TECHNICAL MEMORANDUM

To:	Tom Fortier, Tow of Ogunquit, ME and Mike Horn, Ogunquit Conservation Commission
From:	Emily DiFranco, FB Environmental Associates
Subject:	**Summary of Leavitt Stream Bacteria Sampling July – September 2013**
Date:	October 16, 2013
cc:	Forrest Bell and Whitney Baker, FB Environmental Associates

Introduction

This memo provides results from bacteria sampling and bacteria source tracking using canine detection in the Leavitt Stream from July – September, 2013 in Ogunquit, ME. A discussion of next steps is provided.

FB Environmental (FBE) conducted bacteria sampling on four sample events under various weather conditions (two under wet weather conditions and two under dry weather conditions) at seven locations throughout the Leavitt Stream watershed (Figure 1). Dissolved oxygen and temperature data were also collected during most sample events at each sampling location.

All bacteria samples were analyzed for enterococci bacteria at Nelson Analytical Water Testing Laboratory in Kennebunk, Maine. Enterococci bacteria are used as an indicator of the presence of fecal material in saltwater by the Maine Healthy Beaches program. In Maine, the state water quality standard for enterococci is 104 colonies/100mL for a single grab sample and 35 colonies/100mL for the geometric mean of multiple samples. Though the Leavitt Stream is a freshwater stream, the saltwater water quality standard was used to assess the impact of the Leavitt Stream on potential beach closures in Ogunquit.

High concentrations of fecal indicator bacteria in waterbodies can lead to posted advisories at swimming beaches and closure of shellfish beds. These bacteria are used to signal human health risks such as gastrointestinal, respiratory, eye, ear, nose, throat, and skin infections transmissible to humans through the consumption of contaminated fish and shellfish, skin contact, and/or ingestion of water. Enterococci results from FBE sampling at the Leavitt Stream outlet just north of the Ogunquit River outlet at Ogunquit Beach were above the state standard during two out of four events. Maine Healthy Beaches Program reported no beach closures or advisories. However, the number of posted beach advisories at Ogunquit Beach has shown an increasing trend since 2003 (ME Healthy Beaches, 2013).

Bacteria Results

As shown in Table 1, enterococci concentrations ranged from 10 to over 8,000 colonies/100 mL. The geometric mean ranged from 75 to 473 colonies/100 mL. Geometric mean values for all sites were above the Maine water quality standard. All samples taken on September 23, 2013 were well below the state standard of 104 colonies/100mL for a single sample event. Low results during this wet weather sampling event will be discussed later in this report. Sites OR-15-1 and OR-Jothams had the highest geometric mean concentrations for enterococci in 2013.

Outlet of the Leavitt Stream at the Ogunquit River

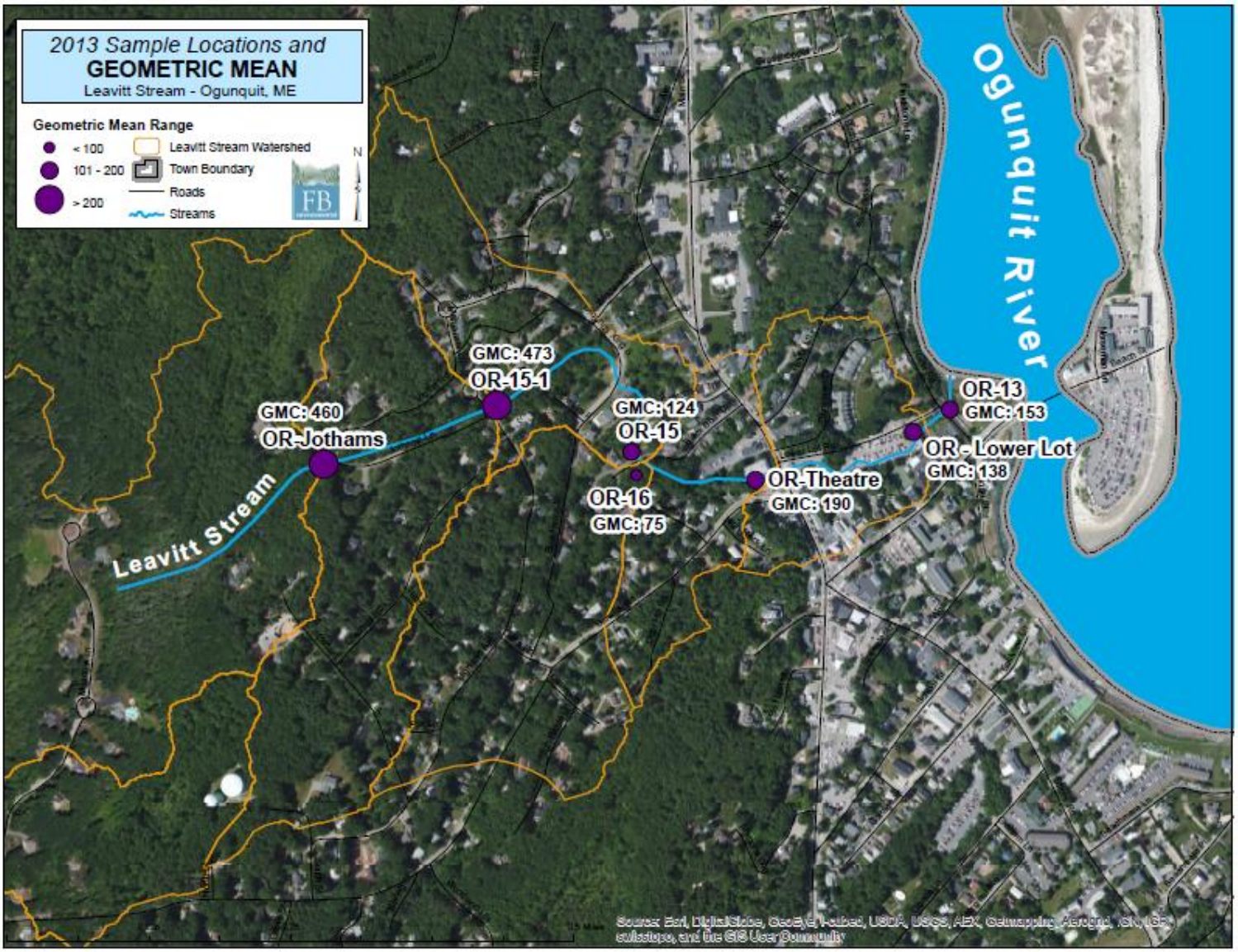
Table 1: Enterococci (colonies/100mL) results & geometric mean for all sampling locations in the Leavitt Stream Watershed from July – September 2013. Sites are organized downstream to upstream.

Sample ID	Site Location	7/30/2013	8/13/2013	9/12/2013	9/23/2013	Geometric Mean
		Dry	Dry	Wet	Wet	
OR-13	Outlet of Leavitt Stream at River Rd.	62	144	1500	41	**153**
OR-Lower Lot	Downstream of the Lower Parking Lot off River Rd.	95	98	613	63	**138**
OR-Theatre	Backside of Ogunquit Theatre off Rte 1	109	75	3050	52	**190**
OR-15	Upstream of Black Boar crossing	63	109	836	41	**124**
OR-16	Abenaki Stream - upstream of convergence with Leavitt Stream	431	183	41	10	**75**
OR-15-1	Downstream of Highland and Jothams	474	272	3095*	20	**473**
OR-Jothams	Upstream of Jothams crossing	171	251*	8840	98	**460**

Gray cells indicate an exceedance of WQS for enterococci (Single sample = 104 colonies/100 mL; Geometric Mean = 35 colonies/100mL).

*** indicates that a field duplicate was collected. Result is the average of two samples.**

Figure 1: Sampling Locations and Bacteria Concentrations (geometric mean) for bacteria sampling in the Leavitt Stream Watershed (July – September 2013)

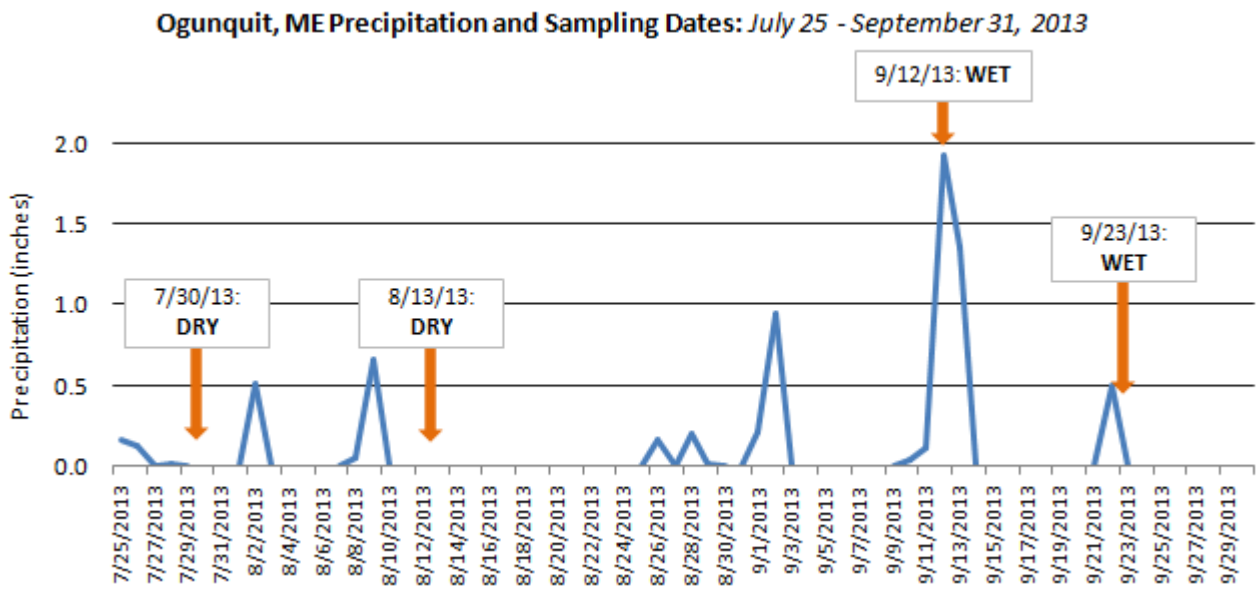


Wet weather and Dry Weather Analysis

The results of wet weather and dry weather samples were compared in an effort to understand the sources of bacteria in the watershed (Table 1). Samples collected in both wet and dry weather conditions exceeded the water quality standard for enterococci at many locations throughout the Leavitt Stream. Generally, it is expected that wet weather bacteria results will be higher than dry weather bacteria results. The significant increase in bacteria in the stream is the result of stormwater inputs as rain water moves over the land and into the Leavitt Stream. However, the wet weather results for September 23rd showed unusually low bacteria results. As shown in Figure 2, the largest rainfall event seen between July and September occurred on the 12th and 13th of September yielding almost two inches of rain in less than 48 hours (Weather Underground precipitation data, 2013). High bacteria counts on September 12th

are likely a result of a flushing of bacteria in the watershed by this large storm including septic systems, leach fields, and accumulating sources found throughout the watershed. The sampling event on September 23rd was technically considered a wet weather event based on precipitation amounts. However, the magnitude of this event was much smaller than the previous rain event. This lower rainfall and flushing from the previous event likely contributed to the lower bacteria concentrations on September 23rd.

Figure 2: Precipitation (inches) in Ogunquit, ME from July – September and enterococci sampling dates for the 2013 sampling season.



Canine Bacteria Source Tracking in the Leavitt Stream Watershed

On August 8, 2012, FB Environmental and Environmental Canine Services (ECS) collaborated with the Town of Ogunquit, ME to conduct targeted bacteria source tracking throughout the Ogunquit River watershed. This investigation resulted in the detection of three potential bacterial "hotspot" locations on the Leavitt Stream. On July 30, 2013 FBE and ECS returned to Ogunquit to focus specifically on bacteria source tracking within the Leavitt Stream watershed. Scott and Karen Reynolds of ECS, along with canines Sable and Logan, pioneered the canine detection method of identifying pollution sources in the upper Midwest and California. Canine detection is recognized by EPA Region 5 as an effective, quality-controlled tool able to rapidly detect human-source wastewater in the environment. FBE coordinated with ECS to conduct this working visit to New England.

Weather conditions leading up to this sample event were hot, dry and sunny, with no rain the prior two days. Samples were collected in buckets at each sampling location. Bacteria samples were also collected and sent to the laboratory for bacteria analysis. Bucket samples were transported to a neutral scent

location and evaluated by Logan and Sable. The dogs alerted to the presence of human wastewater at four of these sample locations. Over half of these locations also exceeded the water quality standard for enterococci bacteria. Table 2 summarizes the canine response for the three sites on Leavitt Stream that were visited in 2012. Figure 2 and Table 3 shows the canine response for each sampling location and the enterococci results for samples collected on July 30, 2013.

Figure 2: Canine Response Results for Sampling Locations in Leavitt Stream on July 30, 2013

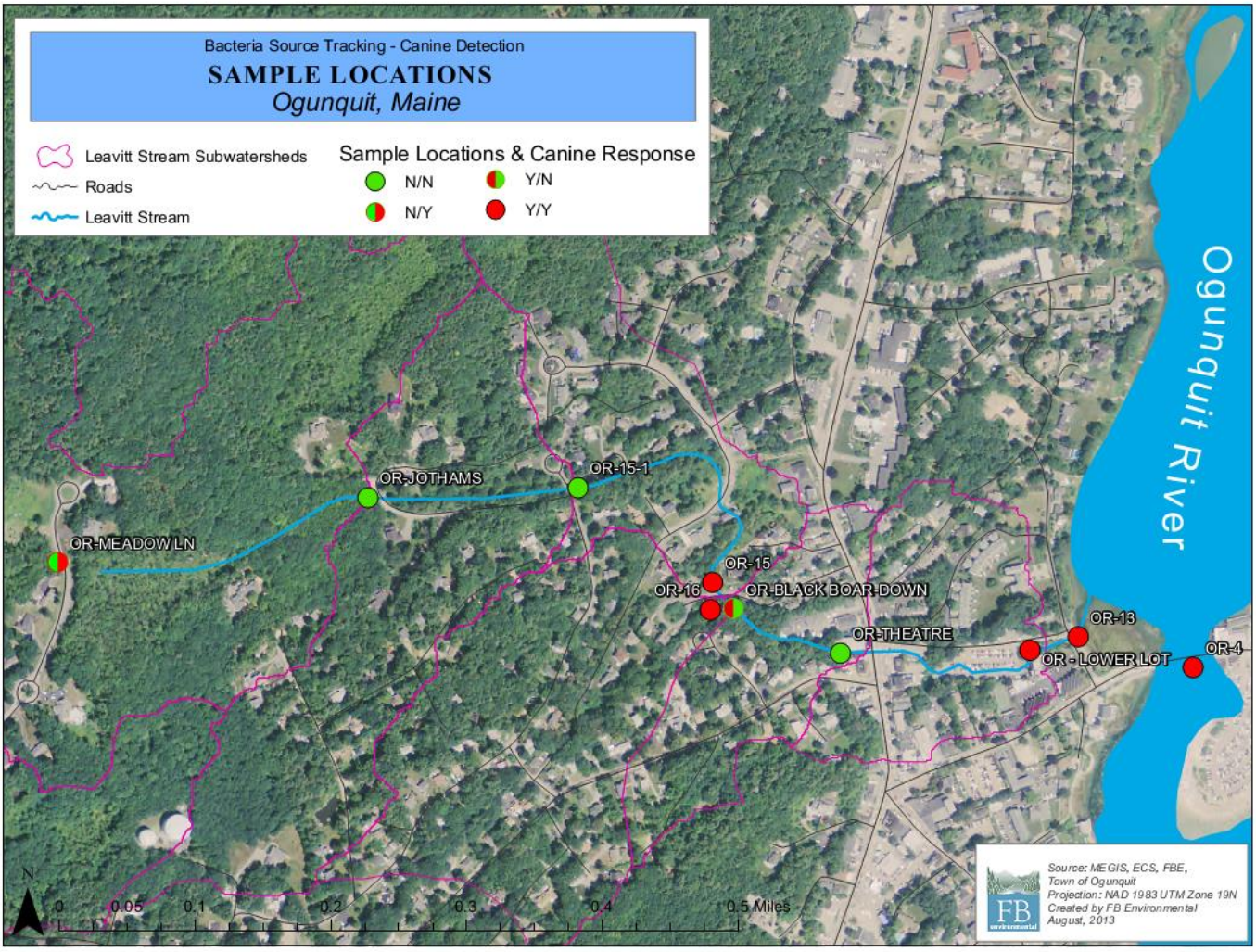


Table 2: Canine Response & Enterococci Results for Sampling Locations in Leavitt Stream in 2012

Site	Location	Date	Enterococci (colonies/ 100mL)	Canine Response	
				Logan	Sable
OR-13	Outlet of Leavitt Stream at River Rd.	8/10/2012	85	**Yes**	**Yes**
OR-15	Upstream of Black Boar crossing	8/10/2012	4884	**Yes**	**Yes**
OR-16	Abenaki Stream - upstream of convergence with Leavitt Stream	8/10/2012	337	No	No

Gray cells indicate an exceedance of the water quality standard (104 colonies/100mL for single samples and 35 colonies/100mL for a geometric man of multiple samples.
Red cells indicate a positive response via canine detection.

Table 3: Canine Response and Enterococci Results for Leavitt Stream Sampling Locations in 2013

Site	Location	Enterococci (colonies/100mL) 7/30/2013	2013 Geometric Mean	Canine Response	
				Logan	Sable
OR-13	Outlet of Leavitt Stream at River Rd.	62	153	**Yes**	**Yes**
OR-Lower Lot	Downstream of the Lower Parking Lot off River Rd.	95	138	**Yes**	**Yes**
OR-Theatre	Backside of Ogunquit Theatre off Rte 1	109	190	No	No
OR-15	Upstream of Black Boar crossing	63	124	**Yes**	**Yes**
OR-16	Abenaki Stream - upstream of convergence with Leavitt Stream	431	75	**Yes**	**Yes**
OR-15-1	Downstream of Highland and Jothams	474	473	No	No
OR-Jothams	Upstream of Jothams crossing	171	460	No	No

Gray cells indicate an exceedance of the water quality standard (104 colonies/100mL for single samples and 35 colonies/100mL for a geometric man of multiple samples.
Red cells indicate a positive response via canine detection.

Discussion

As shown in Table 1, the geometric mean for enterococci for all sites exceeded Maine's water quality standard. As bacteria concentrations under varying weather conditions exceeded the water quality standard, sources of bacteria likely include a mix of sources including stormwater runoff, malfunctioning septic systems, pet waste, and wildlife.

Typically, bacteria concentrations are higher under wet weather conditions than under dry weather conditions. This is not representative of the September 23rd sample results which were most likely low due to a large rain event occurring a week prior to sampling. Dry weather concentrations continuously exceeded the water quality standard indicating that bacteria sources are derived not only from stormwater runoff. Typically, bacteria results taken under dry weather conditions are lower than results taken under wet weather conditions. As rain water moves over the land and into a waterbody, it will carry bacteria from various sources (i.e. pet waste, dumpsters) as well as other pollutants (nutrients from lawn fertilizers and sediment). High bacteria concentrations during dry weather sampling events can suggest a failing septic system or leach fields nearby. In the Leavitt Stream watershed, dry weather results were above the Maine standard for enterococci in many locations. This suggests that septic systems may be contributing bacteria to the stream. Wet weather sampling results ranged from below the Maine standard to over 80 times the water quality standard. These high wet weather concentrations are likely due to a combination of 1) high water tables leading to a flushing of malfunctioning leach fields into the Leavitt Stream, and 2) increased stormwater runoff that carries bacteria, among other pollutants, into the stream.

Canine detection was used to further investigate the sources of bacteria at each sampling location (Tables 2 and 3 and Figure 2). Overall, the dogs indicated that human wastewater is present at some level at many of the sampling locations throughout the Leavitt Stream.

Stormwater runoff can pick up debris, chemicals, dirt, bacteria and other pollutants and then flows into a storm drain system or directly into a river, wetland, or coastal waterbody. Anything that enters a waterbody this way is untreated before it enters areas we may use for swimming, fishing, or boating. As indicated above, in coastal areas and other low-lying areas with a relatively high water table, it is possible that the impact of stormwater runoff is even greater as malfunctioning septic system leach fields may become inundated with water during a period of heavy rain. Most residents in the Leavitt Stream watershed rely on residential septic systems. The age and maintenance history of these systems is currently unknown indicating that malfunctioning septic systems are a likely source of bacteria to the Leavitt Stream. Bacteria from Leavitt Stream can impact the water quality of the coastal waters at Ogunquit Beach. Though no beach closures were reported for Ogunquit Beach in 2013, there is potential for contamination in the future if the sources of bacteria to the Leavitt Stream watershed are not addressed.

Other bacteria sources including pet and wildlife waste should also be considered. Much of the Leavitt Stream watershed is highly developed, indicating the potential for bacteria inputs from animals (i.e. pets) throughout the watershed.

Priorities and Next Steps

1. Continue bacteria source tracking projects currently being conducted on the Leavitt Stream to assess bacteria concentrations at all sites over time and different weather conditions;

2. Conduct a future canine scent tracking project to include walking the shoreline of targeted locations throughout the watershed, particularly in the Black Boar neighborhood;

3. Investigate the wastewater system in the Black Boar neighborhood to determine the potential for septic system or sewer line malfunctions; and

4. Investigate areas throughout the northern portion of the Leavitt Stream watershed for areas of concentrated pet waste and where wildlife congregates (such as birds).

5. Address stormwater runoff throughout the Leavitt Stream watershed. The Town of Ogunquit is currently awaiting the results of the Ogunquit River Watershed Based Plan 319 grant proposal by the ME Department of Environmental Protection. An action item of this plan is to implement BMPs (Best Management Practices) throughout the Ogunquit River Watershed. Multiple locations within the Leavitt Stream watershed have been identified as potential locations for BMPs.

Sable sniffs bucket samples in the Lower Parking Lot near the Leavitt Stream in 2012.