TECHNICAL MEMORANDUM

To: Kim Reed and Dennis McCarthy, Town of Rye, NH

From: Emily DiFranco, FB Environmental Associates

Subject: Summary of Rye Bacteria Sampling June – September 2013

Date: October 10, 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 Parsons Creek from June – September, 2013 in Rye, NH. A discussion of next steps is provided.

FB Environmental (FBE) conducted bacteria sampling on six days under various weather conditions (three under wet weather conditions and three under dry weather conditions) at eight locations throughout the Parsons Creek 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 New Hampshire Department of Environmental Services Beaches Program. In New Hampshire, 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 Parsons Creek is a freshwater stream, the saltwater water quality standard was used to assess the impact of Parsons Creek on potential beach closures in Rye.

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. Though enterococci results from FBE sampling at the Parsons Creek outlet at Wallis Beach were above the state standard during four out of six events, no beach closures or advisories occurred in the 2013 season. New Hampshire Beaches Program results at three locations along Wallis Sands Beach were typically less than 19 colonies/100 mL during the sampling period (NH DES OneStop Data, 2013).

Bacteria Results

As shown in Table 1, enterococci concentrations ranged from 10 to over 24,200 colonies/100 mL (the laboratory's detection limit). The geometric mean ranged from 315 to 2,840 colonies/100 mL. Geometric mean values for all sites were above the New Hampshire standard, as only two sites ('*PC Outlet'* and '*Geremia'*) met the standard of 104 colonies/100mL for a single sample event. Sites BCH11 and ACPSOO5-U15 had the highest geometric mean concentrations for enterococci in 2013.

Outlet of Parsons Creek at Wallis Beach

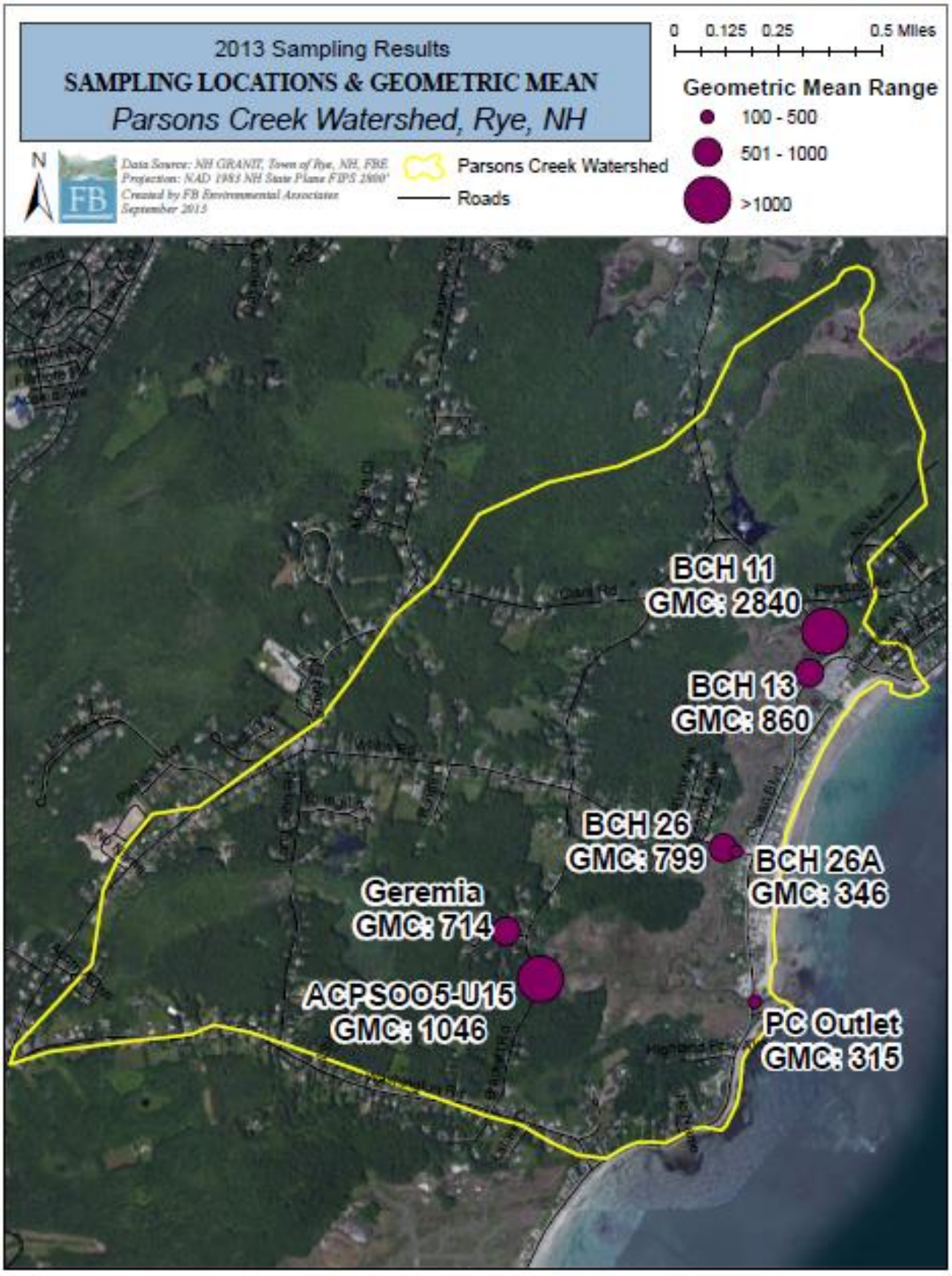
Table 1: Enterococci (colonies/100mL) results & geometric mean for all sampling locations in the Parsons Creek Watershed from June – September 2013.

Sample ID	Site Location	6/12/2013	6/26/2013	7/16/2013	7/31/2013	8/9/2013	9/13/2013	Geometric Mean
		Wet	Wet	Dry	Dry	Dry	Wet	
ACPSOO5-U15	Brackett Road	432	5794	385*	199	959	24196	**1046**
Geremia	Geremia St.	1039	41	259	>24200	*No flow*	697	**714**
BCH 11	Marsh Road	6867	2310	754	313	1789	15531*	**2840**
BCH 26	Wallis Rd.	4160	223	246	135	487	17329	**799**
BCH 26A	Wallis Rd. Trib	785	369	134	309	118	1222	**346**
BCH 13	Ocean Blvd.	3448	408	496	350	538	3076	**860**
PC Outlet	Parsons Creek Outlet at Ocean Blvd.	4611	670	10	10	131	24196	**315**

↳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 2 samples.

Figure 1: Sampling Locations and Bacteria Concentrations (geometric mean) for bacteria sampling in the Parsons Creek Watershed (June – September 2013)



Wet weather and Dry Weather Analysis

The geometric means for wet weather and dry weather samples were also calculated in an effort to understand the sources of bacteria in the watershed (Table 2). Both wet and dry weather geometric mean values exceeded the water quality standard for enterococci at all sites in the Parsons Creek watershed except for the outlet at Parsons Creek. At this location, the dry weather geometric mean did not exceed the water quality standard while the wet weather geometric mean value was over 25 times the water quality standard.

Table 2: Enterococci (colonies/100mL) wet weather, dry weather, and total geometric mean for all sampling locations in the Parsons Creek Watershed from June – September 2013.

Sample ID	Site Location	DRY Weather Geometric Mean	WET Weather Geometric Mean	TOTAL Geometric Mean
ACPSOO5-U15	Brackett Road at the Massacre Site	388	3927	1046
Geremia	Geremia Street behind 17 Geremia	2504	310	714
BCH 11	Marsh Road Culvert	750	7707	2840
BCH 26	Wallis Road Culvert	253	2524	799
BCH 26A	Wallis Road Tributary	170	467	346
BCH 13	Ocean Boulevard near Wallis Sands State Park.	414	1630	860
PC Outlet	Parsons Creek Outlet at Ocean Boulevard.	24	930	315
Gray cells indicate an exceedance of WQS for enterococci (Geometric Mean = 35 colonies/100mL).				

Canine Bacteria Source Tracking in the Parsons Creek Watershed

On July 31, 2013, FB Environmental and Environmental Canine Services (ECS) collaborated with the Town of Rye, NH to conduct targeted bacteria source tracking throughout the Parsons Creek 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.

The primary purpose of this testing was to help identify the potential "hotspots" of bacterial pollution to Rye's waterways. 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 sources of bacteria at all of these sample locations. Almost all of these locations also exceeded the water quality standard for enterococci bacteria. Table 3 shows the canine response for each sampling location and the enterococci results for samples collected on July 31, 2013.

Table 3: Canine Response and Enterococci Results for all Sampling Locations in the Parsons Creek Watershed on July 31, 2013

Sample ID	Site Location	Enterococci Results 7/31/2013 (colonies/100mL)	2013 Geometric Mean	Canine Response	
				Logan	Sable
ACPSOO5-U15	Brackett Road at the Massacre Site	199	1,046	Yes	No
Geremia	Geremia Street behind 17 Geremia	>24,200	714	Yes	Yes
BCH 11	Marsh Road Culvert	313	2,840	Yes	Yes
BCH 26	Wallis Road Culvert	135	799	Yes	No
BCH 26A	Wallis Road Tributary	309	346	Yes	Yes
BCH 13	Ocean Boulevard near Wallis Sands State Park.	350	860	Yes	Yes
PC Outlet	Parsons Creek Outlet at Ocean Boulevard.	10	315	Yes	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.

Logan investigates Wallis Beach

Discussion

As shown in Tables 1 and 2, enterococci concentrations for all sites exceeded New Hampshire's water quality standard throughout the study period. 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.

Overall, bacteria concentrations were higher under wet weather conditions than under dry weather conditions. However, 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 field nearby. In the Parsons Creek watershed, dry weather results were typically high with geometric mean values above the New Hampshire standard for enterococci. This suggests that septic systems may be contributing bacteria to the creek. Wet weather sampling results ranged from nine to over a hundred times the water quality standard in Parsons Creek. 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 Parsons Creek, and 2) increased stormwater runoff that carries bacteria, among other pollutants, into the creek.

Canine detection was used to further investigate the sources of bacteria at each sampling location (Table 4). Overall, the dogs indicated that human sources of bacteria are present at some level at all locations sampled throughout the watershed. In three locations, Logan alerted to the presence of human wastewater while Sable did not. In a 2011 Water Environment Research Foundation study, it was shown that Logan is more sensitive to low levels of human wastewater than Sable. In these cases of a positive alert by Logan only, and if other indicators of human wastewater were not present (such as toilet paper, visible human sewage, or sewage odor) it is likely that the actual amount of human wastewater present at the time of detection was also relatively low. However, human sources should still be included as potential sources of bacteria in follow-up investigations.

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 Parsons Creek 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

Parsons Creek. Despite the high concentrations throughout the watershed, much of these bacteria are mitigated throughout the watershed before reaching the outlet of Parsons Creek. As shown in Tables 1 and 2, bacteria concentrations under dry weather conditions at the outlet were either near or below the water quality standard. However, under wet weather conditions, concentrations at the outlet exceeded the water quality standard by up to over 25 times. Bacteria from Parsons Creek can impact the water quality of the coastal waters at Wallis Beach. Though no beach closures were reported for Wallis Beach in 2013, there is potential for contamination in the future if the sources of bacteria to Parsons Creek are not addressed.

Other bacteria sources including pet and wildlife waste should also be considered. Much of the Parsons Creek watershed is residential or wetland area indicating the potential for bacteria inputs from animals throughout the watershed.

Priorities and Next Steps

1. Continue bacteria monitoring throughout the Parsons Creek watershed under varying weather conditions to monitor changes in bacteria concentrations;
2. Determine the septic system history of priority neighborhoods in the Parsons Creek watershed. Based on sampling and canine detection results, focus areas include the neighborhood near Geremia and ACPS005-U15 (Brackett Road) and Marsh Road. Though other areas are also of concern, many of these are downstream of these priority areas. A septic system database is currently being developed for the watershed should focus efforts on these neighborhoods.
3. Address stormwater runoff throughout the Parsons Creek watershed. The Town of Rye is currently implementing a Watershed Restoration Grant from Maine Department of Environmental Protection that includes the installation of Best Management Practices (BMPs) to treat stormwater runoff. BMPs have already been installed on Marsh Road, Brackett Road, Geremia Road, and Wallis Road.
4. Move the portable toilet from the bank of BCH26A.
5. Educate homeowners about proper disposal of pet waste.
6. Determine areas where wildlife may congregate.

Logan investigates areas around Site BCH 26A