MRWC
Millers River
Watershed Council, Inc.
100 Main Street, Athol, MA 01331
978-248-9491
council@millersriver.net

MRWC Bacteria Monitoring Program

2014 Report: Millers & Otter Rivers

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Monitoring Our Rivers Health.

Prepared by:
Keith Davies
1/12/15

QC Review by Ivan Ussach, MRWC Coordinator

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A digital version of this report can be found at www.millerswatershed.org

Executive Summary

In 2014 the Millers River Watershed Council (MRWC) successfully conducted its fourth consecutive bacteria monitoring season. A group of dedicated volunteers and two staff executed this program by monitoring a total of nine sites on the Millers and Otter rivers. Seven distinct sampling events were completed during the major recreational contact season. MRWC changed the mix of sample sites to cover areas where expanded Blue Trails will be opened in 2015 and to deal with budget realities, some 2013 sites were dropped, but core sites were retained and added.

This program has been building a baseline to improve the water quality database on bacteria concentrations in the rivers and streams of the Millers Basin. Water-based recreational activities (and physical contact or exposure levels) are determined to be appropriate based on the concentration of bacteria in the river or water body. The Massachusetts Department of Environmental Protection (MassDEP) has developed guidelines for making such determinations.

By conducting a continuing annual program of volunteer monitoring, MRWC aims to provide watershed residents and visitors with practical information concerning the safety of using and enjoying local rivers. Results were posted regularly on www.connecticutriver.us through a partnership with CRWC and PVPC. The data collected was determined to be of reliable quality and consistent with all state standards for water quality monitoring.

Fourth-year results indicate a generally healthy river system for a variety of types of recreation: the one ongoing concern is with limiting primary contact after a heavy rainstorm; a typical finding in many watersheds. Data from a "WET" event illustrates this. Often in areas located just downstream of urban centers, which collect greater amounts of stormwater runoff, it is not unusual for bacterial concentrations to run high.

The continued success of this monitoring program illustrates the value and importance of volunteer activities to monitoring and protecting public health. As MRWC 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, MRWC determined that it would be beneficial to maintain 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 Blue Trail and other segments meet the MassDEP water quality contact standards.

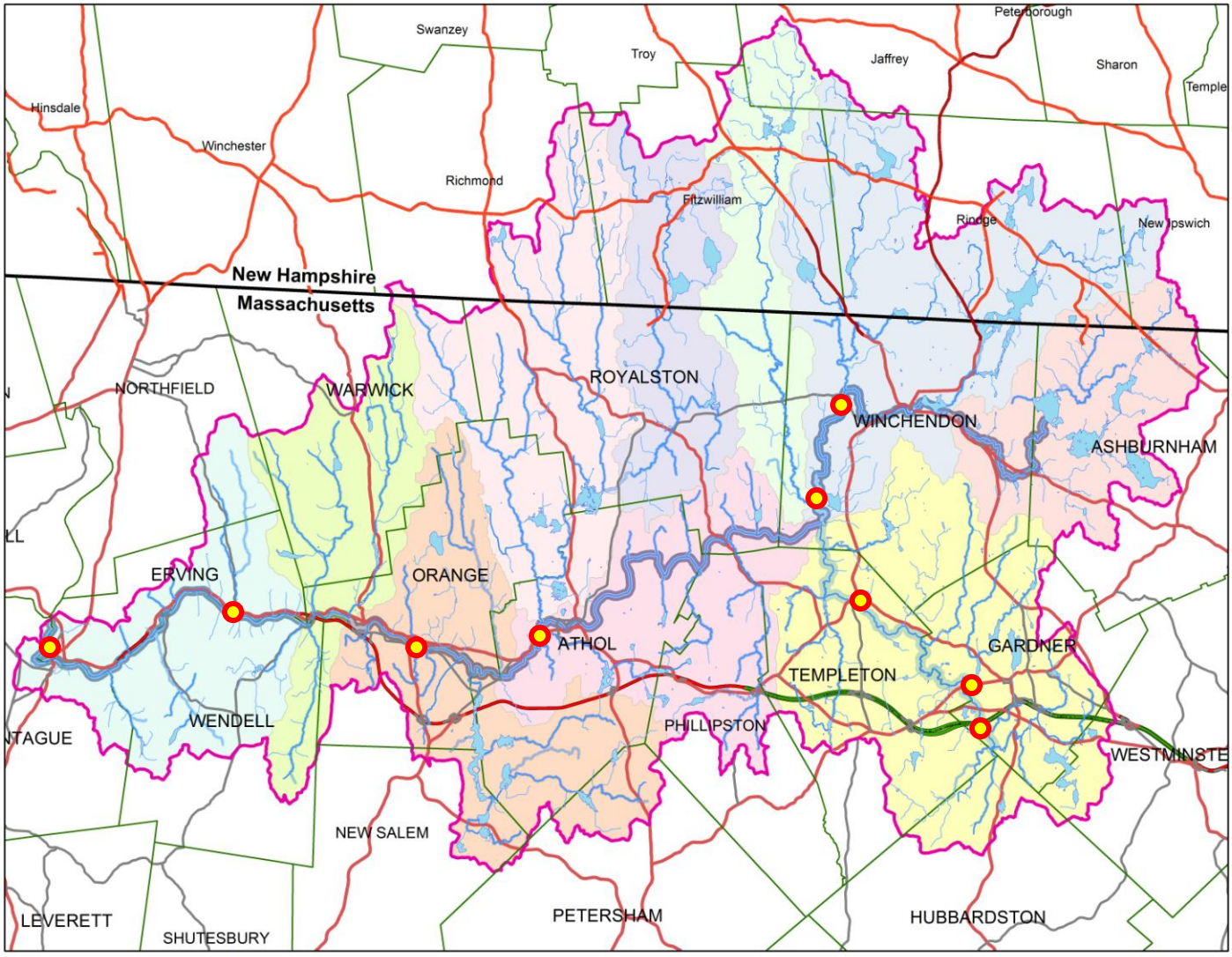
MRWC’s program is guided by a QAPP (Quality Assurance Project Plan) from which to conduct consistent operation of this effort. A QAPP is a formal monitoring plan with ample quality control that is approved by MassDEP. The data from such a program, if followed carefully, is accepted and trusted by the state, and thus provides reliable information which can be used to foster river protection and inform the public.

MRWC relies on fundraising to help support program costs, mainly laboratory analyses of samples and some monitoring equipment. MRWC is grateful for support from individuals/businesses who contributed to our “Adopt-A-Sample" program. MRWC used the CRWC lab in Greenfield for sample analysis. Sampling kits were organized for each sample site.

Another key step was to find volunteer samplers. Outreach brought nine people forward to help. All received training in proper sampling techniques, and bi-weekly sampling began on June 10, 2014 and ran through September 2nd. In all we conducted seven sampling events at nine (9) sampling sites on the Millers and Otter Rivers. Volunteers noted air and water temperatures and other site conditions observed during each sampling event. Weather conditions within 48 hours of sampling events were recorded from NWS (National Weather Service) sources.

The 2014 sampling year was a strong success. Funding limited MRWC to 9 sites, 6 fewer than 2012, but we continued with 7 sampling events. Volunteer samplers did well and there were few complications. Reporting on line also worked well. This experience continues to illustrate MRWC commitment to monitoring and will guide any enhancements to MRWC’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.

2014 Bacteria sample sites in the Millers Basin.



Dark blue river = Millers River, Light Blue river = Otter River

Special thanks to our volunteers!

Becky Finn, Diane Nassif, Bill Belco, Sarah Trafton-Anderson, David & Monique Brule, Irene Murray, Andrea Buglione, Guy Corbosiero

Acronyms:

CRWC = Connecticut River Watershed Council
PVPC = Pioneer Valley Planning Commission
DSH = Daniel Shays Highway
MassDEP = MA Department of Environmental Protection

Project Approach

Purpose (taken from MRWC QAPP)

Quote from MassDEP's 2000 Millers River Water Quality Assessment Report:

"***There is a lack of bacteria data throughout the watershed limiting the assessment of recreational uses***."

***"Primary and Secondary Contact Recreational Summary - Rivers*:**
The majority of the river miles (92%) are currently not assessed for the *Primary* and *Secondary Contact Recreational Uses* because of the lack of current bacteria data."

The Millers River and its watershed offers many fine recreational and nature viewing opportunities. Unfortunately there is a lack of water quality data to determine if the river is 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 for the Millers and Otter Rivers has been too limited to make a clear contact standard determination. 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), sampled the Millers River Watershed in 2005 as part of a five-year rotating basin schedule. DWM sampled selected sites in the Millers in 2011 and MRWC will review this data as available. Only five sites in the Millers basin have received periodic sampling on a regular basis. These are the MassDEP CERO SMART (Strategic Monitoring and Assessment for River basin Teams) sites and are typically sampled every 10 weeks.

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 a clear determination. Sampling at 4-7 sites on the Otter River and 8-12 sites on the Millers, 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 MRWC 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 MRWC and MassDEP to make accurate water quality determinations for the Millers 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.

Stakeholders for this project include residents, visitors to, and recreational users of the Millers River 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 the main stem of the Millers River and one of its major tributaries, the Otter River, have not been extensively nor 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 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:

- Advance improvement of the water quality of rivers and streams in the Millers River 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

MRWC's formal QAPP document describes the various considerations, procedures, reasonings, and details of the monitoring processes. How we conducted 2012 worked out as follows.

Once adequate funding was secured, MRWC began to assemble needed equipment and select a qualified lab. Sampling kits in accordance with our bacteria SOP (MWWP R-3) were assembled for each volunteer and each site. Coolers and ice pack sets were acquired. A sampling pole, 42 inches long with a spring clamp attached to one end, was fabricated for each volunteer. This pole enabled 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 that could be present in the water sampled below a 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 MRWC Chain of Custody (CoC). Samples were then brought to a central meeting place where a MRWC 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 a Colilert system.

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

Temperature was sampled using a conventional non-mercury stick 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 Orange and Fitchburg 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 in South Royalston, Erving, and Gardner.

QC samples were collected and prepared and sent to the lab: a duplicate at each sampling event and a total of three blanks (distilled pure water samples) during the sampling season. Comparing these results gives a sense of the quality of our sampling and the lab's analysis.

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

2014 Monitoring sites

In 2014 MRWC reduced/changed the location of sites from 2013, but maintained key baseline data points along MRWC "Blue Trails," two river sections within the Millers River Watershed; one on the Millers River and one on the Otter River. Since MRWC encourages river discovery/recreation, it was deemed prudent to continue the investigation of how well the Blue Trail segments meet "contact standards."

Table 1: Sampling Sites (First Letter: M=Millers, O=Otter)

Site ID#	Location	Latitude	Longitude	Notes
MOSF1	New Boston Rd-ORSF	42°38'44.38"N	72° 5'55.38"W	Upstream side of bridge in Otter River State Forest
MCM1	Cass Meadow	42°35'36.71"N	72°14'20.95"W	Park at Rich Env Park, sample at boat launch, in current, not eddy
MW1	Winchendon Boat launch	42°41'2.25"N	72°4'59.22"W	Below River St bridge at improved river access location
MORF1	Orange Riverfront Park	42°35'19.52"N	72°18'29.33"W	Sample from boat ramp
MEr1	Erving	42°35'54.72"N	72°24'9.50"W	Below bridge crossing down Arch St off Rt 2, Erving center
MCf1	Millers w/CT confluence River	42°35'44.91"N	72°29'45.02"W	off Rt 2, sample along bank, upstream of bike bridge, Dorsey Rd
OR2A1	Rt 2A crossing	42°33'52.10"N	72° 0'42.32"W	Sample upstream side, west bank
OR101	Rt 101 Crossing	42°34'25.97"N	72° 0'58.43"W	Sample above Rt 101, 100 ft, near pipe crossing along Plant Rd
OBW1	Baldwinville	42°36'23.51"N	72° 4'30.34"W	Park behind Legion Hall, sample upstream, east bank of 202 bridge

The table above lists the 2014 sites. A number of sites straddle the "Millers River Blue Trail" and some sites are located both upstream and downstream where potential paddling trails and fishing areas are planned or exist. The Otter River sites mostly bracket the headwaters section of the Otter River where MRWC is creating a headwaters blue trail. The Baldwinville site is near the intended second phase of the Otter River Blue Trail. The Rt 2A, 101, and 202 sites all present some degree of urban runoff influence. The location of these sites offers a good balance of data from both urban and non-urban conditions.

Results

Bacteria

The table below notes the bacteria levels for the 2014 sampling season. A discussion and interpretation of these results is presented in the Conclusions section.

2014 MRWC Bacteria Sampling Data									2014	
Site ID#	Location - Sample Date	6/10/14	6/24/14	7/8/14	7/22/14	8/5/14	8/19/14	9/2/14	GeoMean	contact
	Millers River	count								RATING
MOSF1	New Boston Rd-OSF	88.6	156.5	517.2	na	133.3	109.9	187.2	164.3	*2nd*
MCM1	Cass Meadow	52.1	81.3	224.7	47.3	76.3	68.3	129.1	84.3	*primary*
MW1	Winchendon boat launch	81.6	123.6	387.3	78.9	139.6	81.3	160.7	128.0	*2nd*
MORF1	Orange-Riverfront park	52.9	30.9	365.4	63.7	88.0	82.0	25.6	68.4	*primary*
MEr1	Erving	86.0	133.3	261.3	48	63.8	83.6	193.5	105.8	*primary*
MCf1	Millers-confluence w/Ct	88.4	34.1	99	36.4	91.0	53.8	39.5	57.6	*primary*
	Otter River	count								
OR2A1	Rt 2A crossing	90.6	123.6	235.9	76.2	99.0	70.8	98.7	104.8	*primary*
OR101	Rt 101 Crossing	66.3	78.5	517.2	74.9	209.8	172.2	135.4	138.7	*2nd*
OBW1	Baldwinville	63.1	71.7	290.9	58.3	137.4	58.3	178.2	101.3	*primary*
	Average of event	74.4	92.6	322.1	60.5	115.4	86.7	127.5		
	Weather	*Dry*	*Dry*	*Wet*	*Dry*	*Dry*	*Dry*	*Dry*		
	State limit for primary contact = 235 cfu single date maximum (seasonal geometric mean of 126 cfu)									
	Secondary contact is acceptable up to a geometric mean of 630 cfu / 1240 cfu single date									

All dry weather sampling events met primary contact standards. Secondary standards were met in all events. Single day results in general were good.

Weather

Weather was recorded from the Orange and Fitchburg Airports for the 24 & 48 hour periods prior to the sampling event. Rainfall during these time periods can produce stormwater runoff, which can impact water quality in streams. Noting the amount of rainfall and comparing it to bacteria counts can illustrate the degree of impact. In 2014, the Orange Airport rain gage was off line for part of the season, the nearest station, Westover, was used.

MRWC 2014 Bacteria Monitoring program Weather Data.								
Date		6/10/14	6/24/14	7/8/14	7/22/14	8/5/14	8/19/14	9/2/14
Station	Orange Airport(Westover)							
precip/24 hr		0	0	0.18	0	0	0	0
precip/48 hr		0	0	0	0	0	0.03	0.01
Station	Fitchburg Airport							
precip/24 hr		0.01	0	1.32	0	0	0	0
precip/48 hr		0	0	0	0	0	0	0.1
USGS flow								
	Otter	29 cfs/low	14 cfs/low	107 cfs/high!	19 cfs-norm	15 cfs norm	19 cfs norm	7.4 cfs low
	Millers-S Royaston	135 cfs/75%	47 cfs/35%	523 cfs/high!	153 cfs high	102 cfs high	133 cfs high	50 cfs low
	Winchendon	61 cfs/low	16cfs/low!	262 cfs/high!	66 cfs high	49 cfs high	68 cfs high	13 cfs low
	Farley	377 cfs/norm	169 cfs/low	1190 cfs high!	458 cfs high!	377 cfs high!	428 cfs high!	123 cfs norm
determination		***DRY***	***DRY***	***WET***	***DRY***	***DRY***	***DRY***	***DRY***
	WET EVENT	M/O					M/O	
	CRITERIA:							
	if rain 2 days(48 hrs) or less prior to sampling event exceeds 0.25 inches, then sampling considered wet.							
	If rain within 24 hours is 0.10 inches or more, then wet sampling event.							
	If >0.25 inches within 3 days and stream flow has not returned to pre-rain level, wet event.							
	IF NONE OF THE ABOVE: THEN DRY EVENT.							

Most sampling was done in dry periods, though river flows were a bit high through most of the middle summer. Rainfall in June was low, July was above normal, and August were near normal.

Field sheets

The table below summarizes general field "Aesthetic" observations noted during sampling events. Presented below are visual color and "nose" odor observations.

2014	**Color odor observations**							
Date	**6/10/14**	**6/24/14**	**7/8/14**	**7/22/14**	**8/5/14**	**8/19/14**	**9/2/14**	***notes***
MW1	**clear, none**	**clear none**	**clear, none**	**clear, none**	**clear, none**	**clear, none**	**clear, none**	
MOSF1	**clear, none**	**clear none**	**clear, none**	**NA**	**lite-tea none**	**clear, none**	**tea none**	**all reported**
MCM1	**clear, lt tea, none**	**light-tea none**	**NA**	**tea, none**	**lite-tea none**	**lt-tea, musty**	**lt-tea, lt musty**	**water was clear**
MORF1	**tea, none**	**tea none**	**tea none**	**tea, none**	**tea, none**	**tea, none**	**tea none**	**just some color**
MEr1	**tea, none**	**clear none**	**tea none**	**lt tea, none**	**tea, none**	**tea, none**	**tea none**	
MCf1	**tea, none**	**clear none**	**brown, none**	**lt tea, none**	**lite-tea none**	**tea, none**	**clear, none**	
OR2A1	**brown, none**	**brown, none**	**clear, none**	**brown, none**	**brown, none**	**clear, none**	**brown, none**	
OR101	**brown, none**	**clear, no**	**clear, none**	**brown, none**	**brown, none**	**clear, none**	**brown, none**	
OBW1	**brown, none**	**brown, none**	**brown, none**	**brown, none**	**brown, none**	**brown, none**	**brown, none**	

In general, both the Millers and Otter Rivers appear to have a tint, often described as a weak tea color. This is common in many New England rivers and relates to the presence of natural tannins from plant decay. ***It is also heartening that there were very little or NO water ODORS observed throughout the summer season.***

These general observations are useful as they can be compared from person to person, year to year and give some continuity to the monitoring. A long term record can help clarify if any changes occur.

Table: 2014 River Temperatures

Water Temperatures 2014								
Date	6/10/14	6/24/14	7/8/14	7/22/14	8/5/14	8/19/14	9/2/14	***notes***
Site/temp H2O-degree F								
MILLERS								
MW1	65	65	72	70	70	63	68	
MOSF1	66	66	74	na	68	65	72	
MCM1	65	67	na	68	70	62	73	
MORF1	68	71	73	73	71	66	75	
MEr1	65	68	70	62	69	63	73	
MCf1	66	68	73	68	70	64	72	
OTTER								
OR2A1	70	72	84	72	71	66	73	
OR101	69	68	72	71	71	66	73	
OBW1	66	66	71	70	70	63	72	

na = no data. Tinted cells note uncertain values.

The river temperatures in July and early August, then 9/2, exceeded cold water fishery standards, which, is considered 68 degree F. Most dates have consistent readings and at a glance appear a bit cooler than 2013 readings. All thermometers were QC checked.

QC Objectives ***(Quality Control = QC)***

MRWC set a number of QC objectives for the sampling program. A review of these objectives, presented below, will determine how well the program performed this season.

Completeness:

MRWC completed 62 out of 63 planned bacteria samplings; >99% achieved. This met our goal of 80+%. We missed 2 blank samples.

Precision:

MRWC's goal for precision was <30% deviation on duplicates when analyzing log10 of the values. Log10 smoothing of values considers the randomness of bacteria concentrations in waters. The 2014 deviations did not exceed 15% on the worst day and was typically 10% or less. Good precision!

QC samples 2014 Field Duplicates								
Grab	6/10/14	6/24/14	7/8/14	7/22/14	8/5/14	8/19/14	9/2/14	Notes
count/site	CM	ORF	Er1	2A	2A	ORF*	CM**	* QC taken 4 minutes later?
site	52.1	30.9	261.3	76.2	99	82	129.1	
duplicate	50.4	42.6	248.1	127.4	83.9	49.6	160.7	
Log 10	1.716837723	1.489958479	2.41713941	1.88195497	1.9956352	1.91381385	2.110926242	
Log 10 Dup	1.702430536	1.629409599	2.39462676	2.10516943	1.923762	1.69548168	2.206015877	
Ave dev	0.007203593	0.06972556	0.01125632	0.11160723	0.0359366	0.10916609	0.047544817	
RPD	0.7	6.9	1.1	11.1	3.6	10.9	4.7	**corrected labeling per sample on CoC form and CRWC notes
blank			<1					

Lab Dup	6/10/14	6/24/14	7/8/14	7/22/14	8/5/14	8/19/14	9/2/14
	Count						
site-CM	52.1	81.3	224.7	47.3	76.3	68.3	129.1
duplicate	51.2	65	209.8	44.8	90.9	60.5	114.5
Log 10	1.716837723	1.910090546	2.35160307	1.67486114	1.8825245	1.8344207	2.110926242
Log 10 Dup	1.709269961	1.812913357	2.32180548	1.65127801	1.9585639	1.78175537	2.058805487
Ave dev	0.003783881	0.048588594	0.01489879	0.01179156	0.0380197	0.02633266	0.026060378
RPD	0.3	4.8	1.5	1.2	3.8	2.6	2.6

Only 1 blank was collected using sterilized water. It was analyzed and was less than 1 cfu, the lab's lower limit. This verifies the lab's precision as well.

Thermometers were checked against a NIST certified thermometer at CRWC lab in May and December of 2014. All thermometers used in our program met our goal of +/- 1 deg C.

Representativeness:

All samples were collected in the same manner at locations within recreational areas; many sites were boat launch areas. Samples were collected in the morning and on a consistent schedule during the prime recreation season. Seven events took place to cover 3 months of the recreational season. All sites had flow.

Comparability

The comparability of the data collected by MRWC to others (e.g., MassDEP) will be good since known protocols and documenting methods were used. Sampling sites and procedures are well documented so that future surveys can produce comparable data by following similar procedures and using same sites.

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. The field dup on 9/2 was not properly labeled, this was remedied.

These results indicate that the QC objectives for 2014 were met.

Conclusions/Discussion

2014 discussion

The spring of 2014 was not unusually wet, May was normal and June a bit low, but July saw rains 2.5 inches above the norm. River levels were high throughout the mid-summer and did not begin to approach normal flows till mid/late August. By chance, most of our sampling dates fell in periods with little or no rain. The one WET event date did have the highest average bacteria counts of our sampling season. All sites met secondary standards, wet or dry, with most sites having a geometric mean for the summer as primary contact attainment. The only time where sites failed the single primary sample limit of 235 cfu was on the day deemed as wet weather, after a rain. This confirms the recommendation that primary contact, swimming and such, be avoided immediately after rain events.

The data from the 2014 sampling season allows the following observations:

- Dry weather events met primary contact standards at all sites, only one site was close to the 235 limit (OR101 on 8/5).
- The poorest day for bacteria was a wet event with the most rain recorded within 24 hours. (7/8/14) All sites still maintained secondary status.
- The site at New Boston Rd, ORSF, again has a secondary use geomean possibly due the nearby wetlands and animal activity.
- Other sites with a secondary rating were near urban areas.
- River Temperatures appeared a bit cooler than to 2013.
- There were no unusual odor or color observances.

The state has established the use of the geometric mean to review bacteria data sets for determination of standard attainment. Use of the geometric mean is generally advised for bacteria data to attain a log normal distribution by reducing skew effects.

2014 Conclusions

The Millers and Otter Rivers have water quality conditions well suited for recreation. Data continues to point out that immediately following a rain storm, river areas in and immediately below urban areas may not be suitable for primary contact, but secondary contact may be acceptable. In dry weather conditions, these rivers appear acceptable for primary and secondary contact recreation.

Communities wishing to improve contact standards should consider implementing (and maintaining) a comprehensive stormwater management program. MassDEP, the Mass Watershed Coalition, and the Mass Association of Conservation Commissions can offer information on other programs. Such programs would offer improvements in water quality that would benefit both people and river health.

2015 efforts

The data from this fourth year of monitoring adds to the baseline of data and helps MRWC and the community broaden its understanding water quality trends. Continuing to add to this baseline will be helpful. At a minimum, MRWC hopes to sample many of the same sites again in 2015, 6-8 times using the same procedures. Regular and consistent monitoring will enable MRWC to keep the public well-informed on the health of the rivers, while developing a clearer water quality history from which to determine trends and identify problems and remedial actions.

MRWC may also wish to have funding resources to perform some "source" tracking if areas are discovered to have high e-coli readings. Source tracking would entail immediate follow up sampling after a high reading in and around a high reading site. This may also include "bracketing" the site by sampling areas above and below any suspected bacteria sources that could contribute to the concern. Reserve funding for up to 20 samples would be beneficial for such an effort.

Funding will determine the final scope of sampling in 2015; between grants and another "Adopt a Sample" campaign we hope to sample at least 9-10 sites.

Maintaining/Recruiting volunteers will begin in the late winter of 2015 with training slated for the late spring. MRWC will likely begin 2015 sampling in early June.

MRWC sees this program as an important resource in advancing watershed protection and community engagement.

Appendix 1

Geometric Mean Comparison

MRWC is approaching a point where the string of continuous data offers an opportunity to review the long term trend of a sites water quality and river health. For example: the Orange Riverfront park launch site has consistently had quite good water quality. Typically 5 or more years of data presents an opportunity to begin statistical analysis.

	Comparing Geomean	2011	2012	2013	2014
Site ID#	Location - Sample Date	GeoMean	GeoMean	GeoMean	GeoMean
MOSF1	New Boston Rd-OSF	NA	106	194	164
MCM1	Cass Meadow	129	274	154	84
MW1	Winchendon boat launch	131	na	na	128
MORF1	Orange-Riverfront park	97	64	98	68
MEr1	Erving	158	108	na	106
MCf1	Millers-confluence w/Ct	NA	104	66	58
OR2A1	Rt 2A crossing	116	209	80	105
OR101	Rt 101 Crossing	198	123	142	139
OBW1	Baldwinville	219	188	128	101

State limit for primary contact is 135 cfu.

Secondary is 630 cfu.