Chicopee = Swift + Ware + Quaboag

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C4RWC Bacteria Monitoring Program

2021 Season Report

Monitoring for healthy rivers.

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A digital version of this report and a second lower Chicopee Project in 2021 can be found at www.c4rivers.org

Executive Summary

In 2021 the Chicopee 4Rivers Watershed Council (C4R) successfully conducted its seventh bacteria monitoring season. A group of dedicated volunteers executed this program by monitoring a total of fifteen (15) sites on the Swift, Ware, Quaboag and Chicopee rivers. Seven distinct sampling events were completed during the major recreational contact season. C4R also performed QC procedures to monitor the quality of our sampling results.

C4R was able to continue this program in 2021 with broad based community support. This sampling is a key part of a larger effort to engage watershed residents in greater watershed awareness and stewardship. Another component of this effort is Blue Trails: improved river access for exploration/recreation. Water-based recreational activities are determined to be healthy based in part on the concentration of bacteria in the river or water body. A rivers general health can also relate to bacteria levels.

By conducting a continuing annual program of volunteer monitoring, C4R aims to provide watershed residents and visitors with practical information concerning the safety of using and enjoying local rivers and ultimately presenting the health of the watershed. Bacteria results were posted regularly on https://connecticutriver.us/content/sites-list through a partnership with CRC. The data collected was determined to be of reliable quality.

2021 results indicate a river system with most segments suitable for a variety of recreation: though there are a few river segments that warrant further study as their use standard may be lower than desired. Rain events and associated storm run-off that preceded samplings, likely caused some of the high bacteria conditions recorded, limiting some recreational uses.

With seven (7) years of data, C4R is now able to begin some trend review. An initial trend review section in this report notes that there is no appreciable negative trend.

Typically, it is wise to limit primary contact after a heavy rainstorm. Often in areas located downstream of urban centers, which collect greater amounts of stormwater runoff, it is not unusual for bacterial concentrations to run high. 2021 sampling saw a number of rain events, which contributed to higher bacteria levels.

The success of this monitoring program illustrates the value and importance of volunteer activities in monitoring public health. As C4R continues its efforts to promote public recreation and enjoyment of local rivers through a series of “Blue Trails,” this volunteer monitoring program should increase in importance and engage more residents to be “the eyes

and ears" of the watershed. Such stewardship efforts are vital to maintaining the health and resiliency of our watershed and the many communities that call it home.

Introduction

As part of promoting a series of recreational "Blue Trails" within the watershed, C4R determined that it would be beneficial to manage a "complementary" bacteria monitoring program. This program serves several purposes: first, to gauge general water quality and river health; and second, to inform the public on the safety of recreational activities on/in the river. For people to enjoy our rivers with piece of mind, it is particularly important to determine if the Blue Trail and other segments meet the MassDEP water quality contact standards.

C4R relies on fundraising and grants to help support program costs, mainly laboratory analyses of samples, monitoring equipment/supplies and some technical services. C4R is grateful for <u>support from:</u>

- *Country Bank*
- *Palmer Conservation Commission*
- *Warren Conservation Commission*
- *Wilbraham Conservation Commission*
- *Springfield Conservation Commission*
- *Town of East Brookfield*
- *Town of Ware Parks & Community Development*
- *LWPA (Lake Wickaboag)*
- *QQLA (Quaboag & Quacumquasit Lakes)*
- *individual donors*

C4R used the CRC (Connecticut River Conservancy) lab in Greenfield for sample analysis. Sampling kits for volunteers were organized for each sample site.

Another key step was to find volunteer samplers. Outreach brought 13 people forward to help. All received training in proper sampling techniques, and bi-weekly sampling began on June 10, 2021 and ran through September 9th. In all we conducted seven sampling events at (15) sampling sites on the Ware, Swift, Quaboag and Chicopee Rivers – ALL 4 Rivers.

In 2021 C4R continued QC measures. This comprised of following a QAPP that called for a blind duplicate sample to be collected at a random site each event. A duplicate is collected simultaneously with the base sample. Results should be statistically similar as an illustration of acceptable quality. Two random blank samples were also sent to the lab as a quality check.

Volunteers also noted temperature and other site conditions observed during each sampling event. Weather conditions within 48 hours of sampling events were recorded.

The 2021 sampling year was a strong success. Volunteer samplers did well and there were few complications. Reporting results on-line also worked well. This seventh year experience illustrates C4R's commitment to monitoring and will guide any enhancements to C4R's monitoring program as we look continually to optimize the choice of monitoring sites, and encourage more people to explore the Watershed and its rivers.

Special thanks to our volunteers!

Catherine Callaghan, Tom Rouleau, Sue Johnson, Rich Goodell, Tim Simon, Ken Cleveland, Tina Pike, Rebekah Cornell, Randy Weiss, John Piechota, Dave Cotter, Nick Zeo, Tim O'Brien, Sky Lloyd, and Keith Davies/coordinator.

Project Approach

Purpose

A 2003 Mass-EOEA comprehensive watershed assessment notes that *"data gaps are most pronounced for certain ecological characteristics, including animal and habitat data, and water quality data. The latter is of particular concern since the quality of the water flowing through and out of the basin is often considered to be a reflection of its overall environmental condition or health. Water quality data is collected by a number of organizations and agencies in the Chicopee River basin, but not in a basin-wide coordinated way."* C4R mission is to work towards a resolution to this deficiency.

The Chicopee River and its watershed offers many fine recreational and nature viewing opportunities. Unfortunately there is a lack of regular water quality data to determine if the river is consistently meeting the state's surface water quality standards (SWQS). Many years ago, the river struggled with point source pollution, such as sewage discharges, which in time have been largely dealt with. Recreational activities are related to either primary or secondary contact standards, which are closely tied to the bacterial condition of the waters. Bacterial data has been too sporadic to make clear/regular contact standard determinations. Having adequate bacteria data to make a clear determination would inform people whether water recreation is safe and healthy.

MassDEP-Division of Watershed Management, (DWM), samples the Chicopee River Watershed on a five-year rotating basin schedule. Very little sampling is done in between cycles. There is a need for more regular and consistent monitoring, a local group such as C4R can help to provide monitoring to fill this gap.

In order to provide a more adequate data set with which to determine whether standards are being attained, having ***more sites sampled at more regular intervals*****,** in season, offers the means to make more consistent determinations. Sampling at key access sites across the watershed, 6-8 times at each, during the prime contact months, May through September, should offer an adequate baseline. Funding may limit the ability to cover this broad range continually, so C4R will focus on key areas and target additional sites when possible.

An expanded data set will give a broad collection of locations and time periods, more wet/dry event information to review, and even a means to begin to consider source issues. Additional new data will help C4R and MassDEP to make accurate water quality determinations for the Chicopee Basin.

Definitions: *(MassDEP)*

PRIMARY AND SECONDARY CONTACT RECREATIONAL USE (DEP)

The *Primary Contact Recreational Use* is supported when conditions are suitable (fecal coliform bacteria densities, turbidity and aesthetics meet the SWQS) for any recreational or other water related activity during which there is prolonged and intimate contact with the water and there exists a significant risk of ingestion. Activities include, but are not limited to, wading, swimming, diving, surfing and water skiing.

The *Secondary Contact Recreational Use* is supported when conditions are suitable for any recreational or other water use during which contact with the water is either incidental or accidental. These include, but are not limited to, fishing, boating and limited contact related to shoreline activities.

State limit for primary contact is 235 cfu/single date maximum and seasonal mean of 126 cfu. The secondary contact standard is 1240 cfu single day and 630 cfu seasonal mean.

Stakeholders for this project include residents, visitors to, and recreational users of the Chicopee 4Rivers Watershed; municipalities, and state, regional and federal environmental agencies. The data produced in this study will be shared with all stakeholders, to aid them in

making personal decisions on safe use of the river for recreational purposes; understanding causes and effects of weather, land use and other human activities on water quality; and developing management strategies for preservation/restoration of watershed health. All data that are reported will be compared with Massachusetts surface water quality standards.

Objectives:

Since key access sites across the basin are not regularly or annually monitored by MassDEP for bacteria loading, this project is meant to complement MassDEP's limited monitoring program by conducting bacteria sampling on waters not regularly/annually monitored by MassDEP in order to facilitate the ability to make water quality standard attainment determinations for primary and/or secondary contact on a regular annual basis.

This monitoring program is intended to:

- Inform the need for improvement of the water quality of rivers and streams in the Chicopee 4Rivers Watershed that may be impaired due to bacterial contamination. Steps towards achieving this goal may entail locating sources of bacteria contamination within targeted sub-watersheds and recommending appropriate action to initiate remediation.
- Contribute to ongoing and future assessments of whether bacterial contamination impairs the river's ability to support primary and secondary contact recreation.
- Convey this information to local, state and federal agencies and to river users through 'rapid response' analysis and communication. 24 hour turnaround of sampling results enables quick public notice.

Methods

C4R's volunteer guide and 2019 QAPP note the procedures, reasonings, and details of the monitoring processes. These procedures have been used since 2015 and renewed in 2019 with new QC protocols approved in the C4R QAPP.

Once adequate funding was secured, C4R began to assemble needed equipment and reviewed plans with a qualified lab (CRC). Sampling kits were assembled for each volunteer and each site. Coolers and ice pack sets were checked or new acquired. A sampling pole, 42 inches long with a spring clamp attached to one end, was prepared for each volunteer. This

pole enables the sampler to reach out into the current and grab a sample from a deeper point in the stream and lessen edge effects.

Each volunteer received training in sample collection, data form completion, appropriate sample care (keeping sample cold), hold time requirements, label completion, safety concerns/requirements, Quality Control (QC) requirements, and sample delivery logistics. Volunteers followed a preset sampling schedule and were reminded of sampling events 3-4 days ahead of time and regularly resupplied with sample bottles and forms if needed. Sampling was done, rain or shine, considering safety, and fortunately no events were cancelled.

Collection was done via a "grab" type sampling procedure using a sampling pole. Samples were collected in 100 ml sterile bottles prepared with thiosulfate – as a precaution against chlorine residuals that could be present in the water sampled below a waste water treatment plant and which would affect sampling results. Bottles were labeled with date and time of collection and put on ice in a cooler immediately after collection. Volunteers also completed a field sheet and internal C4R Chain of Custody (CoC). Samples were then brought to a central meeting place where a C4R runner collected all samples into a single iced cooler and transported all samples to the lab for analysis. Once there, samples were checked in and temperature and time recorded. Samples were analyzed for bacteria using the Colilert system.

Typically, shortly after 24 hours elapsed, the lab report was issued. Data was then posted on line (www.ConnecticutRiver.us) through a partnership with CRC (CRWC), then tabulated by event date and site.

River and air Temperature was sampled using a conventional non-mercury spirit type thermometer, which, was placed in the flow and permitted to equilibrate for two minutes before reading. Temperatures were recorded on a field sheet with other site observations.

Meanwhile, the project coordinator had downloaded weather/rain data from NOAA/NWS for sites at both the Westover and Worcester airports for both the 24 and 48 hours previous to the sampling event. These airports are closest to our monitoring sites. Rainfall was recorded and tabulated for analysis. Wet weather can elevate bacteria, so viewing this data is important. River flows were also downloaded from available USGS stations.

With all this information collected and tabulated, we are able to review the rivers' contact standards.

2021 Monitoring sites

The sites selected for monitoring have been chosen with the following factors in mind: geographic representation in reaches of recreational activity and ease of access. Some sites were sampled to review standards for DEP in areas of concern (lower Quaboag).

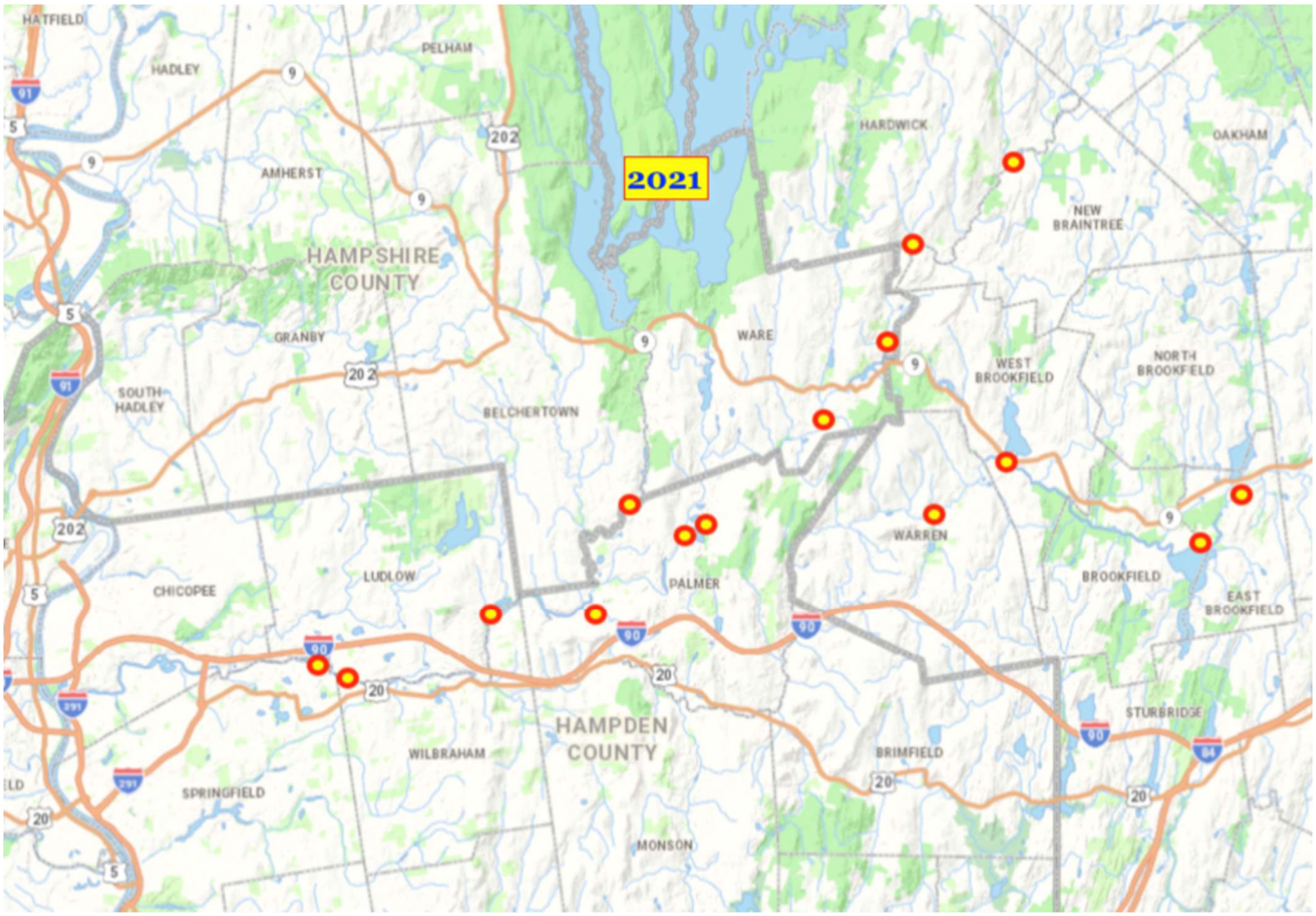
Table 1: 2019 Sampling Sites

Site Name	Site ID	Location	Lat	Long	Notes
CHICOPEE					
Chicopee-Indian Orchard access	ClO1	Water St, Springfield	42.161	-72.5012	Partial CSO near sample site, paddling launch
Chicopee-Putts Bridge access	CPB1	River Rd, Wilbraham	42.153	-72.4102	Paddling launch
Chicopee-lower Red Bridge	CRB1	Red Bridge Rd Wilbraham-below	42.1745	-72.4102	Paddling launch
QUABOAG					
Stevens Rd-E Brookfield access	CQ7S1	At launch, below Bridge St bridge	42.2237	-72.0456	Paddling launch Below Spencer WWTP
Quaboag Pond access	CQPd1	Quaboag St, Brookfield	42.2034	-72.0628	Main Paddling launch
Quaboag Rt 67/9 access	CQ67-9	Rt 67 near Rt 9 W Brookfield	42.2348	-72.1620	Paddling launch, fishing
Quaboag – Lucy Stone Park	CQLSP1	Lucy Stone Park, West Brookfield Rd, Warren	42.2174	-72.1841	Paddling take out
Quaboag-Laviolette Field	CQLF1	In park, above confluence	42.1789	-72.362	mid way in pack, possible future take out
SWIFT					
Swift R – First Street access	CSFS1	First St cul-de-sac, Bondsville	42.209	-72.3495	Fishing area, paddling area
WARE					
Ware R-Old Furnace	CWOF1	Old Furnace at Rt 32	42.34361	-72.1577	Boat access launch
Ware R – New Furnace	CWNF1	Rt 32 @ river crossing in Gilbertville	42.3117	-72.2067	Paddling launch
Ware R – Grenville Park	CWGP1	Off Church St in Ware in park @ launch	42.2667	-72.2275	Boating, paddling, fishing area
Ware-Banas Farm-Robbins Rd	CWBF1	Below WWTP, old farm site along river	42.2442	-72.2544	Paddling launch
Ware-State St	CWSS1	Old bridge abutment	42.2084	-72.3148	Fishing area
Forest Lake	CWFL1	Beach site	42.2102	-72.3079	Beach

The lower Quaboag site (Laviolette)(fewer sites in 2021 due to funding limits) was sampled to continue to review concerns that this stretch has been noted for poor bacteria levels in past.

C4R continues to study this stretch to see if any particular identifiers might emerge to pinpoint an area of concern, more funding may help strengthen this effort.

2021 Sampling Sites Map



Results

Bacteria

The table below notes the bacteria levels for the 2021 sampling season. A discussion and interpretation of these results is presented in the Conclusions section.

2021 Bacteria											
	Bacteria Counts									Geo Mean	Use Note
Site Name	ID#	Date	Date	Date	Date	Date	Date	Date	Date		
		6/10	6/24	7/8	7/22	8/12	8/26	9/9	9/29		
Steven Rd -7 Mile River	CQ7S1	204.6	224.7	261.3	129.6	29.9	156.5	579.4		170.69	secondary
Quaboag Pond access	CQPd1	15.8	10.8	43.2	26.2	5.2	30.1	62		21.12	primary
Quaboag 67/9 access	CQ67-9	13.4	63.7	224.7	65.7	13.5	35.9	47.1		43.35	primary
Quaboag-Lucy Stone Park	CQLSP1	51.2	101.4	488.4	56.3	30.5	52.1	48.8		73.02	primary
Quaboag-Laviolette Field	CQLF1	185.0	248.9	727.0	111.2	365.4	142.1	117.8		217.15	secondary
Swift - First St	CSFS1	33.6	51.2	63.8	55.6	23.3	28.2	866.4		61.88	primary
Ware-Old Furnace	CWOF1	90.5	172.3		117.8	110.6	93.3	307.6		134.16	secondary
Ware - New Furnace	CWNF1	435.2	298.7	2429	325.5	186	365.4	2420		558.29	secondary
Ware - Grenville Park	CWGP1	137.4	135.4	344.8	206.4	152.9	185	167		180.55	secondary
Ware - Banas Farm	CWBF1	145	93.3	365.4	154.1		113	290.9		171.04	secondary
Ware - State	CWSS1	218.7	82	648.8	125.9	121.1	159.7	139.6		169.11	secondary
Forest Lake beach	CWFL1	12.2	18.9	57.3	38.8	2	61.3	10.8		18.27	primary
Chicopee Red Bridge	CRB1	54.6	68.3	95.9	70.3	49.6	98.8	137.6		77.61	primary
Chicopee Putts Bridge	CPB1	112.6	38.4	1414	108.6	73.8	56.3	78.9		111.75	primary
Chicopee Indian Orchard	CIO1	290.9	47.3	770.1	60.5	45.7	45.7		40.2	91.53	primary
Weather		DRY	DRY	WET	DRY	DRY	DRY	WET	DRY		

*The 9/9 sample at First St seems unusually high. Questioning samplers indicate it could have been grabbed close to a side stream inflow, perhaps misrepresenting main stem condition.

State limit for primary contact is 235 cfu/single date maximum and seasonal mean of 126 cfu. The secondary contact standard is 1240 cfu single day and 630 cfu seasonal mean.

Weather

Weather was recorded from the Westover and Worcester Airports for the 24 & 48 hour periods prior to the sampling event. During these time periods, streams are most greatly affected by stormwater runoff, which can illustrate runoff's impacts on water quality.

		Date	Date	Date	Date	Date	Date	Date	Date
		6/10	6/24	7/8	7/22	8/12	8/26	9/9	9/29
Weather		DRY	DRY	WET	DRY	DRY	DRY	WET	DRY
weather beyond 24 hr		rain 39 hr	rain 36 hr	>0.20-24 hr				0.10"	0.08" >12 hr

WET means > 0.10" rain within 24 hours of sampling or > 0.25" within 48 hr.

Field Observations

Field sheets were used by volunteers to record any observations about water color or odor as well as water temperatures.

Odor and color are somewhat subjective. By and large there were no notable or dramatic odor or color observations reported, some occasional foam, nor any on going observations of concern. Color was often clear or a tea tint was noted. Occasionally a musty odor was observed, no significant or troubling conditions were reported. The table below notes water temperatures as recorded by volunteers.

Table: 2021 River Temperatures - F

2021 Stream Temperatures		Deg F							
Stream Temperatures F									
Site Name	ID#	Date	Date	Date	Date	Date	Date	Date	Date
		6/10	6/24	7/8	7/22	8/12	8/26	9/9	9/29
Steven Rd -7 Mile River	CQ7S1	70.0	62.0	70.0	67.0	75.0	70.0	68.0	
Quaboag Pond access	CQPd1	77	71	75	74	80	77	72	
Quaboag 67/9 access	CQ67-9	76	70	76				72	
Quaboag-Lucy Stone Park	CQLSP1	75	64	72	68	75	73.5	70	
Quaboag-Laviolette Field	CQLF1	74.0	65.0	72.0	71.0	75.0	74.0	70.0	
Swift - First St	CSFS1	65		62	70	68	68	65	
Ware-Old Furnace	CWOF1	73	63		70	75	74	67	
Ware - New Furnace	CWNF1	69	65	69	67	74		67	
Ware - Grenville Park	CWGP1	72	68	70	68	75	71	67	
Ware - Banas Farm	CWBF1	76					75		
Ware - State	CWSS1	72	72	68	66	75	72	66	
Forest Lake beach	CWFL1	72	69	78	73	80	78	72	
Chicopee Red Bridge	CRB1	74	68	72	72	75	73	69	
Chicopee Putts Bridge	CPB1	74	68	70	66	75	74	68	
Chicopee Indian Orchard	CIO1	75	71	70	74	75	74		62
		DRY	DRY	WET	DRY	DRY	DRY	WET	DRY

Source Tracking (ST)

Data at New Furnace/Gilbertville, on occasion, seemed a bit higher than other area sites. Danforth Brook enters the river a few hundred yards above this sample site, so C4R collected, on 2 occasions, samples of the brook and just above the brook's confluence to check its influence.

Source Tracking Sampling Results:

Site Name	Site ID	Date	Bac-T count
Old Furnace	CWOF1	9/9/2021	307.6
Danforth Brook	CWDB1	9/9/2021	> 2419.6
Gilbertville New Furnace	CWNF1	9/9/2021	> 2419.6
Grenville Park	CWGP1	9/9/2021	167
Ware R - New Furnace	CWNF1	8/12/2021	186
Danforth Brook-	CWDB1	8/12/2021	142.1
New Furnace above Danforth	CWaDB	8/12/2021	178.2

The 8/12 date was a dry event and showed no influence. But the 9/9 event was wet, yet upstream at Old Furnace and downstream at Grenville Park, levels were much lower, so it seems that the river sample site is influenced by the brook and that the brook adds noticeable bacteria to the river. It seems unmixed by the time flow reaches the present sample site. It is unclear, though it seems to be, diluted as it progresses further downstream. Levels a number of miles below were noticeably lower. It seems that the sample location on the river in Gilbertville will need to be moved away from the brook. Also, it may be prudent to study the brook if funding supports this.

Training:

All volunteers received training in sampling, sample handling, recording, labeling, and safety procedures.

Sample Handling/Hold Times:

All samples were transported on ice packs, in coolers, and were received amply chilled. All samples were delivered to the lab within the six hour maximum hold-time limit. A few samples were delivered so soon that they had little time to chill. There were a few writing legibility issues in noting sample IDs on forms and these were successfully sorted out.

Quality Control:

Field Duplicate analysis indicates that our sampling work by volunteers was acceptable. FD Values for each event fell within goals (<30% RPD-log10) as noted in QAPP. Blanks all came in at acceptable levels (<1) as well. C4R planned 175 samples and 172 were collected, (C4R+SEP sites) a 98% completion ratio.

Observations/Discussion

2021 started off with lower precipitation levels and lower river flows. Rainfall was higher in July and tapered off by August. Heavy rains around July 17, led to record high river levels which kept flows high through the balance of the season. After mid July, mean river flows were consistently above the norm. River temperatures were not noticeably different than in recent years (perhaps a long term probe study could track this best). There were 5 Dry events and 2 wet events as dictated by precipitation amounts and determination criteria within 24/48 hours of sampling. Sampling for Wet/Dry events are hit or miss. Run off from rainfall can effect bacteria levels.

(8) of the (15) sites met primary contact standards for the season, the Ware River and lower Quaboag sites were mostly secondary contact. All sites though were good for boating/paddling/fishing.

Chicopee River Sites:

The 3 Chicopee River sites all had good results and had a seasonal mean that met a Primary water quality standard. The Putts Bridge site has the highest mean as in the past, but it fell within primary standards.

Quaboag River Sites:

The Quaboag River sites can be best divided into 2 segments: the upper through the Brookfields, and the lower in Palmer/Monson/Palmer.

2019 was the first year that the Seven Mile River access in East Brookfield was sampled. It tested a bit high (for Primary use) all season and higher in wet events. It met secondary use standards for boating & fishing. The 2020 results were similar. 2021 was better with a few low readings, a good sign. C4R feels more data from continued sampling here will help to guide better interpretation of the water quality conditions here and what further upstream sampling may be needed.

The longer term upper Quaboag River sites all met a Primary use mean. This has often been the case in this area, but the 67/9 site had a poor year in 2016, but the past few have been good. This section running from Quaboag Pond to Lucy Stone Park in Warren is a great paddle and a prime recreational area.

The lower Quaboag River sites were limited this season to the Laviolette site. Compared to past years, Laviolette was the same in 2021 as 2020, both much better than the first season in 2019.

MaDEP had flagged this lower stretch for further investigation. If grant funding is made available, C4R will work to see what further investigation can be done to see if a particular water quality stressor can be isolated.

Swift River Site:

First St on the Swift continues to meet a Primary use standard, well within the limit. C4R will likely look to create a Blue Trail on the Swift, so sites above and below First St will hopefully be funded and added to our program in the future.

Ware River Sites:

Ware River sites have often been found to be in the low Secondary use standard mean, occasionally Primary, usually Grenville Park (not in 2021). 2021 results show this again. Most sites through Ware and into Palmer are just above the Primary use standard. Geometric means have fluctuated a bit over the years, though not dramatically.

C4R noticed a concern with Gilbertville data and conducted some source tracking as previously noted. Hopefully 2022 sampling will help clarify if any issue exists.

It is C4R's understanding that there may be WWTP issues in the Hardwick area as noted in news report about EPA concerns. We are unsure if this is a cause of active concern, broader sampling would be needed to look into this more carefully.

Forest Lake beach was quite good, well within the Primary standard.

Hopefully, funding and volunteer support will help C4R conduct a broader sampling effort in Gilbertville and further upstream on the Ware River.

General river observations did not present any particularly startling notes.

Recommendations

C4RWC should continue sampling at noted sites to continue to build a data baseline and maintain awareness of river health for river users. As C4R's database grows, useful tracking insights would become an added means of reviewing trends in water quality (an early snap shot follows).

Continued sampling at sites along the Ware River, in Hardwick upstream of Gilbertville should be done, perhaps adding South Barre, if funding and volunteers are provided. A wider profile of the segment could perhaps isolate any given water quality stressor.

Again, if funded, a range of sites along the lower Quaboag River should be sampled and perhaps a carefully targeted placement of sites can be developed to see why this segment has its poorer Secondary rating.

Reserve funds should be marshaled to help strengthen the ability to investigate areas near sites of concern, ie: source tracking. Regular monitoring keeps the public informed and engaged.

Trends & Discussion

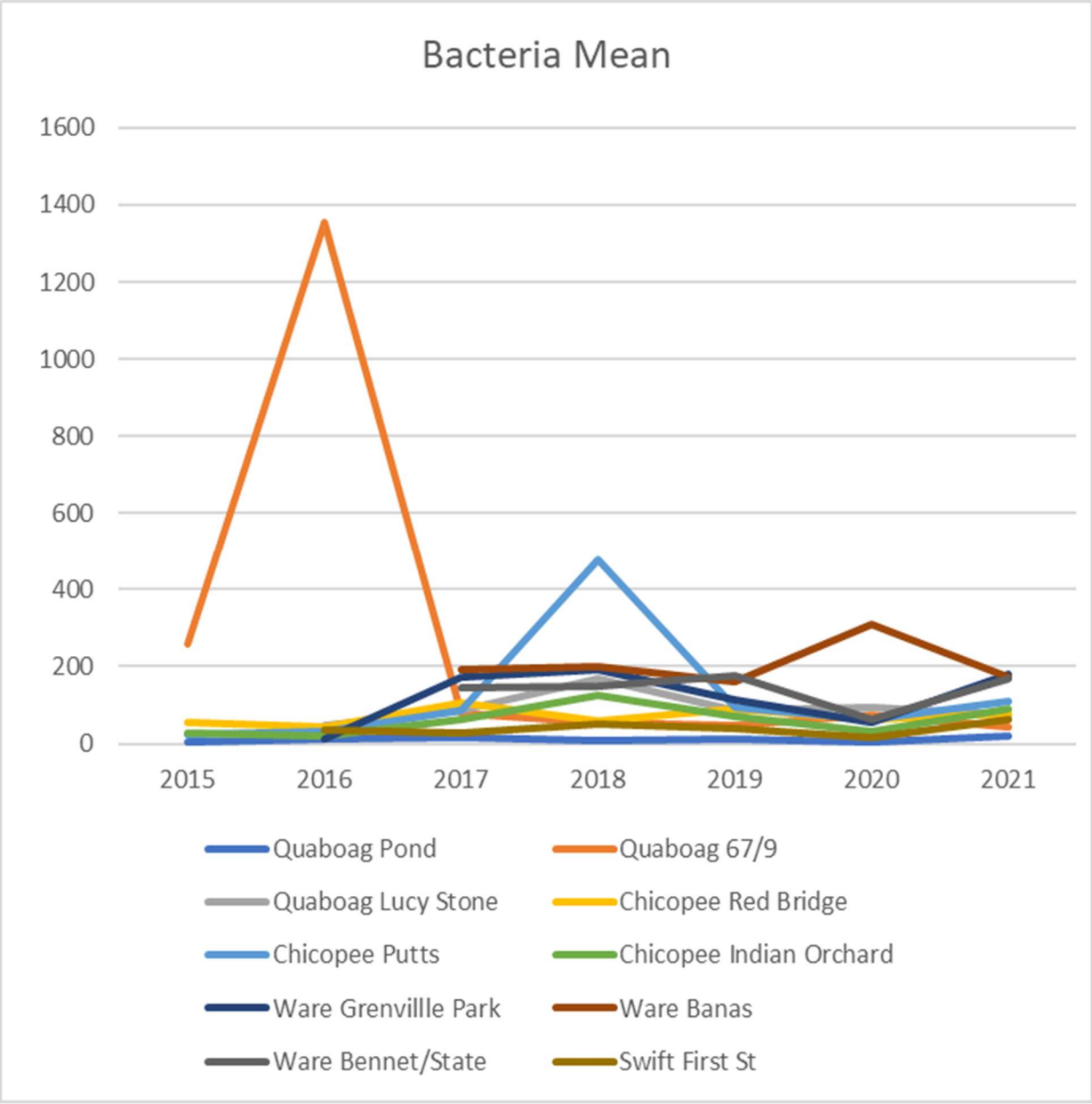
Below is a simple chart of the trend data of the geometric mean for selected sites with the longest terms of sampling.

Bacteria Trends								
Site	2015	2016	2017	2018	2019	2020	2021	Ave
Quaboag Pond	4.09	12.02	14.65	8.45	13.45	3.89	21.12	11.10
Quaboag 67/9	258.23	1354	78.76	54.18	47.4	75.34	43.35	273.04
Quaboag Lucy Stone		46.48	85.73	167.07	86.15	94.93	73.02	92.23
Chicopee Red Bridge	55.49	43.26	104.64	60.71	89.44	61.31	77.61	70.35
Chicopee Putts	22.86	32.11	84.75	479.4	94.67	62.51	111.75	126.86
Chicopee Indian Orchard	29	20.22	64.71	125.85	71.91	31.77	91.53	62.14
Ware Grenvillle Park		11.43	174.1	192.19	113.82	53.34	180.55	120.91
Ware Banas			190.4	200.81	161.28	307.86	171.04	206.28
Ware Bennet/State			144.05	148.8	174.4	62.51	169.11	139.77
Swift First St		36.44	26.73	50.75	40.14	16.01	61.88	38.66
ave	73.93	194.50	96.85	148.82	89.27	76.95	100.10	

Red tinted cells show a possible outlier year, where perhaps an unusual condition existed. Quaboag 67/9 access site had a peculiarly high year in 2016, which has not been seen again, excluding that year (maybe 2015 too), its average is much better. Chicopee Putts had a high year in 2018. Excluding that or even smoothing it down would balance it out with other years. Yet it both cases, there could have been a condition creating higher bacteria that existed during that season and not again.

Outside of the two noted years/sites, there does not seem to be much of change over the past 7 years, maybe only a hint of a rise of averages. Certainly, the longer the trend and the

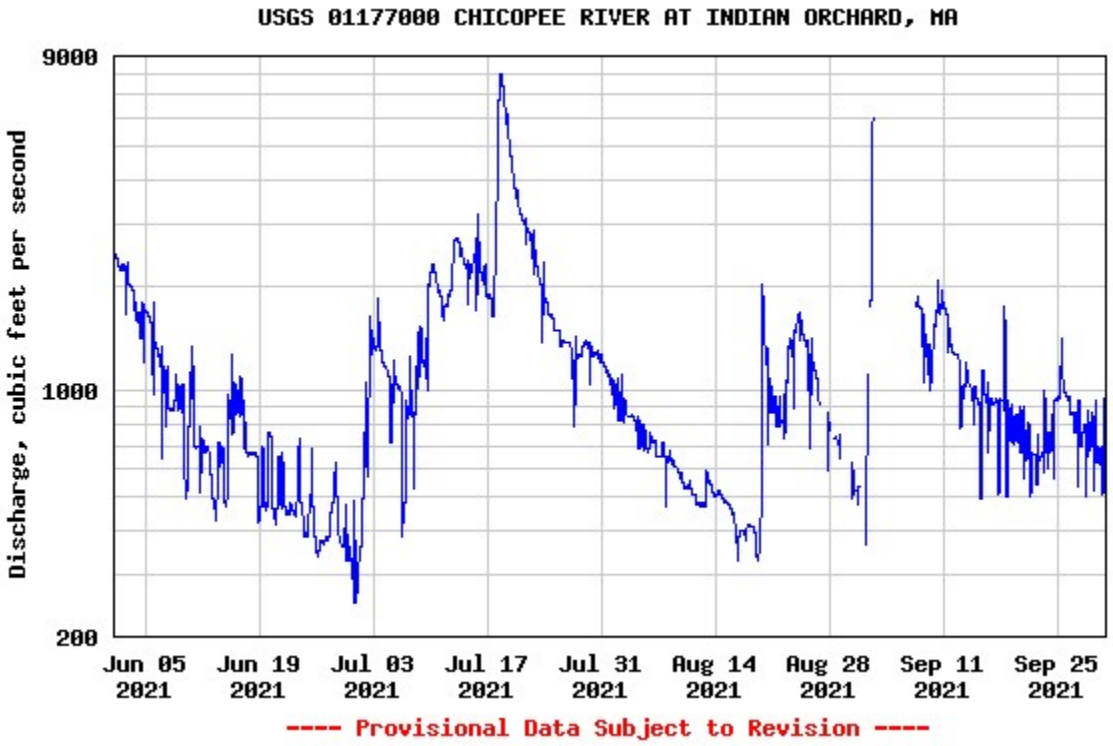
steady addition of quality data will help to notice changes. C4R is reaching the cusp where trend review can be done, so maintaining this program offers stakeholders an opportunity to see the long term health of the rivers. Noticeable trend changes should trigger concern and more probing study of conditions that may be compromising water quality.



Appendix
River Flows 2021

Charts for each of the 4 Rivers through the summer of 2021.
2021 flows were above the 75 year median.

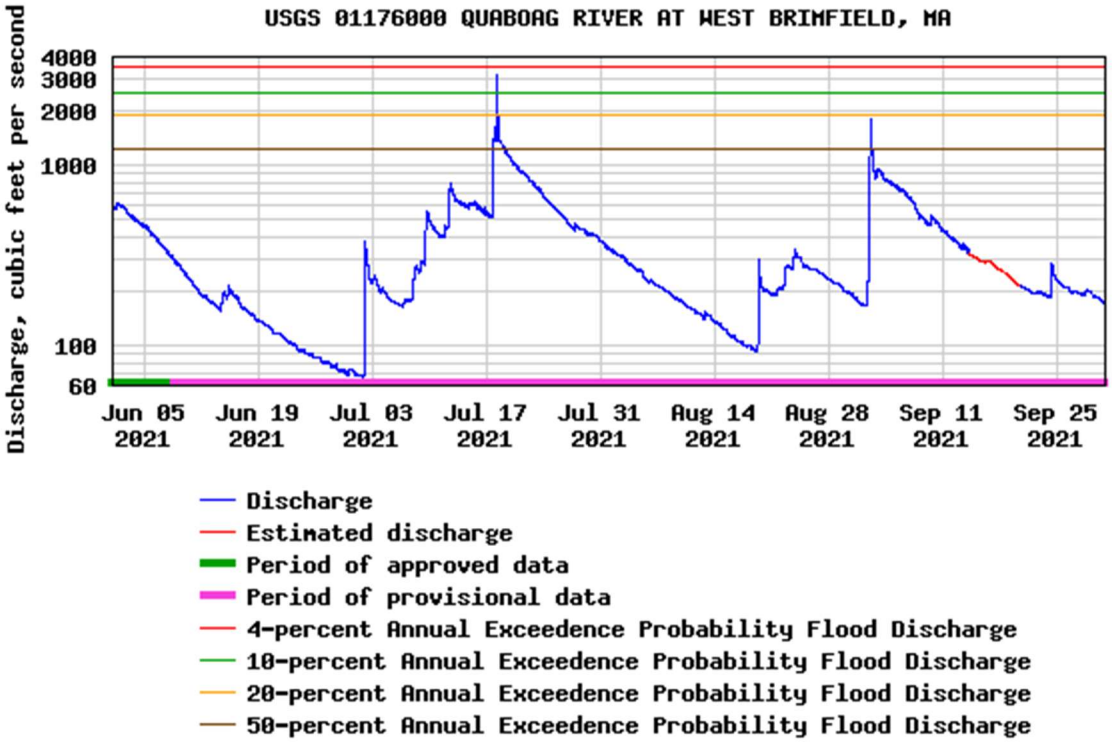
Chicopee River



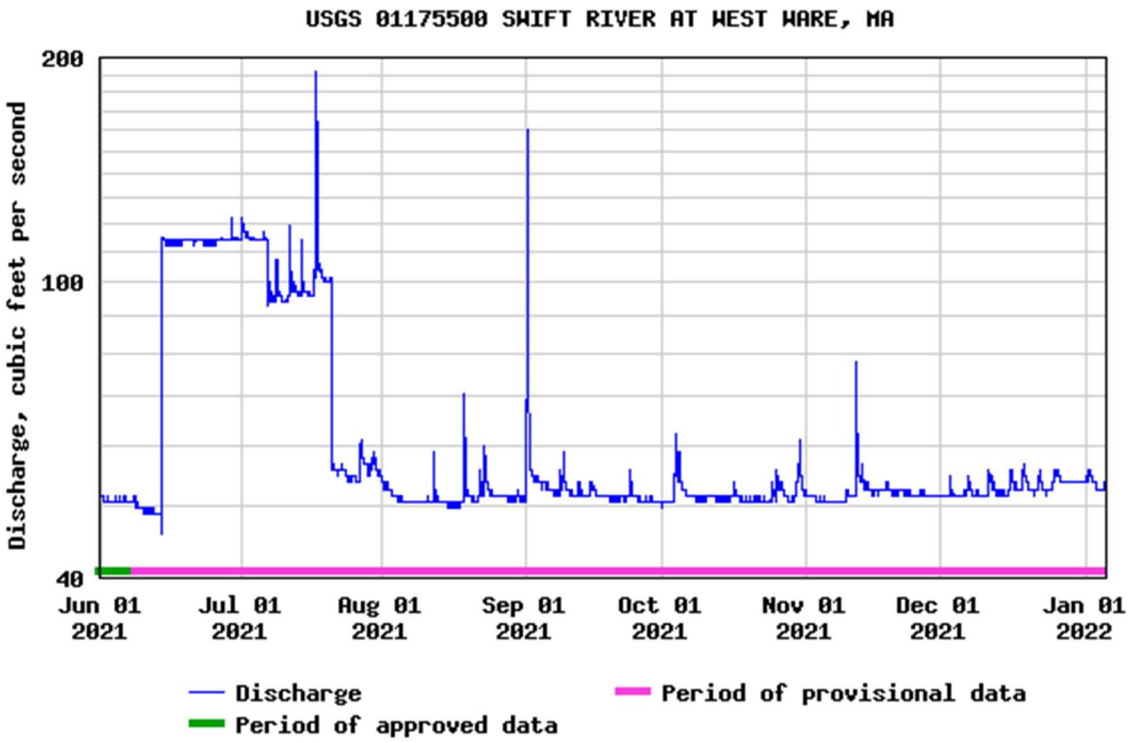
Chicopee River flow here is controlled by a small scale upstream hydro facility, thus the swings in flow. Best to interpret by looking at the mid range of the swing.

Ware River -

Quaboag River - The river was at flood stage in late July.



Swift River flow is controlled out of Quabbin Reservoir. Summer norm is around 50 CFS.



Quality Control Summary

Duplicates QC summary							QC goal <30%	
Date	blank value	dup type	sample value	dup value	s-log 10	d-log 10	RPD	Segments
6/10/2021		FD	290.9	235.9	2.46	2.37	6.44%	upper
			95.9	151.5	1.98	2.18	14.04%	lower-SEP
6/24/2021		FD	68.3	76.7	1.83	1.88	3.56%	upper
			35.9	54.6	1.56	1.74	12.88%	lower
7/8/2021	<1.0	FD	224.7	191.8	2.35	2.28	4.86%	upper
			2420	2420	3.38	3.38	0.00%	lower
7/22/2021		FD	56.3	65	1.75	1.81	4.41%	upper
			52	59.4	1.72	1.77	4.09%	lower
8/12/2021		FD	365.4	435.2	2.56	2.64	5.37%	upper
			115.3	101.9	2.06	2.01	3.79%	lower
8/26/2021		FD	113	131.4	2.05	2.12	4.63%	upper
	<1.0		201.4	275.5	2.30	2.44	9.62%	lower
9/9/2021		NA						
9/29/2021			81.6	93.4	1.91	1.97	4.15%	lower
175 samples planned-172 taken=98% completion missed: OF, Banas, 1 Dup								

All QC met project objectives.