshore waters around Block Island. For many years GA14 was classified as approved waters in the remote status (requiring two sets of samples per year (NSSP Model Ordinance 2019 Chapter IV A .02 D(3)) because most of the area is far from potential human impacts on microbial water quality. The remote status of GA14 was changed in 2022 following an FDA review. Beginning in 2022, GA14 is now monitored as approved waters using the adverse pollution conditions (APC) strategy. Under the APC strategy the growing area is sampled five times annually, with the samples collected at the locations or during the timeframe that the most adverse pollution conditions are likely to occur (NSSP Model Ordinance 2019 Chapter IV A .02 E (1-4)). To accommodate this change, several stations were added at the locations in GA14 most likely to capture adverse pollution conditions. These locations include the portions of GA14 adjacent to Narragansett Bay at the Sakonnet River (station 14E-12 near Sakonnet Light), at the East Passage (station 14E-8 near Brenton Reef) and at the West Passage (station 14E-7 near Whale Rock). In addition, stations were added within the closed safety zones adjacent to the Narraganset WWTF outfall (station 14W-6N) and the Scarborough WWTF outfall (station 14W-6S). NSSP guidance requires that these coastal stations to be sampled five times annually. However, GA14 is the coastal ocean outside Narragansett Bay and the area is challenging to sample under all weather conditions using the Program's current sampling vessel.

12-year sanitary shoreline surveys of the Offshore Growing Area 14E and 14W was conducted in 2006 and 2018. 266 potential sources were located and investigated during the 2018 survey. 155 of the potential sources were not flowing and 111 potential sources were flowing at the time of the 2018 survey. Of these flowing sources, 82 sources had flows too small to measure (trickle or less). No sources identified in 2018 had fecal coliform results requiring resampling as part of the 2022 annual update.

Figure 1: Current (2022-2023) Shellfish Classification Map of GA 14E with routine monitoring stations

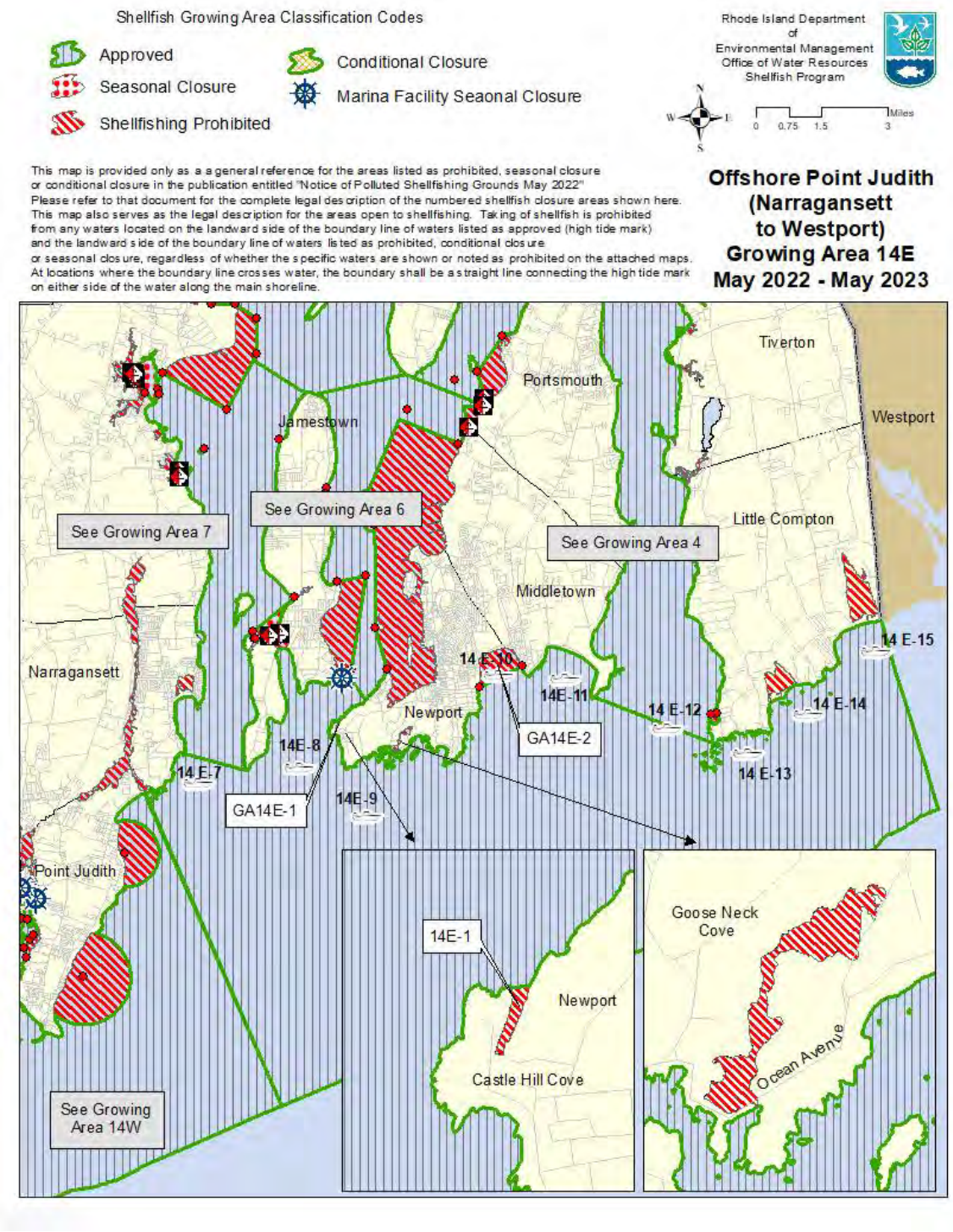
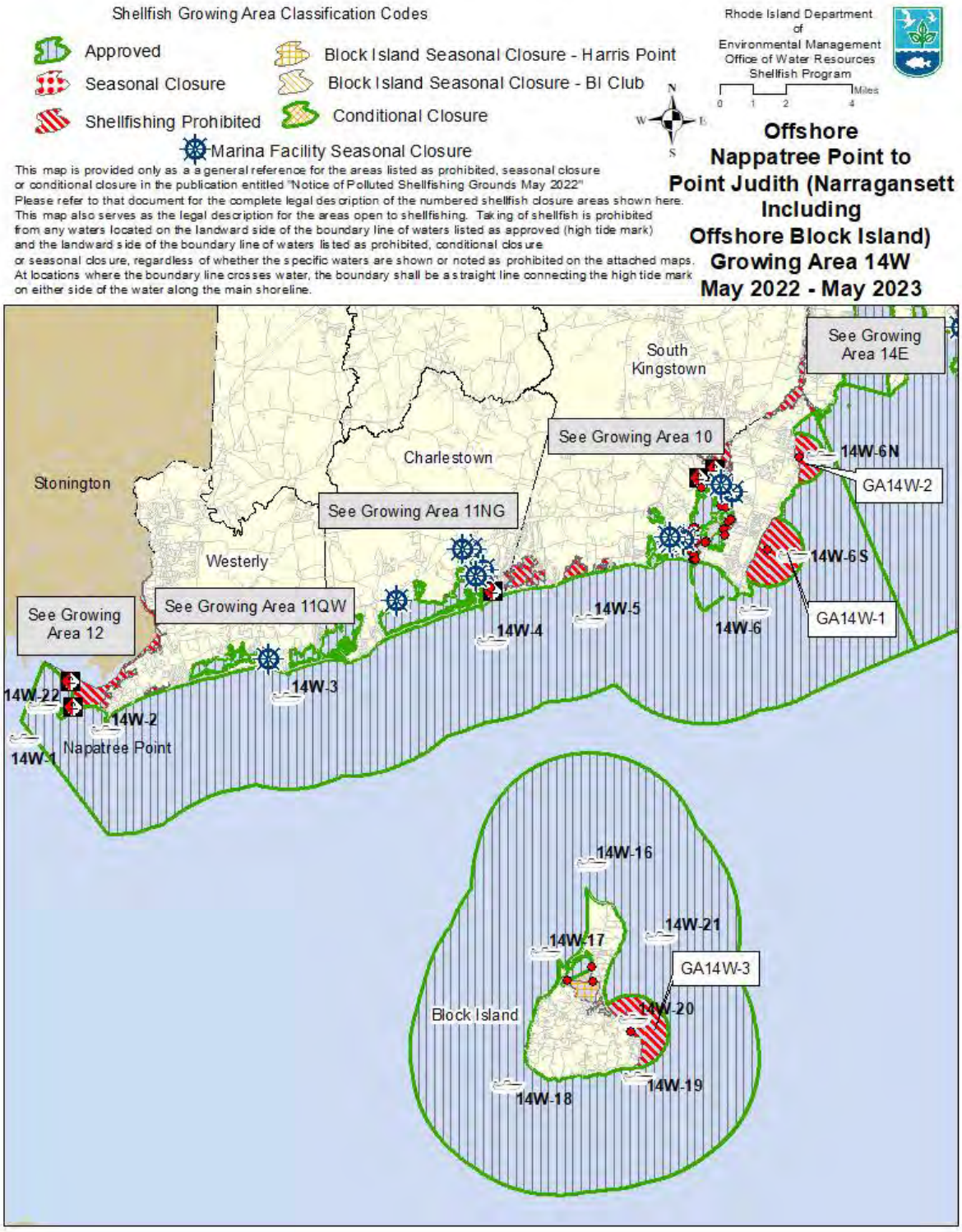


Figure 2: Current (2022-2023) Shellfish Classification Map of GA 14W Offshore with routine monitoring stations.



2. 2022 Survey

During the 2018 12-year survey four (4) sources were determined to require follow-up sampling annually. Locations of these sources are shown in the 2018 12-Year Sanitary Survey available in the Program's permanent files. These four sources were re-visited in 2019 and were either not flowing or had fecal coliform results of less than 240 cfu/100 ml. During the 2021 Triennial Reevaluation nine (9) moderately elevated (240 -2,400 cfu/100 ml) sources were investigated, with only two (2) sources found to be flowing. During 2021 both of these sources (2021-14W-1319 and 2021-14W-1327) had low flow (trickle flow) and fecal coliform of < 100 cfu/100 ml (source 14W-1319) and 270 cfu/100 ml (source 14W-1327). Due to the lack of flow (trickle or less) and the relatively low fecal coliform at these sources in 2019 and 2021, no follow up sampling of these sources was required during 2022.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Growing Area 14E and 14W due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

3. Marinas and Mooring Areas

The growing area has five (5) marinas, two (2) in the offshore waters of Block Island and three (3) in GA14E. The waters surrounding these marinas are classified as prohibited or have seasonal (summer) closures with sufficient dilution waters to be protective of adjacent shellfishing waters. Details of the marina dilution calculations can be found in the report entitled "Marina Dilution Analysis June 2017 with December 2022 Update" in the program's permanent files.

4. Wastewater Treatment Facilities

The watershed adjacent to the offshore growing area is a mix of undeveloped beaches, rocky cliffs, small seasonal communities and other residential uses. There are no industrial or large commercial areas adjacent to approved offshore waters.

The Rhode Island Pollution Discharge Elimination System Program (RIPDES) is responsible for permitting all industrial and municipal waste discharges to waterbodies of the state. The RIPDES Program has documented and permitted three (3) wastewater treatment facilities that discharge into GA14. All WWTF have prohibited safety zones established around their outfalls. The size of these prohibited safety zones was developed to be protective of adjacent shellfish waters using the EPA PLUMES dilution and dispersion model program. The three (3) WWTF discharging to GA14 are:

Table 1: Permitted treated effluent discharge flow rates for WWTF discharging to GA14.

Facility	Location	Permit Flow	2022 Avg. Flow
Scarborough WWTF	Narragansett	1.4 MGD	0.72 MGD
South Kingstown WWTF	S. Kingstown	5.0 MGD	2.47 MGD
New Shoreham WWTF	New Shoreham	0.45 MGD	0.12 MGD

In 2022 the Scarborough WWTF had an average flow of 0.72 MGD compared to a permitted discharge of 1.4 MGD. A review of EPA ECHO DMR data indicated that the Scarborough WWTF had no flow or fecal coliform concentration permit violations during 2022. The South Kingstown WWTF reported an average flow of 2.47 MGD versus a permitted flow of 5.0 MGD and had no flow or fecal coliform violations during 2022. The New Shoreham (Block Island) WWTF had an average flow of 0.12 MGD during 2022 which is well-below the 0.45 MGD permitted discharge. The New Shoreham WWTF had no flow or fecal coliform violations during 2022. The 2022 review of GA14 WWTF indicated that the three (3) WWTF that discharge to GA14 are well-run and are discharging treated effluent within the permitted flow and fecal coliform limits.

5. Water Quality Studies

RIDEM Shellfish Program

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) as managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain interstate shellfish shipper certification.

Water samples are collected at twenty-four (24) monitoring stations throughout the growing area. There are nine (9) monitoring stations in GA14E all of which have approved classification (Figure 1). There are nine (9) monitoring stations located in GA14W of which seven (7) are classified as Approved and two (2) are classified as Prohibited (Figure 2). Two additional stations (14W-6N and 14W-6S) were recently (in 2022) added to the western side of the growing area within closed safety zones (prohibited waters) of the Scarborough and South Kingstown WWTF outfalls. These added stations are required under the adverse pollution conditions (APC) sampling strategy to characterize the impacts of treated WWTF discharge on microbial water quality on the approved waters of GA14. GA14-BI has six (6) monitoring stations (5 approved, 1 prohibited) in the

offshore waters surrounding Block Island.

Water samples are collected and handled according to the DEM Shellfish Programs Standard Operating Procedure (updated August 2021 and available in the Program's permanent files). Briefly, samples are collected 0.5 m (1-2 feet) below the water surface using 125 ml (4-ounce) sterile Nalgene bottles after which they are stored in a cooler packed with ice. They are then transported to the Rhode Island Department of Health Laboratories for analysis. Since June 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics were analyzed by the mTec method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

A. 2022 Review and Statistical Summary of Growing Area 14:

HIGHLIGHTS

* Area changed from remote status sampling strategy (2 samples per year) to adverse pollution conditions sampling strategy (5 samples per year) in 2022.
* All samples analyzed by the mTEC method.
* All stations in program compliance.
* Data run 1/31/2023

For GA14E:

* Area sampled on 18 dates during the 2022 season (not all stations sampled on each date).
* Statistics represent all data collected 12/16/2015 or 9/10/2019 to 1/17/2023 (4 wet weather and 11 dry weather sets of samples).

For GA14-W:

* Area sampled on 6 dates during the 2022 season (not all stations sampled on each date).
* Statistics represent all data collected 12/10/2015 or 11/28/2016 to 1/17/2-23 (2 wet weather and 13 dry weather sets of samples).

For GA14-BI:

* Area sampled on 3 dates during the 2022 season (all stations sampled on each date).
* Statistics represent all data collected 12/10/2015 or 11/28/2016 to 1/17/2-23 (8 wet weather and

7 dry weather sets of samples).

COMMENTARY

The monitoring strategy used for GA14 was changed in 2022 following an FDA review. Beginning in 2022, GA14 is now monitored as approved waters using the adverse pollution conditions (APC) strategy. Under the APC strategy the growing area is to be sampled five times annually, with the samples collected at the locations or during the timeframe that the most adverse pollution conditions are likely to occur. To accommodate this change, several stations were added at the locations in GA14 most likely to capture adverse pollution conditions. These locations include the portions of GA14 adjacent to Narragansett Bay at the Sakonnet River (station 14E-12 near Sakonnet Light), at the East Passage (station 14E-8 near Brenton Reef) and at the West Passage (station 14E-7 near Whale Rock). In addition, stations were added within the closed safety zones adjacent to the Narraganset WWTF outfall (station 14W-6N) and the Scarborough WWTF outfall (station 14W-6S). NSSP guidance requires that these coastal stations to be sampled five times annually. Stations in GA14E and GA14W are monitored through a collaborative effort between DEM Water Resources and DEM Division of Law Enforcement. Waters around Block Island (stations 14-16 to 14-21; GA14-BI) are monitored in collaboration with the Town of New Shoreham Harbor Master's Office. DEM Water Resources staff monitor stations in GA14E and GA14W when weather conditions allow the DEM Water Resources vessel to work in these oceanic coastal waters.

The statistical evaluation included the most recent 15 samples dating back to 2015. All recent samples in the analysis set (n=15) were analyzed by the mTEC method. Fecal coliform concentration in these offshore waters is consistently low with nearly all recent observations being 2 cfu/100 ml or less. Only three (3) of the recent 338 observations (0.9%) in the recent 15 data set exceeding the 2 cfu/100 ml detection limit. The 2022 statistical evaluation demonstrated that all stations in the offshore area (GA14) meet criteria and are in program compliance. The area is properly classified.

RECOMMENDATIONS

*** Continue transition from remote to APC monitoring strategy for GA14.**

*** Continue collaborative efforts to monitor GA14 offshore remote waters.**

*** No other actions recommended based on ambient monitoring results.**

Table 2: Fecal coliform statistical summary for GA14E based on recent 15 samples collected during all weather conditions (12/16/2015 or 9/10/2019 to 1/17/2023; 4 wet weather and 11 dry weather sets of samples; all mTEC).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
14E-7	A	15	1.9	0.0
14E-8	A	15	2.5	6.7
14E-9	A	15	1.9	0.0
14E-10	A	15	1.9	0.0
14E-11	A	15	2.0	0.0
14E-12	A	15	1.9	0.0
14E-13	A	15	1.9	0.0
14E-14	A	15	1.9	0.0
14E-15	A	15	1.9	0.0

Table 3: Fecal coliform statistical summary for GA14W based on recent 15 samples collected during all weather conditions 12/10/2015 or 11/28/2016 to 1/17/2-23; 2 wet weather and 13 dry weather sets of samples; all mTEC analysis.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
14W-1	A	15	1.9	0.0
14W-2	A	15	1.9	0.0
14W-3	A	15	1.9	0.0
14W-4	A	15	1.9	0.0
14W-5	A	15	1.9	0.0
14W-6	A	15	1.9	0.0
14W-6N*	P	4	1.9	0.0
14W-6S*	P	4	1.9	0.0
14W-22	A	15	2.0	0.0

* New station added in 2022 as part of the transition from remote to APC monitoring strategy. Number of samples low (n = 4), statistics for information only, not compliance.

Table 4: Fecal coliform statistical summary for GA14BI based on recent 15 samples collected during all weather conditions 12/10/2015 or 11/28/2016 to 1/17/2-23; 8 wet weather and 7 dry weather sets of sample; all mTEC).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
14BI-16	A	15	1.9	0.0
14BI-17	A	15	1.9	0.0
14BI-18	A	15	1.9	0.0
14BI-19	A	15	1.9	0.0
14BI-20	P	15	1.9	0.0
14BI-21	A	15	1.9	0.0

6. Summary and Conclusions

The 2022 review of Growing Area 14 (Offshore) documented that there are no pollution sources that are negatively impacting the fecal coliform water quality of the growing area. The review also documented that the three (3) municipal WWTFs discharging to the growing area operated well-within permit limits during 2022. The 2022 review of fecal coliform water quality data indicated that all approved stations in Growing Area 14 met NSSP criteria while in the open status.

The 2022 update has demonstrated that the area is properly classified. No changes in classification are recommended.

Growing Area 15
Seekonk River
2022 Annual Update

All waters of the Seekonk River, Growing Area 15, are currently classified as prohibited to shellfishing. The area has historically been closed to shellfish harvesting because of consistently elevated fecal coliform levels, and the multiple industrial, transportation and wastewater discharge uses in the area. The area was not sampled in 2022, but a review of available fecal coliform data indicated elevated bacteria levels in the growing area. The area is properly classified as prohibited.

HIGHLIGHTS

* Area was sampled 3X during 2022.
* Harvest of shellfish is prohibited in Growing Area 15.
* Summary statistics not updated; recent data summarized.

COMMENTARY

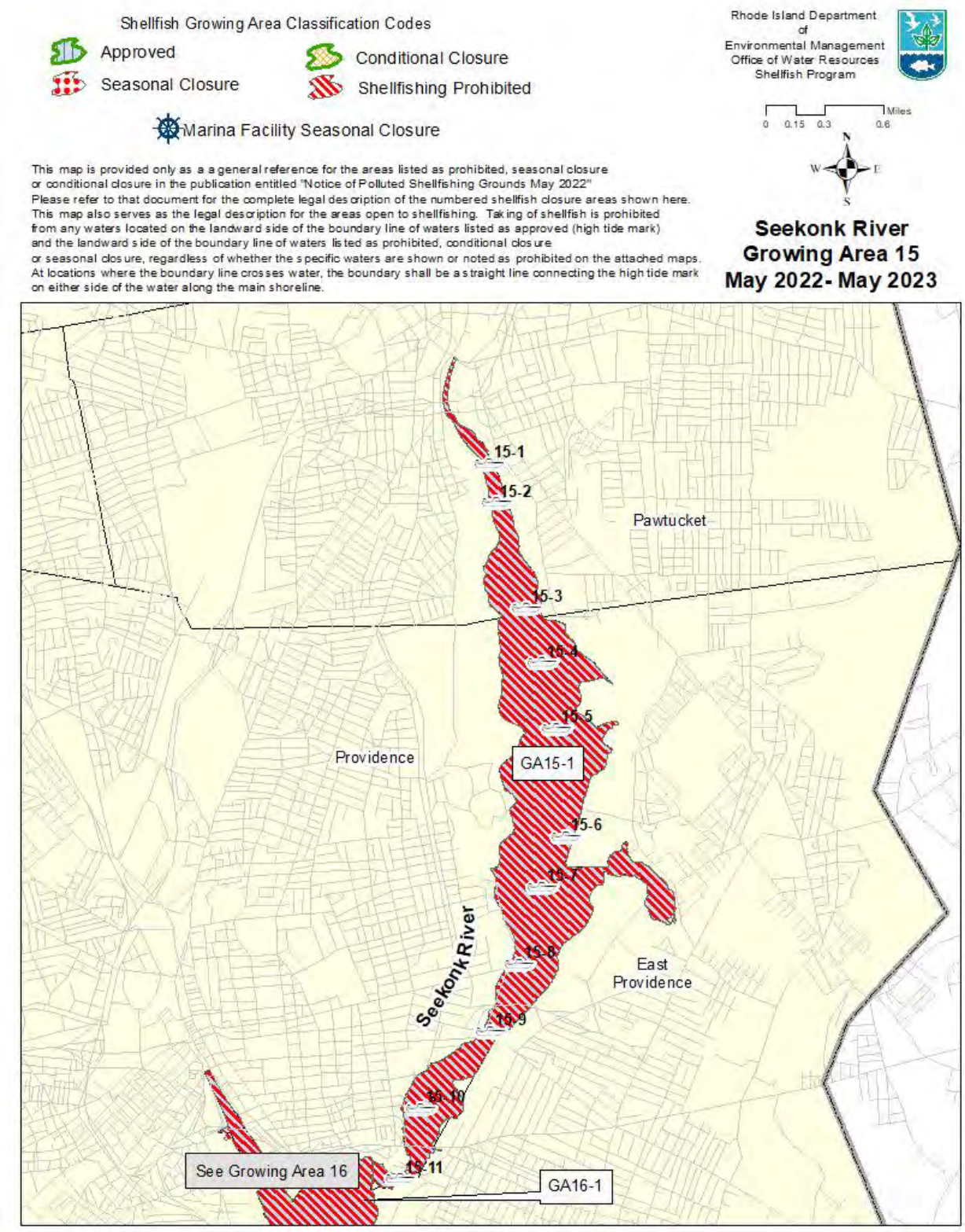
The Seekonk River (GA15) is classified as prohibited for the harvest of shellfish, so there is no minimum sampling requirement. The area is largely urban with stretches of industrial waterfront and has historically been prohibited for the harvest of shellfish because of consistently elevated fecal coliform levels.

Sampling Growing Area 15 is a low priority for the shellfish water quality program because available data indicate fecal coliform levels are too elevated to support safe harvest of shellfish. However, resources allowed sampling the area on three days during 2022. Those results showed elevated fecal coliform levels (geometric mean of 17.1 cfu/100 ml and a 90th percentile of 472 cfu/100 ml) well-above NSSP standards. In addition, A review of Narragansett Bay Commission monitoring data (https://snapshot.narrabay.com/) indicated that fecal coliform levels were consistently far above shellfish harvest standards in the Seekonk River during 2022. These data support the current prohibited classification for GA15.

RECOMMENDATIONS

***** Dependent on staff resources, sample the Seekonk River (Growing Area 15) at least once per year to monitor recent fecal coliform conditions.
* Continue to assess water quality data collected in the Providence River, such as Narragansett Bay Commission water quality data (https://snapshot.narrabay.com/), to evaluate water quality trends in the growing area.
* No action recommended based on ambient monitoring results.

Figure 1. Current (2022-2023) Shellfish Classification Map GA15 with routine monitoring stations.



Growing Area 16
Providence River Conditional Area 'E'
(South of Gaspee and Bullock Points)
2022 Annual Update

Contents

Figures

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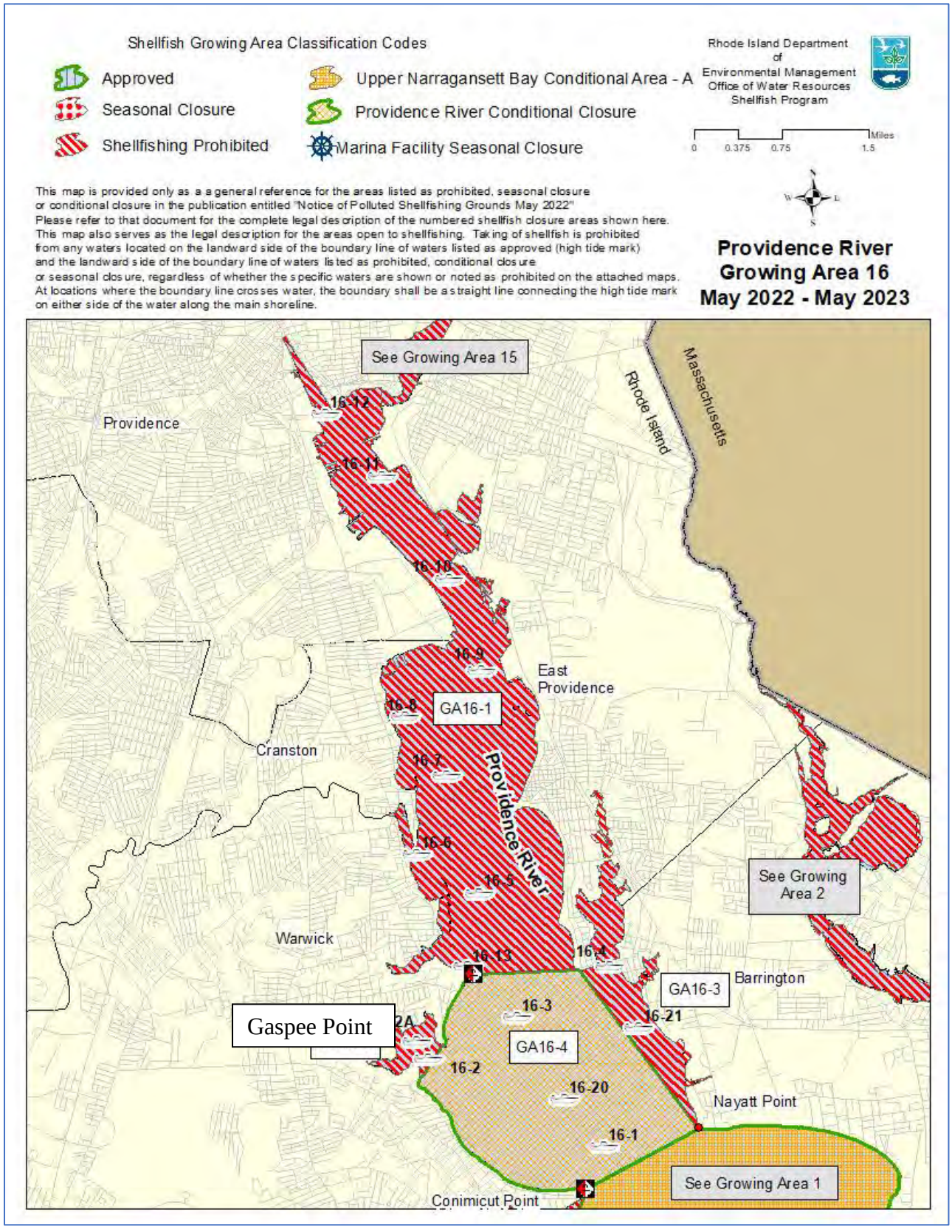
A. Introduction

Growing Area 16 is comprised of the waters of the lower Providence River. The Providence River had been classified as prohibited to shellfishing in its entirety from 1946 until 2021. In May 2021 the area of GA16 south of Gaspee Point was upgraded to Conditionally Approved. This conditional area (Conditional Area E in GA16) has a 0.5" rain, 7-day conditional closure (see the GA16 Conditional Area Management Plan, available in the Program's permanent files) and a limited commercial harvest schedule. The area north of Conditional Area E is classified as Prohibited. A 12-year survey of the lower portion of the Providence River (conditionally approved waters of GA16) was completed in 2021, and a triennial survey of this area was completed in 2017. In the 2021 sanitary survey two (2) sources exceeded the 240 cfu/100mL threshold. The 2022 annual survey involved follow-up sampling of these previously identified elevated sources, and both these sources were found to be discharging <200 cfu/100mL at a trickle flow (Table 1).

Figure 1: Current (2022-2023) Growing Area 16 Classification Map with routine monitoring station locations.



B. 2022 Shoreline Survey

Two (2) sources identified during the 2021 sanitary survey warranted follow-up sampling during 2022. These follow-up samples were collected on 11/22/22 (6 days after 0.98" rain at nearby TF Green Airport).

Source 2022-16-001, a 24" round corrugated pipe, yielded a result of 99 cfu/100 ml and a trickle flow. This source flows into conditionally approved waters and companion in-stream samples collected approximately 8 meters (25 feet) from the source in either direction indicated rapid dilution with results of <2 to 7 cfu/100 ml in the receiving waters.

Source 2022-16-022, a small natural stream, yielded a fecal coliform level of 200 cfu/100 ml and a trickle flow during the 2022 survey. This source flows into conditionally approved waters and companion in-stream samples collected approximately 8 meters (25 feet) from the source indicated rapid dilution with results of <2 cfu/100 ml and 4 cfu/100 ml in the receiving waters.

Table 1: Summary of sources evaluated during 2022 survey.

Source ID	Date Visited	Lat. Long.	Description	Receiving waters classification	Actual / Potential	Direct / Indirect	2020 Results mTEC cfu/100ml	2021 Results mTEC cfu/100ml	2022 Results mTEC cfu/100ml	2022 Volumetric Flow (cfs)
2022-16-001	11/22/23	41.71857 -71.3708	24" RCP Half filled with sediment	Conditionally Approved	A	D	<100	2400	99	Trickle
2022-16-022	11/22/23	41.72835 -71.3817	Stream that drains into marshy beach, upstream is covered in vegetation, address end of Rock Ave.	Conditionally Approved	A	D	<100	<100	200	Trickle

These sources (16-001 and 16-022) had acceptable fecal coliform levels when sampled which was 6 days after 0.98 inches of rain at nearby TF Green Airport (NOA KPVD weather station). Note that the conditional area is managed with a 0.5", 7-day closure and was in the closed status when these samples were collected. The 2022 results indicate that sources 16-001 and 16-022 have negligible impact on the microbial water quality of the growing area.

C. Wastewater Treatment Facilities

No municipal WWTF discharge directly to the conditionally approved waters of the lower Providence River. However, the growing area is downstream of three (3) municipal WWTF that discharge treated effluent to the prohibited waters of the Seekonk River (Growing Area 15) and the prohibited waters of the Providence River (Growing Area 16). The Providence and Seekonk Rivers receive treated effluent from the Narragansett Bay Commission (NBC) Bucklin Point WWTF, NBC Fields Point WWTF and the City of East Providence WWTF. The NSSP MO requires assignment of the Prohibited classification to waters adjacent to a WWTF within an effluent dilution zone of less than 1,000:1 under normal, efficient operating conditions (Normal Operating Conditions, NOC; NSSP MO, Sect IV Guidance Documents – Chap. II, I, Guidance for Dilution Ratios). Waters beyond this zone can be classified as conditionally approved. RI has chosen a more conservative approach and has established prohibited WWTF dilution zones that are of sufficient size to allow proper dilution under WWTF minor upset conditions such as a limited loss of disinfection. Decades of WWTF upgrades (RI DEM, 2016) and CSO abatement in the Providence area have resulted in increased WWTF efficiency and improved microbial water quality in the Providence River as described in the GA1 and GA16 Conditional Area Management Plans. An analyses of WWTF performance and dilution zones completed in 2021 (see analysis in the RI DEM document "Establishing the Closure Zones and Shellfish Water Classifications Adjacent to Waste Water Treatment Facilities (WWTF) in the Providence River (GA16)", RIDEM February 2021) documented that there is sufficient dilution within the prohibited waters of GA15 and GA16 such that effluent discharged to the upper Providence River and the upper Warren River while the treatment plants are operating under normal treatment and permitted flow conditions will not degrade the microbial water quality of the conditionally approved waters of GA16 (Conditional Area E, GA16-4). The WWTF that discharge to the waters upstream of GA16 are modern, efficient, and well-run facilities that rarely exceed permitted effluent criteria .

A review of EPA ECHO data indicated that there were no flow or fecal coliform permit violations in 2022 at NBC Bucklin Point, NBC Fields Point, or the East Providence WWTFs.

The Woonsocket WWTF, located approximately 20 miles upstream of the conditionally approved waters of GA16, reported three fecal coliform permit violations during 2022. Effluent fecal coliform exceedances were reported on 1/31/2022, 3/31/2022 and 6/30/2022. Each of these permit violation was reported to DEM-OWR immediately. Upon notification of the violation DEM OWR Shellfish staff completed dilution analyses to evaluate the impact of the elevated fecal coliform WWTF discharge on the microbial water quality of GA16. In each case dilution calculations demonstrated adequate dilution (to <14 cfu/100 ml) well before reaching the conditionally approved waters of GA16.

D. Water Quality Studies / Annual Statistical Summary

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is the result of an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain interstate shellfish shipper certification.

Water samples are collected monthly at six (6) monitoring stations in or adjacent to the conditionally approved southern portion (south of Gaspee Point) of Growing area 16 (stations 16-2, 16-2A, 16-3, 16-4, 16-20, 16-21). The waters north of Gaspee Point are classified as prohibited and there is no minimum sampling requirement for these prohibited waters and they are monitored as resources allow.

Samples are collected and processed according to the DEM Shellfish Program's standard operating procedure as documented in the Program's permanent files (Shellfish Growing Area Monitoring Program SOP, updated August 2021). Briefly, water samples are collected 0.5 m (1-2 feet) below the water surface using 125 ml (4-ounce) sterile Nalgene bottles after which they are stored in a cooler packed with ice. They are then transported to the Rhode Island Department of Health Laboratories for analysis. Since the summer of 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics were analyzed by the mTEC method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

i. GA16 Fecal Coliform Statistical Summary

HIGHLIGHTS

* Stations in the conditionally approved waters of the lower Providence River were sampled seventeen (17) times during 2022 under both wet conditions when the area was in the closed status (n= 6) and dry conditions when the area was in the open status (n= 11).
* In May 2021 the southern portion of the area (south of Gaspee Point to Conimicut Point) was classified as Conditionally Approved with a 0.5", 7-day rain closure.
* Marine Fisheries regulations limit commercial harvest according to an annually approved schedule.
* The portion of the growing area north of Gaspee Point remains classified as Prohibited for shellfish harvest.
* The prohibited waters of GA16 north of Gaspee Point were sampled four times during 2022.
* Statistics represent recent 15 samples collected while the conditional area was in the open status.
* Recent 15 dry weather samples collected 2/24/2021 to 11/1/2022.
* All samples analyzed by mTEC method.
* All conditionally approves stations meet NSSP criteria and are in compliance.
* Data run 1/11/2023

COMMENTARY

The lower Providence River has experienced improvements in fecal coliform water quality due to WWTF and storm water control (Narragansett Bay CSO tunnel) upgrades. Sampling over the past several years has documented that these improvements have resulted in fecal coliform water quality meeting NSSP criteria for conditionally approved waters under a management plan having a 0.5", 7-day rain closure. Accordingly, RI DEM reclassified the lower Providence River (south of Gaspee Point) as conditionally approved in May 2021 and this area has been open to commercial shellfish harvest under a carefully managed harvest schedule. Recreational harvest is 'open daily' in the conditionally approved area of GA16.

The conditionally approved waters of the southern portion of the Providence River (stations 16-2, 16-3, 16-4, 16-20, 16-21 and 16-2A in Growing Area 16) were sampled 17 times during 2022 under a variety of wet (n= 6; area in closed status) and dry (n= 11; area in open status) weather conditions. The Providence area had drier than usual weather during July and August 2022. Only 0.46" of rain fell in the area during July 2022 compared to an average of 3.26" rain in July, resulting in a drought warning for the area. August 2022 was also dry, with approximately 50% of the normal rain falling during that month (1.7" of rain fell at TF Green Airport during August 2022 compared to a long-term average of 3.4"). Rainfall patterns returned to slightly wetter than-normal during September through December 2022. The dry spring and summer weather resulted in conditionally approved portion of GA16 (Area E) being in the open status for 249 days during 2022 (open 68% of days during 2022).

All conditionally approved stations in the growing area met NSSP criteria while in the open status (Table 2). In addition, five of six stations in Area E met criteria under an approved management strategy (Table 3, shown for information only, not for compliance). The prohibited waters north of Gaspee Point were sampled four times during 2022 under dry (n-3) and wet (n=1) conditions (Table 4). The majority (59%) of fecal coliform measurements made in these prohibited waters north of Gaspee Point exceeded the NSSP criterion of 14 cfu/100 ml (Table 4).

The 2022 statistical update demonstrated that the growing area supports a Conditionally Approved management scenario with a 0.5", 7-day rain closure. All conditionally approved stations met NSSP criteria during 2022. 2022 marks the seventh consecutive year (2016 to 2022) that the stations in the now conditionally approved central portion of the lower Providence River (GA16) met NSSP criteria for Conditionally Approved areas using a 0.5", 7-day rain closure criteria. Sampling north of Gaspee Point demonstrated that these waters exceed fecal coliform levels that could support safe shellfish harvest.

The area is properly classified as Conditionally Approved with a 0.5", 7-day rain closure.

RECOMMENDATIONS

* Continue to monitor Providence River (GA16) under all weather conditions to evaluate impacts of WWTF and CSO upgrades on fecal coliform water quality.
* Monitor prohibited waters to north of Gaspee Point as resources allow.
* No other actions recommended based on ambient monitoring results.

Table 2: GA16 Lower Providence River conditional area (Area E) fecal coliform compliance statistics. Recent 15 samples collected 2/22/2021 or 7/26/2021 to 11/1/2022 when the area was in the open status, all dry weather.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
16-2	P	15	4.4	13.3
16-2A	P	15	5.0	0.0
16-3	CA	15	4.1	0.0
16-4	P	15	5.7	13.3
16-20	CA	15	2.6	0.0
16-21	P	15	3.7	0.0

Table 3: GA16 Lower Providence River fecal coliform statistics under an approved management scenario. Recent 30 samples collected 7/14/2020 to 11/1/2022, 10 wet weather and 20 dry weather samples. Statistics shown for information purposes only, not for compliance.

Station	Classification	n	Geometric mean (cfu/ 100 ml)	90th percentile (cfu/100 ml)
16-2	P	30	6.0	29.3
16-2A	P	30	6.7	24.5
16-3	CA	30	5.4	21.2
16-4	P	30	7.5	40.3
16-20	CA	30	4.1	16.3
16-21	P	30	4.8	14.6

Table 4: 2022 Fecal coliform data for GA16 prohibited stations north of Gaspee Point. Station locations shown in Figure 1.

			P	P	P	P	P	P	P	P	P
Date	Rain (")	Days since	Stn 16-5	Stn 16-6	Stn 16-7	Stn 16-8	Stn 16-9	Stn 16-10	Stn 16-11	Stn 16-12	Stn 16-13
3/23/2022	0.30	5	2		2		2	2	4	50	
6/6/2022	0.55	2	8		2		4	2	2	36	
7/19/2022	0.17	1	40		4		900	600	1,200	1,600	
8/11/2022	0.16	2	54	480	31	46	22	30	84	340	50

E. Summary and Conclusions

The 2022 review documented that there are no shoreline pollution sources that are negatively impacting the fecal coliform water quality of the conditionally approved waters of the shellfish growing area. A review of the WWTF discharging treated effluent into adjacent areas demonstrated that these WWTF are well-run and are discharging effluent within permitted fecal coliform concentration and flow rates. The review of fecal coliform water quality data indicated that all conditionally approved monitoring stations in the growing area met NSSP criteria while in the open status during 2022.

The current GA16 Conditional Area Management Plan was reviewed, and an evaluation indicated that the current operating procedures for GA16 were consistent with the management plan. The GA16 conditional area management plan with a 0.5” , 7-day rain closure is protective of public health as demonstrated by the monitoring stations in conditionally approved waters of the growing area meeting NSSP fecal coliform criteria for safe shellfish harvest for each year from 2016 through 2022. Available fecal coliform data from the prohibited waters to the north of Gaspee Point were reviewed and demonstrated that these waters are properly classified as prohibited.

The 2022 update has demonstrated that the area is properly classified and that the conditional management plan for the growing area is protective of public health. No changes in classification are recommended.

GA17 Mt. Hope Bay Annual Update 2022

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1. Introduction

A 12-year sanitary survey of Mount Hope Bay was conducted during August of 2014 by staff from RIDEM's Office of Water Resources Shellfish Program. The survey included a shoreline reconnaissance of the study area to locate and catalog pollution sources and collect bacteriological samples from all sources actively flowing into the survey area.

Triennial re-evaluations of this growing area were completed in 2005, 2008, 2011, 2017 and most recently in 2020. The 2022 annual update survey (this report) involved review of previous sanitary surveys followed by bacteriological sampling of actual pollution sources noted in previous surveys that were found to be equal to or greater than 240 FC/100ml and identification of any new sources of pollution if applicable. These previously identified pollution sources were re-evaluated to determine their bacteriological impacts on Mount Hope Bay.

The Mount Hope Bay Growing Area (GA17) is presently managed as a conditionally approved shellfish growing area with a 0.5", 7-day rain closure. There are 16 routine monitoring stations located throughout the growing area between the state line of Massachusetts to the north and the Bristol Point / Arnold Point line and the Sakonnet River Bridge line to the south. Management of GA17 runs concurrently with management of the conditionally approved Kickemuit River (GA5) that is contiguous with the northwestern corner of Mt. Hope Bay.

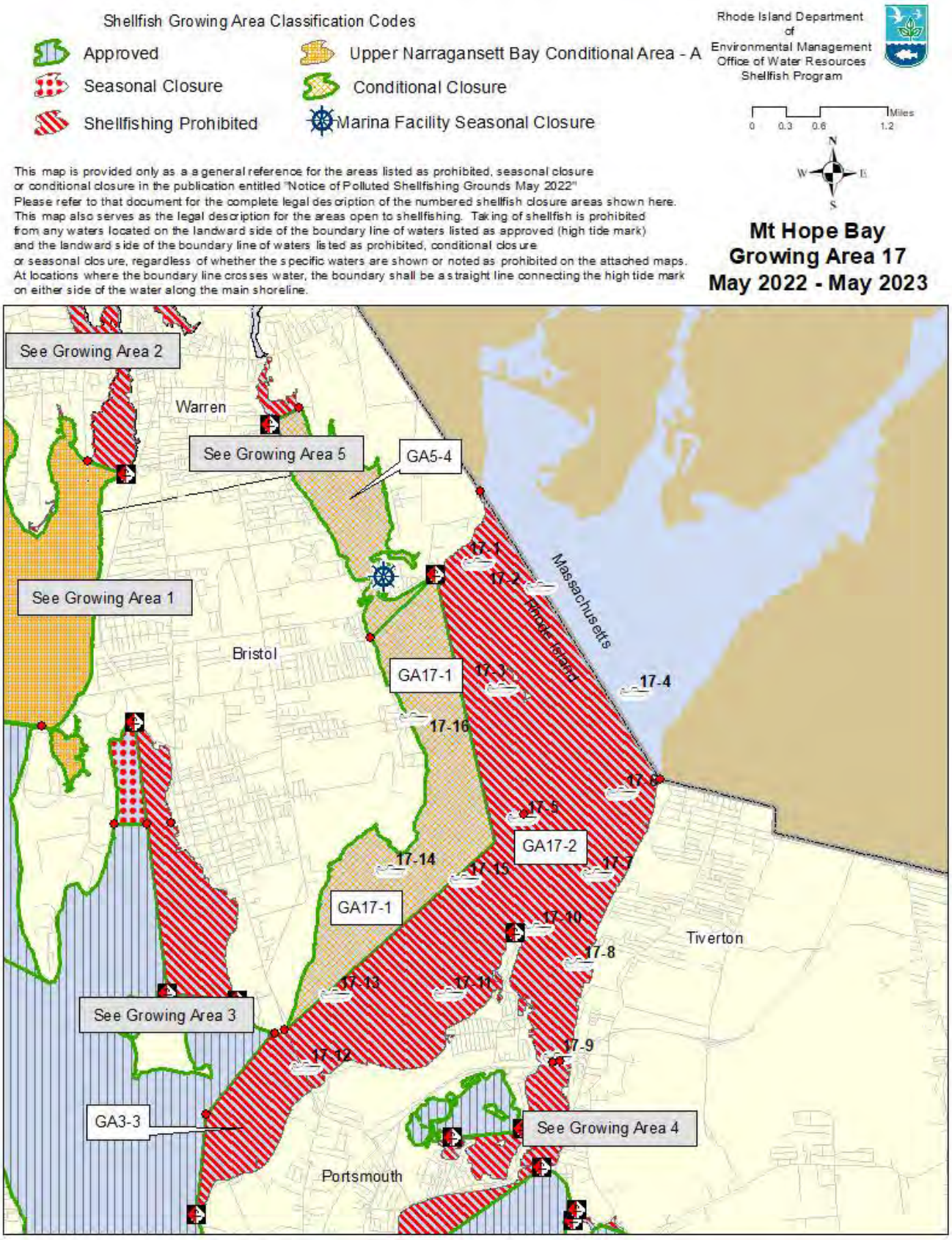
Mt. Hope Bay forms the northeast corner of Narragansett Bay, lying within both Rhode Island to the south and west and Massachusetts to the north and east. The southwest limit of the growing area is bounded by a line that parallels the Mt Hope Bridge from Bristol Point to Portsmouth. The southeast limit is the Sakonnet River Bridge. The northwest limit abuts the Kickemuit River Growing Area (GA5) just outside the mouth of the river, and the northeast limit is the state line traversing the Bay between Rhode Island and Massachusetts. Mount Hope Bay adjoins the East Passage of Narragansett Bay at the southwest corner of Mt. Hope Bay near the Mt. Hope Bridge and adjoins the Sakonnet River near the Sakonnet River Bridge. There are five major freshwater inputs to the Bay. The Taunton River is the largest freshwater source; others include the Quequechan River, which discharges into the Bay from the north along with the smaller Kickemuit, Cole and Lee Rivers.

Growing Area 17 is presently comprised of sections classified as either prohibited or conditionally approved for shellfishing (Figure 1). This divide in classification runs generally north to south with the conditionally approved area being along the town of Bristol shoreline. The prohibited area has been established as a closed safety zone due to discharges from the Fall River, MA WWTF. The conditionally approved portion of the growing area is managed as a rainfall triggered closure with 0.5" of rain or greater requiring a minimum 7-day closure. The precipitation that initiates the shellfishing closures can be in the form of rain and/or snowmelt. All precipitation totals are based on the total accumulation during any consecutive 24-hour period (24 hr. total) as recorded at the NOAA Taunton weather station (KTAN).

The following information describes the physical geography of the Mt. Hope Bay (GA17) growing area.

Area of Shellfishing Prohibited in Mt. Hope Bay	4246.8 acres
Area of Conditionally Approved waters	1508.4 acres
Longest reach	5.0 miles
Widest reach	2.6 miles
Deepest point	75 feet

Figure 1: Mount Hope Bay (GA17) May 2022 classification



2. 2022 Shoreline Survey

A triennial update of the Mt Hope Bay Growing Area 17 was conducted in 2020. No sources with >2,400 cfu/100 ml were identified during the 2020 triennial survey and no sources greater than 2,400 cfu/100mL were identified during the previous 12-year survey. Given the history of no flow at many sources and no values of greater than 2,400 cfu/100 ml during 2020 and 2021 investigations, no follow up source sampling was required as part of the 2022 annual update.

3. Mooring Fields and Marinas

There are two marinas located along the northeastern shore of Portsmouth within the prohibited portion of the Mount Hope Bay growing area. There are approximately 400 slips for a variety of vessels at these two marinas. There is a pump out facility located at the larger of the two marinas (Safe Harbor Sakonnet Marina) that services the marine sanitation devices on these boats. All RI waters are designated as a "No Discharge Zone". The dilution calculations used to establish marina closures can be found in the programs permanent file and are tabulated in the document entitled "Marina Dilution Analysis Background, June 2017".

Information regarding the "No Discharge Zone" enforcement and inspection procedures for vessels operating in RI waters can be found on our website by following this link: http://www.dem.ri.gov/programs/water/shellfish/marine-pumpouts.php

4. Wastewater Treatment Facilities (WWTF)

There is only one permitted discharge within the Rhode Island portion of the growing area. Inland Fuel Terminals has a permit to discharge non-sanitary water on the eastern portion of the prohibited zone of this growing area. It is the only non-WWTF permit within close proximity to the growing area and discharges non-sanitary water to the prohibited waters of GA17-2.

There are several sanitary discharges from wastewater treatment plants in the Massachusetts portion of the watershed to Mt. Hope Bay. The WWTF closest to the growing area are the Fall River Wastewater Treatment Facility (WWTF) approximately 2 miles from the growing area, the Somerset WWTF (~ 3 miles upstream of the GA) and the Taunton WWTF (approximately 16 miles up the Taunton River from the growing area). These sources could potentially have a significant impact on the water quality of the growing area. Consequentially, the majority of the RI portion of Mount Hope Bay is a closed safety zone around the Fall River WWTF outfall that is classified as "Prohibited" in which shellfishing is not allowed. This prohibited area was originally established along the eastern and southern sides of the bay as a necessary closure in the case of a failure of the Fall River WWTF. Hydrographic time of travel dye studies in November 1989 (Rippey and Watkins, 1988) helped to originally establish the prohibited area and more recent hydrographic dye studies (FDA, 2017, 2018) have verified the suitability of the prohibited zone in the RI portion of Mt. Hope Bay (GA17). A dye study also has verified that there is sufficient dilution between the Somerset WWTF and the conditionally approved waters of GA17 to be protective of public health in the event of loss of disinfection at the Somerset WWTF (FDA, 2018). The recent FDA hydrographic dye study was completed in cooperation with FDA that assessed both the Fall River and Somerset WWTF impacts on this growing area. The recommendations for management of this conditionally approved harvest area that are contained within this recently completed report (FDA, 2017) confirm that the existing closure area provides adequate protection in the event of an upset in operations at the Fall River or Somerset WWTF. The 2017 FDA report also included a recommendation for adding a 6 MG Fall River WWTF bypass closure criteria to enhance protection of GA17. This additional closure criterion is to protect public health in the rare event of a 6 MG or larger bypass under

rainfall of less than 0.5" (GA17 is managed with a 0.5" in 24 hour rain closure criteria). This added closure criteria was incorporated into the 2021 GA17 Conditional Area Management Plan update.

A review of EPA ECHO DMR data for the Fall River WWTF indicated that average flow was 24.95 MGD during 2022 compared to a permitted value of 30.9 MGD. The Fall River WWTF had no flow or fecal coliform violations during 2022. Treated effluent fecal coliform concentration was typically less than 10 cfu/100 ml, well below the permitted limit of 200 cfu/100 ml. The 2022 review demonstrated that the Fall River WWTF was discharging treated effluent within permitted limits and is not impacting GA17 water quality outside of the closed (Prohibited to shellfish harvest) WWTF safety zone.

In addition to identifying fecal coliform sources, all actual and potential pollution sources discharging or having the potential to discharge to shellfish waters were evaluated for the likelihood of poisonous or deleterious substances that may adversely affect a growing area. Growing Areas with the potential to be impacted by poisonous and deleterious sources from existing and legacy sources have been established and classified as Prohibited. The likely sources of these substances are industrial discharges, seepage from waste disposal sites, or agricultural lands. Prohibited areas were established based on land uses within the watershed, consultation with DEM's Office of Waste Management, in situ water column, sediment and shellfish testing. Natural toxins such as those produced by phytoplankton are addressed through routine harmful algae monitoring according to the program's HAB Monitoring and Contingency Plan, RIDEM November 2021.

At the time of the shoreline survey, identified sources and immediately adjacent upland areas are visually inspected for any indications of activities having the potential to contribute poisonous or deleterious substances. Further evaluation is conducted during background watershed analysis when developing the shoreline survey report. Follow-up sampling or further field work and evaluation is conducted as warranted. There were no indications that any of the sources identified during this survey have the potential to impact the approved waters of Growing Area 17 due to poisonous or deleterious substances at harmful levels that would be of concern and cause a public health risk.

5. Water Quality Studies

The RIDEM Shellfish Program participates in the Shellfish Growing Area Monitoring (SGAM) program, which is an agreement between the State of Rhode Island and the Food and Drug Administration (FDA) and managed by the National Shellfish Sanitation Program (NSSP). The purpose of the program is to maintain national health standards by regulating the interstate shellfishing industry. The NSSP is designed to oversee the shellfish producing states' management programs and to enforce and maintain industry standards. As part of this agreement, the state of Rhode Island is required to conduct bacteriological monitoring of shellfish harvesting waters for direct human consumption in order to maintain interstate shellfish shipper certification.

Water samples are collected at sixteen (16) monitoring stations throughout the growing area. Two (2) stations are located in the conditionally approved waters of GA17 while fourteen (14) monitoring stations are located in prohibited waters (Figure 1). The extensive prohibited waters of GA17 are part of the closed safety zone for the Fall River WWTF (see Growing Area 17 Conditional Area Management Plan).

Water samples are collected 0.5 m below the water surface using 125 ml sterile Nalgene bottles after which they are stored in a cooler packed with ice. They are then transported to the Rhode Island Department of Health Laboratories for analysis. Since June 2012, RIDOH has analyzed samples using the mTEC membrane filtration method; all samples used to calculate compliance statistics were

analyzed by the mTec method. Fecal coliform results are sent to the RIDEM Shellfish Program at which time they are reviewed and incorporated into a database. Shellfish growing area fecal coliform data are analyzed and compliance statistics are calculated annually. A summary of these statistics and related commentary is below.

A 2022 Review and Statistical Summary of Growing Area 17:

HIGHLIGHTS

* Mt. Hope Bay (Growing Area 17) was sampled ten times during 2022 (8X while in the open status, 2X while in the closed status).
* For conditionally approved stations, statistics represent recent 15 samples when area was open during 2/11/2021 to 11/15/2022.
* Prohibited station summary statistics calculated for informational purposes only.
* All conditionally approved stations are in program compliance.
* All samples analyzed by mTEC method.
* Data run 1/11/2023.

COMMENTARY

Mt. Hope Bay (Growing Area 17) was sampled ten times during 2022, eight times while the area was in the open status and twice while the area was in the closed status. Samples were not collected during January, April and May of 2022 due to mechanical problems with the monitoring boat engine. However, a new outboard engine was purchased in May of 2022 and double sampling (twice per month) was completed in June and November 2022 to compensate for the months in which sampling did not occur. September 2022 was extremely wet in the Providence, RI area, 5.95" of rain falling at TF Green Airport compared to a long-term means September rainfall of 4.26". This wet weather kept the Mt. Hope growing area in the closed status for 26 of 30 days (87%) and 19 of 22 weekdays (87%) and prevented sampling during September 2022. Other than the wet month of September 2022, sampling Mt. Hope Bay has been completed every month since the May 2022 replacement of the monitoring boat engine.

The two wet weather samples (area in closed status) collected during 2022 indicated improved wet weather fecal coliform levels as compared to historical wet weather data. Samples collected two days after 0.62" rain (10/6/2022; 14 of 16 stations less than 31 cfu/100 ml) and five days after 2.05" rain (15 of 16 samples less than 31 cfu/100 ml) suggest wet weather fecal coliform elevations in Mt. Hope Bay are not as high as those seen in the early 2000s. Improved fecal coliform water quality in Mt. Hope Bay appears to be due to CSO abatement and upgrades to waste water treatment completed by the City of Fall River, MA between 1984 and 2018 (summarized in Force, 2013).

Sixteen (16) stations are sampled in Mt, Hope Bay, with two stations located on the western side of the growing area classified as conditionally approved and the remainder of the stations are classified as prohibited. The 2022 statistical review (Table 1) demonstrated that both conditionally approved stations (17-14 and 17-16) in the Mt. Hope Bay (Growing Area 17) meet NSSP criteria and are in program compliance. The 2022 statistical review also demonstrated that the 14 stations in the growing area that are classified as prohibited also met criteria under a conditionally approved management scenario with a 0.5" rain closure. These 14 stations are classified as prohibited due to 1) historical exceedances of

NSSP fecal coliform criteria in dry weather and/or 2) time of travel and dilution in the event of an upset in treatment at the Fall River wastewater treatment facility.

Table 1: Fecal coliform statistical summary based on recent 15 samples collected when the area was open during 2/11/2021 to 11/15/2022 (all mTEC, all dry weather).

Station	Classification	n	Geometric mean (cfu/ 100 ml)	% greater than 31 cfu/100 ml
17-1	P	15	3.0	0.0
17-2	P	15	2.3	0.0
17-3	P	15	4.3	6.7
17-4	P	15	2.4	0.0
17-5	P	15	2.4	0.0
17-6	P	15	2.0	0.0
17-7	P	15	2.1	0.0
17-8	P	15	2.0	0.0
17-9	P	15	2.0	0.0
17-10	P	15	1.9	0.0
17-11	P	15	2.2	0.0
17-12	P	15	2.1	0.0
17-13	P	15	2.5	0.0
17-14	CA	15	2.7	0.0
17-15	P	15	2.2	0.0
17-16	CA	15	2.7	0.0

Declining dry weather fecal coliform: Stations 17-1 and 17-2 located in the northwestern corner of GA17 (Figure 1) are currently classified as prohibited based on historical evaluations of sanitary water quality. Through the 1980s and early 1990s these stations frequently exceeded NSSP fecal coliform criteria during both wet and dry weather. However, CSO abatement and WWTF upgrades in Fall River, MA (summarized by Force, 2013) have resulted in reduced fecal coliform levels in Mt. Hope Bay. As documented in the GA17 Conditional Area Management Plan, fecal coliform at RI DEM station 17-4 located nearby the Fall River WWTF outfall had a log-scale decline in fecal coliform during the late 1990s coincident with Fall River WWTF upgrades. Fecal coliform at station 17-4 declined from levels of 10 to 1,000 cfu/100 ml during wet weather in the 1980s and early 1990s to levels of 10 cfu/100 ml during wet weather in the 2000s and 2010s (see Figure 2 in the GA17 CAMP). Similarly, dry weather fecal coliform levels declined at stations 17-1 and 17-2 during the same time frame (Figures 2, 3).

Station 17-1 has met NSSP criteria for conditionally approved waters under a 0.5", 7-day rain closure for decades. Station 17-1 has continuously met the NSSP fecal coliform geometric mean standard since 1990 and has continuously met the 15-sample variability standard (<10% exceed 31 cfu/100 ml) since 2010 (Figure 2). Similarly, Station 17-2 has continuously met the NSSP fecal coliform geometric mean standard (14 cfu/100 ml) since 1999 and has continuously met the 15-sample variability standard (<10% exceed 31 cfu/100 ml) since 2010 (Figure 3).

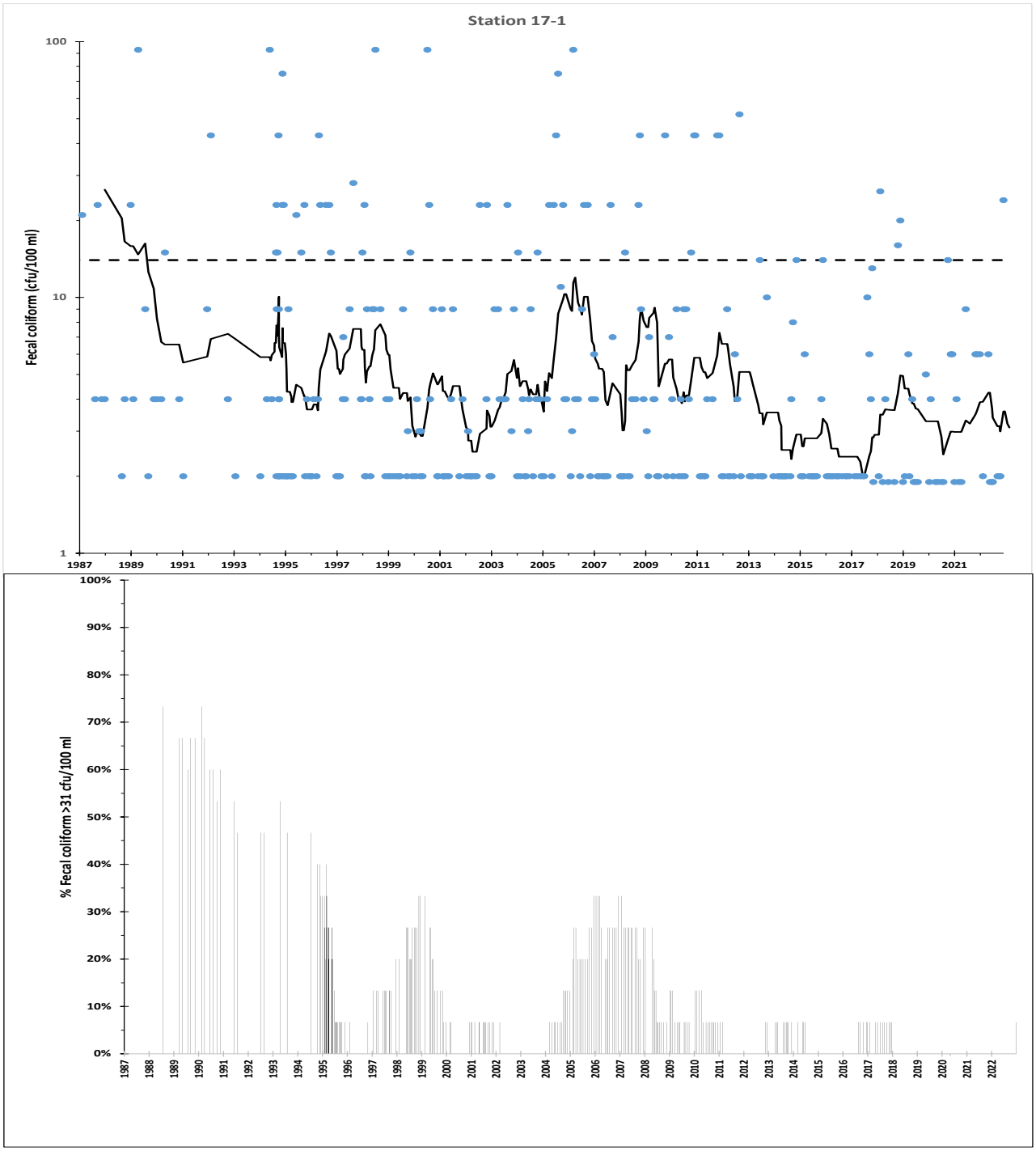


Figure 2: Fecal coliform trend at station 17-1 during dry weather (<0.5" rain in prior 7 days) 1987 to 2022. Top panel: fecal coliform observations (dots) and a 15-sample geometric mean (solid line). Note that station 17-1 has continuously met the NSSP fecal coliform geometric mean standard (dashed horizontal line) since 1990. Bottom panel: percent of recent 15 fecal coliform samples that exceed 31 cfu/100 ml during 1987 to 2022. Note that station 17-1 has met the NSSP fecal coliform continuously since 2010.

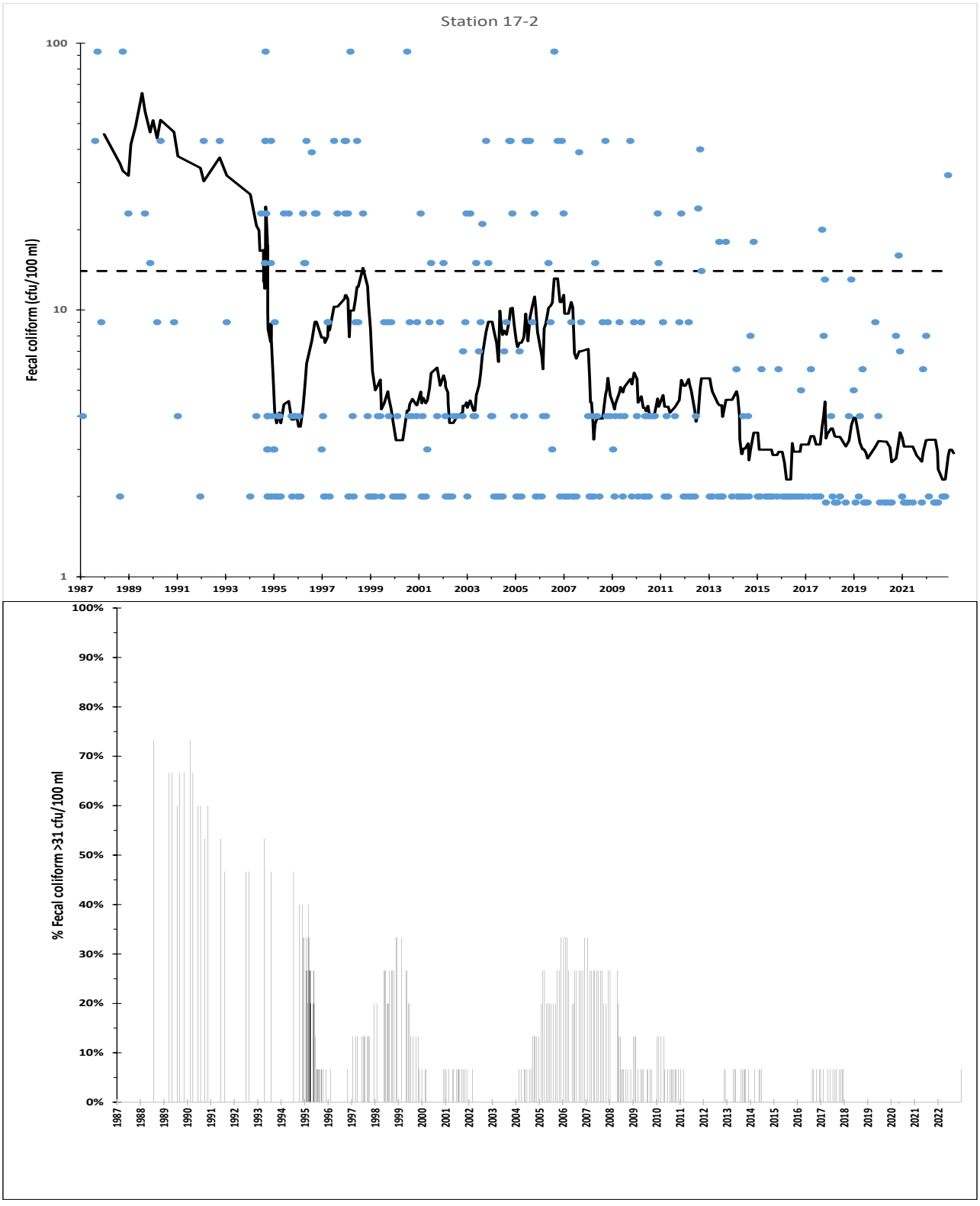


Figure 3: Fecal coliform trend at station 17-2 during dry weather (<0.5" rain in prior 7 days) 1987 to 2022. Top panel: fecal coliform observations (dots) and a 15-sample geometric mean (solid line). Note that station 17-1 has continuously met the NSSP fecal coliform geometric mean standard (dashed horizontal line) since 1999. Bottom panel: percent of recent 15 fecal coliform samples that exceed 31 cfu/100 ml during 1987 to 2022. Note that station 17-1 has met the NSSP fecal coliform continuously since 2010.

Time of travel and dilution: Mount Hope Bay is a tidal salt-wedge estuary having its dominant freshwater input from the Taunton River. Tidal flow into and out of Mt. Hope Bay peaks at approximately 3,000 $m^3 s^{-1}$ (neap tide) to 6,000 $m^3 s^{-1}$ during spring tides (Kincaid, 2006). The semi-diurnal tidal prism in Mt. Hope Bay accounts for approximately 20% of the volume of the Bay per tidal cycle (Chinman and Nixon, 1985). Mt. Hope Bay has two connections with the more oceanic waters of Rhode Island Sound: The East Passage of Narragansett Bay and the Sakonnet River. Tidal average transport is dominated by the flow through the East Passage connection near the Mt. Hope Bridge, with the East Passage flow approximately twice that flowing through the Sakonnet River (Kincaid, 2006). If there was an upset in treatment at the Fall River WWTF, the strong tidal currents potentially could quickly carry partially treated effluent towards the East Passage or Sakonnet River on an outgoing tide. The time of travel to areas near Common Fence Point may be less than the 8-12 hours from the time of the discharge, notification of the discharge and then installation of a precautionary shellfish closure (FDA, 2017). The FDA completed a dye study that illustrated areas of Mt. Hope Bay that may be exposed to less than the 1,000:1 dilution recommended by the FDA for mitigation of the risk of contaminating shellfish with viruses (FDA, 2017). The northwestern corner of Mt. Hope Bay near stations 17-1 and 17-2 had dilution rations of 1,872:1 to 93,600:1 while the Fall River WWTF was discharging 14.7 MGD. These dilution ratios exceed the 1,000:1 FDA dilution guidance and demonstrate that the area near stations 17-1 and 17-2 receives sufficient dilution as long as the Fall River WWTF is discharging under normal operations. The current GA17 CAMP includes closure provisions to safeguard public health in the event of an upset of treatment at the Fall River WWTF.

Shellfish Tissue Analyses: Quahog tissue samples were collected from the area off Touisset Point (near station 17-1) on 4/5/2023 (5 days after 2.49" rain at TF Green Airport) and analyzed for indicator pathogens and heavy metals (Table 2). Fecal coliform levels were below detection in the composite quahog tissue sample (Table 2). Note that these quahogs were harvested during wet weather (5 days after 2.49" rain) when the conditionally approved waters of GA17 were in the closed status. The absence of fecal coliform in the shellfish tissue immediately after a relatively large rainfall supports that the waters off Touisset Point are not subject to microbial contamination from shoreline freshwater sources. Similarly, heavy metals were well below the 2007 standards, supporting that shellfish harvest is appropriate for this currently prohibited area (Table 2).

		Lat, Long---->	41.703, -71.230
Analyte	**FDA (2007) Standard**	**Units**	**GA17-2 TOUISSETT**
METALS			
ARSENIC	**86.0**	**mg/kg**	5.25
CADMIUM	**4.0**	**mg/kg**	ND
CHROMIUM	**13.0**	**mg/kg**	0.66
COPPER	**N/A**	**mg/kg**	1.55
IRON	**N/A**	**mg/kg**	21.6
LEAD	**1.7**	**mg/kg**	0.14
MERCURY	**1.0**	**mg/kg**	ND
NICKEL	**80.0**	**mg/kg**	1.16
ZINC	**N/A**		9.05
Indicator Pathogens			
FECAL COLIFORM	**230.0**	**MPN/100 g**	ND
MALE SPECIFIC BACTERIOPHAGE	**50 (or established background levels)**	**PFU/100 g**	52

Table 2: Heavy metal and indicator pathogen results for a composite quahog tissue samples collected in the prohibited waters near Touisset Point on 4/5/2023 (5 days after 2.49" rain at TF Green Airport).

Stations 17-1 and 17-2 are located off Touisset Point near the Warren, RI – Swansea, MA state line, with station 17-1 located about 600 yards southwest of the MA-RI state line and station 17-2 being located on the MA-RI state line (Figure 1). Massachusetts manages the adjacent waters as conditionally approved area MHB1.1 with a 0.75" rain closure. RI manages the conditionally approved waters of Mt. Hope Bay with a more conservative 0.5" rain closure. ***Given improved fecal coliform water quality, the demonstration of sufficient WWTF effluent dilution and the fact that adjacent MA waters are conditionally approved with a 0.75" rain closure, it is recommended that the waters near stations 17-1 and 17-2 in the northwestern portion of the RI portion of Mt. Hope Bay be reclassified as conditionally approved with a 0.5" rain closure***. A suggested new demarcation line is a sightline from the Annawamscutt boat ramp to the Borden Flats lighthouse separating the conditionally approved waters to the north and west (near stations 17-1 and 17-2) from the prohibited waters to the south and east, in the RI portion of Mt. Hope Bay. This would upgrade the classification of ~515 acres from prohibited to conditionally approved (Figure 4). Note that under this classification configuration Spar Island and the waters around Spar Island will remain classified as prohibited.

6. Conclusions and Recommendations

The 2022 annual re-evaluation of the Mt. Hope Bay shellfish Growing Area 17 (GA17) demonstrated that shoreline sources are not negatively impacting the microbiological water quality of the growing area when this conditionally approved area is in the open status for shellfish harvest. In addition, the Fall River WWTF potentially impacting the growing area was shown to have improved effluent quality during the past decade. In addition, a review of EPA ECHO data demonstrated the Fall River WWTF is operating in an efficient manner that consistently resulted in effluent flow and fecal coliform concentration being well below permitted discharge levels. A statistical review of water column fecal coliform collected while the conditionally approved area was in the open status indicated that all conditionally approved stations in GA17 met NSSP criteria and that the conditionally approved area of GA17 are in program compliance and are properly classified.

Growing Area 17 is a conditionally approved growing area, impacted by precipitation events and also potentially impacted by discharge from sewage treatment facilities. Therefore, the RIDEM Shellfish Program monitors Growing Area 17 in accordance with the guidelines set forth in the Mt. Hope Bay Conditional Area Management Plan (CAMP) amended 2021. The GA17 CAMP was re-evaluated during this review and monitoring and management actions were consistent with the management plan (CAMP).

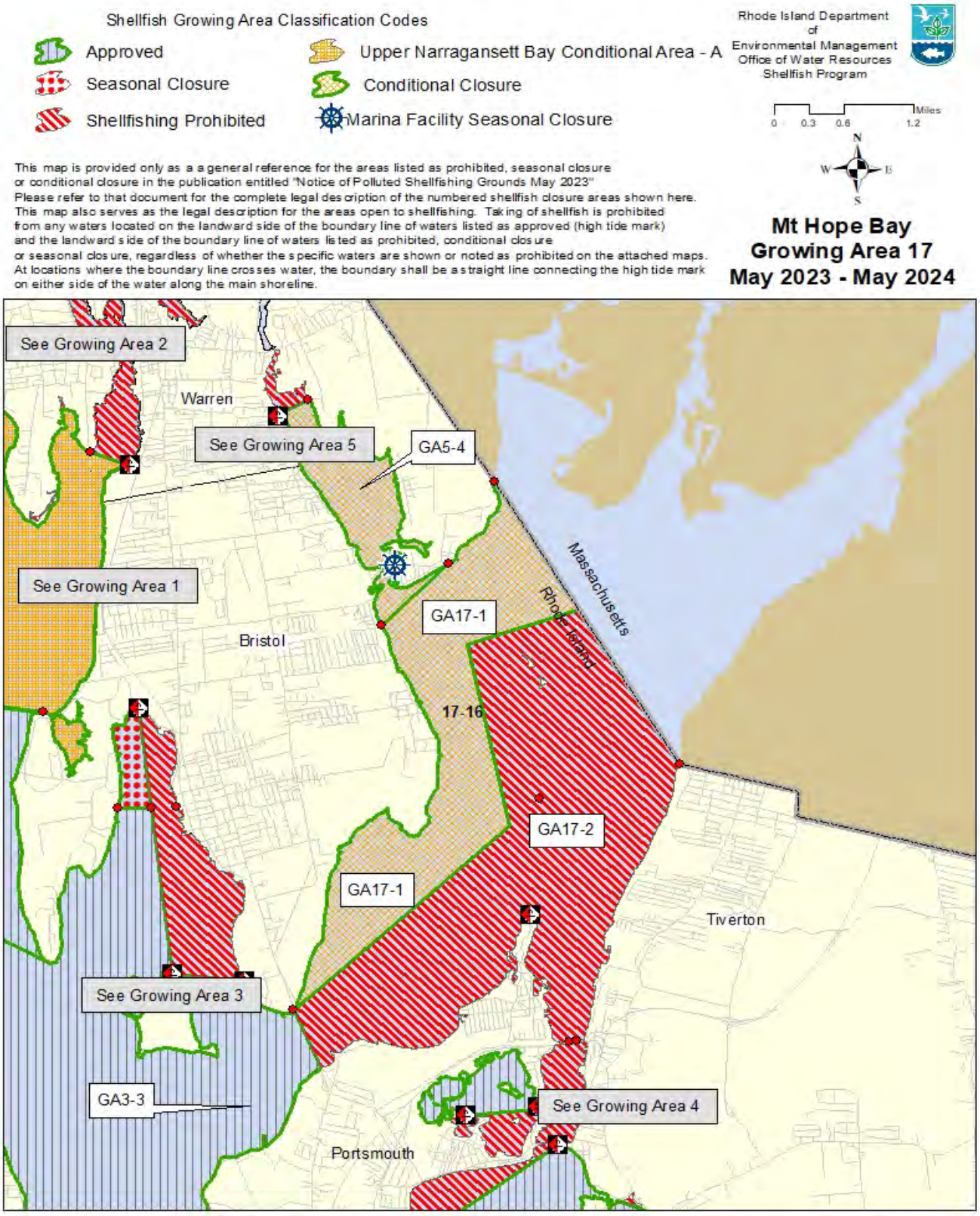
A classification upgrade is recommended for the northwestern section of the Mt. Hope Bay shellfish growing area off Touisset Point. As documented above, waters in the NW corner of the growing area off Touisset Point near station 17-1 and 17-2 that are currently classified prohibited waters have met NSSP fecal coliform criteria for decades (Figure 2, Figure 3). That area also receives sufficient dilution from the Fall River WWTF (FDA, 2017). A 12-year shoreline survey of GA17 was completed in 2014 and no sources greater than 240 cfu/100 ml were found adjacent to the area to be reclassified. A shoreline survey triennial update was completed in 2020 and again, no elevated fecal coliform sources were found along the shoreline adjacent to the area to be reclassified. In addition, the shoreline of the area (currently classified as prohibited) was surveyed on 4/5/2023. A single potential source (source 17-SL), a small creek draining a marsh, was found to be flowing. Source 17-SL had a fecal coliform value of <100 (minimum detection for shoreline sources) on 4/5/2023 (5 days after 2.49" rain at TF Green Airport) and companion in-stream samples had values of <2 cfu/100 ml in the receiving waters 25 feet north and south of the source. Note that conditionally approved waters of GA17 are managed with a

0.5” rain closure and source 17-SL was sampled five days after 2.49” rain – conditions under which the growing area is in the closed status. The acceptable wet weather results after 2.49” rain demonstrates that source 17-SL will not significantly degrade the microbial water quality of the area during dry (<0.5” rain) weather.

In addition to the reasons outlined above, the recommended upgrade in classification from prohibited to conditionally approved for ~515 acres in the NW corner of Rhode Island GA17 is consistent with the conditionally approved classification of adjacent water in MA growing area MHB1.1.

The recommended 2023 shellfish classification map for GA17 is shown in Figure 4, below.

Figure 4: Recommended 2023 shellfish classification for the Mt. Hope Bay growing area (GA17).



7. Literature Cited

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RI DEM & RI DOH HAB Phytoplankton and Biotoxin Monitoring: 2022

A. Introduction

The RI DEM OWR Shellfish Program in conjunction with the RI Department of Health routinely monitors three genera of potentially toxigenic HAB phytoplankton (*Alexandrium spp.*, *Dinophysis spp.*, *Pseudo-nitzschia spp.*) in RI shellfish growing waters. This is consistent with NSSP guidance to ensure early warning of the presence of toxigenic phytoplankton in shellfish growing waters. For 2022, HAB phytoplankton monitoring began on January 4, 2022 and continued through December 28, 2022. During this period a total of 320 HAB phytoplankton samples were collected and analyzed for HAB species abundance.

In addition to RI DEM and RI DOH HAB phytoplankton counts summarized below, the program also assesses HAB phytoplankton data collected by partner agencies. These included approximately 100 HAB phytoplankton observations made by URI-GSO Plankton Time Series monitoring in the West Passage of Narragansett Bay (weekly samples) and Narragansett Bay Commission 'Bay Window' phytoplankton monitoring in the lower Providence River (approximately monthly samples). In addition, the program monitors in situ video monitoring of phytoplankton at the URI- GSO dock and at WHOI monitoring sites in Buzzards Bay and Vineyard Sound (IFCB phytoplankton imaging in near real-time).

B. 2022 HAB Biotoxin closures:

No HAB-biotoxin closures were required in Rhode Island waters during 2022.

C. HAB Phytoplankton Observations

i. *Alexandrium* spp.:

Alexandrium spp. were uncommon, being detected in only seven (7) samples of 320 samples analyzed (~2%) during 2022 (Figure 1). Consistent with prior observations, all observations of *Alexandrium* were made during the spring and early summer months of April, May and June during 2022 (Figure 1). Maximum 2022 *Alexandrium* spp. abundance was 350 cells/L (sample collected in Greenwich Bay near Chepiwanoxet on 4/21/2022) which is below the 1,000 cell/L action level so no follow-up *Alexandrium* biotoxin testing was required during 2022.

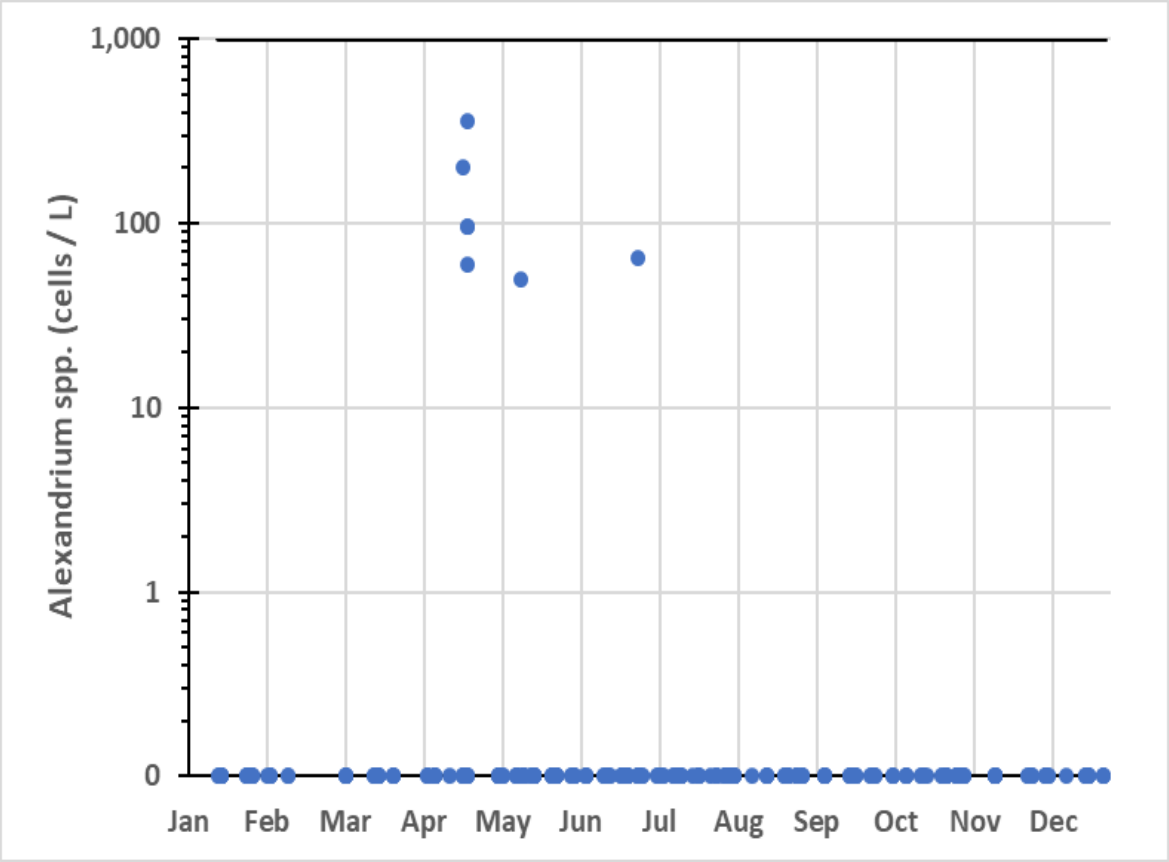

Figure 1: *Alexandrium* spp. abundance (dots) at RI DEM and DOH HAB monitoring stations during 2022. Alexandrium was detected in 7 of 320 samples analyzed and maximum abundance during 2022 was 350 cells per liter.

ii. *Dinophysis* spp.:

Dinophysis spp. were detected in 24 of 320 (7.5%) HAB phytoplankton samples analyzed during 2022 and abundance varied from 0 (not detected) to a maximum of 1,000 cells per liter. Consistent with prior years, *Dinophysis* abundance was greatest during summer (May - July) of 2022 (Figure 2). Maximum 2022 *Dinophysis* spp. abundance of 1,000 cells/L was observed in the Kickemuit River (station 5-5) on 6/2/2022. The increase in *Dinophysis* to near 1,000 cells/L occurred at several areas: Kickemuit River, Mt. Hope Bay, Greenwich Bay in late May to early June 2022, but quickly returned to levels of 100 to 200 cells per liter by mid-June 2022 (Figure 2).

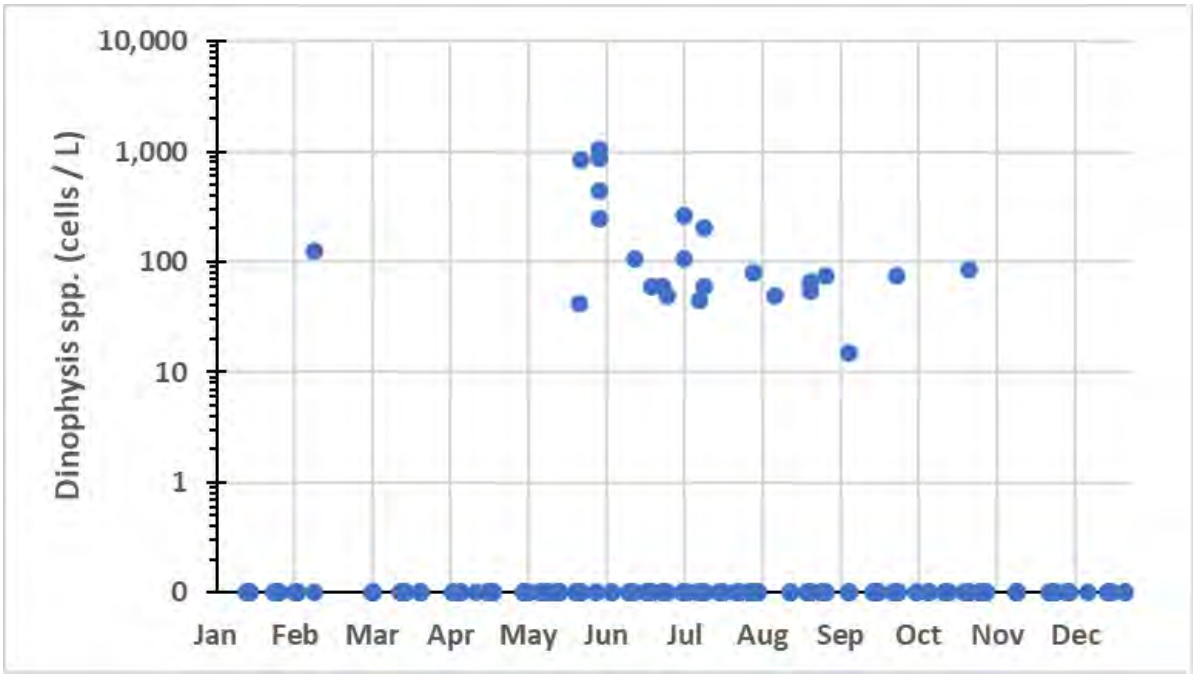

Figure 2: *Dinophysis* spp. abundance (dots) at RI DEM and DOH HAB monitoring stations during 2022.

iii. *Pseudo-nitzschia* spp.:
Diatoms in the genus *Pseudo-nitzschia* spp. were present in 49% (157 of 320 samples) of the HAB phytoplankton samples analyzed, and a maximum abundance of 161,000 *Pseudo-nitzschia* cells L^{-1} (at GA16, Lower Providence River, on 5/17/2022) was recorded during 2022. *Pseudo-nitzschia* abundance was relatively low during January through March of 2022, followed by an increase during April and May and sustained moderate abundance (hundreds to 10,000 cells per liter) during June through December of 2022 (Figure 3).

The RI HAB plan uses a 20,000 cell per liter *Pseudo-nitzschia* action level and during 2022 that action level was exceeded 12 times; all 12 exceedances occurred during April and May 2022 (Table 1). Note that elevated *Pseudo-nitzschia* was observed throughout the West Passage and Upper Narragansett Bay, and on Block Island, but was not observed in the salt ponds, the Sakonnet River or East Passage (Table 1). These elevated abundance observations led to follow-up testing of sentinel mussels on three occasions during 2022 (Table 2). Sentinel mussels collected at the GSO dock on 4/20/22 and 5/19/2022 were analyzed for domoic acid by LC-MS-MS and were found to be free of domoic acid. Quahogs harvested from the Upper Bay (GA1A) on 5/19/2022 were analyzed and also demonstrated to be below the detection level for domoic acid. *Pseudo-nitzschia* levels remained variable, but below the 20,000 cell per liter action level from June through December 2022 (Figure 3).

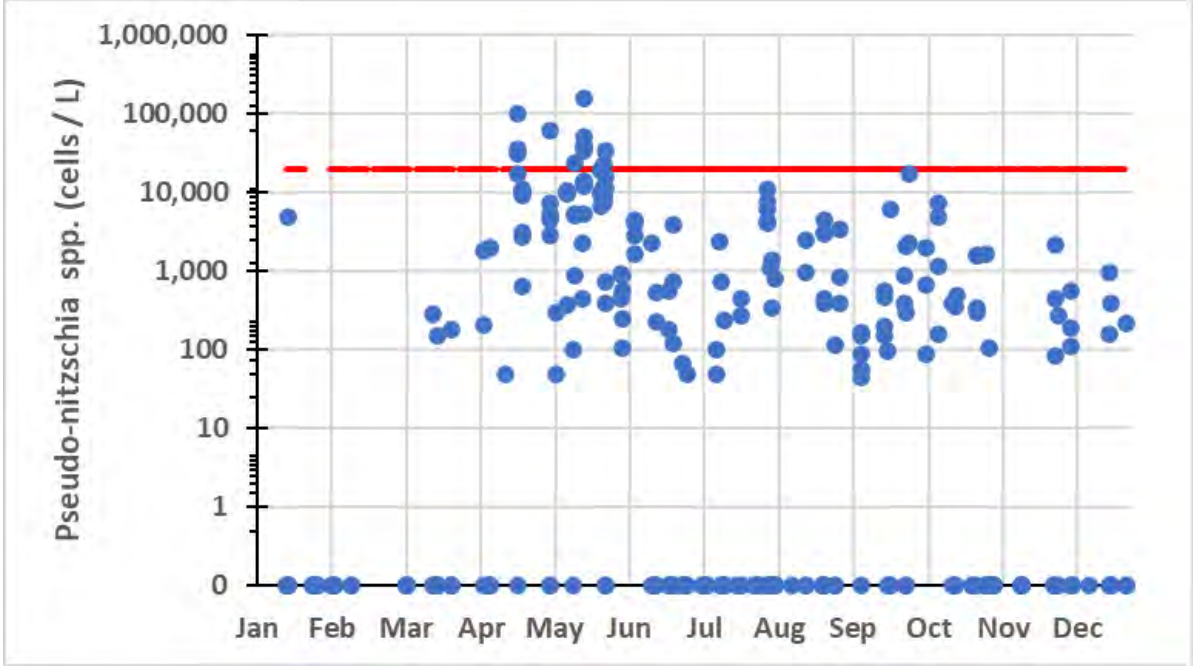

Figure 3: *Pseudo-nitzschia* spp. abundance (dots) at RI DEM and DOH HAB monitoring stations during 2022. 20,000 cell per liter *Pseudo-nitzschia* spp. action level (red line) shown for reference. Follow-up sampling was conducted in response to action level exceedances during April and May 2022, with sentinel shellfish samples showing absence (< 0.4 ppm) of domoic acid and no biotoxin shellfish closures were required.

Date	Shellfish Area	Station ID	Station Description	Water Temp (°F)	Pseudo-nitzschia spp. (cells/L)
4/19/2022	8, Greenwich Bay	8-Chepi	S side Chepiwanoxet	48.0	30,800
4/19/2022	1, Upper Bay B	1-RockyPt	Rocky Point pier		35,000
4/19/2022	1, Upper Bay A	1-CSP	Colt State Park pier		101,000
5/3/2022	7, West Passage	7-WickYC	Wickford Shipyard dock	56.0	61,500
5/13/2022	7, West Passage	7-WickYC	Wickford Shipyard dock	57.2	23,300
5/17/2022	12, Little Narragansett Bay	12-3	@closure line on west side of LNB	56.8	34,700
5/17/2022	7, West Passage	7-WickYC	Wickford Shipyard dock	60.0	37,000
5/17/2022	1, Upper Bay A	1A-CSP	Colt State Park pier	62.6	40,000
5/17/2022	8, Greenwich Bay	8-EG	S side Chepiwanoxet	60.0	51,000
5/17/2022	16, Prov River	16-RockI	Prov River rock island	62.6	161,500
5/25/2022	13, Block Island	13-1	dock at entrance to Great Salt Pond	55.4	22,500
5/26/2022	8, Greenwich Bay	8C-3	GrenBay west	64.4	34,000

Table 1: RI DEM – DOH HAB monitoring *Pseudo-nitzschia* spp counts that exceeded the 20,000 cell per liter action level during 2022.

CollectionTime	LabSampleID	StationName	SampleName	Result	ReportingLimit	Units	Analyte	Analysis
4/20/2022 8:55:00 AM	2201651-01	7B-S01	BLUE MUSSELS	ND	0.400	ug/g	DOMOIC ACID	FC08 LC MS/MS Domoic Acid
5/19/2022 8:05:00 AM	2201921-01	7B-S01	BLUE MUSSELS	ND	0.400	ug/g	DOMOIC A	FC08 LC MS/MS Domoic Acid
5/19/2022		1A-DLR	Quahogs	ND	0.400	ug/g	DOMOIC A	FC08 LC MS/MS Domoic Acid

Table 2: Results of shellfish (blue mussel and bay quahog) meat analysis for the presence of domoic acid after *Pseudo-nitzschia* counts exceeded the action threshold during 2022. Domoic acid content was absent (< 0.4 ppm) in all samples analyzed.

iv. Other 2022 Phytoplankton Observations:

There were few water-discoloring phytoplankton blooms detected or reported to DEM Office of Water Resources during 2022. While monitoring of 'rust tide' is not a primary focus, available HAB monitoring observations indicated that 2022 was a low abundance year for *Cochlodinium (now Margalefidinium) polykrikoides* in Rhode Island. Relatively few calls were received reporting 'rust tide' during 2022 and DEM *Cochlodinium* cell counts (n = 75) showed a maximum of only several hundred *Cochlodinium* cells per liter observed in the West Passage during August 2022.