Bacterial Assessment: 2009 Shigella outbreak at Shannon Beach, Winchester, MA

Mystic River Watershed Association
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Hotspot Sampling Date: August 24, 2009

Report Date: July 8, 2010

Technical Report # 1007-001

CITATION

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Executive Summary

From the Centers for Disease Control and Prevention: ***What is shigellosis?***

Shigellosis is an infectious disease caused by a group of bacteria called Shigella. Most who are infected with Shigella develop diarrhea, fever, and stomach cramps starting a day or two after they are exposed to the bacteria. The diarrhea is often bloody. Shigellosis usually resolves in 5 to 7 days. Persons with shigellosis in the United States rarely require hospitalization. A severe infection with high fever may be associated with seizures in children less than 2 years old. Some persons who are infected may have no symptoms at all, but may still pass the Shigella bacteria to others.
*(CDC Website: www.c*dc.gov/nczved/divisions/dfbmd/diseases/shigellosis/)

On Aug 21, 2009, Shannon Beach in Winchester, MA was closed as a result of an outbreak of Shigellosis (see DCR Press Release Aug 21, 2009, link below). The MA- Department of Public Health (MA-DPH) performed an investigation at the site to determine the source of pollution leading to the sicknesses. The Mystic River Watershed Association (MyRWA) conducted Hotspot sampling in the area of Shannon Beach to contribute greater knowledge of possible sewage contamination. The beach was closed for the remainder of the season partly due to the unknown source of contamination and the staffing seasonal cycle.

According to the MA-DPH, a total 31 confirmed cases of Shigellosis occurred during the outbreak with exposure dates extending from July 17 to August 16, 2009 (pers. comm., Patricia Kludt, Chris Huskey and Joe Conidi MA DPH).

Upon learning of the outbreak at Shannon Beach, on August 24, Patrick Herron of MyRWA contacted Chris Huskey of MA-DPH to offer assistance in tracking the source of bacterial contamination at the beach. MA-DPH expressed appreciation for the offer but did not provide direction to MyRWA in their investigation.

The following text describes the efforts of the MA- DPH to investigate the outbreak of Shigellosis at Shannon Beach. MA-DPH has not released a report of the incident (as of July 1, 2010), as such all information contained in this report has been gathered by phone calls made by Patrick Herron of MyRWA to employees of the MA-DPH. The information on the MA-DPH report is not a substitute for the official MA-DPH report and is an incomplete record of MA-DPH work.

This report also contains the results of a Hotspot sampling effort. Water quality data was collected by MyRWA with Roger Frymire on Aug 24, 2009 from the ambient waters as well as pipes in the area of Shannon Beach.

Department of Public Health Investigation.

The following information was gathered through multiple phone calls between Patrick Herron (MyRWA) and MA-DPH staff (Chris Huskey, Joe Conidi and Patricia Kludt).

On August 6, 2009 the first cases of Shigellosis were reported that were connected with a visit to Shannon Beach. The information was passed from the municipal level on to the state level of MA-DPH. On August 9 MA-DPH began an investigation at Shannon Beach in response to information gathered from emergency room patients who identified visiting the beach. MA-DPH visited Shannon Beach, beach use was observed and a number of samples were taken to test for high bacteria concentrations.

An initial survey performed by MA-DPH revealed poor sanitary conditions in the lavatory facilities at Shannon Beach. No soap or sanitary products (e.g. paper towels) were found in the bathrooms. The bathrooms were generally found to be in "dirty" condition. MA-DPH subsequently requested a record of cleaning at the facility (e.g. a "Cleaning log"). No "Cleaning log" was provided to MA-DPH but an employee of DCR reported to MA-DPH that the facility was cleaned on a "daily basis".

Information gathered between August 9 and August 21, 2009 created a degree of confidence that Shigella transmission was occurring at Shannon Beach leading to dysentery in emergency room patients. On Aug 21, 2009, Shannon Beach in Winchester, MA was closed as a result of an outbreak of Shigellosis (see DCR Press Release Aug 21, 2009, link below).

Surface swabs: Following the closure of Shannon Beach, MA-DPH began an intensive investigation to isolate the source of bacterial contamination at the beach. As a part of the effort to determine the source of contamination, the MA-DPH swabbed all surfaces near to the beach including the beachhouse facilities and the playground area at some distance to the beach. None of the swab samples at any location tested positive for Shigella. According to MA-DPH, the swab samples were taken after DCR had performed an initial cleaning of the facilities. The timing of the swab samples after the initial cleaning may have had an impact on test results.

Data gathered from emergency room visits: MA-DPH reviewed hospital admissions and gathered data from interviews with patients. The investigation revealed 31 confirmed cases of Shigellosis occurred from exposure at Shannon Beach. The period that individuals were exposed to Shigella bacteria at Shannon Beach extended from July 17, 2009 to Aug 16, 2009 (31 days). The mean age of the patients that contracted Shigellosis at Shannon Beach was 14 years old, median age was 6 years old; 23 of 31 patients were under 18 years old.

Environmental water samples: Samples taken during the week at the Medford Boat Club by the state did not identify bacterial concentrations of concern. Shannon Beach was tested for an indicator bacteria of human fecal material, *Enterococcus* on a weekly basis throughout the summer prior to the event with no evidence of a problem.

Communication between MA-DPH and MA-DCR:
MA-DPH reports that MA-DCR has been responsive to all requests for information.

Press release on closing of Shannon Beach on Aug 21, 2009
http://www.mass.gov/dcr/news/2009/pr09-8-21.pdf

Press release on re-opening of Shannon Beach Playground on Sep 4, 2009
http://www.mass.gov/dcr/news/2009/MediaAdvisory%20ShannonBeachPlaygroundReopens.pdf

Investigation by the Mystic River Watershed Association (MyRWA)

The Mystic River Watershed Association (MyRWA) performed a Hotspot sampling investigation in the area of Shannon Beach to identify sources of bacteria and worked to gather anecdotal reports on the use and condition of Shannon Beach.

Anecdotal reports collected by MyRWA described the sanitary conditions at Shannon Beach as poor. Multiple beach users reported disposable diapers being left behind at the waters edge, trash barrels overfilled and poor conditions in the facilities. One issue identified by users of the beach is that the staffing of the beach often ends at 5 PM with the restroom facilities locked at that time.

A MyRWA staff member visited Shannon Beach at 6 PM on Tuesday, June 29, 2010 to make observations on the condition of the beach and use. At 6 PM of that day, there were 117 people on the beach at 6 PM with the majority of the people of Latino background. There were abundant trash barrels lining the beach. Trash barrels were all lined with plastic bags. The bathroom facilities were locked (apparently at 5PM). There was not a visible place to wash hands outside the facility but there was a functioning drinking fountain on the end of the building. Two port-o potties were present at the edge of the beach. One port-o-potty had both toilet paper and hand sanitizer. The second port-o-potty had no toilet paper and the soap dispenser had been broken off.

Hotspot Sampling Design MyRWA performed Hotspot sampling on August 26, 2009. A review of the history of sampling by MyRWA in the area of Shannon Beach did not lead to the identification of any highly suspicious pipes that might have contributed to the Shigellosis outbreak. A sampling regime was designed to test for the presence of *E. coli* at Shannon Beach, the forebays of Upper Mystic Lake and within the Aberjona River.

Hotspot Sampling Results**:** The bacteria data gathered by MyRWA did not identify a source of pollution that likely contributed to the outbreak of Shigella at Shannon Beach. While in heavy rainfall or storm conditions bacteria contamination in the Aberjona River can cause high bacteria counts at Shannon Beach, these conditions did not exist leading up to the Shigella outbreak.

Table 1 indicates the levels of *E.* coli and parameters measured at the Hotspot sampling sites visited. Three types of samples were taken: Ambient (near shore or on waterbody), Pipe (sample taken from effluent of pipe), Centerline (taken from middle of stream or river). Figure 1 provides the data in graphical format, Figure 2 provides the locations of samples on a map and Table 3 provides additional information on location.

The results indicate that a Winchester pipe in the Aberjona River releases sewage at a level that warrants attention (5910 *E. coli*/ 100 ml.) and contributes to the compromised water quality in the Aberjona River. Results from two centerline samples ABR001 and ABR006 indicate water quality of the Aberjona River is impaired for swimming (MA DEP swimming standard 235 *E. coli*/100 ml.).

Three facts lead MyRWA to the conclusion that there is a low probability that the Aberjona River is the source of contamination leading to the Shigellosis outbreak: 1) distance of Shannon Beach from the outlet of the Aberjona River, 2) the presence of two forebays between Aberjona River and the beach and 3) the tendency of bacteria to be attached to solid material that settles out of the water column.

However, in small to medium sized storm conditions, the Aberjona River water quality deteriorates and can impact water quality at Shannon Beach (high bacteria counts). During large storm events, millions of gallons of sewage is intentionally released into the Aberjona River at a site 1.3 miles upstream of the beach (MWRA managed, Wedgemere siphon). These events are called Sanitary Sewer Overflows (SSO's) and will cause impairment at the beach. Two other Hotspot site failed water quality standards marginally (MYOPIA and OLETRIB).

Conclusions and Action Items:

Sanitary conditions at Shannon Beach were less than adequate in 2009 and may have contributed to the spread of Shigellosis to a total of 31 people. Reports include overflowing garbage, full diapers left on the beach and at waters edge and facilities that did not have proper sanitation products or were sufficiently cleaned.

A report on the Shigella outbreak at Shannon Beach is being generated at the Epidemiology Program at the MA- Department of Public Health. As of June 28, 2010, no report has been released on the disease outbreak that was identified in August 2009.

Action Items:

MA-DPH should make the investigative report available to MA-DCR at the earliest convenience to facilitate a review of management practices at Shannon Beach.

MA-DCR should review management practices at Shannon Beach and implement changes that further protect the health of people using the beach. Some changes that might be considered in review of management of beach:

1) Improve sanitary conditions within the restrooms
    a. Ensure availability of tissue, paper towels, soap.
    b. Enact regular cleaning schedule with clear responsibility.
    c. Develop cleaning log to record management of facility.
    d. Provide facility for changing diapers in facilities for men and women.
    e. Improve conditions of restrooms such that the condition of the facility does not act as a deterrent to use of the facility.
2) Improve sanitary conditions of beach area
    a. Place adequate sanitation barrels at multiple locations on beach.
    b. Regularly schedule the dumping and cleaning of barrels.
    c. Improve signs at the beach that guide proper disposal. (e.g. provide signs on importance of need for people to help with sanitation/trash in a language appropriate to user group (e.g. English, Spanish, Portuguese).
    d. Determine use pattern after 5 PM at beach and facilitate sanitary conditions after hours (are restrooms available?).
3) Examine on-site management at facilities
    a. Is their adequate management at facility to maintain sanitary conditions and safety of people?

b. Consider hiring at least one Spanish-speaking staff member to communicate with the many recreational users for whom English is a second language.
c. Develop communication skills among staff to improve stewardship of beach.
d. Consider providing evening staff for the site to handle the significant recreational use after 5 PM.
e. Consider hiring a qualified consultant to develop recommendations on improving management of the beach.

Shannon Beach represents a precious resource for the residents of the Mystic River Watershed. It is the only freshwater swimming beach in the watershed that is open to all residents of all towns. As a result, the beach is heavily used during warm days of the summer. This high use places strain on DCR staff and the aged facilities. It is imperative that DCR conduct a review of the 2009 conditions at Shannon Beach to determine whether improved management of the beach could reduce the probability of a repetition of an illness being spread.

MyRWA Background.

The Mystic Monitoring Network (MMN) was created in 2000 by the Mystic River Watershed Association (MyRWA) to collect valuable water quality data along the Mystic River and its tributaries. The MMN is a volunteer-based project that is made up of trained citizen volunteers, student interns, and scientific advisors throughout the region.

The goals of the MMN are to establish a high quality baseline of data for the Mystic River Watershed, identify and address water pollution problems, raise public, municipal and state agency awareness of water quality in the Mystic, and create a network of informed and active citizen advocates. MMN's Hot Spot monitoring program at MyRWA allows the organization to test water quality in locations not regularly sampled in our baseline program or that are suspected of having problems with bacteria loading.

Methods

Water quality samples are always collected by trained MyRWA staff and volunteers following the protocol written in MyRWA's Quality Assurance Project Plan (QAPP). For centerline locations, bacteria samples are collected directly from the river and for end-of-pipe samples, water is collected directly from the outfall. In fresh water, samples are analyzed for the bacteria *E. coli* and in saltwater, samples are analyzed for the presence of *Enterococcus*. The bacteria samples are collected in sterile containers containing a sodium thiosulfate tablet and kept on ice until delivery to either the EPA lab in Chelmsford, or MyRWA's

lab at Tufts University. Samples are analyzed using the Colilert method for enumerating colony forming units (cfu) of bacteria.

Physical habitat parameters are measured according to the QAPP. A YSI meter is used to collect measurements for water temperature, dissolved oxygen, specific conductivity, and salinity. The coordinates of each sample location are recorded with a Garmin 76Cx GPS unit. Air temperature is recorded with an alcohol thermometer at the beginning and end of the sampling period. Data on precipitation during the past 48 hours are obtained from the USGS website (real-time data for stream gage located at Muddy River in Brookline: http://waterdata.usgs.gov/nwis/uv?01104683).

Quality Assurance

Quality control procedures have been documented for each parameter tested by MyRWA, and can be reviewed in Table B5-1 of the QAPP (approved December 2006).

Quality control of data is ensured in several ways. YSI meters are subjected to pre- and post-calibration for each sampling event. Thermometers are calibrated on an annual basis. GIS coordinates are marked at an accuracy of ≤ 20'. As discussed in the QAPP, field duplicates are not collected due to the heterogeneous nature of bacteria in an aquatic medium. EPA Region 1 Laboratory has submitted a copy of their quality assurance plan and standard operating procedures. They do not submit results of their quality control measures, such as relative percent difference, but QC protocol are followed according to their standard operating procedures (available on request).

During this sample event, no violations of QC occurred. All samples were delivered to the EPA lab within the designated holding time, and the EPA lab did not report any violations of their standards.

Data received from the EPA lab and collected from the field were entered into MyRWA's Excel database by the Project Manager and were checked for error by another staff person. No changes to the data entry were made. Following the QAPP, these data, as reported here, are sent to the Department of Public Works and the Board of Health of the relevant municipalities. After 30 days, the data will be sent to MassDEP, the EPA, conservation commissions of the relevant communities, and any other stakeholders that have expressed interest in receiving water quality data from MyRWA. A full list of these recipients is available upon request.

Location	Winchester, MA
Water Bodies	Upper Mystic Lake, Aberjona River
Hot Spot Sample Date	8/26/2009
Rain Events (past 48 hours)	DRY
Air Temp, beginning and ending	None Taken
Monitors	R. Frymire
Lab	EPA Region 1 - Chelmsford

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Table 1 **Hotspot Sample Results**

Sample #	*Site ID*	*E coli cfu/100ml*	*H2O Temp. C°*	*DO mg/l*	*Sp. Cond. µs/cm*	*Salinity*	*Time (AM)*	*Type*	*Comments*
1800	SHBSW	12	27.0	7.53	698	0.34	7:12	Ambient	Thick line of foam at Shannon Beach
1801	UMLFL5	25	26.8	7.56	671	0.32	7:19	Ambient	
1802	MYOPIA	246	19.4	8.65	755	0.37	7:29	Pipe	
1803	FL2MID	76	26.3	6.96	594	0.29	7:35	Ambient	
1804	UMLFL3	39	25.1	6.53	586	0.28	7:39	Ambient	
1805	FL1MIDS	48	24.4	4.96	582	0.28	7:46	Ambient	Edge of weeds
1806	UMLFL1N	30	24.6	6.95	613	0.30	7:52	Ambient	
1807	ABR001	448	23.1	6.28	717	0.35	7:59	Centerline	
1808	SBROOKS	Not Detected	23.3	7.79	173	0.08	8:08	Pipe	
1809	FENWICK	5910	20.6	8.67	563	0.27	8:20	Pipe	
1810	ABR006	461	22.9	6.65	738	0.36	8:57	Centerline	
1811	OLETRIB	238	17.2	9.2	630	0.31	9:18	Centerline	Tributary

Data Entry	PMH
Data QA:	LBP

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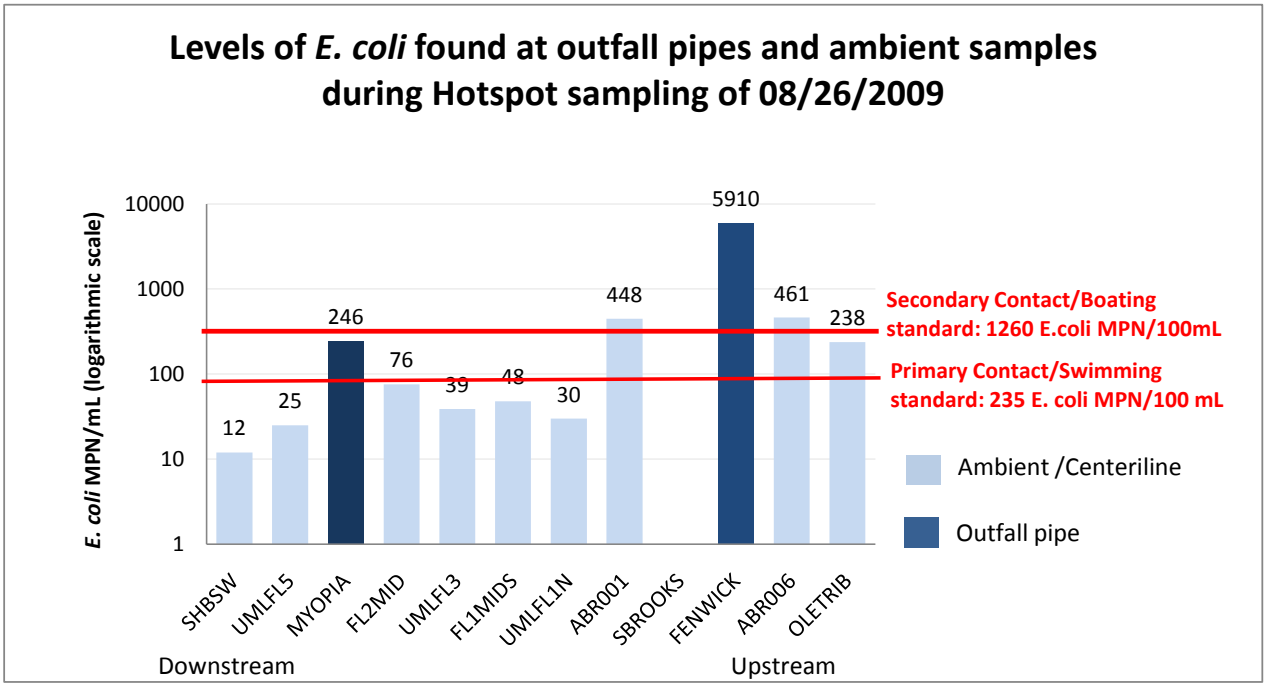

Figure 1. Bacteria counts from samples collected by MyRWA on 08/26/2009 during Hotspot sampling event in Winchester at Upper Mystic Lake and Aberjona River.. Note: bacteria counts are plotted logarithmically.

Location	Winchester, MA
Water Bodies	Upper Mystic Lake, Aberjona River
Hot Spot Sample Date	8/26/2009
Rain Events (past 48 hours)	DRY
Air Temp, beginning and ending	None Taken
Monitors	R. Frymire
Lab	EPA Region 1 - Chelmsford

Blue labels = water quality standards met (*E. coli* concentrations < 235 cfu / 100 mL)
Yellow labels = primary contact / swimming standards not met (*E. coli* between 236 - 1259 cfu / 100 mL)
Red labels = secondary contact / boating standards not met (*E. coli* > 1260 cfu / 100 mL)

Fig. 2 Location of sites sampled on August 26, 2009 for hotspot sampling.

Location	Winchester, MA
Water Bodies	Upper Mystic Lake, Aberjona River
Hot Spot Sample Date	8/26/2009
Rain Events (past 48 hours)	DRY
Air Temp, beginning and ending	None Taken
Monitors	R. Frymire
Lab	EPA Region 1 - Chelmsford

Table 2 **Additional Site Data**

Sample	Site	Town	Water Body	Latitude	Longitude	Directions
1800	SHBSW	Winchester	Upper Mystic Lake	42.439892°	-71.146412°	Accessed at Shannon Beach
1801	UMLFL5	Winchester	Upper Mystic Lake	42.439603°	-71.149958°	Accessed by kayak, Lower Forebay-Upper Lake
1802	MYOPIA	Winchester	Upper Mystic Lake	42.441229°	-71.152106°	Accessed at shore directly South of Winchester Boat Club
1803	FL2MID	Winchester	Upper Mystic Lake	42.440764°	-71.151051°	Accessed by kayak, Lower Forebay-Upper Lake
1804	UMLFL3	Winchester	Upper Mystic Lake	42.441577°	-71.149248°	Accessed by walking path behind Shannon Beach to point of consriction of two forebays
1805	FL1MIDS	Winchester	Upper Mystic Lake	42.442657°	-71.145778°	Accessed by kayak, Upper Forebay-Upper Lake
1806	UMLFL1N	Winchester	Upper Mystic Lake	42.444946°	-71.145751°	Accessed by kayak, Upper Forebay-Upper Lake
1807	ABR001	Winchester	Upper Mystic Lake	42.442897°	-71.142446°	Accessed by parking at small parking lot where Aberjona feeds into Upper Mystic L.
1808	SBROOKS	Winchester	Aberjona River	42.442957°	-71.142174°	Accessed by parking at small parking lot where Aberjona feeds into Upper Mystic L.
1809	FENWICK	Winchester	Aberjona River	42.444047°	-71.138780°	Walking through woods from Fenwick Rd to Aberjona
1810	ABR006	Winchester	Aberjona River	42.447397°	-71.138721°	Baseline site at USGS gauge
1811	OLETRIB	Winchester	Aberjona River	42.442923°	-71.151490°	Access at north side of Everett Ave., Winchester