PARSONS CREEK WATERSHED
WATER QUALITY REPORT

FEBRUARY 2018

PREPARED FOR

Town of Rye
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TRACKING FECAL CONTAMINATION

Current Tools and Challenges

STATEWIDE FECAL CONTAMINATION ISSUE

Surface waters near developed areas are impacted by fecal contamination from polluted stormwater runoff, malfunctioning septic systems, pet, livestock, and wildlife waste, leaky sewer lines, and other aging infrastructure on residential, municipal, and commercial properties. The State of New Hampshire lists over 300 river and estuarine segments as impaired for fecal indicator bacteria (FIB). These impaired waterbodies are particularly concentrated in the populated Seacoast Region. This fecal contamination generates a significant threat to water quality, public health, and the local economy.

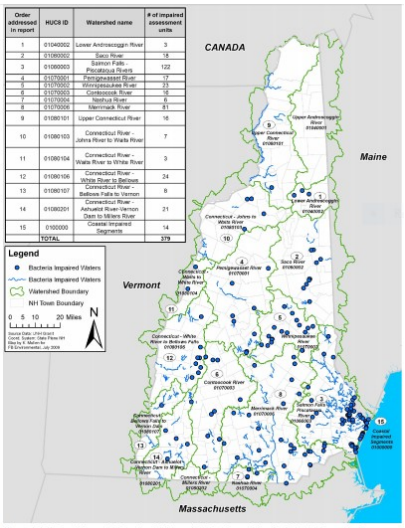
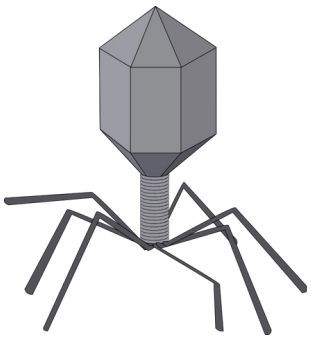


Figure 1-1: Map of Bacteria Impaired Waters in New Hampshire, by HUC 8 Watershed.

TRACKING FECAL SOURCES IS DIFFICULT

Monitoring, tracking, and managing pathogens in fecal matter is extremely difficult, particularly when fecal indicators (e.g., *E.coli,* Enterococci, or fecal coliform) are also highly variable to track and measure. FIB are used to detect fecal contamination and the pathogens associated with fecal matter in surface waters. Previous studies of beaches impacted by point sources of sewage discharge found a significant correlation between FIB and the probability of gastrointestinal (GI) illness in swimmers. However, there are some limitations to using FIB to track pathogens in fecal matter. Bacteria and viral pathogens react differently in the natural environment, so that external factors (temperature, sunlight, proliferation, etc.) may influence the concentration of FIB, but not the viral pathogens of interest for protecting public health. In addition, laboratory analysis of FIB can be highly variable due to the biological nature of the bacteria. For instance, laboratory and field duplicates can vary up to 200% or more, particularly at lower concentrations. As such, bacteria results should not be interpreted as absolute numbers, but as a rough estimate of concentration. New indicators are currently being tested that help address these issues, but until then current FIB must be interpreted with some caution when determining its actual threat to public health.



Designed by L. Diemer, FBE
Graphic credit: OpenClipArt

BEACH SAMPLING

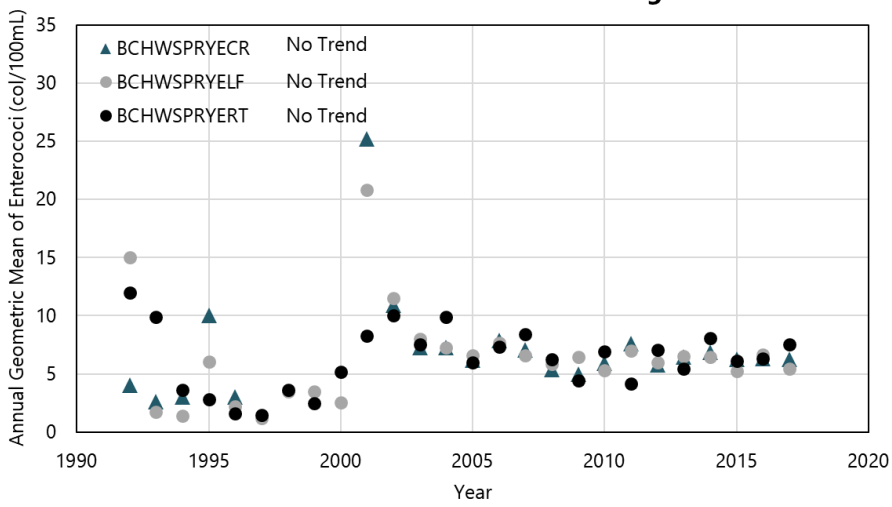
Wallis Sands State Beach and Wallis Beach, Rye, NH

NHDES BEACHES PROGRAM

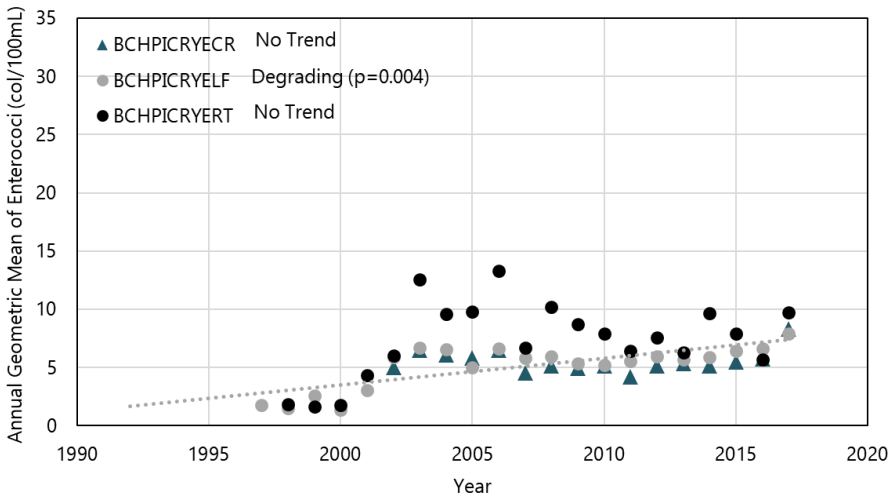
NHDES conducts regular sampling of freshwater and coastal beaches and issues advisories if FIB counts exceed water quality criteria established for the protection of public health. The annual geometric means for the six monitored beach sites were well within acceptable limits for NHDES water quality criteria. One site (BCHPICRYELF) showed a statistically-significant degrading trend from 1997-2017. A beach advisory was issued for both Wallis Sands State Beach and Wallis Beach from 7/25-7/26/2017. This was the first advisory for Wallis Sands State Beach and one of six total advisories for Wallis Beach (other advisory years included 2014, 2010, 2009, 2008, and 2006). FIB counts were especially elevated (>1,000 mpn/100mL) at three of the six sites (BCHWSPRYERT, BCHPICRYELF, and BCHPICRYECR) on 7/25/2017.

Wallis Sands State Beach and Wallis Beach were issued a swimming advisory in July 2017, the first ever or since 2014, respectively.

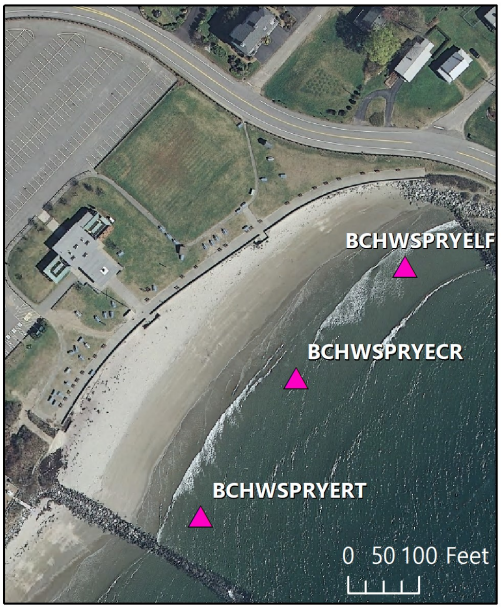
Wallis Sands State Beach Monitoring Sites



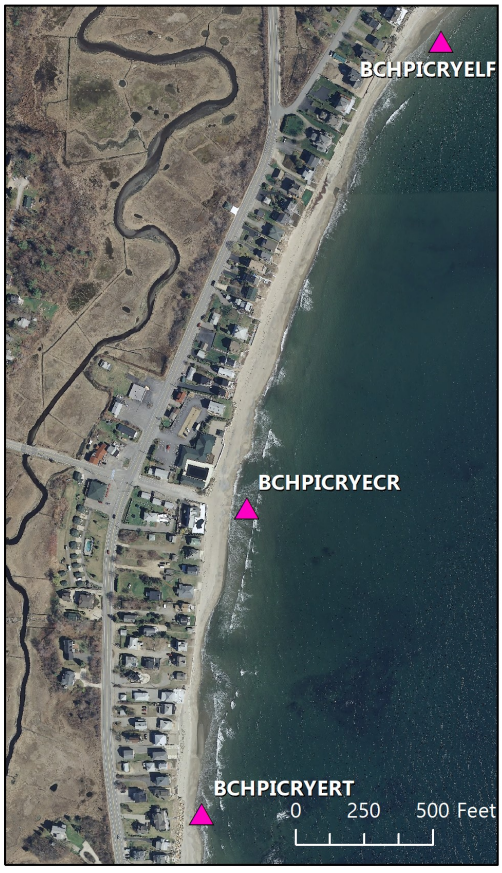
Wallis Beach Monitoring Sites



Wallis Sands State Beach



Wallis Beach



WATERSHED SAMPLING

Parsons Creek, Rye, NH

WINTER-SPRING WATERSHED MONITORING

NHDES conducted winter-spring monthly sampling from December 2016 to June 2017 at ten sites. These sites were located at the upper marsh fringes of the east branch of Parsons Creek and at the outlet, where elevated FIB counts have historically been measured. FIB exceedances during wet weather were found on 3/29/2017 at three sites (BCH11, PC09, and PC-OUT); 0.30 inches of precipitation occurred prior to sampling. FIB exceedances during dry weather were also found on 6/27/2017 at two sites (BCH10 and PC07). Three sites (BCH11, PC09, and PC-OUT) showed a geometric mean that exceeded the state water quality criterion of 35 mpn/100mL for Enterococci.

NHDES also conducted a field survey to identify possible failing septic systems (as defined in RSA 485-A-2:IV) in the sampling areas along Brackett and Parsons Rd; no visible surface issues were found. NHDES also noted large numbers of waterfowl loafing in the riffle area upstream of PC-OUT, which may be contributing fecal waste. NHDES will conduct bracket sampling to determine if there are FIB from the birds. Refer to Appendix A for data.

Overall, lower FIB counts were measured during the winter-spring monitoring; this is expected given changes in seasonal use by wildlife and humans, changes in water movement, and die-off and/or flocculation of FIB in cold waters. Three sites (BCH11, PC09, and PC-OUT) showed both single-sample and geometric mean water quality exceedances during the winter-spring monitoring.

Looking downstream from Marsh Rd at BCH11.
Photo Credit: FBE.

WATERSHED SAMPLING

Parsons Creek, Rye, NH

SUMMER WATERSHED MONITORING

Six sites (BCH08, PC07, PC08, BCH11, PC-OUT, and ACPS005-U35) within the Parsons Creek watershed were sampled for Enterococci and optical brighteners six times at low tide during wet and dry weather conditions from June to October 2017. These sites were sampled at primary locations throughout the watershed to re-investigate potential "hotspots" of fecal contamination compared to those found during previous bracket sampling efforts from 2008-2010. Three new sites outside the Parsons Creek watershed were added in 2017 (OF-EelPond, AwcominMarsh, and HarborRoad) to assess differences in FIB counts in other areas of the town.

All sites, except BCH08, exceeded the state criterion for geometric mean and showed especially-high FIB counts during wet weather on 7/25/2017, when a beach advisory was issued due to high FIB also measured at the beach. The major source of fecal contamination stemmed from the headwater areas of the watershed (BCH11, PC08 on the eastern branch). BCH11 has been a hotspot site for high FIB counts since monitoring began in 2008. Canine detection alerted to the presence of human waste at BCH11 in both 2013 and 2015. HarborRoad (mix of septic and sewer) also had high FIB counts, especially during wet weather; AwcominMarsh (mostly septic, some sewer) and OF-EelPond (sewer) had single samples more frequently within acceptable limits, though geometric means were in exceedance of the water quality criterion. Presence of optical brighteners was not found at any site. Refer to Appendix A for data and Appendix B for methods.

Similar to 2015 and 2016, the upper east branch of Parsons Creek showed multiple locations (BCH11, PC08) where individual samples and/or geometric means exceeded state criteria. As part of the new health regulation, several septic systems near or contributing to the area around these sites have been found to be malfunctioning and possibly contributing to human fecal contamination in Parsons Creek. Low FIB counts at BCH08 support the theory that BCH08 is impacted largely by wildlife, not human sources.

Awcomin Marsh. Photo Credit: FBE.

WATERSHED SAMPLING

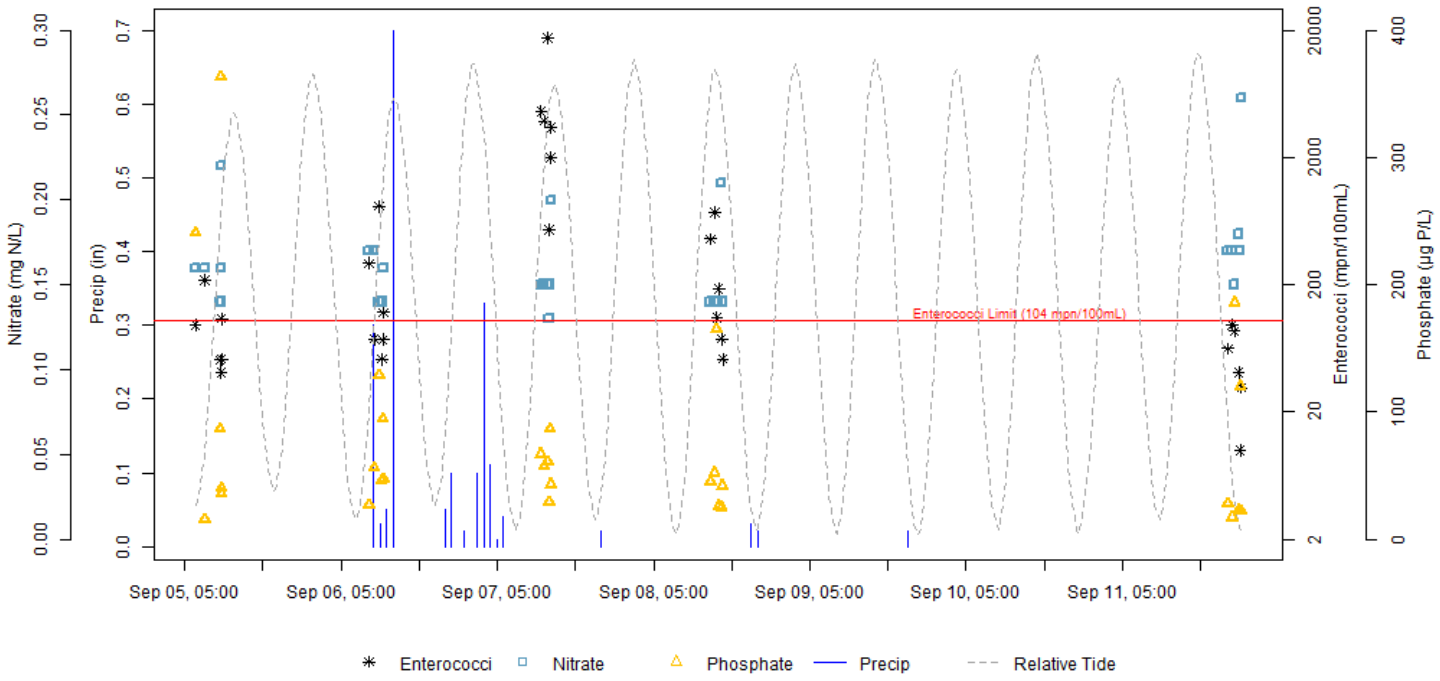
Parsons Creek, Rye, NH

STORM EVENT MONITORING

Six sites (BCH08, PC07, PC08, BCH11, PC-OUT, and ACPS005-U15) within the Parsons Creek watershed were sampled for Enterococci and other co-indictors to fecal contamination (e.g., ammonia, nitrate, phosphate, and optical brighteners) at low tide during a large storm event that delivered 1.93 inches of precipitation from 9/6-9/7/2017. Samples were collected at the six sites twice prior to the storm, twice during the storm, and once after the storm.

FIB counts spiked immediately following the storm, increasing by over 3,000% and recovering four days later. FIB counts were especially high at BCH11 at 17,329 mpn/100mL. Nitrate remained relatively unchanged (despite large volumes of incoming water), suggesting large, possibly human-derived nitrate sources were mobilized during the storm event. Phosphate diluted and quickly recovered at most sites, except BCH11 and ACPS005-U15, where large, possibly human-derived phosphate sources were also mobilized during the storm event. BCH11 also increased from 1 to 3 ppm in ammonia from pre-storm to storm conditions. Presence of optical brighteners was not found at any site. Refer to Appendix A for data.

Storm event monitoring using FIB and co-indicators to fecal contamination (e.g., ammonia, nitrate, and phosphate) showed that human fecal contamination is very likely at BCH11. The Town has identified failing septic systems within the drainage to BCH11. Future monitoring should continue to assess water quality improvements following system replacements.



Early morning sunrise at the Parsons Creek outlet the day prior to the large storm event Photo Credit: FBE.

WET/DRY WEATHER ANALYSIS

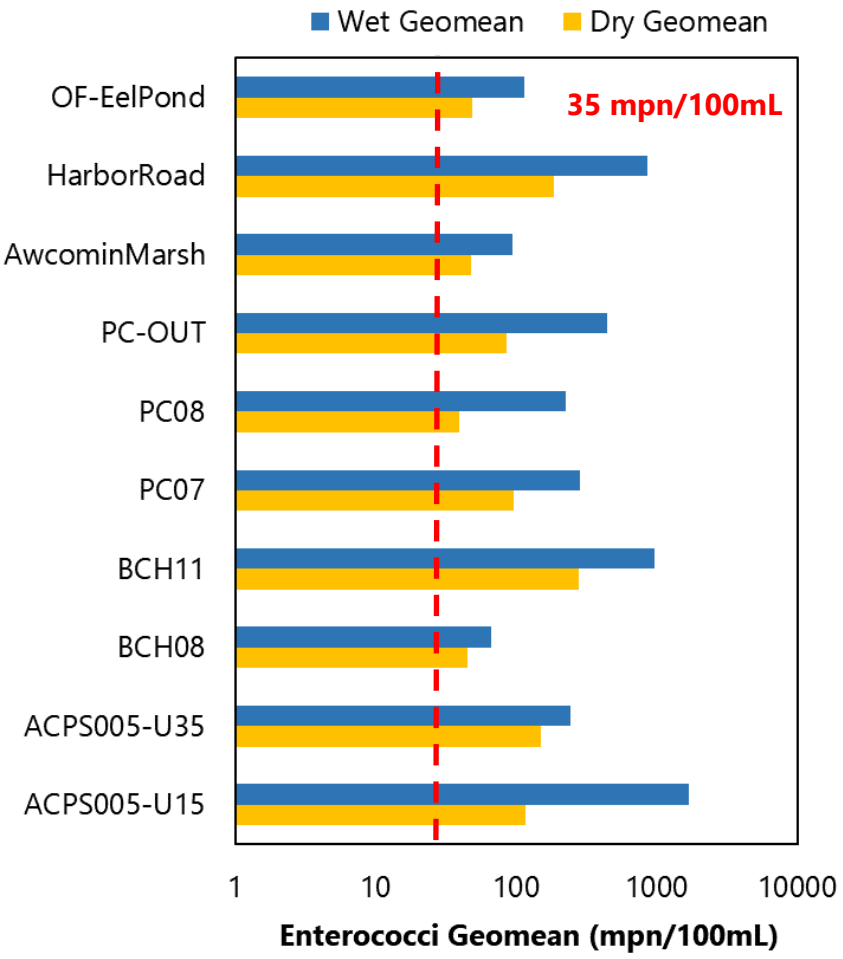
Parsons Creek Watershed

2017 WET/DRY WEATHER ANALYSIS

Similar to historical patterns, wet weather in 2017 generated higher counts of FIB (Enterococci) in surface waters compared to dry weather conditions (though the geometric mean was exceeded during both wet and dry weather at all sites), suggesting that the sources of fecal contamination are coming off the landscape as surface runoff (i.e., stormwater). However, during significant rain events (several inches), the water table may rise and intercept leachfields, which flush out to nearby waterbodies. BCH11, PC-OUT, and HarborRoad showed the greatest differences between FIB counts during wet and dry weather.

Historically and in 2017, FIB counts have exceeded state criteria during both wet and dry weather conditions, suggesting that both stormwater runoff and groundwater are significant sources of contamination to Parsons Creek and the beach. The low-lying topography and high groundwater table in the watershed make leachfields susceptible to malfunction, which is likely the primary source of fecal contamination in the watershed and at the beaches.

Eroded banks at Parsons Creek outlet after storm event in 2017. Photo Credit: FBE.



HarborRoad following large storm event on 7/25/2017. Photo Credit: FBE.

SUMMARY

Snapshot of Results

Overall, the Town of Rye, the NHDES Beaches Program, the NHDES Watershed Assistance Section, the NH Shellfish Program, FB Environmental Associates, the Jackson Laboratory, and Environmental Canine Services have done a considerable amount of work to track sources of fecal contamination in the Parsons Creek watershed and along the beach. This work has generated a long-term dataset for analysis and interpretation for determining next steps in dealing with this issue. A summary of results is provided below.

Beach Results

⇒ Elevated FIB counts were measured at the beach following a storm event on 7/25/2017; this led to a two-day beach advisory—the first ever for Wallis Sands State Beach and the first in three years for Wallis Beach. Elevated FIB counts were also reflected in watershed monitoring results following the same storm event and may be the source of elevated FIB counts at the beach. This demonstrates the critical connection between Parsons Creek water quality and protection of public health at the beach.

Watershed Results

⇒ Elevated FIB counts continue to be measured throughout the watershed, particularly in the upstream headwater areas around BCH11 and PC08. Historical canine investigations showed that human fecal contamination is a diffuse problem throughout the watershed due to the area's low-lying topography and high groundwater table that likely intercept leachfields on a regular basis. Even if a high water table is not the issue, sandy soils would allow for fast percolation rates of contaminated leachfield water to groundwater and ultimately surface waters without adequate treatment of pathogens.

⇒ As part of the new health regulation, several septic systems near or contributing to the area around these hotspot sites have been found to be malfunctioning and possibly contributing to human fecal contamination in Parsons Creek.

⇒ Low FIB counts at BCH08 support the theory that BCH08 is impacted largely by wildlife, not human sources.

Storm Event Monitoring

⇒ Elevated FIB, ammonia, nitrate, and phosphate concentrations at BCH11 suggest that human fecal contamination is very likely. The Town has identified failing septic systems within the drainage to BCH11.

Wet/Dry Weather Analysis

⇒ Historically and in 2017, fecal contamination was elevated during both wet and dry weather conditions, suggesting that both stormwater runoff and groundwater are significant sources of contamination to Parsons Creek and the beach.

TAKE HOME

The low-lying topography and high groundwater table in the Parsons Creek watershed make septic system leachfields susceptible to malfunction, which is likely the primary source of fecal contamination in the watershed and at the beaches.

NEXT STEPS

Recommendations and Priorities

Address groundwater sources of fecal contamination

- ⇒ Update the septic system database on a regular basis.
- ⇒ Continue to enforce the septic system health regulation that requires pump-outs every 3 years.
- ⇒ Continue evaluation of individual properties for septic system functioning near hotspots.
- ⇒ Consider incorporating stricter guidelines for septic system replacement or installation to town ordinances.
- ⇒ Consider groundwater study of homes near beach seeps at the outlet and along the marsh edges to determine proper septic system functioning.

Address surface runoff sources of fecal contamination

- ⇒ Continue to locate candidate sites for BMP implementation to address stormwater runoff.
- ⇒ Continue to secure funding that implements these candidate BMP sites.
- ⇒ Continue to track and monitor existing BMP conditions and fix or improve sites as necessary.
- ⇒ Maintain installed pet waste signs.

Enhance public outreach program

- ⇒ Post and maintain a wet-weather advisory at the beach.
- ⇒ Continue to distribute educational materials and reports to the public via the Town's website.
- ⇒ Continue to educate homeowners on proper disposal of pet waste and maintenance of septic systems.
- ⇒ Continue regular meetings with the Parsons Creek Water Quality Committee.

Continue monitoring program

- ⇒ Continue water quality sampling throughout the Parsons Creek watershed under varying weather conditions to track changes in FIB over time, especially as failing septic systems are replaced.
- ⇒ Continue to measure co-indicators along with FIB to better pinpoint human sources of fecal contamination. Co-indicators include optical brighteners and inorganic nutrients present in human wastewater.
- ⇒ Consider updating the 2011 Parsons Creek Watershed Management Plan.

APPENDIX A

2017 NHDES Winter-Spring Data

Site ID	Date	E. coli (cfu/100mL)	Enterococci (col/100mL)
PC08	12/22/2016	10	10
BCH08	12/22/2016	10	5
PC09	12/22/2016	20	52
BCH10B	12/22/2016	10	5
PC07	12/22/2016	90	10
BCH10	12/22/2016	100	5
BCH10A	12/22/2016	20	5
BCH10	01/19/2017	75	10
PC09	01/19/2017	13	10
PC08	01/19/2017	10	41
PC07	01/19/2017	65	10
BCH11	01/19/2017	12	41
PC OUT	01/19/2017	36	31
PC OUT	02/17/2017	41	31
BCH10B	03/29/2017	310	41
BCH10	03/29/2017	210	20
BCH10A	03/29/2017	10	20
PC08	03/29/2017	10	98
PC09	03/29/2017	10	*459*
PC07	03/29/2017	80	20
BCH11	03/29/2017	10	*146*
PC OUT	03/29/2017	10	*134*
BCH10	04/17/2017	10	10
BCH10B	04/17/2017	10	10
BCH10A	04/17/2017	10	10
PC09	04/17/2017	10	10
PC08	04/17/2017	10	10
PC07	04/17/2017	10	10
BCH11	04/17/2017	10	10
PC OUT	04/17/2017	10	41
PC OUT	06/27/2017	110	52
PC07	06/27/2017	50	*173*
BCH09	06/27/2017	10	10
BCH10	06/27/2017	*610*	62
BCH10A	06/27/2017	310	20
BCH10B	06/27/2017	30	10

APPENDIX A

2017 NHDES Winter-Spring Data

Site ID	Date	E. coli (cfu/100mL)	Enterococci (col/100mL)
PC09	06/27/2017	60	74
PC08	06/27/2017	70	74
BCH10	05/16/2017	20	10
BCH10A	05/16/2017	2	10
BCH10B	05/16/2017	8	10
PC09	05/16/2017	90	41
PC08	05/16/2017	5	10
PC07	05/16/2017	20	10
PC OUT	05/16/2017	31	20

Bold and italicized red text indicates exceedance of the state criterion for individual E.coli (406 cfu/100mL) and Enterococci (104 col/100mL) samples.

APPENDIX A

2017 Watershed Data

Site ID	Date	Weather	Water Temp (°C)	DO (%)	DO (ppm)	Spec Cond (µS/cm)	Salinity (ppt)	Enterococci (mpn/100mL)
OF-EelPond	6/26/2017	dry	21.9	76.6	6.7	1,046	0.6	20
HarborRoad	6/26/2017	dry	16.8	87.0	8.4	32,700	24.7	*389*
AwcominMarsh	6/26/2017	dry	16.6	85.4	8.3	36,500	26.8	*110*
PC-OUT	6/26/2017	dry	15.2	*67.8*	6.8	35,750	28.4	52
ACPS005-U35	6/26/2017	dry	20.1	*6.1*	*0.6*	312	0.2	*108*
BCH11	6/26/2017	dry	18.9	*34.3*	*2.9*	33,200	23.9	*1,120*
BCH08	6/26/2017	dry	24.4	110.4	9.2	23,970	14.7	52
PC07	6/26/2017	dry	19.3	*45.5*	*4.2*	31,840	22.6	*185*
PC08	6/26/2017	dry	22.4	*50.1*	*4.5*	31,650		*146*
OF-EelPond	7/25/2017	wet	17.1	764.3	53.7	1,476	0.9	*120*
HarborRoad	7/25/2017	wet	16.2	*69.6*	6.8	28,470	21.6	*1,660*
AwcominMarsh	7/25/2017	wet	16.3	80.9	8.0	34,360	26.5	*313*
PC-OUT	7/25/2017	wet	16.2	*55.1*	5.5	36,570	28.4	*299*
ACPS005-U35	7/25/2017	wet	17.8	*7.3*	*0.7*	454	0.3	*1,010*
BCH11	7/25/2017	wet	16.8	*26.3*	*2.6*	30,640	23.0	*2,600*
PC07	7/25/2017	wet	17.3	*17.5*	*1.7*	34,450	25.9	*323*
PC08	7/25/2017	wet	16.8	*18.1*	*1.8*	34,180	26.0	*1,470*
BCH08	7/25/2017	wet	18.6	79.3	7.5	12,680	8.4	63
OF-EelPond	7/28/2017	dry	24.3			1,849	1.0	*187*
HarborRoad	7/28/2017	dry	25.2			39,430	25.2	30
AwcominMarsh	7/28/2017	dry	22.8			44,620	30.0	10
PC-OUT	7/28/2017	dry	24.1			40,290	26.2	10
ACPS005-U35	7/28/2017	dry	19.7			334	0.2	*250*
BCH11	7/28/2017	dry	21.2				26.2	*211*
BCH08	7/28/2017	dry	29.9			27,470	15.2	10
PC07	7/28/2017	dry	26.3			32,170	19.5	*<10*
PC08	7/28/2017	dry	26.5			30,280	18.1	20
OF-EelPond	8/24/2017	wet	22.5	*51.4*	*4.4*	4,334	2.5	*201*
HarborRoad	8/24/2017	wet	17.6	90.8	7.8	29,360	22.3	*350*
AwcominMarsh	8/24/2017	wet	17.4	84.5	6.7	40,200	30.7	31
PC-OUT	8/24/2017	wet	18.1	86.6	6.9	37,500	27.9	*121*
ACPS005-U35	8/24/2017	wet	19.8	*11.1*	*1.0*	480	0.3	*145*
BCH11	8/24/2017	wet	21.3	*30.3*	*2.3*	38,950	27.0	*465*
BCH08	8/24/2017	wet	24.1	*73.6*	5.8	20,620	12.6	20
PC07	8/24/2017	wet	23.1	*68.2*	5.2	35,150	23.3	86
PC08	8/24/2017	wet	21.0	*67.7*	6.3	27,850	17.6	31
PC-OUT	9/21/2017	dry	17.9	*63.0*	*4.9*	38,250	28.7	*388*
OF-EelPond	9/21/2017	dry	19.2	80.0	7.3	996	0.6	31
AwcominMarsh	9/21/2017	dry	17.4	*70.4*	5.6	39,150	30.8	97

APPENDIX A

2017 Watershed Data

Site ID	Date	Weather	Water Temp (°C)	DO (%)	DO (ppm)	Spec Cond (µS/cm)	Salinity (ppt)	Enterococci (mpn/100mL)
HarborRoad	9/21/2017	dry	17.9	*71.1*	5.7	35,900	26.6	*529*
ACPS005-U35	9/21/2017	dry	18.8	*5.5*	*0.5*	371	0.0	*350*
BCH11	9/21/2017	dry	19.2	*9.5*	*0.7*	38,400	28.0	*573*
BCH08	9/21/2017	dry	18.5	*66.2*	5.7	38,900	30.0	*146*
PC08	9/21/2017	dry	17.6	*35.5*	*3.0*	39,950	31.1	10
PC07	9/21/2017	dry	17.1	*61.9*	6.5	34,400	25.9	*110*
OF-EelPond	10/10/2017	wet	19.2	*74.2*	6.9	1,270	0.6	62
HarborRoad	10/10/2017	wet	17.6	87.0	8.3	27,500	17.0	*1,090*
AwcominMarsh	10/10/2017	wet	16.9	*73.0*	7.1	44,580	28.9	86
PC-OUT	10/10/2017	wet	17.8	*51.0*	*4.9*	39,200	25.0	*233*
ACPS005-U35	10/10/2017	wet	17.8	*7.1*	*0.7*	365	0.2	96
BCH11	10/10/2017	wet	18.5	*5.5*	*0.5*	32,780	20.6	*373*
BCH08	10/10/2017	wet	19.5	*46.0*	*4.1*	13,550	7.8	10
PC07	10/10/2017	wet	18.2	*68.0*	6.5	18,370	10.9	*246*
PC08	10/10/2017	wet	21.0	*64.5*	5.8	34,010	21.4	*121*

Bold and italicized red text indicates exceedance of the state criterion for individual Enterococci samples (104 col/100mL).

APPENDIX A

2017 Storm Event Data

Site ID	Date	Weather	Water Temp (° C)	DO (%)	DO (ppm)	Spec Cond (µS/cm)	Salinity (ppt)	Enterococci (mpn/100mL)	Ammonia (ppm)	Nitrate (ppm)	Phosphate (ppb)
PC-OUT	9/5/2017	pre-storm	15.7	79.6	6.7	29,720	22.9	97	0.25	0.16	241
WIL-CUL	9/5/2017	pre-storm	18.9	***39.8***	***3.5***	22,800	15.7	***163***	0.25		
ACPS005-U15	9/5/2017	pre-storm	16.4	84.5	8.3	682	0.4	***216***	0.25	0.16	15
ACPS005-U35	9/5/2017	pre-storm	17.1	***9.7***	***0.9***	272	0.2	52	0.25		
BCH26	9/5/2017	pre-storm	17.5	***41.8***	***4.0***	29,630	21.8	***156***	0.25		
BCH26A	9/5/2017	pre-storm	17.4	***61.0***	5.7	34,690	26.0	***253***	0.25		
PC10	9/5/2017	pre-storm	18.6	***56.0***	5.3	28,830	20.6	***109***	0.25		
BCH11	9/5/2017	pre-storm	19.8	***2.7***	***0.2***	30,530	21.2	51	0.25	0.14	87
BCH08	9/5/2017	pre-storm	21.8	***40.0***	***3.4***	20,300	13.0	52	0.50	0.14	40
PC08	9/5/2017	pre-storm	19.2	***59.7***	5.7	27,060	19.0	41	0.00	0.16	363
PC07	9/5/2017	pre-storm	18.9	***61.1***	5.1	13,170	8.7	***108***	0.50	0.22	36
BCH10	9/5/2017	pre-storm	18.0	***57.7***	5.7	739	0.4	***121***	0.50		
PC-0UT	9/6/2017	pre-storm	16.4	***55.0***	***4.6***	34,520	26.1	***295***	***1.00***	0.17	27
ACPS005-U15	9/6/2017	pre-storm	17.5	***65.8***	6.3	1,369	0.8	75	***3.00***	0.17	56
BCH11	9/6/2017	pre-storm	19.2	***2.2***	***0.2***	32,590	24.4	***826***	***1.00***	0.14	129
BCH08	9/6/2017	pre-storm	20.8	***29.9***	***2.5***	28,620	19.3	52	0.50	0.14	46
PC08	9/6/2017	pre-storm	18.5	***6.1***	***0.5***	30,610	22.0	74	***1.00***	0.14	95
PC07	9/6/2017	pre-storm	18.7	***51.8***	***4.5***	22,100	15.0	***121***	0.50	0.16	47
PC-OUT	9/7/2017	storm	16.3	***68.9***	5.5	20,780	12.4	***4,611***	0.25	0.15	67
ACPS005-U15	9/7/2017	storm	16.2	84.4	8.3	402	0.2	***3,873***	0.25	0.15	57
BCH11	9/7/2017	storm	18.4	***34.4***	***2.7***	26,300	20.2	***17,329***	0.25	0.15	61
BCH08	9/7/2017	storm	17.8	99.0	9.0	9,200	6.1	***538***	0.00	0.13	29
PC08	9/7/2017	storm	17.1	***26.0***	***2.4***	9,870	6.6	***1,989***	0.25	0.15	87
PC07	9/7/2017	storm	16.3	***65.3***	6.6	1,465	0.9	***3,448***	0.25	0.20	43
PC-OUT	9/8/2017	storm	15.1	***58.0***	5.2	22,600	17.3	***457***	0.25	0.14	45
ACPS005-U15	9/8/2017	storm	15.1	81.2	8.2	398	0.2	***743***	0.50	0.14	52
BCH11	9/8/2017	storm	18.3	***10.0***	***0.8***	23,370	16.5	***110***	***3.00***	0.14	165
BCH08	9/8/2017	storm	19.7	***64.4***	5.7	8,520	5.3	***185***	0.25	0.14	26
PC07	9/8/2017	storm	17.3	***73.1***	7.1	4,980	3.2	75	0.25	0.21	25
PC08	9/8/2017	storm	18.6	***43.8***	***3.9***	9,420	6.2	52	0.25	0.14	42
PC-OUT	9/11/2017	post-storm	16.7	110.0	9.9	28,350	16.7	63	0.25	0.17	28
ACPS005-U15	9/11/2017	post-storm	14.9	99.4	10.1	397	0.2	97	0.25	0.17	17
BCH11	9/11/2017	post-storm	19.5	***17.0***	***1.2***	24,640	16.9	86	0.50	0.15	186
BCH08	9/11/2017	post-storm	19.8	86.1	7.7	5,220	3.2	41	0.25	0.18	23
PC08	9/11/2017	post-storm	18.6	***30.0***	***2.5***	11,770	7.8	***<10***	0.25	0.17	120
PC07	9/11/2017	post-storm	19.2	83.3	7.5	10,280	6.6	31	0.25	0.26	22

Bold and italicized red text indicates exceedance of the state criterion for individual Enterococci samples (104 col/100mL).

APPENDIX B

Summary of Methods

SAMPLING PROTOCOL

Sampling was performed as documented in the *NHDES Generic Beach Program Quality Assurance Project Plan* dated April 3, 2012, RFA # 06193, Section B2.0. Samples were collected in labeled whirlpak bags and stored on ice in a cooler for transport to Nelson Analytical Laboratory in Kennebunk, ME for analysis of Enterococci. Samples for nitrate and phosphate were collected in 60 mL HDPE bottles and stored on ice in a cooler for transport to the University of New Hampshire Water Quality Analysis Laboratory in Durham, NH. Water quality parameters (DO, temperature, salinity, and specific conductivity) were collected in the field using calibrated instruments: YSI PrODO and YSI 30. Optical brighteners were measured using a handheld Aquaflor fluorometer, based on methods described in SOP 3.4.1.4 *Measuring Optic Brighteners in Ambient Water Samples Using a Fluorometer*, by Erick Burres, dated March 2011. Ammonia was measured using ammonia test strips.

WET/DRY WEATHER CLASSIFICATION

Wet weather was determined as: >0.1" of precipitation in the prior 24 hours; or >0.25" in the prior 48 hours; or >2.0" in the prior 96 hours. Conditions were considered dry weather when precipitation was <0.1" for each day within 72 hours.

STATISTICAL METHODS

A Mann-Kendall trend analysis was performed for beach sites with at least 10 years of data. The Mann-Kendall Trend Test is a non-parametric statistical test that determines if the central value (median) of a dataset has changed over time. A non-parametric test is appropriate here because it does not make assumptions about the normality or variability of the dataset; variation seen year-to-year or within seasons will not influence the results of non-parametric analysis the way that parametric tests can be influenced.

DATA INTERPRETATION – WATER QUALITY STANDARDS

The NHDES Consolidated Assessment Listing Methodology (CALM) describes the process and water quality standards used to assess the state's waters. This information is used to help interpret Parsons Creek water quality results and relate it to state criteria. https://www.des.nh.gov/organization/divisions/water/wmb/swqa/2014/documents/r-wd-15-9.pdf