MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

Bacterial Monitoring Results for Michigan Rivers and Streams: 2017

1 Introduction

Staff from the Michigan Department of Environmental Quality (MDEQ), Water Resources Division (WRD), and its contractors collected samples from 67 sites on rivers and streams throughout the Lower Peninsula of Michigan, and 3 sites in the Upper Peninsula (Figure 1). Samples from these sites were analyzed for *E. coli* on a weekly basis, for 5-6 weeks, and results are shown in Appendix 1. Site locations are described in Table 1. Monitoring objectives are as follows:

1. Assess the current status and condition of individual waters of the state and determine whether the Total Body Contact (TBC) and Partial Body Contact (PBC) Designated Uses are being met. Michigan is committed to assessing the waters of the state to determine the attainment status of the designated uses. All data were considered in the upcoming 2020 Clean Water Act Sections 303(d) and 305(b) list.
2. Obtain screening level dissolved oxygen (D.O.) measurements in the Maple, Pine, and Chippewa Rivers watersheds.
3. Conduct microbial source tracking in impaired priority waters.

2 *Water Quality Standards (WQS)*

2.1 E. coli

Michigan's designated use rule states that all water bodies shall be protected for TBC recreation from May 1 through October 31 and PBC recreation year-round (Rule 100 [R 323.1100] of the Part 4 Rules, WQS, promulgated pursuant to Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended). To maintain these designated uses, Michigan has established ambient *E. coli* WQS in Rule 62 of the Part 4 Rules.

E. coli is a type of bacteria (single cell organism) that is used as an indicator of the presence of fecal contamination in surface water, such as lakes, streams, and wetlands. Ensuring that waters meet the *E. coli* WQS also ensures that other disease-causing microorganisms (pathogens) are kept below harmful levels. Pathogens in a stream or lake can infect humans through ingestion or skin contact, resulting in diseases such as gastroenteritis, giardia, hepatitis, or cholera.

The WQS of 130 *E. coli* per 100 milliliters (mL) as a 30-day geometric mean, and 300 *E. coli* per 100 mL as a daily maximum are established to protect the TBC use from May 1 through October 31. To protect the PBC use (year-round), 1,000 *E. coli* per 100 mL as a daily maximum is used.

2.2 D.O.

D.O. minimum WQS are described in R 323.1064 of the Part 4 Rules and rely upon the coldwater and warmwater fishery designations set forth in the 1997 Michigan Department of Natural Resources Directors Order DFI-101.97 (MDNR, 1997). In surface waters of the state designated to protect coldwater fish, the D.O. shall not fall below a minimum of 7 millligrams per liter (mg/L). In the remainder of streams, the WQS is a minimum of 5 mg/L, to protect warmwater fish species. D.O. results (with violations of the minimum WQS highlighted) and the coldwater or warmwater designations are found in Table 2. D.O. is lowest before sunrise because plants and microorganisms respire (and do not photosynthesize) throughout the night using up oxygen. Photosynthesis begins at sunrise releasing and replenishing oxygen.

3 **Interpretation of *E. coli* Results**

Many environmental factors may affect the concentrations of *E. coli* in surface water, including: precipitation, flow, settling of *E. coli* through the water column (such as in a lake or impoundment), and the dying off of *E. coli* due to the passage of time or exposure to sunlight, proximity to sources, etc. In trying to determine sources of *E. coli* to a sampling site, it is helpful to look at results in the context of precipitation prior to sampling (shown in Appendix 1). When *E. coli* concentrations are high regardless of the weather conditions, the sources may be different from a location where *E. coli* is only high following rainfall. The results in Appendix 1 are color-coded to indicate TBC and PBC WQS exceedances.

Dry weather exceedances, or exceedances during low flows, indicate a constant source of *E. coli* is impacting the site, such as failing septic systems, illicit sanitary connections, livestock or wildlife congregating in the water, or shallow groundwater contamination.

Wet weather exceedances, or exceedances during high flows, indicate that the source is flushed during precipitation events, such as urban or rural storm water, runoff from agricultural fields or pastures, illicit sanitary connections to storm drains or field tiles, accumulated waste (animal or human) in storm drains on the ground surface, or pet or wildlife waste on lawns or parks.

4 **Sampling Methods**

4.1 *E. coli*

Each *E. coli* sampling event consisted of 3 samples taken at representative locations within a defined sampling area. In a flowing water body, these locations are referred to as left, right, and center. The center sample was collected in the spatial center of the stream, the right sample was collected midway between the center and the right bank, and the left sample was collected midway between the center location and the left bank. Care was taken to ensure that all samples were collected in the moving portion of the stream, avoiding stagnant areas near the banks, debris dams, or pilings. Samples were collected directly from the stream, just below the surface, into sterile wide-mouthed polypropylene bottles. Collection occurred using a sampler lowered from the bridge by a rope or by wading in and sampling upstream of the body. Care was exercised to avoid the surface microlayer of water and bottom sediment layer, both of which may be enriched in bacteria and not representative of the water column. Samples were not collected if the flow of the stream had become stagnant throughout the width of the channel. Clean latex gloves were worn and replaced after sample collection at each site.

Field blanks were collected at a rate of 5 percent, by filling a sample bottle with deionized water. Duplicates were collected at a rate of 10 percent (1 duplicate every 10 samples). Duplicates were taken by collecting a larger volume of sample and pouring alternately between the sample bottle and the duplicate bottle. A minimum of 1 duplicate and 1 blank were collected per sampling date. Samples were submitted to the MDEQ, Drinking Water Laboratory (DWL). Chain of custody was maintained at all times and 6-hour bacterial hold times were met.

Precipitation data for the 24-hours and 48-hours prior to each sampling event are recorded in Appendix 1, and graphed in Appendix 2, and were obtained from nearby weather stations (Michigan State University (MSU) Extension, 2018; Weather Underground, 2018). Where possible, the relative water level was determined at each sampling event by measuring the distance in centimeters from a set point on the bridge or culvert to the surface of the river using a weighted metal tape (Appendix 3).

4.2 D.O.

Instantaneous D.O. and temperature measurements were recorded weekly during *E. coli* sample collection using a YSI EXO Multiparameter Water Quality Sonde. The sonde was calibrated weekly following the manufacturer's instructions. When violations of the D.O. WQS were recorded in the field, or the D.O. seemed abnormally high (above 10 mg/L), the sonde was recalibrated on site and the measurement was verified. The D.O. measurements collected during this study were collected between 8 a.m. and 12 p.m., thereby missing the most critical time for D.O. depletion (just prior to sunrise).

4.3 Microbial Source Tracking

For the Pine River source tracking study, a large sample volume (250 mL) was collected from the left, center, and right portions of the stream. Of each sample, 100 mL was sent to the MDEQ-DWL and the remaining volume was composited and sent to Saginaw Valley State University (SVSU). For the Flint study, a large volume was collected from the center location and split between the MDEQ-DWL and Helix Biolabs. For the Maple River study, 3 large volumes (1 Liter) were collected from each site, split between the MSU lab and the MDEQ-DWL. Upon receipt by the respective Microbial Source Tracking lab, the samples were filtered and frozen according to each lab's standard operating procedures. Chain of custody was maintained at all times.

5 **Quality Control**

5.1 Goals

The goals for quality assurance and quality control for sampling are as follows:

- Blanks – Field blanks should not contain detectable levels of *E. coli*. The detection level for *E. coli* in surface water is <10 *E. coli* per 100 mL.

- Duplicates - The results of duplicate analyses should be used to calculate a relative percent difference (RPD) between the samples. The target for the RPD is ≤35 percent, and data falling outside of this RPD should be flagged; however, *E. coli* is a highly variable parameter and data should not be discarded based solely on a high RPD. *E. coli* forms clumps and also adheres to suspended sediment, making the concentration of *E. coli* heterogeneous in rivers where water is constantly moving and is sometimes turbid. If both the sample and the duplicate fall within 0-299 *E. coli* per 100 mL (attainment with the TBC WQS), or conversely, both samples are more than 300 *E. coli*

per 100 mL (nonattainment with the TBC WQS), then the data are considered acceptable. When the RPD is >35 percent, and the samples indicate a split between attainment and nonattainment, the results were flagged.

5.2 Quality Control Results

The results for quality assurance and quality control in this study were as follows:

- Blanks – All field blanks contained less than 10 *E. coli* per 100 ml (reporting level).
- Duplicates - Of the 109 samples randomly selected for duplicate sample collection, 30 of the *E. coli* sample/duplicate sets (27 percent) had an RPD greater than 35 percent due to the highly heterogeneous nature of *E. coli* in water. Of these, the variation in 25 sets was considered acceptable because both the sample and duplicate were in the same regulatory category (either both met the 300 *E. coli* per 100 mL threshold, or both exceeded it). The *E. coli* variation did not meet the quality control goals in Section 5.1 for 5 duplicates collected at the following sites/dates: 370165 (July 5, 2017); 580442 (July 11, 2017); 580618 (July 13, 2017); 290185 (September 14, 2017); and 631202 (October 2, 2017). Samples collected on July 5, July 13, September 14, and October 2, 2017, were represented by at least 1 other acceptable duplicate set that did meet the quality assurance/quality control goals. No *E. coli* was detected in the field blanks on any of these dates, thus the variation is not thought to be from contamination resulting from equipment or methods; but rather the variation is likely a result of the heterogeneous nature of bacteria in flowing rivers. Two of these duplicates were collected on dates (July 11 and July 13, 2017), where significant rain had occurred within the prior 24-hours, potentially leading to increased particulate matter in the sample/duplicates.

6 **Conclusions**

6.1 Monitoring Objective 1

Most of the sampling sites exceeded either (or both) the daily maximum or the 30-day geometric mean TBC WQS, at least once (Appendix 1). The 6 exceptions, which met all applicable *E. coli* WQS were the Flint River at East Carpenter Road (250098); Kearsley Creek at Dutch Road (250545); South Ore Creek at Hamburg Road (470475); Swan Creek at Dixie Highway (580049); West Branch Chippewa River at 19-Mile Road (540156); and South Pine River at Brinton Road (370146). In addition, 4 sites exceeded only the 30-day geometric mean TBC WQS, and not the daily maximum TBC WQS, indicating fairly good water quality when compared with other sites in this study (Black Creek at Irish Road [250030], Stony Creek at West Taft Road [190203], South Branch White River at Baldwin Avenue [620307], and Chippewa River at West Vernon Road [370100]).

Several sites in this study had *E. coli* concentrations that consistently exceeded the PBC WQS, and thus are of particular concern: Stony Creek at Lowell Road (190157) in the Maple River watershed; Brayton Creek at Cleveland Road in the White River watershed; and several sites in the Ottawa-Stony Creeks watershed (Tributaries to Swan and Sandy Creeks). These PBC exceedances occurred during all weather and flow conditions sampled (Appendices 2 and 3). This indicates a serious and persistent contamination issue due to illicit connections, failing septic systems, contaminated groundwater, or livestock with direct access to the water. Preliminary remote sensing in these areas did not identify any obvious signs of livestock with direct access to these water bodies.

Water levels relative to a fixed point (relative water levels) were measured at most sites, shown in Appendix 2. *E. coli* at some sites appeared to be related to water level, while at the majority of the sites the relationship between water level and *E. coli* concentration was not clear (Appendix 3). Water levels were very stable at most sites during the Maple River and White River studies, so no water level relationships could be discerned (these are not shown in Appendix 3).

E. coli concentrations had a positive relationship with increased water levels (increased as the water level increased) at sites on the Remey-Chandler Drain (190148), Flint River (250547 and 250098), Swan Creek (580049 and 580617), Little Swan Creek (580616), Stony Creek (580409), Ely Creek (290224), and the Chippewa River (370100). This indicates that high flow issues are impacting these sites, such as urban storm water or tiles and ditches flowing during times of high water table.

Conversely, *E. coli* concentrations had a negative relationship with decreased water levels (increased with decreasing water level) at sites 370164 (Tributary to the Pine River-Coe Road), and 470475 (South Ore Creek), indicating dominant impacts from dry weather and low flow sources such as illicit connections, failing septic systems, or livestock with direct access to the water body. The South Ore Creek site showed this relationship but did not exceed the WQS during this study.

6.2 Monitoring Objective 2

D.O. met the applicable minimum WQS at most monitored sites (Table 2); however, because these events were instantaneous readings, it cannot be determined if the designated use is being met. Warmwater designated sites that violated the minimum WQS include the South Branch Pine River (370146) with 3 of 3 monitoring events resulting in violations of the WQS, and D.O. as low as 1.74 mg/L recorded well after sunrise. Warmwater sites in the Tributary to the Pine River (at Coe Road), Bass Lake Drain and Ely Creek, also periodically violated the minimum D.O. WQS. Coldwater designated sites that violated the minimum WQS were the North Branch Pine River (290220), Pine River at McBride Road (590364), and Pony Creek (370105). Because these measurements were not collected prior to sunrise, during the time that is generally critical for low D.O., it is recommended that continuous D.O. studies be conducted at these sites, by either the MDEQ or another organization, as resources allow.

6.3 Monitoring Objective 3

To assist in determining the sources of *E. coli* to water bodies, Microbial Source Tracking analysis was conducted for selected sites and projects (Maple, Flint and Pine Rivers). The presence of a host-specific genetic source tracking marker (either human or bovine), indicates the presence of a potential source of that type present in the sample. Quantitative polymerase chain reaction (qPCR) or two end-point PCR (resulting in a detect vs a non-detect) was used. Because of the different methods, results from SVSU, MSU and Helix are presented separately. There are a few considerations when interpreting Microbial Source Tracking data, as follows:

- Deoxyribonucleic acid (DNA), used in Microbial Source Tracking, does survive waste water treatment and composting processes. DNA may appear in the sample, while the source bacteria are dead. It is important to consider the presence of wastewater treatment facilities upstream of sites, which would not contribute significantly to live *E. coli* (if in compliance with their permit) but could contribute human Microbial Source Tracking markers.
- The Microbial Source Tracking genetic targets are based on host-specific *Bacteroides* bacteria, which are very different from *E. coli*.

- DNA degrades over time, once the host cell is dead. The decay occurs at variable rates due to many factors, including: the taxa of the Microbial Source Tracking target; sunlight; substrate where the bacteria are residing (water vs. sediment); and ambient temperature (Murphy, 2018). The detection of a marker with a short persistence time indicates more recent pollution by the host animal.
- A non-detect result does not rule out the host animal as a source in the upstream areas. Microbial Source Tracking markers may not be detected due to decomposition, dilution below detection levels, the presence of compounds in the sample which inhibit the detection using qPCR techniques (known as 'inhibition'), or the complete absence of the target marker in the sample.
- Weather at the time the sample was collected and location of known sources (such as National Pollutant Discharge Elimination System discharges) are important considerations in determining potential sources.
- Knowledge of the *E. coli* concentration at the time of sampling assists in interpreting results. Higher bacterial concentrations would be more likely to yield a positive detection, while low bacterial densities would be more likely to result in a non-detect. Additionally, if *E. coli* levels were below the daily maximum TBC WQS, the MDEQ typically chose not to analyze the source tracking samples.
- The specific markers used in the projects are varied and specified in the summaries below.

Maple River: Averaging *E. coli* results by week, across all sites, shows that *E. coli* was the highest overall during the first week of sampling when scattered rain had fallen in the previous 48-hours (Figure 2). Stony Creek at Lowell Road had the highest 30-day geometric mean of the sites in the Maple River. Samples from 3 sites in the Maple River project were submitted for analysis using digital droplet PCR techniques (Table 3). *Bacteroides thetaiotaomicron* (*B. theta*) was used as a human marker (Yampara-Iquise et al., 2008) and CowM2 as the bovine marker (Shanks et al., 2008). B. theta dies almost immediately on exposure to the environment and degrades quickly at surface water temperatures. Studies have shown that only 10 percent is detectable using qPCR after about 3 days in riverine conditions (Balleste and Blanch, 2010), and its presence therefore indicates recent contamination by treated or untreated human sewage. Results indicate recent human source contamination was prevalent at all 3 sites on the dates analyzed. Bovine marker was detected less frequently than human, at 2 of 3 sites. In Hardy-Jennings Drain, notably high levels of bovine marker were found on September 14, 2017 (a dry weather event). No point sources of either treated human sewage or bovine waste (e.g., concentrated animal feeding operations [CAFO]) are known in this watershed, thus nonpoint or illegal sources are suspected.

Flint River: Averaging *E. coli* results by week, across all sites, shows that *E. coli* was the highest overall during the fifth week of sampling when scattered rain had fallen in the previous 48-hours (Figure 3). This is most notable among the Kearsley Creek sites (including Phillips Drain), which also had the highest 30-day geometric means found in the Flint portion of this study (Figure 3). The Dutch Road site (located below an impoundment on Kearsley Creek) was the exception to this with relatively low *E. coli*. Impoundments may result in lower *E. coli* concentrations due to a variety of factors including mortality during the increased retention time, and associated exposure to sunlight (Murphy, 2018). This effect is limited during times of high flow when water is retained for a shorter period because mortality of *E. coli* is related to time spent outside of the host. Of the 3 sites located on the Flint River mainstem, the 30-day geometric means increased in the downstream direction through the city of Flint. All samples analyzed were positive for both human and bovine markers (Table 4). These are qualitative results, which are either positive or non-detect, regardless of the quantity of genetic marker in

the sample. For human host source detection, *B. theta* was used (Yampara-Iquise et al., 2008) and CF128 was used for bovine detection (Liu et al., 2012). No permitted sources of treated human sewage are located upstream of the sampled sites, indicating that any contamination would be either nonpoint source or illegal. A wastewater treatment plant had been planned for Ortonville near the Kearsley Creek at Oakwood Road (Site 631202) but construction was cancelled, and the community continues to rely on septic systems. Regarding the bovine detections, there are only small amounts of agricultural land in Gilkey Creek and Phillips Drain, and no permitted livestock facilities upstream of any of the sites in Table 4. Research has shown that the bovine marker CF128 persists for up to 14 days in surface water (Walters and Field, 2009). MDEQ staff have not done reconnaissance in these areas to confirm that nonpoint source bovines are present. The bovine marker (CF128) has been shown to be specific to bovines about 76 percent of the time, thus it is possible that these results may indicate the presence of other ruminants (such as deer, goats, or sheep) (Shanks et al., 2010).

Pine River: Samples from selected sites in the Pine River project were sent to the SVSU for filtration and qPCR analysis; however, due to inhibition present in the samples, likely caused by an unknown substance in the water column, the filters were sent to MSU for further analysis using a different method. MSU analyzed the samples with digital droplet qPCR, which is better suited to the analysis of inhibited samples because it disperses a sample to 20,000 droplets and provides a result for each droplet. This increases likelihood that a true positive detection result will be achieved. MSU confirmed that inhibition of the samples was present and the results from this study may contain more false negatives than is typical.

A false negative occurs when the target marker is not found in the sample (the result is non-detect), but the marker is present. It is not possible to know if a negative result indicates the source is absent from the sample, or if the marker is not detectable due to inhibition, decomposition, or other reason. Positive results were found despite the inhibition, and inhibition is not likely to cause false positives (an incorrect positive result); therefore, the MDEQ has confidence in the positive detection of the biomarkers but recommends caution when interpreting non-detect results.

Results of the Pine River *E. coli* study are summarized in Figure 4, and microbial source tracking study are shown in Tables 5 and 6 The MSU lab (Table 5) used *B. theta* as a human marker (described in (Yampara-Iquise et al., 2008) and CowM2 as a bovine marker (described in (Shanks et al., 2008)). The SVSU used the HF183 marker for human (Haugland et al., 2010) and BoBac as a ruminant target (Layton et al., 2006). According to Shanks et al (2010), bovine marker CowM2 is 100 percent specific to cattle, while the specificity of BoBac is around 47 percent specific to cattle. Because the results from the SVSU and MSU were generated using different techniques and biomarkers, the numeric results are not directly comparable. Conclusions are summarized for both labs as follows:

- Bovine/ruminant markers were found at Pony Creek (370105), Wolf Creek (370166), Cedar Creek (590348), Bass Lake Drain (290221), Pine River at Walton Road (540115), and the tributary to the Pine River at Coe Road (370164) (Table 5). There are no bovine CAFOs or CAFO land-application fields upstream of these sites; therefore, nonpoint source livestock agriculture is a likely source contributing to the bovine marker and high *E. coli*. The vast majority of these occurrences were during dry weather; only the Bass Lake Drain sample was collected following wet weather. All 5 dry weather samples for Cedar Creek (590348) contained the bovine marker, indicating a persistent source of bovine contamination such as direct animal access or an agricultural illicit discharge (Table 5). Cedar Creek also had the highest 30-day geometric mean *E. coli* of any site in this project (Figure 4).

- Bovine/ruminant markers were also found at sites on Honeyoey Creek (290222) during wet weather (Table 5), and Ely Creek (290224) and Coles Creek (290223) during dry weather (Table 6). Bovine CAFO land-application fields are located upstream of these sites, making the CAFO facilities a potential source, in addition to the nonpoint source agriculture in these watersheds. These facilities will be inspected by the MDEQ in the future, as previously scheduled, with these results in mind.
- Human markers were found during dry conditions at Thatcher Creek (370165), Pony Creek (370105), Coles Creek (290223), Ely Creek (290224), Cedar Creek (590348), Pine River at West Walton Road (540115), and Tributary to the Pine River at Coe Road (370164) (Tables 5 and 6). Following rainfall, the human marker was found in Bass Lake Drain (290221) (Table 5). The human marker was found less frequently than the bovine marker, overall. Of these sites, Pony Creek and Thatcher Creek receive treated sewage seasonally (Wheatland Township Wastewater Sewage Lagoon [WWSL] and Morey Charter School WWSL). These seasonal discharges cease by the end of May, and given the rapid degradation of the *B. theta* biomarker, it is unlikely that the discharges are the source found in June. There are no permitted sanitary discharges upstream of the other sites, indicating that nonpoint sources of human sewage (failing septic systems or illicit discharges) are contributing to *E. coli* issues in these streams.
- On a weekly basis, the most detections of the bovine/ruminant markers occurred the second week of sampling (June 14 and 15), during very low water levels. The bovine/ruminant markers were detected in 6 of 9 samples collected on these dates (Tables 5 and 6, combined). Given the low water levels and dry weather at that time, direct cattle access or illicit farm connections (such as barn wash water) was the likely source. Averaging the *E. coli* results across all sites, the second week of sampling found the highest *E. coli* concentrations, corresponding with the high frequency of bovine detections (Figure 4).

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8 References

Balleste, E. and A. R. Blanch (2010). "Persistence of Bacteroides species populations in a river as measured by molecular and culture techniques." Appl Environ Microbiol **76**(22): 7608-7616.

Haugland, R. A., M. Varma, et al. (2010). "Evaluation of genetic markers from the 16S rRNA gene V2 region for use in quantitative detection of selected Bacteroidales species and human fecal waste by qPCR." Syst Appl Microbiol **33**(6): 348-357.

Layton, A., L. McKay, et al. (2006). "Development of Bacteroides 16S rRNA gene TaqMan-based real-time PCR assays for estimation of total, human, and bovine fecal pollution in water." Appl Environ Microbiol **72**(6): 4214-4224.

Liu, R., C. Chan, et al. (2012). "Improving the performance of an end-point PCR assay commonly used for the detection of Bacteroidales pertaining to cow feces." Appl. Microbiol Biotechnol **93**(4): 1703-1713.

MDNR (1997). "Designated Trout Streams for the State of Michigan. Director's Order # DFI-101.97."

MSU Extension. (2018). "Michigan Enviro-Weather." Retrieved Januare, 2018, 2018, from http://www.enviro-weather.msu.edu/.

Murphy, H. (2018). Persistence of Pathogens in Sewage and Other Water Types. Part 4: Management of Risk from Excreta and Wastewater, Global Water Protection Project.

Shanks, O. C., E. Atikovic, et al. (2008). "Quantitative PCR for detection and enumeration of genetic markers of bovine fecal pollution." Appl Environ Microbiol **74**(3): 745-752.

Shanks, O. C., K. White, et al. (2010). "Performance assessment PCR-based assays targeting bacteroidales genetic markers of bovine fecal pollution." Applied and Environmental Microbiology **76**(5): 1359-1366.

Walters, S. P. and K. G. Field (2009). "Survival and persistence of human and ruminant-specific faecal Bacteroidales in freshwater microcosms." Environ Microbiol **11**(6): 1410-1421.

Weather Underground. (2018). "http://www.wunderground.com. KMIIRONW3 Ironwood MI US." Retrieved January, 2018, 2018.

Yampara-Iquise, H., G. Zheng, et al. (2008). "Use of a Bacteroides thetaiotaomicron-specific alpha-1-6, mannanase quantitative PCR to detect human faecal pollution in water." J Appl Microbiol **105**(5): 1686-1693.

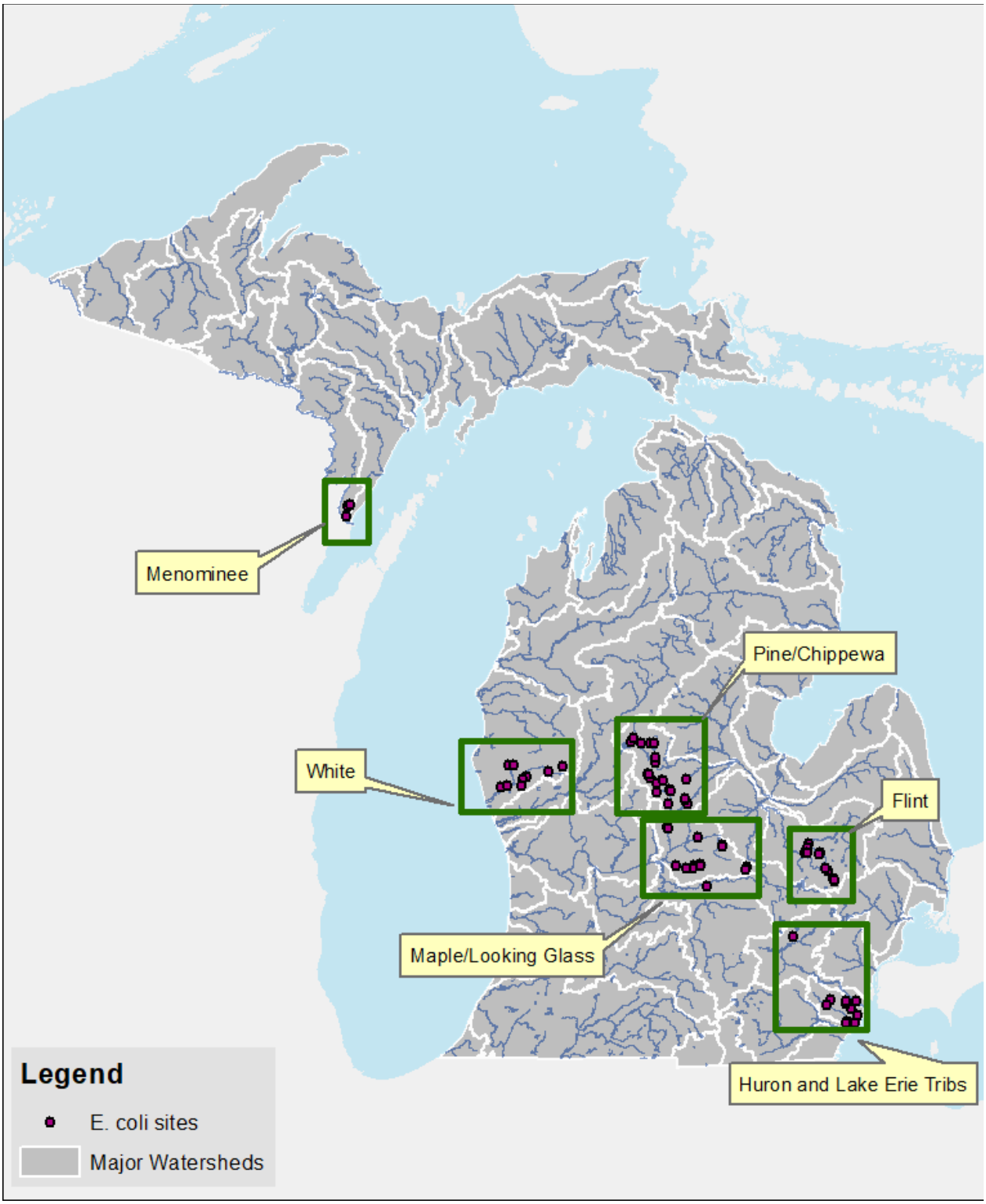


Figure 1. *E. coli* stream and river monitoring locations in Michigan, 2017.

Site Descriptions	Week 1	Week 2	Week 3	Week 4	Week 5	Site 30-Day Geometric Means
Bad Creek - S Lowell Rd	659	521	462	400	708	538
Baker Creek - Ovid St	1361	541	1364	626	510	796
Fish Creek - Condensery Rd	690	387	731	704	697	626
Fish Creek - Mt. Hope Rd	2596	547	454	367	742	706
Hardy Jennings Drain - Waugh Rd	730	475	513	433	407	501
Kloeckner and Fuller Creek - W Taft Rd	897	923	1059	876	1041	956
Maple River - Morrice Rd	806	776	1316	383	664	731
Maple River - S State Rd	623	273	188	214	259	282
Muskrat Creek - S Dexter Trl	691	701	799	428	739	657
South Branch of Baker Creek - Ovid St	374	277	257	202	437	298
Stony Creek - DeWitt Rd	1063	653	837	570	629	731
Stony Creek - Lowell Rd	1001	1538	1514	1080	1166	1240
Stony Creek - W Taft Rd	174	208	122	206	157	170
Weekly average across all sites	897	602	740	499	627	

Figure 2. Daily geometric mean *E. coli* at all Maple River sites, by week. Cells with warmer colors (red and orange) indicate *E. coli* results above the median of all data (yellow cells). Cooler colors (blues) indicate results below the median. Data are summarized by weekly averages and the 30-day geometric mean to allow spatial and temporal visualization of results.

Site Descriptions	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Site 30-Day Geometric Means
Black Creek – N Irish Rd	186	170	129	46	290		140
Duck Creek - Ortonville Rd	178	444	424	222	296		294
Flint River - E Carpenter Rd	16	91	120	39	176	132	100
Flint River - N Dort Hwy	70	77	130	79	230	371	147
Flint River - Longway Blvd	195	419	99	140	254	144	184
Gilkey Creek - Kearsley Park Blvd	663	329	146	243	242		285
Kearsley Creek - Oakwood Rd	235	650	456	196	1469		458
Kearsley Creek - Dutch Rd	102	36	70	23	116		58
Kearsley Creek - Granger Rd	186	463	1328	353	1119		538
Kearsley Creek - Green Rd	193	573	1232	318	1352		567
Kearsley Creek - Pierson Rd	597	353	98	231	915		337
Phillips Dr - Lapeer Rd	816	229		147	3774		
Weekly average across all sites	286	320	385	170	853		

Figure 3. Daily geometric mean *E. coli* at all Flint River watershed sites, by week. Cells with warmer colors (red and orange) indicate *E. coli* results above the median of all data (yellow cells). Cooler colors (blues) indicate results below the median. Data are summarized by weekly averages and the 30-day geometric mean to allow spatial and temporal visualization of results.

Site Descriptions	Week1	Week2	Week3	Week4	Week5	Site 30-Day Geometric Means
Bass Lake Drain - N Ferris Rd	692	1078	274	324	263	445
Cedar Creek - Fremont Rd	730	2138	567	466	432	708
Coles Creek - N Winans Rd	189	977	538	567	451	479
Ely Creek - N Ely Hwy	162	175	541	671	458	343
Honeyoey Creek - N Winans Rd	195	581	885	1293	626	605
N Br Pine River - W Jefferson Rd	215	19,948	282	266	263	610
Pine River - E McBrides Rd	149	1480	263	232	201	306
Pine River - W Walton Rd	149	428	513	250	292	299
Pony Creek - W Walton Rd	246	427	300	80	161	210
S Br Pine River - S Brinton Rd	104	156	71	87	56	89
Thatcher Creek - W Fremont Rd	82	116	802	346	368	249
Trib to the Pine R - Coe Rd	1405	1328	688	152	379	594
Wolf Creek - E Edgar Rd	262	714	589	153	381	364
Weekly average across all sites	352	2273	486	376	333	

Figure 4. Daily geometric mean *E. coli* at all Pine River sites, by week. Cells with warmer colors (red and orange) indicate *E. coli* results above the median of all data (yellow cells). Cooler colors (blues) indicate results below the median. Data are summarized by weekly averages and the 30-day geometric mean to allow spatial and temporal visualization of results.

Table 1. Site location information including watershed name, 10-digit hydrologic unit code (HUC), description, site ID (WQX/Storet) and weather station name (https://mawn.geo.msu.edu/).

Watershed	10-Digit HUC	Site ID	Site Description	Latitude	Longitude	Weather Station
Flint	0408020404	250030	Black Cr - N Irish Rd	43.02429	-83.55600	Flint
	0408020404	631240	Duck Cr - Ortonville Rd	42.84509	-83.44845	Flint
	0408020404	250098	Flint R - E Carpenter Rd	43.07636	-83.65428	Flint
	0408020404	250547	Flint R - N Dort Hwy	43.05318	-83.66910	Flint
	0408020404	250164	Flint R - Robert T Longway Blvd	43.02405	-83.68682	Flint
	0408020404	250328	Gilkey Cr - Kearsley Park Blvd	43.02713	-83.67112	Flint
	0408020404	631202	Kearsley Cr - Oakwood Rd	42.85874	-83.45144	Flint
	0408020404	250545	Kearsley Cr - Dutch Rd	42.92210	-83.51430	Flint
	0408020404	631239	Kearsley Cr - Granger Rd	42.84381	-83.43823	Flint
	0408020404	250544	Kearsley Cr - Green Rd	42.90430	-83.49235	Flint
	0408020404	250161	Kearsley Cr - Pierson Rd	43.05385	-83.66833	Flint
	0408020404	250546	Phillips Dr - Lapeer Rd	43.01144	-83.57260	Flint
Huron	0409000501	470475	S Ore Cr - Hamburg Rd	42.49793	-83.80257	CommerceTwp
	0409000504	580442	Wagner and Pink Dr - S Huron R Dr	42.08427	-83.28769	CommerceTwp
Maple	0405000504	190127	Bad Cr - S Lowell Rd	42.94349	-84.64654	MSUHtrc
	0405000502	190193	Baker Cr - Ovid St	43.08144	-84.38718	Ithaca
	0405000503	590272	Fish Cr - Condensery Rd	43.20267	-84.86186	Entrican
	0405000503	590300	Fish Cr - Mt. Hope Rd	43.19590	-84.85084	Entrican
	0405000501	780260	Hardy Jennings Dr - Waugh Rd	42.92417	-84.19787	MSUHtrc
	0405000504	190129	Kloeckner and Fuller Cr - W Taft Rd	42.95830	-84.79570	MSUHtrc
	0405000501	780193	Maple River - Morrice Rd	42.94692	-84.18353	MSUHtrc
	0405000502	290185	Maple River - S State Rd	43.13904	-84.59885	Ithaca
	0405000504	190128	Muskrat Cr - S Dexter Trl	42.94414	-84.70711	MSUHtrc
	0405000502	190202	S Br of Baker Cr - Ovid St	43.07800	-84.38716	Ithaca

Watershed	10-Digit HUC	Site ID	Site Description	Latitude	Longitude	Weather Station
Maple	0405000504	190194	Stony Cr - DeWitt Rd	42.96559	-84.58201	MSUHtrc
	0405000504	190157	Stony Cr - Lowell Rd	42.96212	-84.64091	MSUHtrc
	0405000504	190203	Stony Cr - W Taft Rd	42.95781	-84.58086	MSUHtrc
Menominee	0403010809	550191	Kelly Cr - 6.5 Lane	45.20984	-87.65703	Stephenson
	0403010809	550200	Little River - 6.25 LANE	45.21390	-87.63310	Stephenson
	0403010809	550223	Little River - Co Rd 581	45.14508	-87.66538	Stephenson
Ottawa-Stony	0410000101	821523	Bradshaw Dr - Arkona Rd	42.10036	-83.51139	CommerceTwp
	0410000101	580618	Little Sandy Cr - N Monroe St	41.94887	-83.38263	CommerceTwp
	0410000101	580616	Little Swan Cr - Telegraph Rd	42.03972	-83.33202	CommerceTwp
	0410000101	580619	N Br Swan Cr - Grafton Rd	42.08859	-83.38124	CommerceTwp
	0410000101	580615	Sandy Cr - N Monroe St	41.95899	-83.37704	CommerceTwp
	0410000101	580614	Stony Cr - N Dixie Hwy	41.94870	-83.30964	CommerceTwp
	0410000101	580409	Stony Cr - Rawsonville Rd	42.06470	-83.53885	CommerceTwp
	0410000101	580049	Swan Cr - Dixie Hwy	41.99443	-83.28615	CommerceTwp
	0410000101	580617	Swan Cr - Grafton Rd	42.07281	-83.38072	CommerceTwp
Pere Marquette-White	0406010107	640349	Brayton Cr - Cleveland Rd	43.52541	-86.06323	Fremont
	0406010109	610031	Carlton Cr - Fruitvale Rd	43.45650	-86.28420	Fremont
	0406010107	640321	Cushman Cr - S 184th Ave	43.51120	-86.09980	Fremont
	0406010108	640232	Robinson Cr - E Johnson Rd	43.59970	-86.22160	Hart
	0406010107	620307	S Br White River - Baldwin Ave	43.55640	-85.88100	Fremont
	0406010107	620295	S Br White River - Monore	43.59051	-85.75399	Fremont
	0406010107	610532	Skeels Cr - Skeels Rd	43.46819	-86.11401	Fremont
	0406010108	640231	Swinton Cr - E Johnson Rd	43.59955	-86.18067	Hart
	0406010109	610531	White River - Fruitvale Rd	43.46457	-86.23259	Fremont
Pine	0408020203	290221	Bass Lake Dr - N Ferris Rd	43.42548	-84.82647	Mecosta
	0408020203	590348	Cedar Cr - Fremont Rd	43.49580	-84.90605	Mecosta
	0408020202	370168	Chippewa R - Littlefield Rd	43.61005	-84.95051	Mecosta

Watershed	10-Digit HUC	Site ID	Site Description	Latitude	Longitude	Weather Station
Pine	0408020202	370100	Chippewa River -W Vernon Rd	43.72649	-85.07862	Mecosta
	0408020202	370102	Coldwater River -Baseline Rd	43.64000	-84.95580	Mecosta
	0408020202	370103	Coldwater River -W Vernon Rd	43.72659	-84.96099	Mecosta
	0408020203	290223	Coles Cr - N Winans Rd	43.37498	-84.70611	Mecosta
	0408020203	290224	Ely Cr - N Ely Hwy	43.34686	-84.68623	Mecosta
	0408020203	290222	Honeyoey Cr - N Winans Rd	43.37976	-84.70658	Mecosta
	0408020201	540113	N Br Chippewa -M66	43.76208	-85.14765	Mecosta
	0408020203	290220	North Branch Pine River - W Jefferson Rd	43.43740	-84.83974	Mecosta
	0408020203	590364	Pine River - E McBrides Rd	43.34989	-84.85012	Mecosta
	0408020203	540115	Pine River - W Walton Rd	43.53823	-85.01846	Mecosta
	0408020203	370105	Pony Cr - W Walton Rd	43.53831	-85.00769	Mecosta
	0408020203	370146	S Br Pine River - S Brinton Rd	43.51184	-85.00592	Mecosta
	0408020205	370119	Salt Cr - Fremont Rd	43.49705	-84.69179	Ithaca
	0408020203	370165	Thatcher Cr - W Fremont Rd	43.49586	-84.88610	Mecosta
	0408020203	370164	Trib to the Pine R - Coe Rd	43.48089	-84.95215	Mecosta
	0408020201	540156	W Br Chippewa -19-Mile Rd	43.74151	-85.16321	Mecosta
	0408020202	370167	Walker Cr -Vernon Rd (eastern xing)	43.72653	-84.99350	Mecosta
	0408020203	370166	Wolf Cr - E Edgar Rd	43.42262	-84.95027	Mecosta
St. Joseph	0405000125	110799	Blue Creek downstream of Millburg	42.12130	-86.34390	Swmrec
	0405000125	110798	Blue Creek upstream of Millburg	42.12090	-86.34360	Swmrec
	0405000125	Discharge	Discharge at end of 3rd St	42.12170	-86.34307	Swmrec
Upper Grand	0405000406	190148	Remey-Chandler Dr - Webb Rd	42.83078	-84.53532	MSUHtrc

Table 2. Dissolved oxygen and temperature results for selected sites and dates in the Maple, Pine and Upper Grand watersheds. NOTE: Violations of the minimum D.O. standards (coldwater or warmwater, as applicable) are shaded red. Daily average D.O. measurements are not available.

Watershed	Site ID	Site Description	Date	Time	D.O. (mg/L)	Temp (F)	Cold or Warm Water?
Maple	190127	Bad Cr - S Lowell Rd	8/16/2017	10:34 AM	7.32	69.98	WW
			8/23/2017	9:04 AM	6.92	63.68	WW
			8/30/2017	8:55 AM	6.89	62.42	WW
			9/6/2017	8:28 AM	7.44	54.7	WW
			9/13/2017	8:18 AM	7.54	58	WW
Maple	190193	Baker Cr - Ovid St	8/17/2017	9:54 AM	5.92	67.28	WW
			8/24/2017	9:47 AM	7.23	58.82	WW
			8/31/2017	9:43 AM	6.83	62.42	WW
			9/7/2017	9:38 AM	8	54.4	WW
			9/14/2017	9:39 AM	7.3	58.9	WW
Maple	590272	Fish Cr - Condensery Rd	8/17/2017	8:29 AM	7.67	68.54	CW
			8/24/2017	8:31 AM	8.76	60.44	CW
			8/31/2017	8:36 AM	8.45	63.32	CW
			9/7/2017	8:15 AM	8.43	53.9	CW
			9/14/2017	8:23 AM	9.16	59.67	CW
Maple	590300	Fish Cr - Mt. Hope Rd	8/17/2017	8:47 AM	7	66.2	CW
			8/24/2017	8:08 AM	8.14	57.56	CW
			8/31/2017	8:20 AM	7.46	61.88	CW
			9/7/2017	8:32 AM	9.49	54.9	CW
			9/14/2017	8:06 AM	8.03	59.3	CW
Maple	780260	Hardy Jennings Dr - Waugh Rd	8/17/2017	11:09 AM	9.59	60.98	WW
			8/24/2017	10:40 AM	11.4	54.86	WW
			8/31/2017	10:25 AM	8.8	57.74	WW
			9/7/2017	10:30 AM	9.5	52.6	WW
			9/14/2017	10:41 AM	10.18	55.6	WW
Maple	190129	Kloeckner and Fuller Cr - W Taft Rd	8/16/2017	10:03 AM	8.6	64.76	WW
			8/23/2017	8:02 AM	7.21	60.8	WW
			8/30/2017	7:59 AM	7.68	58.1	WW
			9/6/2017	7:47 AM	8.2	52.6	WW
			9/13/2017	7:47 AM	8.14	54.15	WW

Watershed	Site ID	Site Description	Date	Time	D.O. (mg/L)	Temp (F)	Cold or Warm Water?
Maple	780193	Maple River - Morrice Rd	8/17/2017	11:21 AM	5.55	69.8	WW
			8/24/2017	10:57 AM	7.22	59.72	WW
			8/31/2017	10:49 AM	6.52	64.4	WW
			9/7/2017	11:03 AM	7.2	56.1	WW
			9/14/2017	10:56 AM	7.12	60.41	WW
Maple	290185	Maple River - S State Rd	8/17/2017	9:21 AM	5.56	73.76	WW
			8/24/2017	9:10 AM	5.14	67.28	WW
			8/31/2017	9:06 AM	5.83	67.82	WW
			9/7/2017	8:57 AM	6.02	60.1	WW
			9/14/2017	8:59 AM	6.86	63.6	WW
Maple	190128	Muskrat Cr - S Dexter Trl	8/16/2017	10:18 AM	8.24	68.18	WW
			8/23/2017	8:30 AM	6.2	63.68	WW
			8/30/2017	8:32 AM	6.37	62.06	WW
			9/6/2017	8:06 AM	7.1	56	WW
			9/13/2017	8:02 AM	6.95	57.95	WW
Maple	190202	S Br of Baker Cr - Ovid St	8/17/2017	10:12 AM	7.4	69.62	WW
			8/24/2017	10:00 AM	9.42	59	WW
			8/31/2017	9:49 AM	8.83	63.32	WW
			9/7/2017	9:42 AM	9.94	54.7	WW
			9/14/2017	9:54 AM	10.05	59.4	WW
Maple	190194	Stony Cr - DeWitt Rd	8/16/2017	11:04 AM	11.46	68.18	WW
			8/23/2017	9:43 AM	8.15	61.88	WW
			8/30/2017	9:34 AM	6.78	61.34	WW
			9/6/2017	9:05 AM	7.8	53.7	WW
			9/13/2017	8:48 AM	6.63	56.73	WW
Maple	190157	Stony Cr - Lowell Rd	8/16/2017	10:46 AM	8.65	70.7	WW
			8/23/2017	9:23 AM	7.02	65.12	WW
			8/30/2017	9:12 AM	6.71	63.68	WW
			9/6/2017	8:45 AM	7.65	55.6	WW
			9/13/2017	8:34 AM	7.28	58.41	WW

Watershed	Site ID	Site Description	Date	Time	D.O. (mg/L)	Temp (F)	Cold or Warm Water?
Maple	190203	Stony Cr - W Taft Rd	8/16/2017	11:14 AM	9.05	66.38	WW
			8/23/2017	10:20 AM	8.15	62.42	WW
			8/30/2017	9:50 AM	7.88	59.9	WW
			9/6/2017	9:18 AM	8.25	54.6	WW
			9/13/2017	9:05 AM	7.97	55.19	WW
Pine	290221	Bass Lake Dr - N Ferris Rd	6/8/2017	8:10 AM	7.15	56	WW
			6/15/2017	8:22 AM	5.96	61	WW
			6/22/2017	8:14 AM	**4.47**	64.6	WW
			6/29/2017	8:24 AM	5.1	61.2	WW
			7/6/2017	8:09 AM	6.28	62.6	WW
Pine	590348	Cedar Cr - Fremont Rd	6/21/2017	9:59 AM	8.25	56.6	WW
			6/28/2017	10:07 AM	8.35	56.8	WW
			7/5/2017	10:10 AM	8.4	58.1	WW
Pine	370168	Chippewa R - Littlefield Rd	7/12/2017	10:58 AM	6.87	74.84	WW
Pine	370100	Chippewa River -W Vernon Rd	7/12/2017	9:14 AM	7.33	71.6	WW
			7/17/2017	9:54 AM	8.15	68	WW
			7/26/2017	9:36 AM	7.9	67.1	WW
			8/2/2017	9:35 AM	7.23	68.5	WW
			8/9/2017	9:34 AM	7.51	64.04	WW
Pine	370102	Coldwater River -Baseline Rd	7/17/2017	10:59 AM	8.65	74.3	WW
			7/26/2017	10:22 AM	8.5	74.48	WW
			8/2/2017	10:41 AM	7.88	76.9	WW
			8/9/2017	10:24 AM	7.31	71.6	WW
Pine	370103	Coldwater River -W Vernon Rd	7/12/2017	8:41 AM	7.66	65.3	WW
			7/17/2017	10:30 AM	9.27	63.68	WW
			7/26/2017	10:01 AM	8.6	63.5	WW
			8/2/2017	10:15 AM	8.03	65.8	WW
			8/9/2017	10:02 AM	8	62.24	WW

Watershed	Site ID	Site Description	Date	Time	D.O. (mg/L)	Temp (F)	Cold or Warm Water?
Pine	290223	Coles Cr - N Winans Rd	6/8/2017	9:52 AM	9.84	59	WW
			6/15/2017	9:43 AM	8.58	66	WW
			6/22/2017	9:34 AM	8.46	58.8	WW
			6/29/2017	9:56 AM	9	61.2	WW
			7/6/2017	9:33 AM	9.28	64.6	WW
Pine	290224	Ely Cr - N Ely Hwy	6/8/2017	9:14 AM	**4.82**	63	WW
			6/15/2017	9:20 AM	**3.29**	72	WW
			6/22/2017	9:07 AM	5.71	63.7	WW
			6/29/2017	9:25 AM	5.59	63.4	WW
			7/6/2017	9:06 AM	**4.81**	68.5	WW
Pine	290222	Honeyoey Cr - N Winans Rd	6/8/2017	10:01 AM	9.08	59	WW
			6/15/2017	10:00 AM	8.47	68	WW
			6/22/2017	9:48 AM	7.83	62.4	WW
			6/29/2017	9:56 AM	8.12	62.6	WW
			7/6/2017	9:53 AM	8.52	64.9	WW
Pine	540113	N Br Chippewa -M66	7/17/2017	9:15 AM	7.92	65.66	WW
			7/26/2017	9:12 AM	8.01	65.3	WW
			8/2/2017	9:05 AM	7.2	66.5	WW
			8/9/2017	9:10 AM	7.61	62.42	WW
Pine	290220	North Branch Pine River - W Jefferson Rd	6/8/2017	7:53 AM	7.78	59	CW
			6/15/2017	8:05 AM	**5.87**	68	CW
			6/22/2017	7:59 AM	7.4	62.2	CW
			6/29/2017	7:59 AM	**6.1**	61.2	CW
			7/6/2017	7:55 AM	7.12	64.6	CW
Pine	590364	Pine River - E McBrides Rd	6/8/2017	8:50 AM	8.06	62	WW
			6/15/2017	8:52 AM	6.82	71	WW
			6/22/2017	8:46 AM	**4.47**	64.2	WW
			6/29/2017	8:57 AM	6.77	62.6	WW
			7/6/2017	8:43 AM	7.53	68.5	WW

Watershed	Site ID	Site Description	Date	Time	D.O. (mg/L)	Temp (F)	Cold or Warm Water?
Pine	540115	Pine River - W Walton Rd	6/21/2017	8:31 AM	7.94	57	CW
			6/28/2017	8:46 AM	7.51	57.6	CW
			7/5/2017	8:40 AM	7.61	61	CW
Pine	370105	Pony Cr - W Walton Rd	6/21/2017	8:53 AM	**6.77**	58.6	CW
			6/28/2017	9:05 AM	**2.46**	61.5	CW
			7/5/2017	9:02 AM	**4.75**	64.8	CW
Pine	370146	S Br Pine River - S Brinton Rd	6/21/2017	9:10 AM	**2.37**	61.1	WW
			6/28/2017	9:24 AM	**1.74**	61.7	WW
			7/5/2017	9:21 AM	**2.88**	66.6	WW
Pine	370119	Salt Cr - Fremont Rd	7/12/2017	11:44 AM	7.1	66.92	WW
			7/17/2017	11:59 AM	8.2	64.58	WW
			7/26/2017	11:07 AM	8	64.4	WW
			8/2/2017	11:42 AM	7.35	67	WW
			8/9/2017	11:08 AM	7.56	63.32	WW
Pine	370165	Thatcher Cr - W Fremont Rd	6/21/2017	10:18 AM	7.29	60.9	WW
			6/28/2017	10:27 AM	6.66	60.8	WW
			7/5/2017	10:33 AM	11.63	64.6	WW
Pine	370164	Trib to the Pine R - Coe Rd	6/21/2017	9:38 AM	6.21	62.2	WW
			6/28/2017	9:46 AM	**3.84**	62.9	WW
			7/5/2017	9:49 AM	6.42	63	WW
Pine	540156	W Br Chippewa -19-Mile Rd	7/12/2017	9:55 AM	6.71	74.12	WW
			7/17/2017	9:26 AM	7.26	70.52	WW
			7/26/2017	8:52 AM	6.63	70.34	WW
			8/2/2017	8:52 AM	6.3	71.8	WW
			8/9/2017	8:55 AM	6.67	66.02	WW
Pine	370167	Walker Cr -Vernon Rd (eastern xing)	7/12/2017	10:22 AM	7.94	65.3	CW
			7/17/2017	10:15 AM	8.68	61.88	CW
			7/26/2017	9:49 AM	8.72	62.06	CW
			8/2/2017	9:57 AM	7.9	63.7	CW
			8/9/2017	9:50 AM	8.41	59.9	CW

Watershed	Site ID	Site Description	Date	Time	D.O. (mg/L)	Temp (F)	Cold or Warm Water?
Pine	370166	Wolf Cr - E Edgar Rd	6/21/2017	10:46 AM	6.38	62.8	WW
			6/28/2017	11:00 AM	8.72	60.9	WW
			7/5/2017	11:01 AM	8.43	65.5	WW
Upper Grand	190148	Remey-Chandler Dr - Webb Rd	8/16/2017	12:04 PM	6.39	67.64	WW
			8/23/2017	10:57 AM	5.79	61.16	WW
			8/30/2017	10:29 AM	5.34	59.54	WW
			9/6/2017	10:01 AM	5.9	54	WW
			9/13/2017	9:26 AM	5.73	55.53	WW

Table 3. Maple River microbial source tracking results. Results are the average (in gene copies/100 mL) of 2-3 detectable results. Results lower than the method detection limit (354 copies/100 mL) are considered non-detect (ND).

Site	Site Description	Date	*E. coli* daily Geometric Mean	24-hour rain	Human Bacteroides (copies/100mL)	Bovine Bacteroides (copies/100mL)
190193	Baker Cr - Ovid St	9/14/2017	510	0	6962	ND
590300	Fish Cr - Mt. Hope Rd	8/24/2017	547	0	1410	ND
590300	Fish Cr - Mt. Hope Rd	8/31/2017	454	0	1580	1510
590300	Fish Cr - Mt. Hope Rd	9/7/2017	367	0	1476	ND
780260	Hardy-Jennings Dr - Waugh Rd	8/24/2017	475	0	1913	6566
780260	Hardy-Jennings Dr - Waugh Rd	8/31/2017	513	0	5743	618
780260	Hardy-Jennings Dr - Waugh Rd	9/7/2017	433	0	13450	ND
780260	Hardy-Jennings Dr - Waugh Rd	9/14/2017	407	0	1676	29329

Table 4. Flint River qualitative source tracking results. Markers used were *B. theta* for human, and CF128 for bovine.

Site	Site Description	Date	*E. coli* Daily Geometric Mean	24-hour rain	Human	Bovine
250030	Black Cr - Irish Rd	10/10/2017	290	0	+	+
250328	Gilkey Cr - Kearsley Park Blvd	9/12/2017	663	0	+	+
250328	Gilkey Cr - Kearsley Park Blvd	9/19/2017	n/a	0	+	+
250328	Gilkey Cr - Kearsley Park Blvd	9/25/2017	329	0	+	+
250546	Phillips Dr - Lapeer Rd	9/11/2017	816	0	+	+
250546	Phillips Dr - Lapeer Rd	10/9/2017	3774	0.11	+	+
631202	Kearsley Cr - Oakwood Rd	9/18/2017	650	0.04	+	+
631202	Kearsley Cr - Oakwood Rd	9/25/2017	456	0	+	+
631202	Kearsley Cr - Oakwood Rd	10/9/2017	1469	0.11	+	+
631239	Kearsley Cr - Granger Rd	9/18/2017	463	0.04	+	+
631239	Kearsley Cr - Granger Rd	9/25/2017	1328	0	+	+
631239	Kearsley Cr - Granger Rd	10/2/2017	353	0	+	+
631239	Kearsley Cr - Granger Rd	10/9/2017	1119	0.11	+	+
631240	Duck Cr - Ortonville Rd	9/18/2017	444	0.04	+	+
631240	Duck Cr - Ortonville Rd	9/25/2017	424	0	+	+

Table 5. Pine River ddPCR results, shown as the average (in gene copies/100mL) of 2-3 detectable results. Results lower than the method detection limit (354 copies/100mL) are considered non-detect (ND). Markers used were *B. theta* for human, and CowM2 for bovine.

Site ID	Site description	Date	*E. coli* daily Geometric Mean	24-hour rain	Human (copies/100mL)	Bovine (copies/100mL)
290221	Bass Lake Drain - N Ferris Rd	6/8/2017	692	0	ND	ND
290221	Bass Lake Drain - N Ferris Rd	6/15/2017	1078	0.49	1023	425
290221	Bass Lake Drain - N Ferris Rd	6/29/2017	324	0.91	ND	ND
290222	Honeyoey Creek - N Winans Rd	6/15/2017	581	0.49	ND	598
290222	Honeyoey Creek - N Winans Rd	6/22/2017	885	0.22	ND	ND
290222	Honeyoey Creek - N Winans Rd	6/29/2017	1293	0.91	ND	ND
290223	Coles Creek - N Winans Rd	6/15/2017	977	0.49	ND	ND
290223	Coles Creek - N Winans Rd	6/22/2017	538	0.22	ND	ND
290223	Coles Creek - N Winans Rd	6/29/2017	567	0.91	ND	ND
290223	Coles Creek - N Winans Rd	7/6/2017	451	0	ND	ND
290224	Ely Creek - N Ely Hwy	6/22/2017	541	0.22	ND	ND
290224	Ely Creek - N Ely Hwy	6/29/2017	671	0.91	ND	ND
370105	Pony Creek - W Walton Rd	6/14/2017	427	0	708	1156
370164	Trib to the Pine R - Coe Rd	6/14/2017	1328	0	ND	1424
370164	Trib to the Pine R - Coe Rd	6/21/2017	688	0	756	ND
370164	Trib to the Pine R - Coe Rd	7/5/2017	379	0	ND	ND
370165	Thatcher Creek - W Fremont Rd	6/7/2017	82	0	ND	ND
370165	Thatcher Creek - W Fremont Rd	6/28/2017	346	0	ND	ND
370165	Thatcher Creek - W Fremont Rd	7/5/2017	368	0	ND	ND
370166	Wolf Creek - E Edgar Rd	6/14/2017	714	0	ND	ND
370166	Wolf Creek - E Edgar Rd	6/21/2017	589	0	ND	ND
370166	Wolf Creek - E Edgar Rd	7/5/2017	381	0	ND	728
540115	Pine River - W Walton Rd	6/14/2017	428	0	ND	527
590348	Cedar Creek - Fremont Rd	6/7/2017	730	0	580	2170
590348	Cedar Creek - Fremont Rd	6/14/2017	2138	0	ND	2675
590348	Cedar Creek - Fremont Rd	6/21/2017	567	0	ND	3393
590348	Cedar Creek - Fremont Rd	6/28/2017	466	0	ND	3760
590348	Cedar Creek - Fremont Rd	7/5/2017	432	0	ND	1188

Table 6. Pine River qPCR results, shown as the average (in gene copies/100mL) of 3 detectable results. Results lower than the method detection limit (186 and 200 copies/100 mL for human and bovine, respectively) are considered non-detect (ND). Markers used were HF183 for human, and BoBac for bovine.

Site ID	Site description	Date	*E. coli* daily Geometric Mean	24-hour rain	Human (copies/100mL)	Bovine (copies/100mL)
290221	Bass Lake Drain - N Ferris Rd	7/6/2017	263	0	ND	ND
290222	Honeyoey Creek - N Winans Rd	6/15/2017	581	0.49	ND	ND
290223	Coles Creek - N Winans Rd	7/6/2017	451	0	8300000	5500000
290224	Ely Creek - N Ely Hwy	7/6/2017	458	0	13000000	8500000
370105	Pony Creek - W Walton Rd	6/21/2017	300	0	ND	ND
370165	Thatcher Creek - W Fremont Rd	6/21/2017	802	0	394	ND
540115	Pine River - W Walton Rd	6/21/2017	513	0	2170	ND

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Watershed:	Flint				10-Digit HUC	0408020404	
8-Digit HUC:	04080204				North Branch Flint River		
Site ID/Storet:	250030						
Description	Black Cr - N Irish Rd						
9/12/2017	190	200	170	186		0.00	0.00
9/19/2017	240	170	120	170		0.03	0.07
9/26/2017	130	150	110	129		0.00	0.00
10/3/2017	60	80	20	46		0.00	0.00
10/10/2017	260	360	260	290	**140**	0.00	0.11
Site ID/Storet:	631240						
Description	Duck Cr - Ortonville Rd						
9/11/2017	150	180	210	178		0.00	0.00
9/18/2017	510	440	390	**444**		0.04	0.04
9/25/2017	440	480	360	**424**		0.00	0.00
10/2/2017	200	260	210	222		0.00	0.00
10/9/2017	270	300	320	296	**294**	0.11	0.38
Site ID/Storet:	250098						
Description	Flint R - E Carpenter Rd						
9/12/2017	60	1	70	16		0.00	0.00
9/19/2017	140	90	60	91		0.03	0.07
9/26/2017	130	120	110	120		0.00	0.00
10/3/2017	40	30	50	39		0.00	0.00
10/10/2017	200	130	210	176	66	0.00	0.11
10/17/2017	150	170	90	132	100	0.00	0.11
Site ID/Storet:	250547						
Description	Flint R - N Dort Hwy						
9/12/2017	120	70	40	70		0.00	0.00
9/19/2017	140	30	110	77		0.03	0.07
9/26/2017	130	130	130	130		0.00	0.00
10/3/2017	140	50	70	79		0.00	0.00
10/10/2017	440	230	120	230	105	0.00	0.11
10/17/2017	1500	170	200	**371**	**147**	0.00	0.11

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	250164						
Description	Flint R - Robert T Longway Blvd						
9/12/2017	60	130	950	195		0.00	0.00
9/19/2017	360	500	410	**419**		0.00	0.07
9/26/2017	90	120	90	99		0.00	0.00
10/3/2017	380	80	90	140		0.00	0.00
10/10/2017	390	200	210	254	**196**	0.00	0.11
10/17/2017	270	100	110	144	**184**	0.00	0.11
Site ID/Storet:	250328						
Description	Gilkey Cr - Kearsley Park Blvd						
9/12/2017	600	640	760	**663**		0.00	0.00
9/19/2017	670		2900			0.00	0.07
9/25/2017	470	230	330	**329**		0.00	0.00
9/26/2017	140	130	170	146		0.00	0.00
10/3/2017	210	180	380	243		0.00	0.00
10/10/2017	210	280	240	242	**343**	0.00	0.11
Site ID/Storet:	631202						
Description	Kearsley Cr - Oakwood Rd						
9/11/2017	260	250	200	235		0.00	0.00
9/18/2017	630	670	650	**650**		0.04	0.04
9/25/2017	440	480	450	**456**		0.00	0.00
10/2/2017	250	150	200	196		0.00	0.00
10/9/2017	1800	1600	1100	**1469**	**458**	0.11	0.38
Site ID/Storet:	250545						
Description	Kearsley Cr - Dutch Rd						
9/11/2017	120	110	80	102		0.00	0.00
9/18/2017	20	80	30	36		0.07	0.07
9/25/2017	80	70	60	70		0.00	0.00
10/2/2017	40	10	30	23		0.00	0.00
10/9/2017	110	130	110	116	58	0.11	0.38

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	631239						
Description	Kearsley Cr - Granger Rd						
9/11/2017	220	140	210	186		0.00	0.00
9/18/2017	500	510	390	**463**		0.04	0.04
9/25/2017	1200	1500	1300	**1328**		0.00	0.00
10/2/2017	370	320	370	**353**		0.00	0.00
10/9/2017	1000	1400	1000	**1119**	**538**	0.11	0.38
Site ID/Storet:	250544						
Description	Kearsley Cr - Green Rd						
9/11/2017	140	190	270	193		0.00	0.00
9/18/2017	680	470	590	**573**		0.04	0.04
9/25/2017	1200	1200	1300	**1232**		0.00	0.00
10/2/2017	370	310	280	**318**		0.00	0.00
10/9/2017	1900	1000	1300	**1352**	**567**	0.11	0.38
Site ID/Storet:	250161						
Description	Kearsley Cr - Pierson Rd						
9/12/2017	590	600	600	**597**		0.00	0.00
9/19/2017	340	350	370	**353**		0.03	0.07
9/26/2017	130	120	60	98		0.00	0.00
10/3/2017	210	210	280	231		0.00	0.00
10/10/2017	1000	900	850	**915**	**337**	0.00	0.11
Site ID/Storet:	250546						
Description	Phillips Dr - Lapeer Rd						
9/11/2017	850	840	760	**816**		0.00	0.00
9/18/2017	230	210	250	229		0.07	0.07
10/2/2017	150	150	140	147		0.00	0.00
10/9/2017	3500	4800	3200	**3774**		0.11	0.38

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Watershed:	Huron			10-Digit HUC	0409000501		
8-Digit HUC:	04090005			Woodruff Creek-Huron River			
Site ID/Storet:	470475						
Description	S Ore Cr - Hamburg Rd						
7/11/2017	90	40	70	63		0.59	0.64
7/18/2017	60	70	30	50		0.00	0.00
7/25/2017	40	10	20	20		0.00	0.00
8/1/2017	250	240	170	217		0.00	0.00
8/8/2017	240	170	280	225	79	0.00	0.02
Watershed:	Huron			10-Digit HUC	0409000504		
8-Digit HUC:	04090005			Huron River			
Site ID/Storet:	580442						
Description	Wagner and Pink Dr - S Huron R Dr						
7/11/2017	1800	2200	2100	**2026**		0.63	0.64
7/18/2017	1100	2400	1000	**1382**		0.00	0.00
7/25/2017	1300	1700	2000	**1641**		0.00	0.00
8/1/2017	810	370	420	**501**		0.00	0.00
8/8/2017	1900	2600	3200	**2510**	**1420**	0.00	0.02
Watershed:	Maple			10-Digit HUC	0405000501		
8-Digit HUC:	04050005			Little Maple River-Maple River			
Site ID/Storet:	780260						
Description	Hardy Jennings Dr - Waugh Rd						
8/17/2017	570	690	990	**730**		0.08	0.08
8/24/2017	520	430	480	**475**		0.00	0.01
8/31/2017	450	470	640	**513**		0.00	0.01
9/7/2017	540	430	350	**433**		0.00	0.16
9/14/2017	480	370	380	**407**	**501**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	780193						
Description	Maple River - Morrice Rd						
8/17/2017	780	860	780	**806**		0.08	0.08
8/24/2017	810	790	730	**776**		0.00	0.01
8/31/2017	1200	1900	1000	**1316**		0.00	0.01
9/7/2017	390	350	410	**383**		0.00	0.16
9/14/2017	610	640	750	**664**	**731**	0.00	0.00
Watershed:	Maple			10-Digit HUC	0405000502		
8-Digit HUC:	04050005			Pine Creek-Maple River			
Site ID/Storet:	190193						
Description	Baker Cr - Ovid St						
8/17/2017	1500	1200	1400	**1361**		0.39	0.39
8/24/2017	510	420	740	**541**		0.00	0.01
8/31/2017	1300	1500	1300	**1364**		0.00	0.00
9/7/2017	430	770	740	**626**		0.00	0.00
9/14/2017	610	640	340	**510**	**796**	0.00	0.00
Site ID/Storet:	290185						
Description	Maple River - S State Rd						
8/17/2017	600	620	650	**623**		0.39	0.39
8/24/2017	250	280	290	273		0.00	0.07
8/31/2017	130	190	270	188		0.00	0.00
9/7/2017	230	170	250	214		0.00	0.01
9/14/2017	290	240	250	259	**282**	0.00	0.00
Site ID/Storet:	190202						
Description	S Br of Baker Cr - Ovid St						
8/17/2017	420	430	290	**374**		0.39	0.39
8/24/2017	290	270	270	277		0.00	0.01
8/31/2017	210	300	270	257		0.00	0.00
9/7/2017	180	240	190	202		0.00	0.00
9/14/2017	390	420	510	**437**	**298**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Watershed:	Maple			10-Digit HUC	0405000503		
8-Digit HUC:	04050005			Fish Creek			
Site ID/Storet:	590272						
Description	Fish Cr - Condensery Rd						
8/17/2017	830	590	670	**690**		0.28	0.28
8/24/2017	450	380	340	**387**		0.00	0.00
8/31/2017	770	590	860	**731**		0.00	0.00
9/7/2017	740	800	590	**704**		0.00	0.02
9/14/2017	670	610	830	**697**	**626**	0.00	0.00
Site ID/Storet:	590300						
Description	Fish Cr - Mt. Hope Rd						
8/17/2017	2400	2700	2700	**2596**		0.28	0.28
8/24/2017	590	630	440	**547**		0.00	0.02
8/31/2017	410	440	520	**454**		0.00	0.00
9/7/2017	340	330	440	**367**		0.00	0.02
9/14/2017	790	820	630	**742**	**706**	0.00	0.00
Watershed:	Maple			10-Digit HUC	0405000504		
8-Digit HUC:	04050005			Stony Creek			
Site ID/Storet:	190127						
Description	Bad Cr - S Lowell Rd						
8/16/2017	870	530	620	**659**		0.00	0.31
8/23/2017	510	470	590	**521**		0.05	0.12
8/30/2017	460	420	510	**462**		0.01	0.09
9/6/2017	470	390	350	**400**		0.18	0.19
9/13/2017	750	630	750	**708**	**538**	0.00	0.01
Site ID/Storet:	190129						
Description	Kloeckner and Fuller Cr - W Taft Rd						
8/16/2017	840	860	1000	**897**		0.00	0.31
8/23/2017	930	880	960	**923**		0.09	0.12
8/30/2017	1100	900	1200	**1059**		0.01	0.09
9/6/2017	820	910	900	**876**		0.18	0.19
9/13/2017	840	1600	840	**1041**	**956**	0.00	0.01

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	190128						
Description	Muskrat Cr - S Dexter Trl						
8/16/2017	640	620	830	**691**		0.00	0.31
8/23/2017	720	590	810	**701**		0.05	0.12
8/30/2017	860	750	790	**799**		0.01	0.09
9/6/2017	500	340	460	**428**		0.18	0.19
9/13/2017	720	790	710	**739**	**657**	0.00	0.01
Site ID/Storet:	190194						
Description	Stony Cr - DeWitt Rd						
8/16/2017	1000	1000	1200	**1063**		0.00	0.31
8/23/2017	750	630	590	**653**		0.02	0.12
8/30/2017	840	830	840	**837**		0.01	0.09
9/6/2017	460	650	620	**570**		0.16	0.19
9/13/2017	550	580	780	**629**	**731**	0.00	0.01
Site ID/Storet:	190157						
Description	Stony Cr - Lowell Rd						
8/16/2017	900	1200	930	**1001**		0.00	0.31
8/23/2017	1400	1300	2000	**1538**		0.05	0.12
8/30/2017	1700	1700	1200	**1514**		0.01	0.09
9/6/2017	1400	900	1000	**1080**		0.16	0.19
9/13/2017	1800	1100	800	**1166**	**1240**	0.00	0.01
Site ID/Storet:	190203						
Description	Stony Cr - W Taft Rd						
8/16/2017	160	150	220	174		0.00	0.31
8/23/2017	170	240	220	208		0.02	0.12
8/30/2017	120	150	100	122		0.01	0.09
9/6/2017	200	220	200	206		0.16	0.19
9/13/2017	120	180	180	157	**170**	0.00	0.01

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Watershed:	Menominee			10-Digit HUC	0403010809		
8-Digit HUC:	04030108			Menominee River			
Site ID/Storet:	550191						
Description	Kelly Cr - 6.5 Lane						
7/20/2017	86	81	88	85		0.00	
7/27/2017	73	100	130	98		0.01	
8/2/2017	110	130	120	120		0.05	
8/10/2017	520	690	440	**540**		0.11	
8/17/2017	240	190	210	212	**163**	0.49	
Site ID/Storet:	550200						
Description	Little River - 6.25 LANE						
7/20/2017	30	44	54	41		0.00	
7/27/2017	35	26	52	36		0.01	
8/2/2017	78	36	63	56		0.05	
8/10/2017	460	550	460	**488**		0.11	
8/17/2017	72	120	80	88	82	0.49	
Site ID/Storet:	550223						
Description	Little River - Co Rd 581						
7/20/2017	93	110	96	99		0.00	
7/27/2017	72	62	86	73		0.01	
8/2/2017	160	220	110	157		0.05	
8/10/2017	2500	2500	2500	**2500**		0.11	
8/17/2017	4300	3400	3600	**3748**	**403**	0.49	
Watershed:	Ottawa-Stony			10-Digit HUC	0410000101		
8-Digit HUC:	04100001			Stony Creek-Frontal Lake Erie			
Site ID/Storet:	821523						
Description	Bradshaw Dr - Arkona Rd						
7/13/2017	1700	3200	2500	**2387**		0.48	0.51
7/20/2017	1800	1400	1300	**1485**		0.00	0.00
7/27/2017	480	700	720	**623**		0.00	0.00
8/3/2017	1800	2100	1700	**1859**		0.40	0.40
8/10/2017	700	650	620	**656**	**1219**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	580618						
Description	Little Sandy Cr - N Monroe St						
7/13/2017	3700	5600	3700	**4248**		0.45	0.48
7/20/2017	2200	2500	1800	**2147**		0.00	0.00
7/27/2017	800	800	700	**765**		0.00	0.00
8/3/2017	4600	3600	5600	**4526**		0.40	0.40
8/10/2017	910	720	1000	**869**	**1939**	0.00	0.00
Site ID/Storet:	580616						
Description	Little Swan Cr - Telegraph Rd						
7/13/2017	8000	8400	10000	**8759**		0.45	0.48
7/20/2017	1900	900	1400	**1338**		0.00	0.00
7/27/2017	1200	2000	3200	**1973**		0.00	0.00
8/3/2017	10000	11000	13000	**11266**		0.40	0.40
8/10/2017	1300	650	880	**906**	**2982**	0.00	0.00
Site ID/Storet:	580619						
Description	N Br Swan Cr - Grafton Rd						
7/13/2017	1300	1900	2400	**1810**		0.48	0.51
7/20/2017	4000	2800	3800	**3491**		0.00	0.00
7/27/2017	1200	600	90	**402**		0.00	0.00
8/3/2017	23000	16000	17000	**18426**		0.40	0.40
8/10/2017	1600	2000	2000	**1857**	**2442**	0.00	0.00
Site ID/Storet:	580615						
Description	Sandy Cr - N Monroe St						
7/13/2017	4600	5000	4400	**4660**		0.45	0.48
7/20/2017	1500	1300	2000	**1574**		0.00	0.00
7/27/2017	1200	1800	1900	**1601**		0.00	0.00
8/3/2017	54000	43000	57000	**50962**		0.40	0.40
8/10/2017	15000	12000	13000	**13276**	**6026**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	580614						
Description	Stony Cr - N Dixie Hwy						
7/13/2017	1500	1500	1500	**1500**		0.45	0.48
7/20/2017	440	450	510	**466**		0.00	0.00
7/27/2017	380	380	540	**427**		0.00	0.00
8/3/2017	6200	5900	6200	**6098**		0.40	0.40
8/10/2017	440	290	350	**355**	**916**	0.00	0.00
Site ID/Storet:	580409						
Description	Stony Cr - Rawsonville Rd						
7/13/2017	1300	700	930	**946**		0.48	0.51
7/20/2017	430	340	270	**340**		0.00	0.00
7/27/2017	320	310	340	**323**		0.00	0.00
8/3/2017	390	320	370	**359**		0.40	0.40
8/10/2017	340	370	430	**378**	**427**	0.00	0.00
Site ID/Storet:	580049						
Description	Swan Cr - Dixie Hwy						
7/13/2017	310	160	80	158		0.45	0.48
7/20/2017	220	320	310	279		0.00	0.00
7/27/2017	20	30	50	31		0.00	0.00
8/3/2017	120	160	150	142		0.40	0.40
8/10/2017	10	70	20	24	86	0.00	0.00
Site ID/Storet:	580617						
Description	Swan Cr - Grafton Rd						
7/13/2017	3500	3000	3900	**3447**		0.48	0.51
7/20/2017	940	950	1100	**994**		0.00	0.00
7/27/2017	2000	900	1600	**1423**		0.00	0.00
8/3/2017	30000	31000	19000	**26046**		0.40	0.40
8/10/2017	650	520	600	**588**	**2369**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Watershed:	Pere Marquette-White			10-Digit HUC	0406010107		
8-Digit HUC:	04060101			South Branch White River			
Site ID/Storet:	640349						
Description	Brayton Cr - Cleveland Rd						
7/10/2017	1732.9	1299.7	1732.9	**1574**		0.15	0.15
7/17/2017	2419.6	2419.6	2419.6	**2420**		0.00	0.00
7/24/2017	2247	2755	1935	**2288**		0.00	0.12
7/31/2017	1732.9	1986.3	1986.3	**1898**		0.00	0.00
8/7/2017	1986.3	1986.3	1413.6	**1773**	**1904**	0.00	0.00
Site ID/Storet:	640321						
Description	Cushman Cr - S 184th Ave						
7/10/2017	344.8	307.6	290.9	**314**		0.15	0.15
7/17/2017	307.6	461.1	272.3	**338**		0.00	0.00
7/24/2017	461.1	686.7	579.4	**568**		0.00	0.12
7/31/2017	272.3	307.6	214.2	262		0.00	0.00
8/7/2017	159.7	344.8	307.6	257	**332**	0.00	0.00
Site ID/Storet:	620307						
Description	S Br White River - Baldwin Ave						
7/10/2017	77.6	90.8	108.1	91		0.15	0.15
7/17/2017	145	98.7	101	113		0.00	0.00
7/24/2017	214.2	228.2	201.4	214		0.00	0.13
7/31/2017	119.1	133.4	98.8	116		0.00	0.00
8/7/2017	152.9	139.6	186	158	**132**	0.00	0.00
Site ID/Storet:	620295						
Description	S Br White River - Monore						
7/10/2017	410.6	410.6	517.2	**443**		0.14	0.14
7/17/2017	275.5	290.9	307.6	291		0.00	0.00
7/24/2017	344.8	240	365.4	**312**		0.00	0.13
7/31/2017	387.3	435.2	344.8	**387**		0.00	0.00
8/7/2017	249.5	214.3	235.9	233	**325**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	610532						
Description	Skeels Cr - Skeels Rd						
7/10/2017	387.3	387.3	365.4	**380**		0.15	0.15
7/17/2017	488.4	547.5	410.6	**479**		0.00	0.00
7/24/2017	488.4	517.2	770.1	**579**		0.00	0.12
7/31/2017	387.3	387.3	547.5	**435**		0.00	0.00
8/7/2017	547.5	816.4	727	**688**	**501**	0.00	0.00
Watershed:	Pere Marquette-White			10-Digit HUC	0406010108		
8-Digit HUC:	04060101			North Branch White River			
Site ID/Storet:	640232						
Description	Robinson Cr - E Johnson Rd						
7/10/2017	261.3	275.5	313	282		0.30	0.30
7/17/2017	365.4	260.3	344.1	**320**		0.00	0.00
7/24/2017	613.1	816.4	517.2	**637**		0.00	0.38
7/31/2017	461.1	435.2	344.1	**410**		0.00	0.00
8/7/2017	344.8	218.7	261.3	270	**364**	0.01	0.01
Site ID/Storet:	640231						
Description	Swinton Cr - E Johnson Rd						
7/10/2017	770.1	517.2	613.1	**625**		0.30	0.30
7/17/2017	387.3	365.4	387.3	**380**		0.00	0.00
7/24/2017	488.4	648.8	461.1	**527**		0.00	0.38
7/31/2017	365.4	224.7	365.4	**311**		0.00	0.00
8/7/2017	325.5	248.9	238.2	268	**401**	0.01	0.01
Watershed:	Pere Marquette-White			10-Digit HUC	0406010109		
8-Digit HUC:	04060101			White River			
Site ID/Storet:	610031						
Description	Carlton Cr - Fruitvale Rd						
7/10/2017	365.4	410.6	313	**361**		0.15	0.15
7/17/2017	365.4	410.6	325.5	**366**		0.00	0.00
7/24/2017	547.5	488.4	517.2	**517**		0.00	0.12
7/31/2017	461.1	461.1	344.8	**419**		0.00	0.00
8/7/2017	325.5	325.5	325.5	**326**	**392**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	610531						
Description	White River - Fruitvale Rd						
7/10/2017	107.6	124.6	178.2	134		0.15	0.15
7/17/2017	135.4	114.5	125.9	125		0.00	0.00
7/24/2017	410.6	410.6	435.2	**419**		0.00	0.12
7/31/2017	88.4	95.9	98.5	94		0.00	0.00
8/7/2017	143.9	137.6	209.8	161	**160**	0.00	0.00
Watershed:	Pine			10-Digit HUC	0408020201		
8-Digit HUC:	04080202			West Branch Chippewa River			
Site ID/Storet:	540113						
Description	N Br Chippewa -M66						
7/12/2017	290	420	360	**353**		0.00	0.05
7/17/2017	280	350	330	**319**		0.00	0.00
7/26/2017	330	520	500	**441**		0.00	0.00
8/2/2017	250	340	280	288		0.00	0.00
8/9/2017	210	380	260	275	**330**	0.00	0.00
Site ID/Storet:	540156						
Description	W Br Chippewa -19-Mile Rd						
7/12/2017	80	40	50	54		0.00	0.05
7/17/2017	80	140	170	124		0.00	0.00
7/26/2017	180	200	180	186		0.00	0.00
8/2/2017	120	120	80	105		0.00	0.00
8/9/2017	90	110	156	116	109	0.00	0.00
Watershed:	Pine			10-Digit HUC	0408020202		
8-Digit HUC:	04080202			Coldwater River-Chippewa River			
Site ID/Storet:	370168						
Description	Chippewa R - Littlefield Rd						
7/12/2017	50	70	90	68		0.03	0.03

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	370100						
Description	Chippewa River -W Vernon Rd						
7/12/2017	100	130	120	116		0.00	0.13
7/17/2017	90	70	100	86		0.00	0.00
7/26/2017	190	180	130	164		0.00	0.00
8/2/2017	250	180	270	230		0.00	0.00
8/9/2017	240	250	190	225	**153**	0.00	0.00
Site ID/Storet:	370102						
Description	Coldwater River -Baseline Rd						
7/17/2017	50	10	100	37		0.00	0.00
7/26/2017	160	100	110	121		0.00	0.00
8/2/2017	60	90	40	60		0.00	0.00
8/9/2017	90	80	30	60		0.00	0.00
8/16/2017	350	380	420	**382**	91	0.00	0.02
Site ID/Storet:	370103						
Description	Coldwater River -W Vernon Rd						
7/12/2017	430	290	550	**409**		0.00	0.13
7/17/2017	270	180	340	255		0.00	0.00
7/26/2017	590	320	430	**433**		0.00	0.00
8/2/2017	260	290	330	292		0.00	0.00
8/9/2017	290	380	350	**338**	**339**	0.00	0.00
Site ID/Storet:	370167						
Description	Walker Cr -Vernon Rd (eastern xing)						
7/12/2017	380	350	380	**370**		0.00	0.05
7/17/2017	410	490	430	**442**		0.00	0.00
7/26/2017	950	970	1000	**973**		0.00	0.00
8/2/2017	260	290	400	**311**		0.00	0.00
8/9/2017	280	310	270	286	**427**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Watershed:	Pine				10-Digit HUC	0408020203	
8-Digit HUC:	04080202				Honeyoey Creek-Pine Creek		
Site ID/Storet:	290221						
Description	Bass Lake Dr - N Ferris Rd						
6/8/2017	730	720	630	**692**		0.00	0.00
6/15/2017	1100	950	1200	**1078**		0.49	0.49
6/22/2017	390	330	160	274		0.22	0.22
6/29/2017	320	410	260	**324**		0.91	0.91
7/6/2017	290	240	260	263	**445**	0.00	0.00
Site ID/Storet:	590348						
Description	Cedar Cr - Fremont Rd						
6/7/2017	760	640	800	**730**		0.00	0.00
6/14/2017	2300	2500	1700	**2138**		0.00	0.00
6/21/2017	640	570	500	**567**		0.00	0.00
6/28/2017	510	390	510	**466**		0.00	0.00
7/5/2017	390	560	370	**432**	**708**	0.00	0.00
Site ID/Storet:	290223						
Description	Coles Cr - N Winans Rd						
6/8/2017	180	170	220	189		0.00	0.00
6/15/2017	980	970	980	**977**		0.49	0.49
6/22/2017	440	570	620	**538**		0.30	0.30
6/29/2017	630	490	590	**567**		0.91	0.91
7/6/2017	390	510	460	**451**	**479**	0.00	0.00
Site ID/Storet:	290224						
Description	Ely Cr - N Ely Hwy						
6/8/2017	190	140	160	162		0.00	0.00
6/15/2017	150	200	180	175		0.49	0.49
6/22/2017	610	590	440	**541**		0.30	0.30
6/29/2017	790	570	670	**671**		0.91	0.91
7/6/2017	520	330	560	**458**	**343**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	290222						
Description	Honeyoey Cr - N Winans Rd						
6/8/2017	150	150	330	195		0.00	0.00
6/15/2017	660	550	540	**581**		0.49	0.49
6/22/2017	770	920	980	**885**		0.30	0.30
6/29/2017	1800	1200	1000	**1293**		0.91	0.91
7/6/2017	650	650	580	**626**	**605**	0.00	0.00
Site ID/Storet:	290220						
Description	North Branch Pine River - W Jefferson Rd						
6/8/2017	180	240	230	215		0.00	0.00
6/15/2017	18000	21000	21000	**19948**		0.49	0.49
6/22/2017	260	260	330	282		0.22	0.22
6/29/2017	250	280	270	266		0.91	0.91
7/6/2017	290	240	260	263	**610**	0.00	0.00
Site ID/Storet:	590364						
Description	Pine River - E McBrides Rd						
6/8/2017	130	180	140	149		0.00	0.00
6/15/2017	2000	1800	900	**1480**		0.49	0.49
6/22/2017	270	250	270	263		0.30	0.30
6/29/2017	200	260	240	232		0.91	0.91
7/6/2017	230	270	130	201	**306**	0.00	0.00
Site ID/Storet:	540115						
Description	Pine River - W Walton Rd						
6/7/2017	140	140	170	149		0.00	0.00
6/14/2017	380	450	460	**428**		0.00	0.00
6/21/2017	480	510	550	**513**		0.00	0.00
6/28/2017	340	230	200	250		0.00	0.00
7/5/2017	330	360	210	292	**299**	0.00	0.00

Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	370105						
Description	Pony Cr - W Walton Rd						
6/7/2017	250	270	220	246		0.00	0.00
6/14/2017	430	370	490	**427**		0.00	0.00
6/21/2017	280	300	320	300		0.00	0.00
6/28/2017	70	120	60	80		0.00	0.00
7/5/2017	140	150	200	161	**210**	0.00	0.00
Site ID/Storet:	370146						
Description	S Br Pine River - S Brinton Rd						
6/7/2017	110	170	60	104		0.00	0.00
6/14/2017	170	160	140	156		0.00	0.00
6/21/2017	80	50	90	71		0.00	0.00
6/28/2017	90	120	60	87		0.00	0.00
7/5/2017	50	50	70	56	89	0.00	0.00
Site ID/Storet:	370165						
Description	Thatcher Cr - W Fremont Rd						
6/7/2017	60	70	130	82		0.00	0.00
6/14/2017	70	170	130	116		0.00	0.00
6/21/2017	870	630	940	**802**		0.00	0.00
6/28/2017	310	370	360	**346**		0.00	0.00
7/5/2017	430	350	330	**368**	**249**	0.00	0.00
Site ID/Storet:	370164						
Description	Trib to the Pine R - Coe Rd						
6/7/2017	2100	1200	1100	**1405**		0.00	0.00
6/14/2017	1300	1200	1500	**1328**		0.00	0.00
6/21/2017	700	750	620	**688**		0.00	0.00
6/28/2017	160	170	130	152		0.00	0.00
7/5/2017	410	340	390	**379**	**594**	0.00	0.00

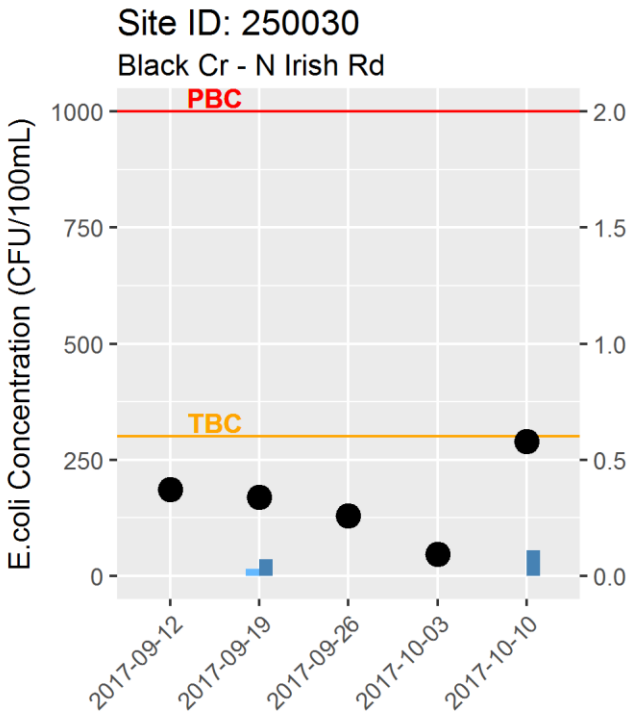
Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

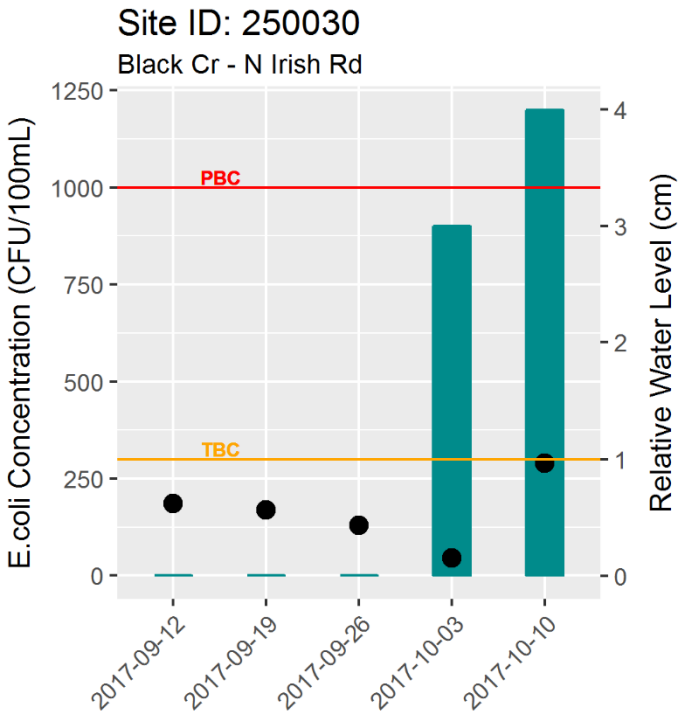
	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	370166						
Description	Wolf Cr - E Edgar Rd						
6/7/2017	260	300	230	262		0.00	0.00
6/14/2017	820	740	600	**714**		0.00	0.00
6/21/2017	630	500	650	**589**		0.00	0.00
6/28/2017	170	140	150	153		0.00	0.00
7/5/2017	350	350	450	**381**	**364**	0.00	0.00
Watershed:	Pine			10-Digit HUC	0408020205		
8-Digit HUC:	04080202			Chippewa River			
Site ID/Storet:	370119						
Description	Salt Cr - Fremont Rd						
7/12/2017	730	750	680	**719**		0.05	0.05
7/17/2017	670	830	750	**747**		0.00	0.00
7/26/2017	1200	1600	900	**1200**		0.00	0.00
8/2/2017	1300	1000	980	**1084**		0.00	0.00
8/9/2017	730	850	690	**754**	**880**	0.00	0.21
Watershed:	St. Joseph			10-Digit HUC	0405000125		
8-Digit HUC:	04050001			Paw Paw River			
Site ID/Storet:	110799						
Description	Blue Creek downstream of Millburg						
8/1/2017	249	327	309	**301**		0.00	0.00
8/7/2017	387.3	290.9	260.3	**304**		0.00	0.00
8/14/2017	365.4	307.6	290.9	**317**		0.00	0.00
8/21/2017	488.4	307.6	275.5	**336**		0.00	0.10
8/28/2017	866.4	980.4	866.4	**922**	**390**	0.12	0.12
Site ID/Storet:	110798						
Description	Blue Creek upstream of Millburg						
8/1/2017	175	213	275	216		0.00	0.00
8/7/2017	218.7	224.7	235.9	226		0.00	0.00
8/14/2017	410.6	387.3	290.9	**366**		0.00	0.00
8/21/2017	365.4	365.4	410.6	**376**		0.00	0.10
8/28/2017	980.4	920.8	1119.9	**982**	**368**	0.12	0.12

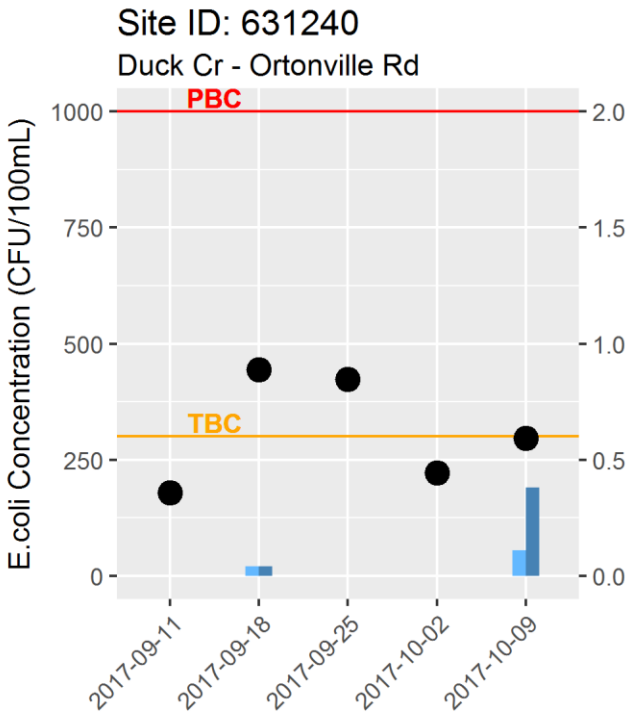
Appendix 1. E. coli results by 10-digit Hydrologic Unit Code (HUC), including prior precipitation (in inches). Exceedances of the WQS are indicated in light red (TBC) and black (PBC).

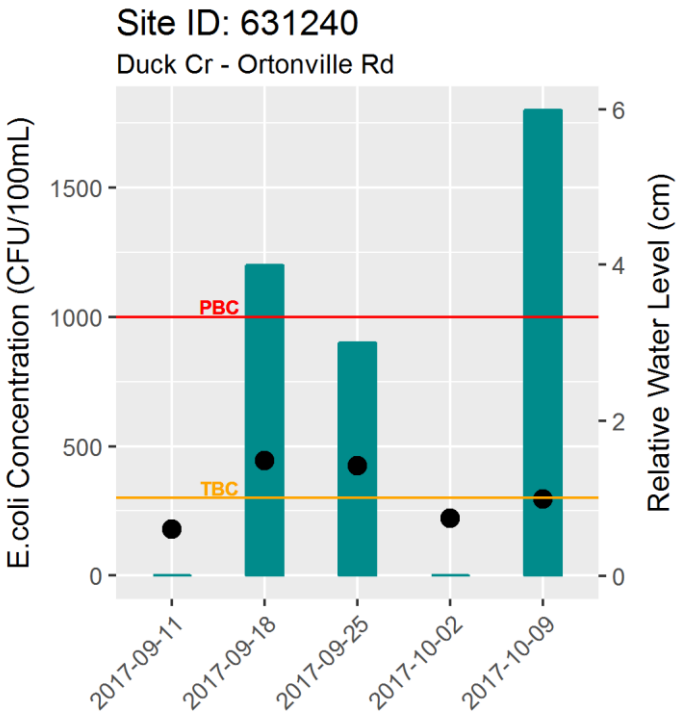
	L	C	R	Daily Geometric Mean	30-Day Geometric Mean	24-Hour Prior Rain	48-Hour Prior Rain
Site ID/Storet:	Discharge						
Description	Discharge at end of 3rd St						
8/1/2017		275500				0.00	0.00
8/7/2017		173290				0.00	0.00
8/14/2017		68670				0.00	0.00
8/21/2017		98040				0.00	0.10
8/28/2017		19863				0.12	0.12
Watershed:	Upper Grand			10-Digit HUC	0405000406		
8-Digit HUC:	04050004			Looking Glass River			
Site ID/Storet:	190148						
Description	Remey-Chandler Dr - Webb Rd						
8/16/2017	690	610	590	**629**		0.00	0.31
8/23/2017	490	480	480	**483**		0.01	0.12
8/30/2017	440	360	330	**374**		0.01	0.09
9/6/2017	150	110	160	138		0.16	0.19
9/13/2017	130	150	130	136	**292**	0.00	0.01

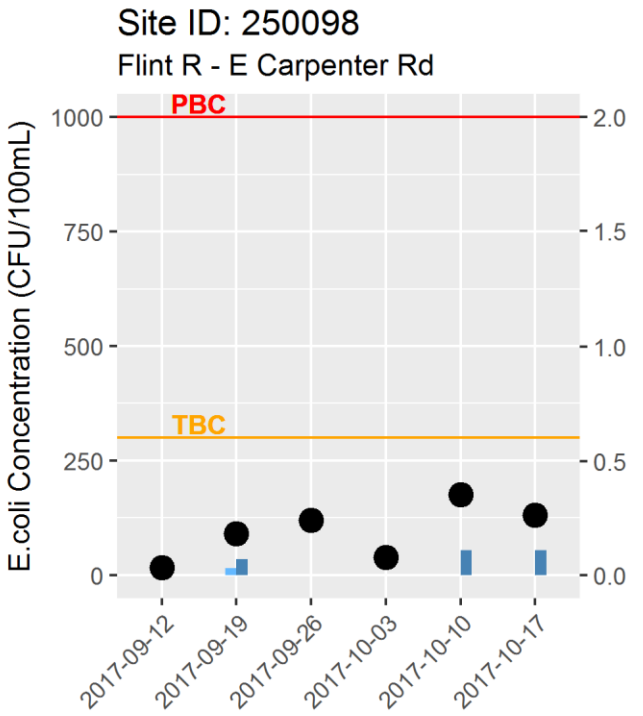
Appendix 2. *E. coli* concentrations for each site (organized by watershed) graphed with prior precipitation (left column) and relative water levels (right column). Relative water levels are the change in water level relative to the lowest measured during the 5-week study and are represented by bars on the secondary y-axis. Prior precipitation is represented by light (24-hour) and dark (48-hour) blue bars on the secondary axis.

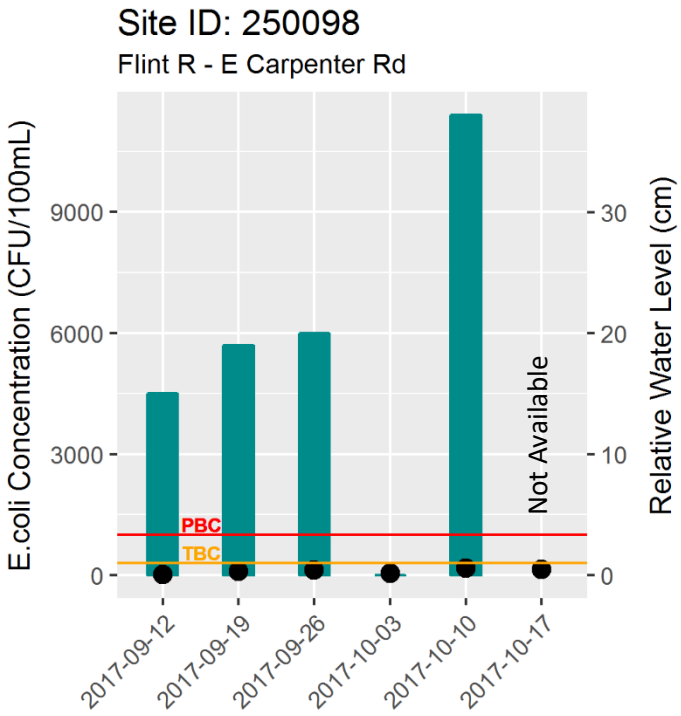


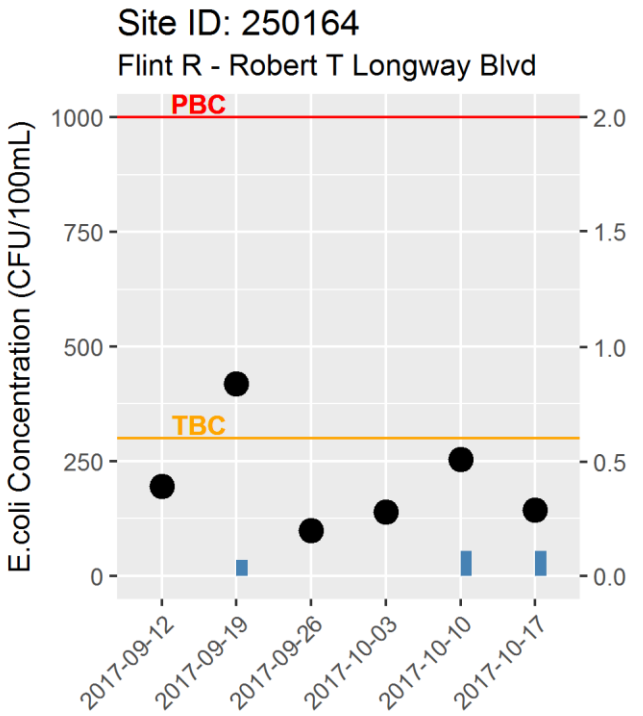


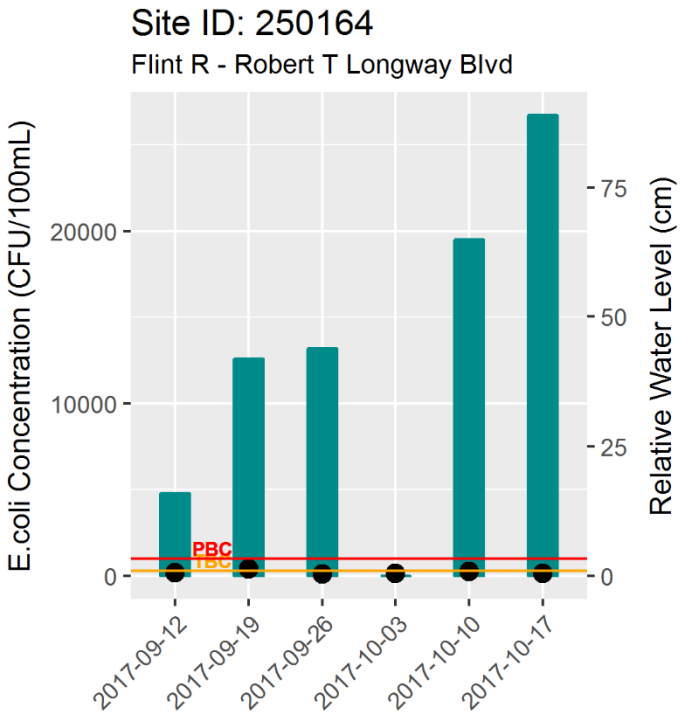


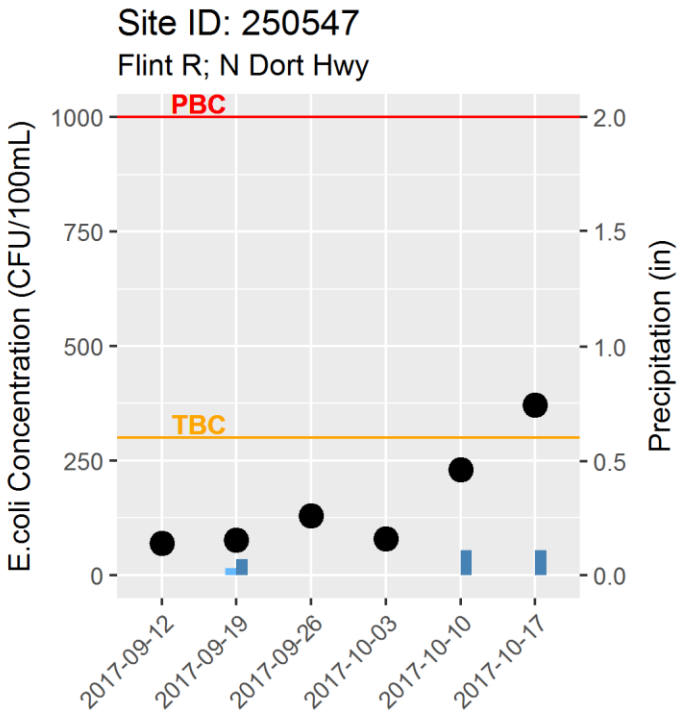


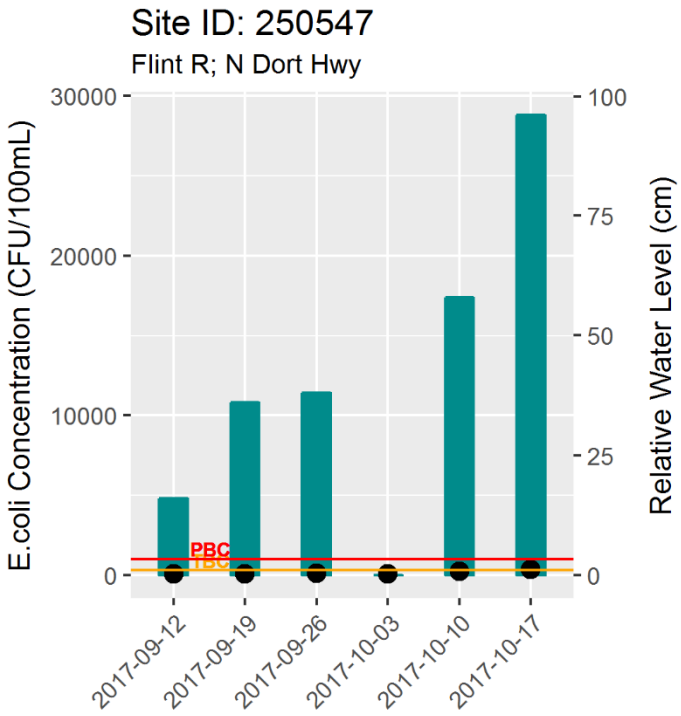

Site ID: 250098
Flint R - E Carpenter Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10
2017-10-17

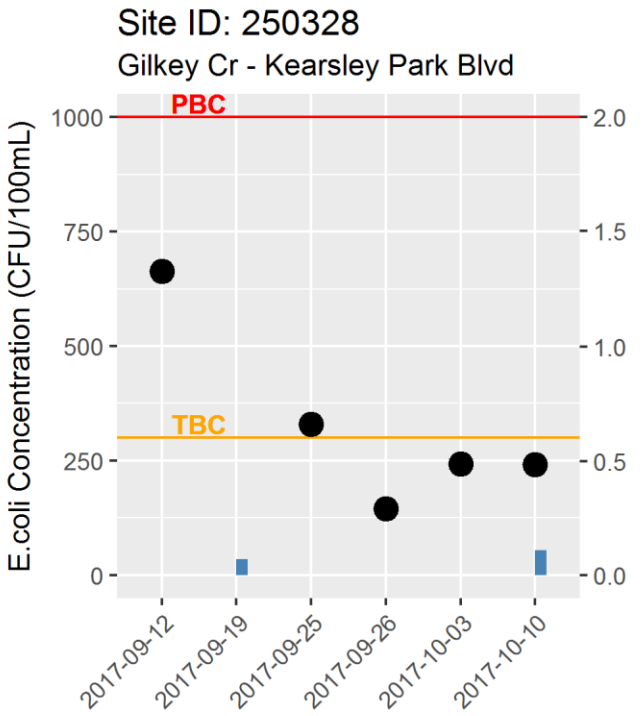

Site ID: 250098
Flint R - E Carpenter Rd
PBC
TBC
Not Available
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
9000
6000
3000
0
30
20
10
0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10
2017-10-17

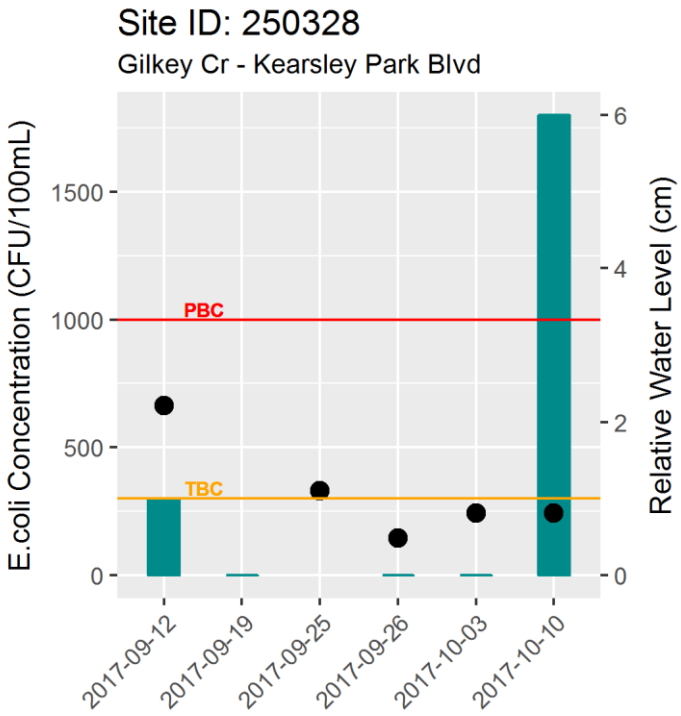

Site ID: 250164
Flint R - Robert T Longway Blvd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10
2017-10-17

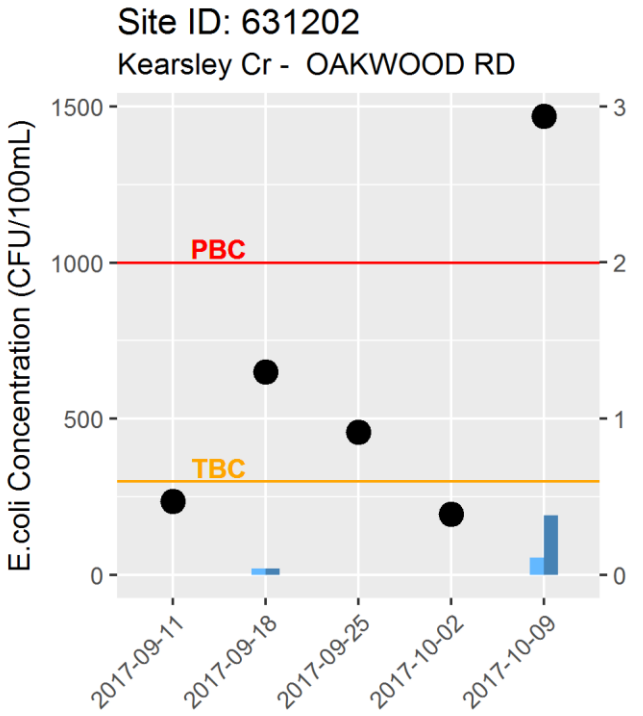

Site ID: 250164
Flint R - Robert T Longway Blvd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
20000
10000
0
75
50
25
0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10
2017-10-17

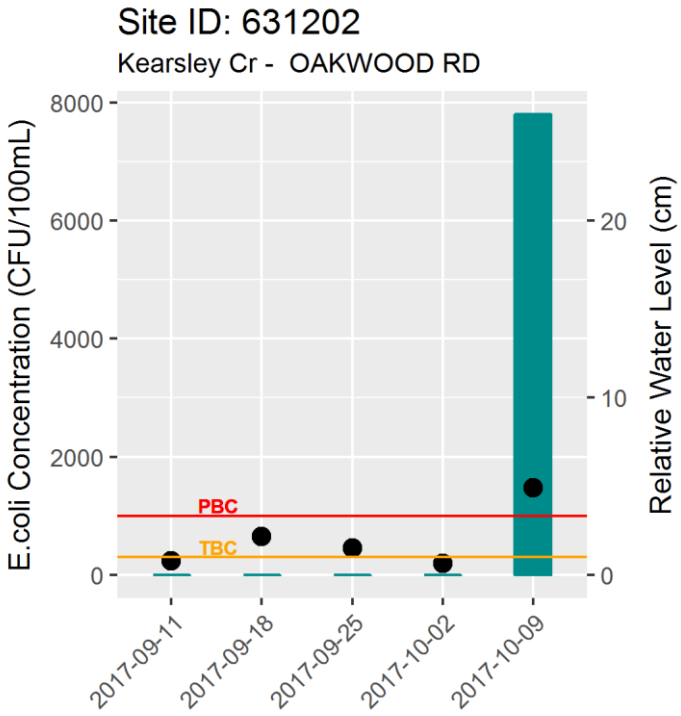

Site ID: 250547
Flint R; N Dort Hwy
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10
2017-10-17

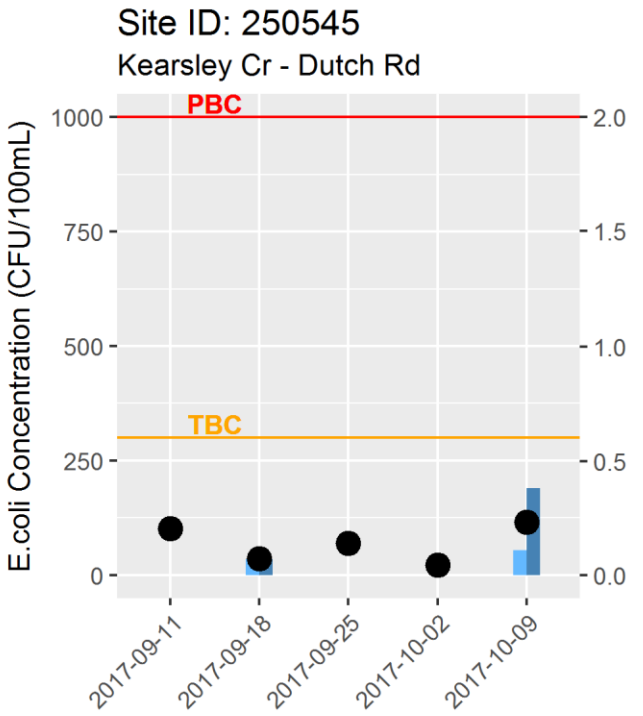

Site ID: 250547
Flint R; N Dort Hwy
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
30000
20000
10000
0
100
75
50
25
0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10
2017-10-17

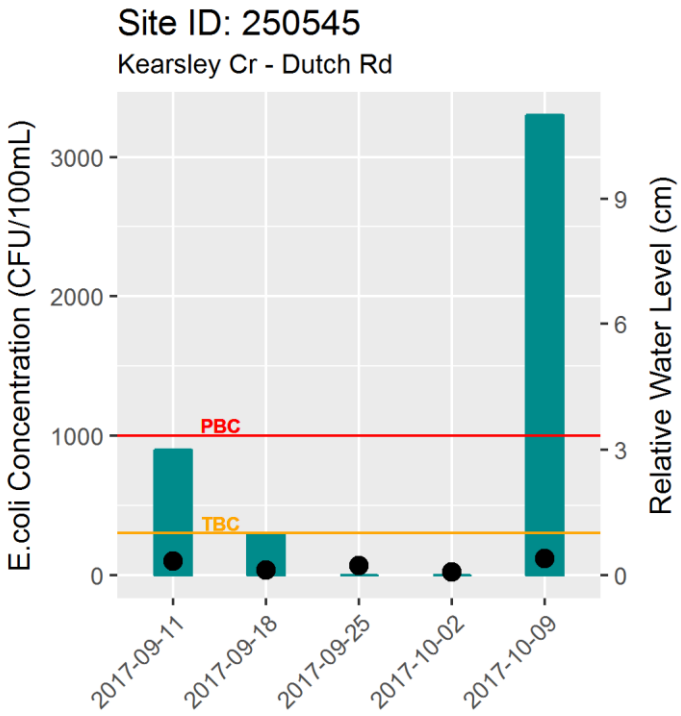

Site ID: 250328
Gilkey Cr - Kearsley Park Blvd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-09-12
2017-09-19
2017-09-25
2017-09-26
2017-10-03
2017-10-10

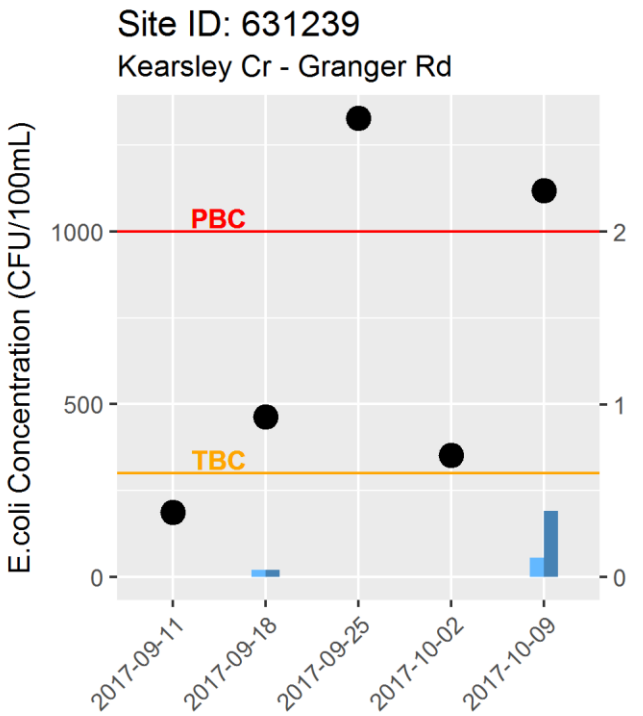

Site ID: 250328
Gilkey Cr - Kearsley Park Blvd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1500
1000
500
0
6
4
2
0
2017-09-12
2017-09-19
2017-09-25
2017-09-26
2017-10-03
2017-10-10

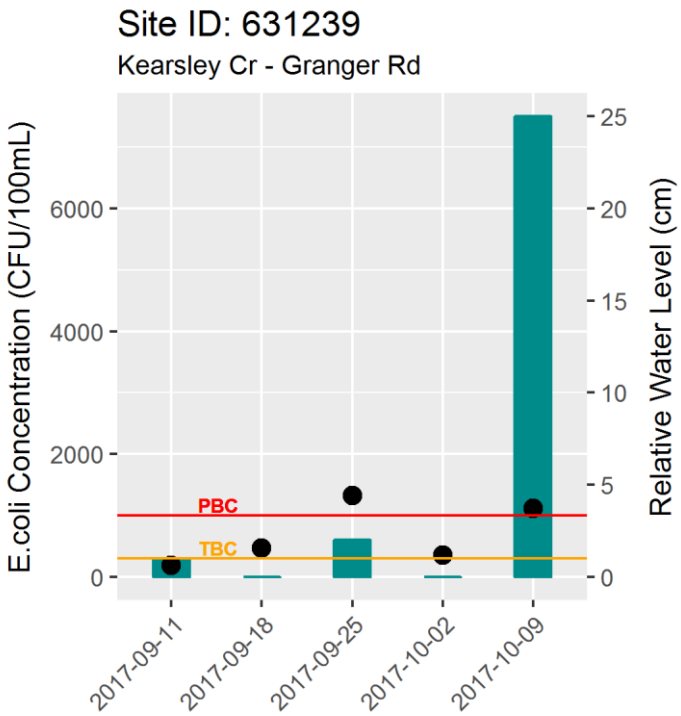

Site ID: 631202
Kearsley Cr - OAKWOOD RD
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1500
1000
500
0
3
2
1
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

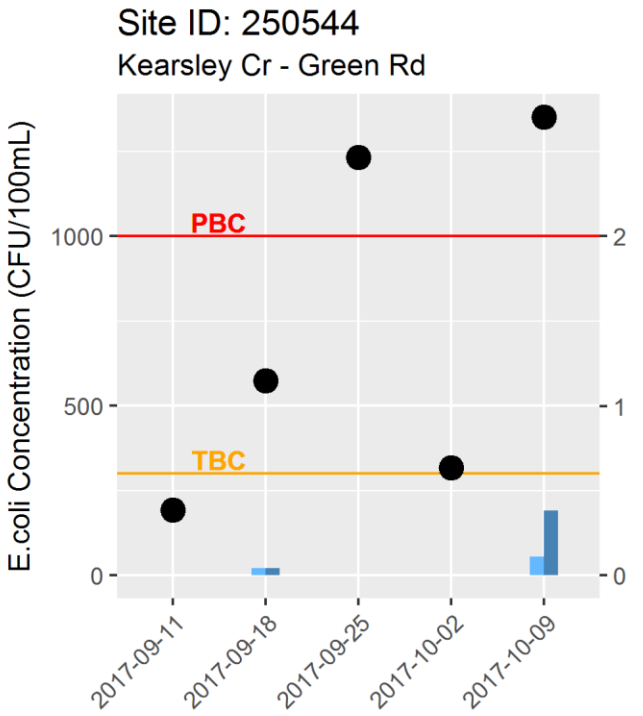

Site ID: 631202
Kearsley Cr - OAKWOOD RD
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
8000
6000
4000
2000
0
20
10
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

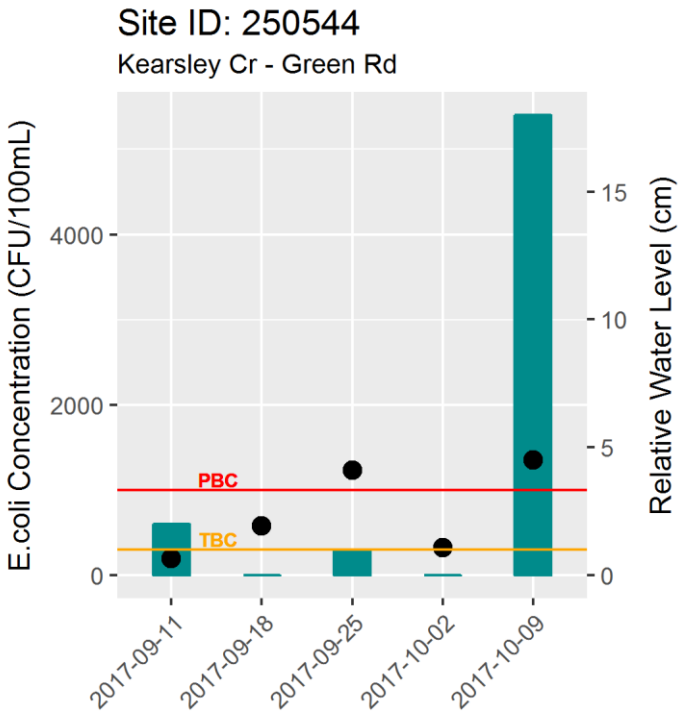

Site ID: 250545
Kearsley Cr - Dutch Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

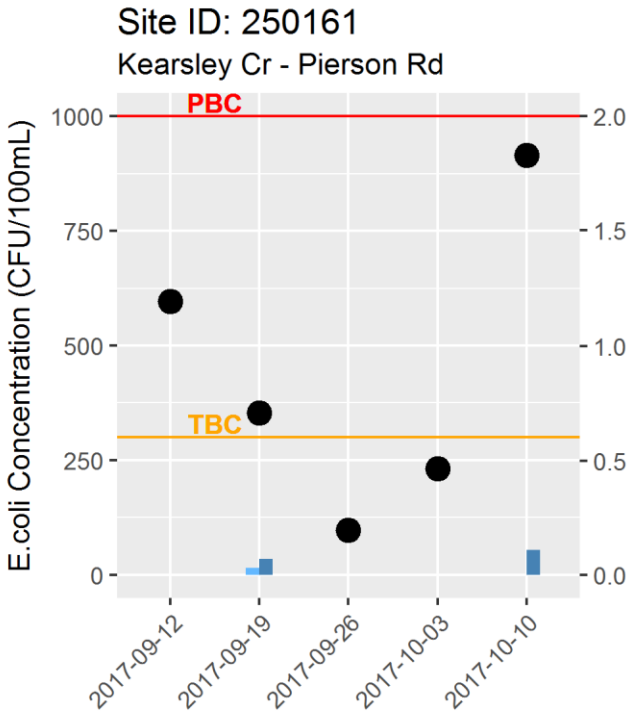

Site ID: 250545
Kearsley Cr - Dutch Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
3000
2000
1000
0
9
6
3
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

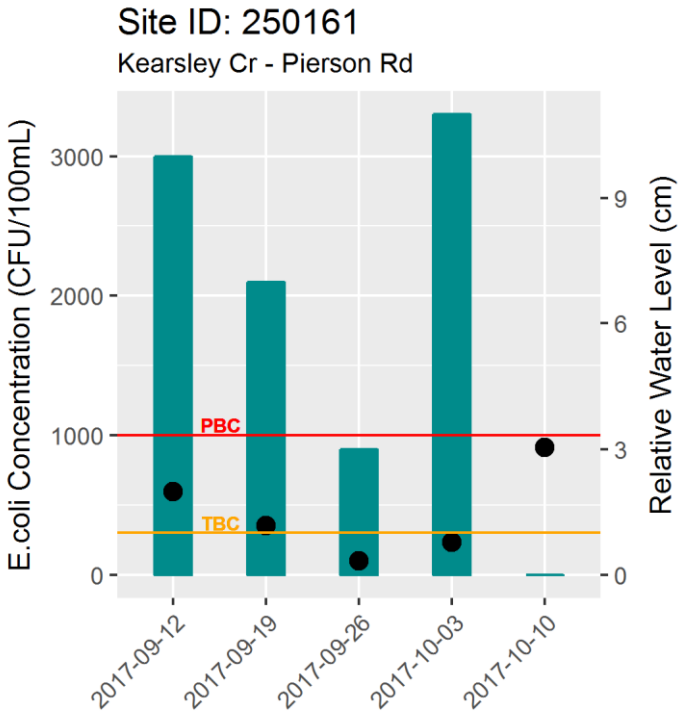

Site ID: 631239
Kearsley Cr - Granger Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
500
0
2
1
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

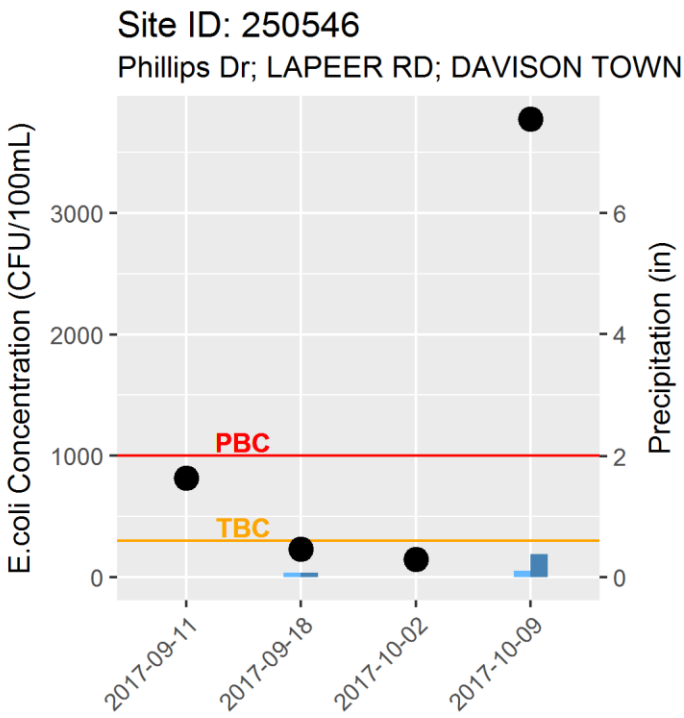

Site ID: 631239
Kearsley Cr - Granger Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
6000
4000
2000
0
25
20
15
10
5
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

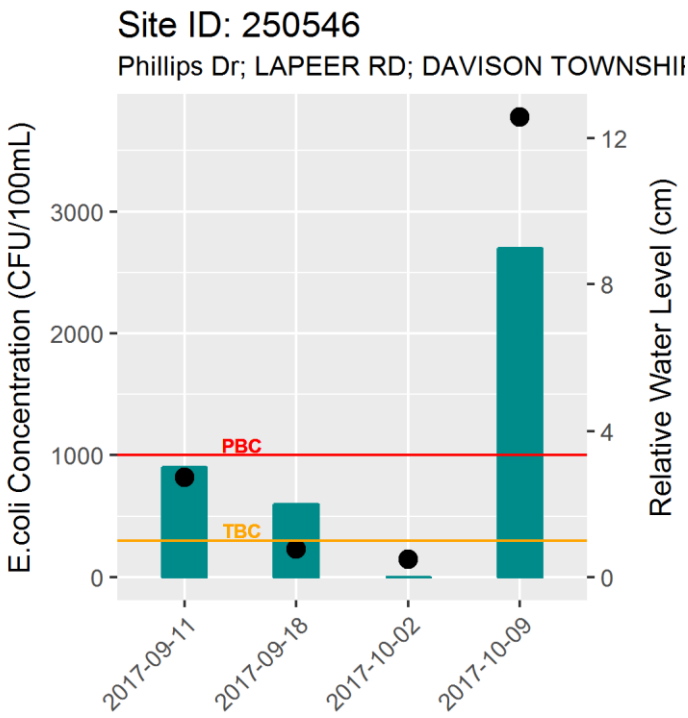

Site ID: 250544
Kearsley Cr - Green Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1000
500
0
2
1
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

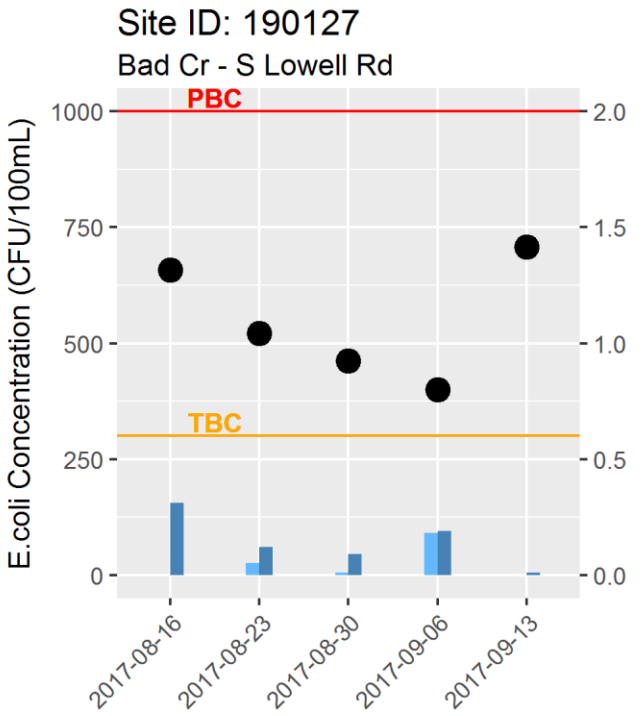

Site ID: 250544
Kearsley Cr - Green Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
4000
2000
0
15
10
5
0
2017-09-11
2017-09-18
2017-09-25
2017-10-02
2017-10-09

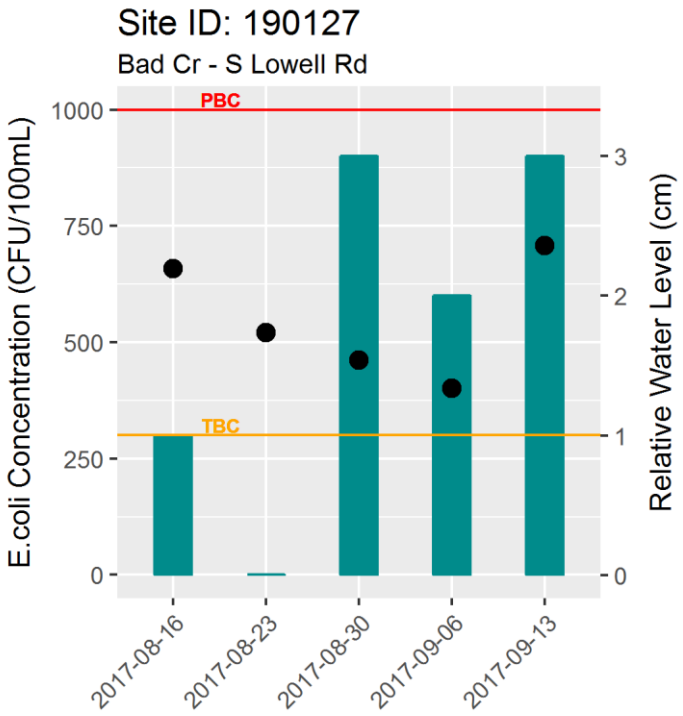

Site ID: 250161
Kearsley Cr - Pierson Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10

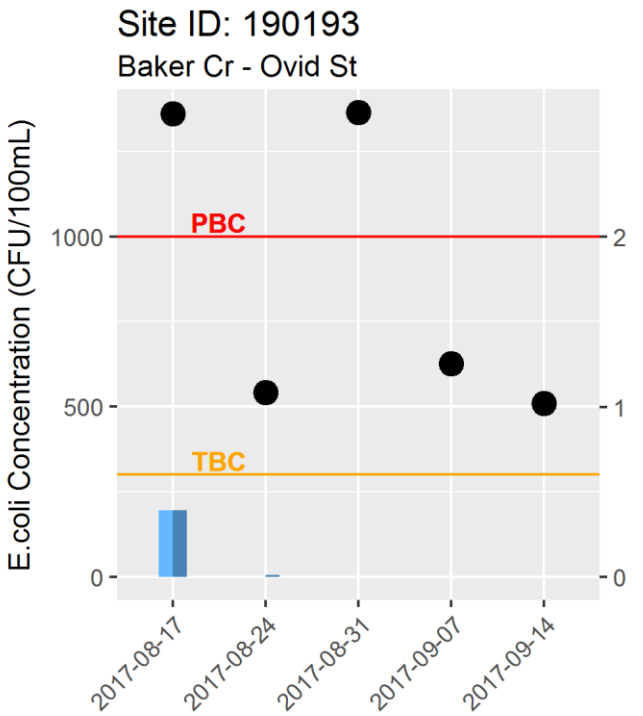

Site ID: 250161
Kearsley Cr - Pierson Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
3000
2000
1000
0
9
6
3
0
2017-09-12
2017-09-19
2017-09-26
2017-10-03
2017-10-10

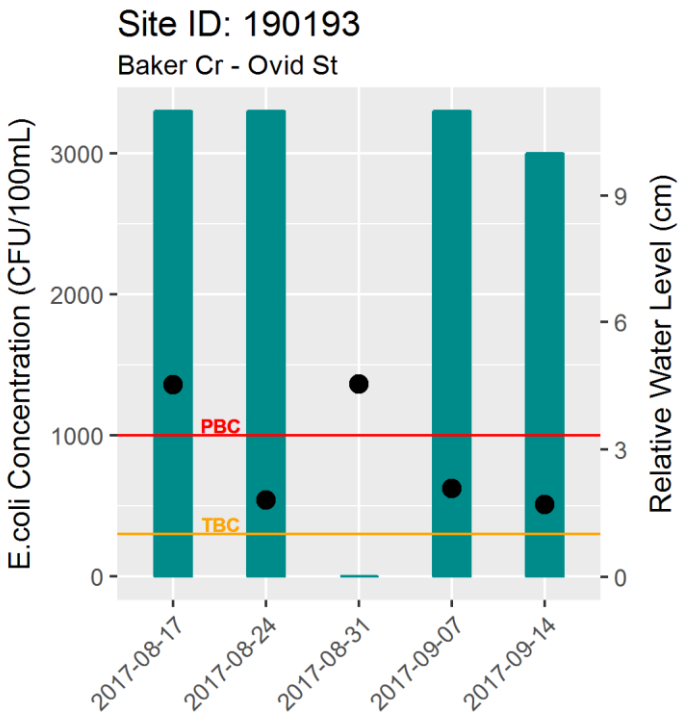

Site ID: 250546
Phillips Dr; LAPEER RD; DAVISON TOWN
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
0
1000
2000
3000
0
2
4
6
2017-09-11
2017-09-18
2017-10-02
2017-10-09

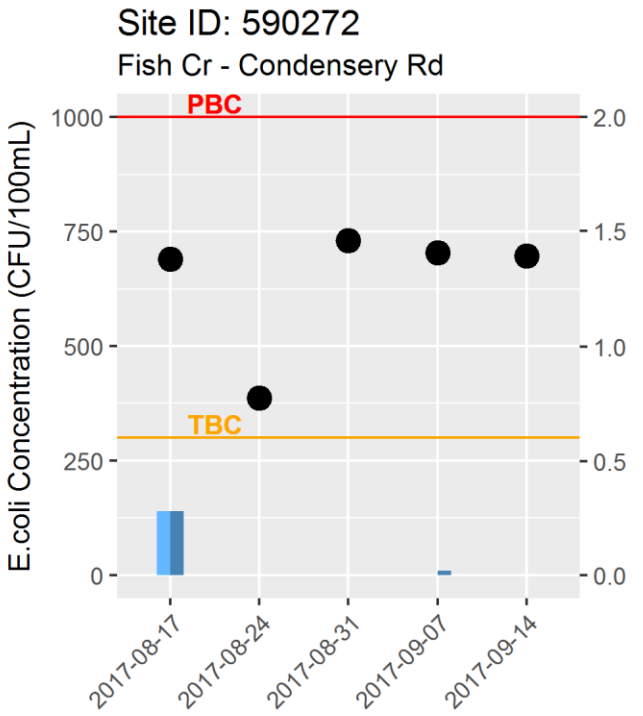

Site ID: 250546
Phillips Dr; LAPEER RD; DAVISON TOWNSHI
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
0
1000
2000
3000
0
4
8
12
2017-09-11
2017-09-18
2017-10-02
2017-10-09

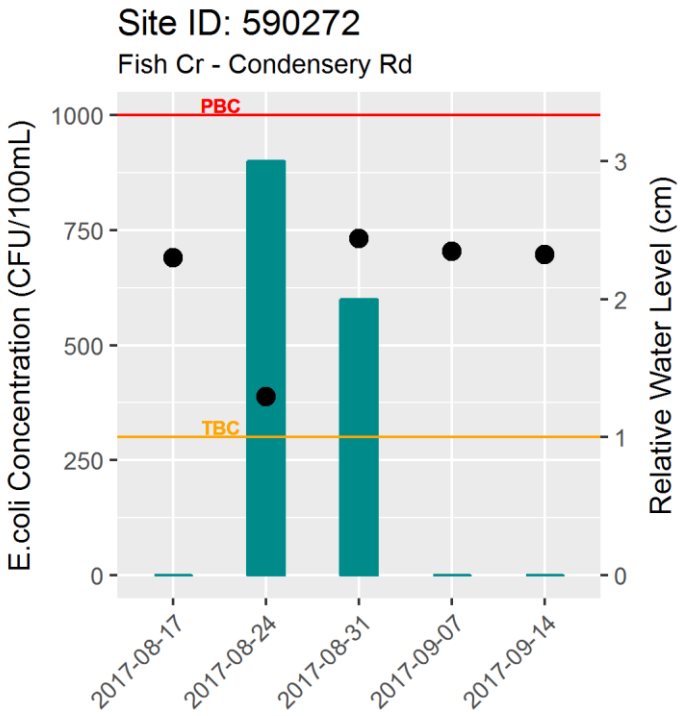

Site ID: 190127
Bad Cr - S Lowell Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

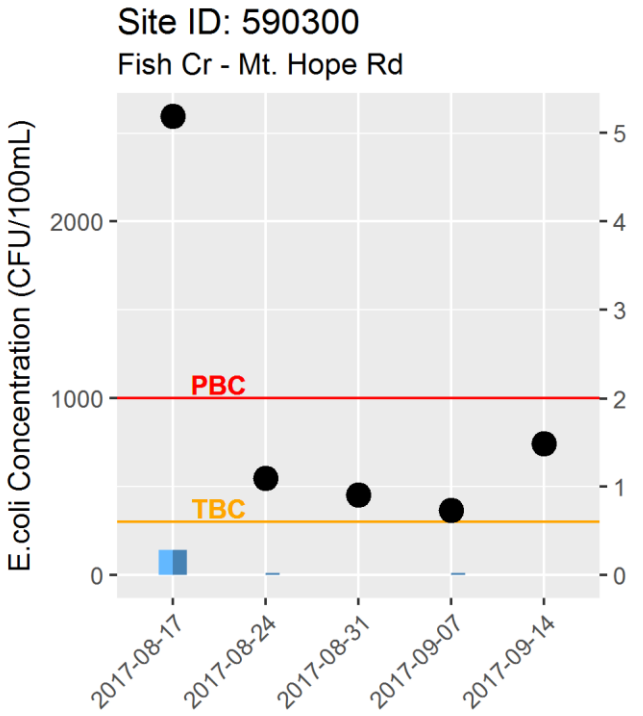

Site ID: 190127
Bad Cr - S Lowell Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

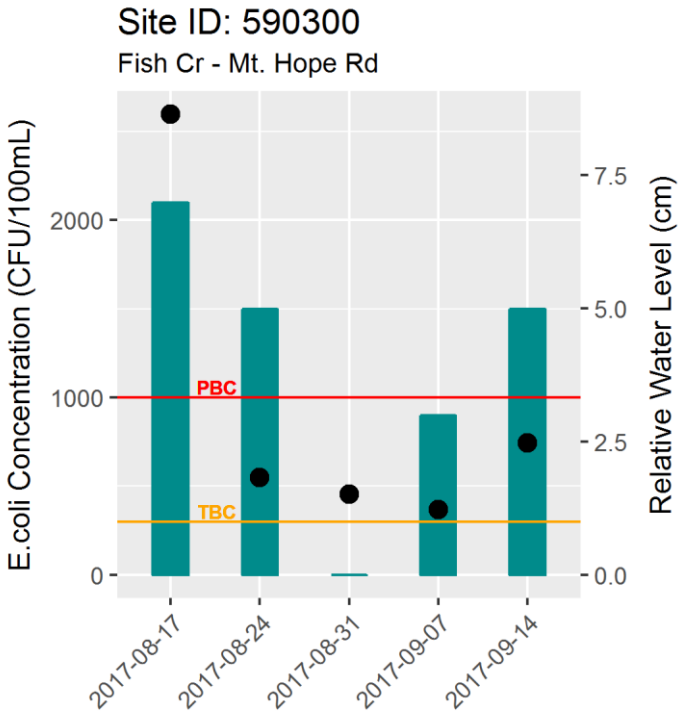

Site ID: 190193
Baker Cr - Ovid St
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
500
0
2
1
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

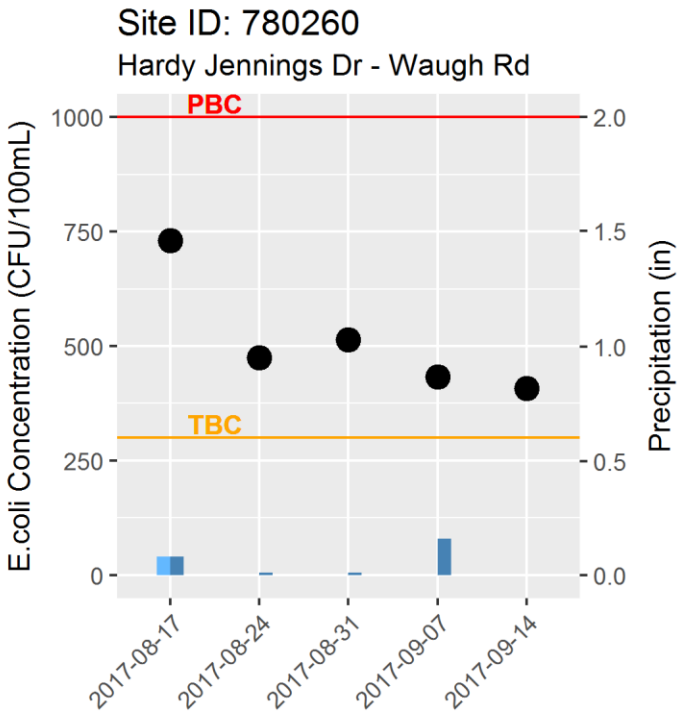

Site ID: 190193
Baker Cr - Ovid St
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
3000
2000
1000
0
9
6
3
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14


Site ID: 590272
Fish Cr - Condensery Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14


Site ID: 590272
Fish Cr - Condensery Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

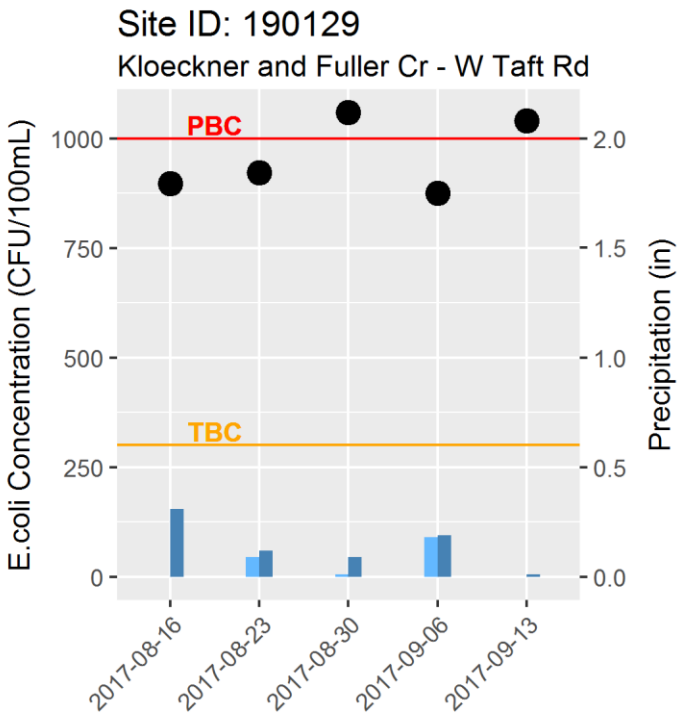

Site ID: 590300
Fish Cr - Mt. Hope Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
2000
1000
0
5
4
3
2
1
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

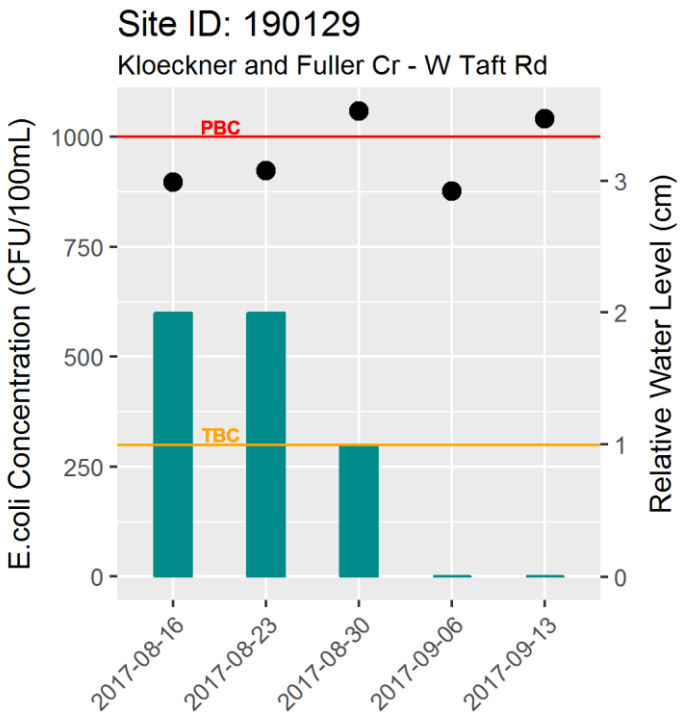

Site ID: 590300
Fish Cr - Mt. Hope Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
2000
1000
0
7.5
5.0
2.5
0.0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

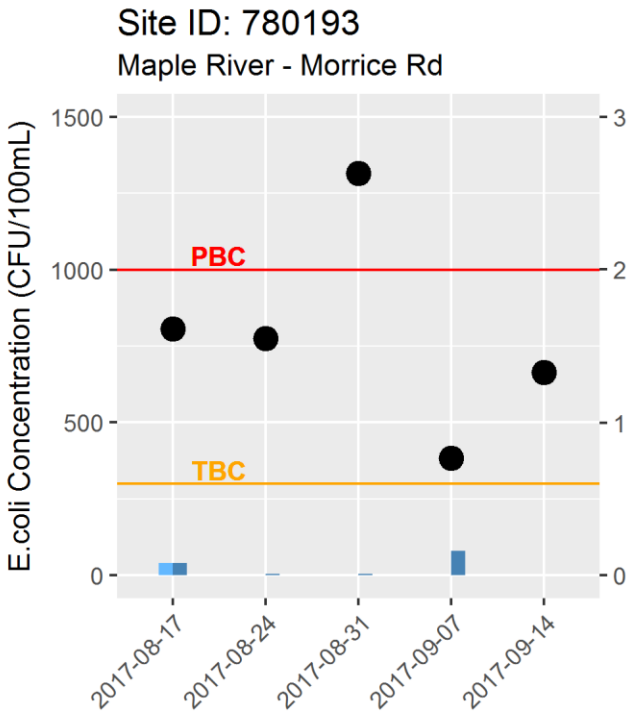


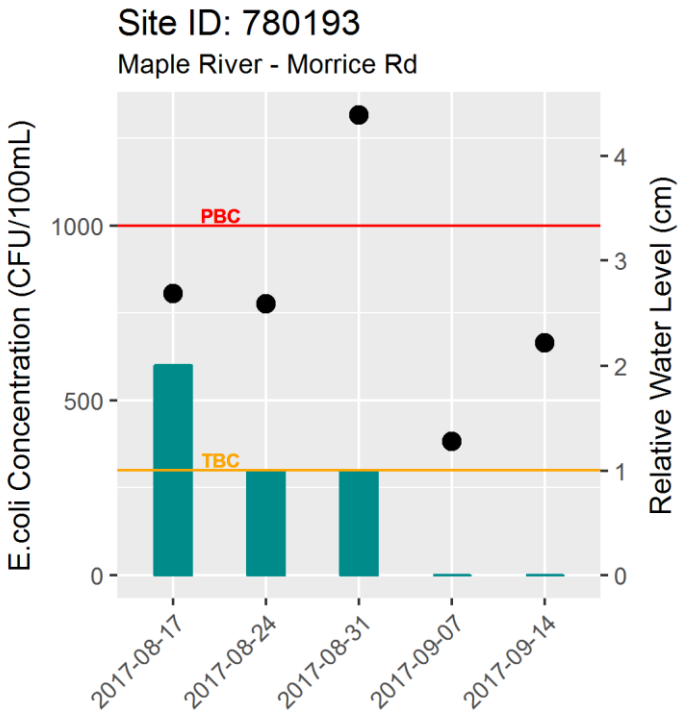
Site ID: 780260

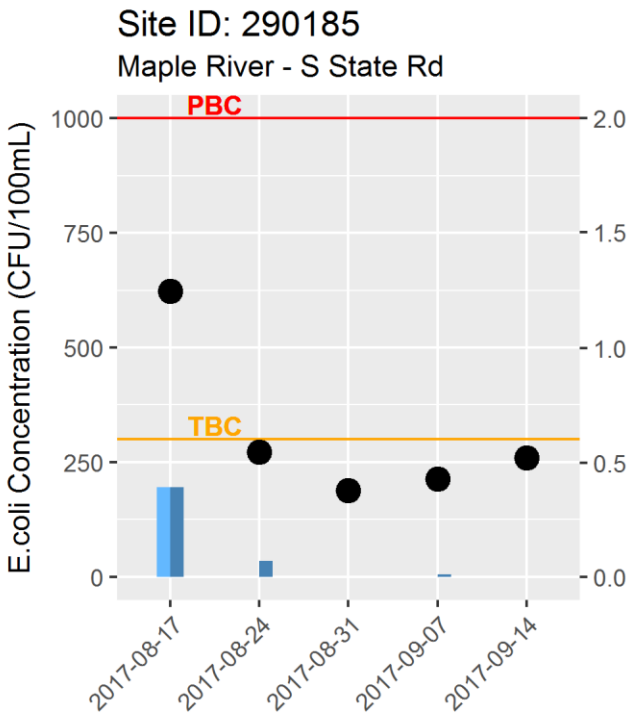
Water Levels Not Available

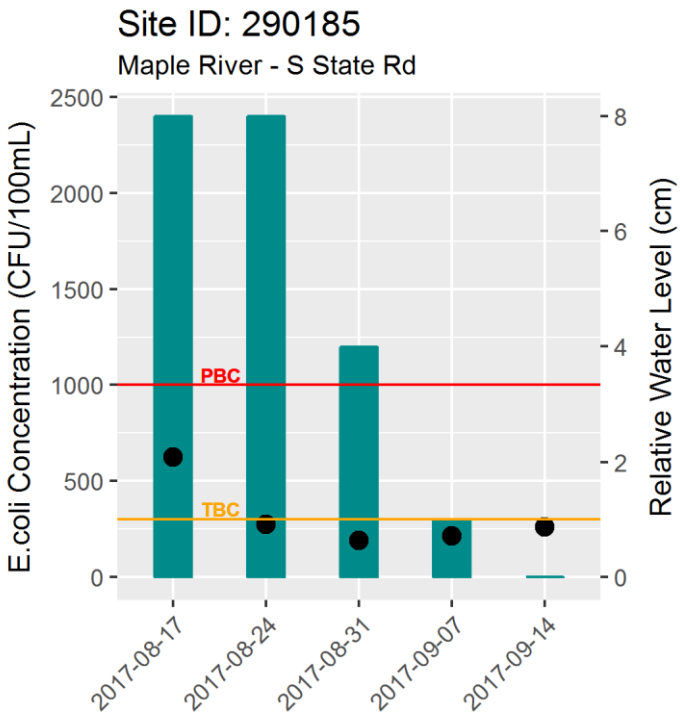


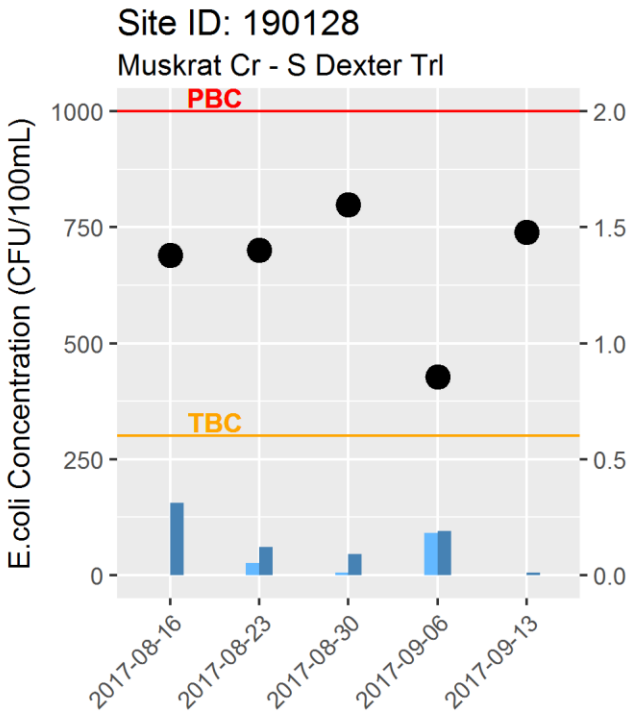


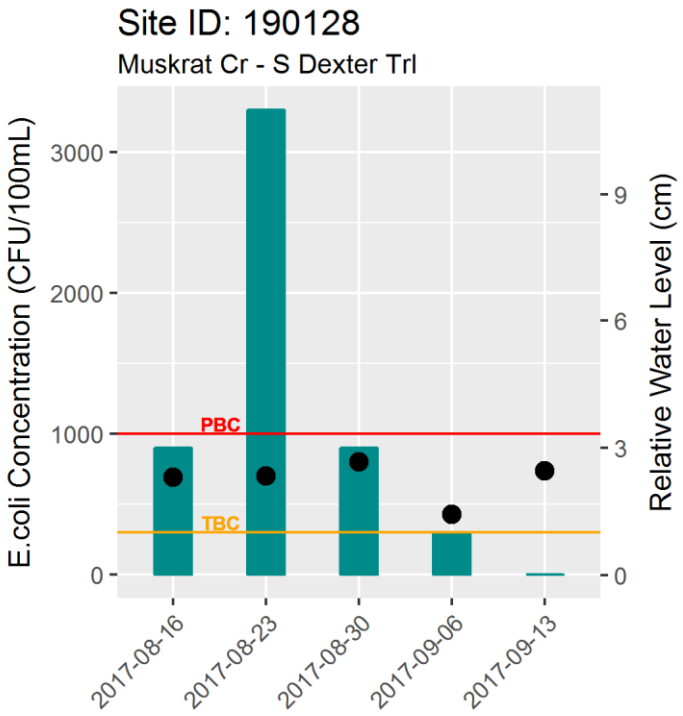

Site ID: 780193
Maple River - Morrice Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1500
1000
500
0
3
2
1
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

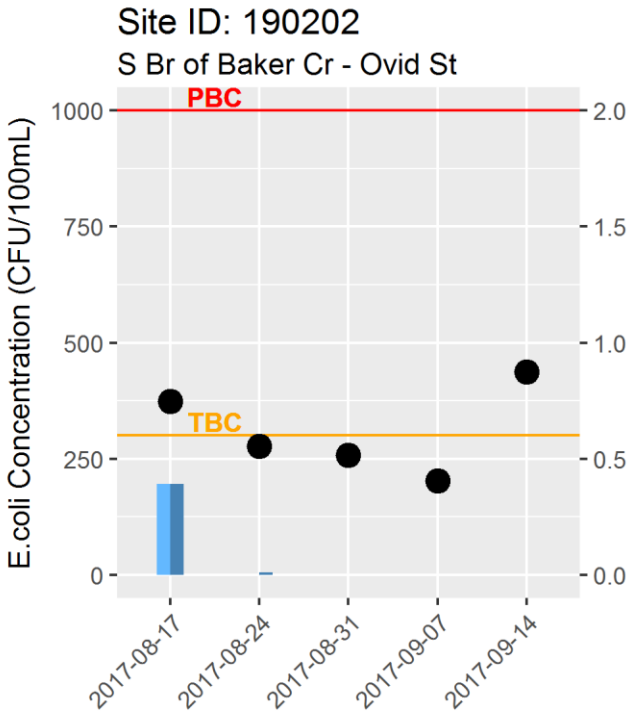

Site ID: 780193
Maple River - Morrice Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
1000
500
0
4
3
2
1
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

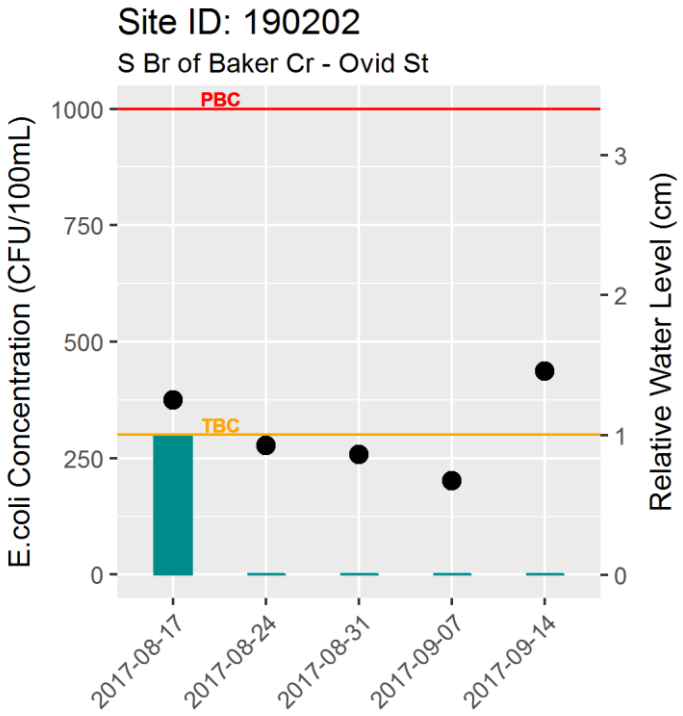

Site ID: 290185
Maple River - S State Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

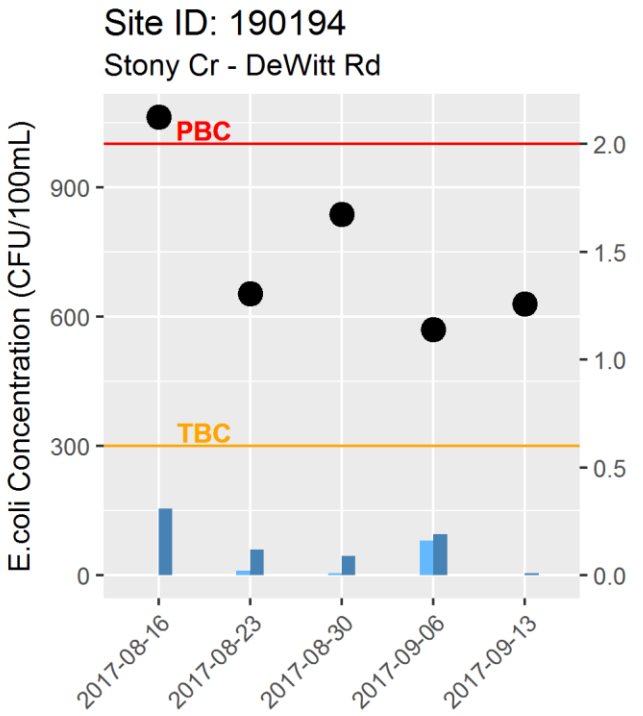

Site ID: 290185
Maple River - S State Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2500
2000
1500
1000
500
0
8
6
4
2
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

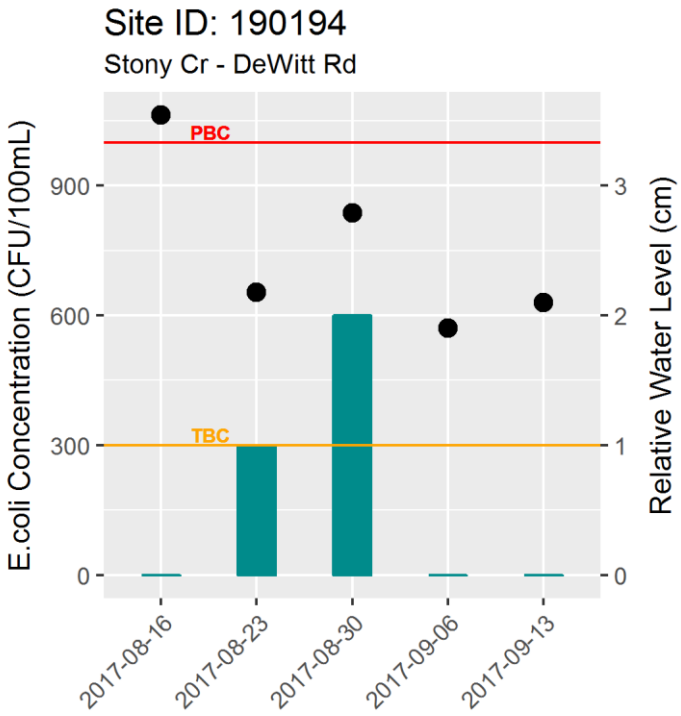

Site ID: 190128
Muskrat Cr - S Dexter Trl
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

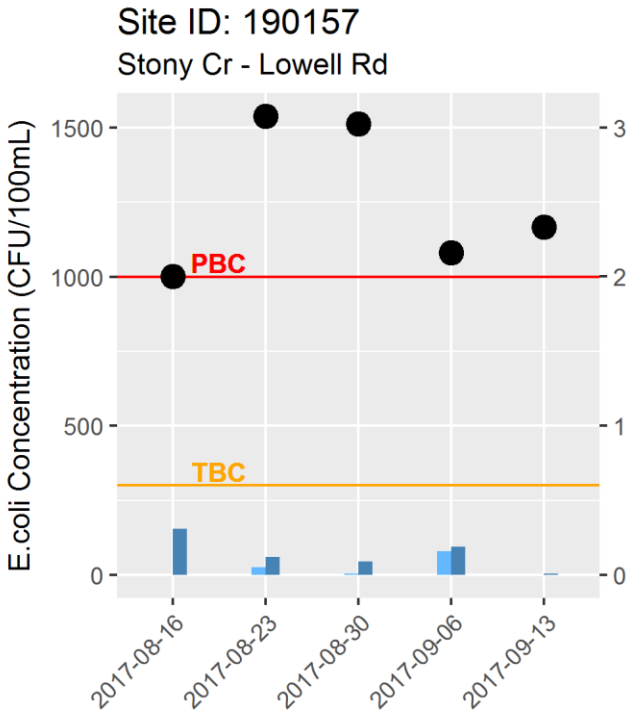

Site ID: 190128
Muskrat Cr - S Dexter Trl
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
3000
2000
1000
0
9
6
3
0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

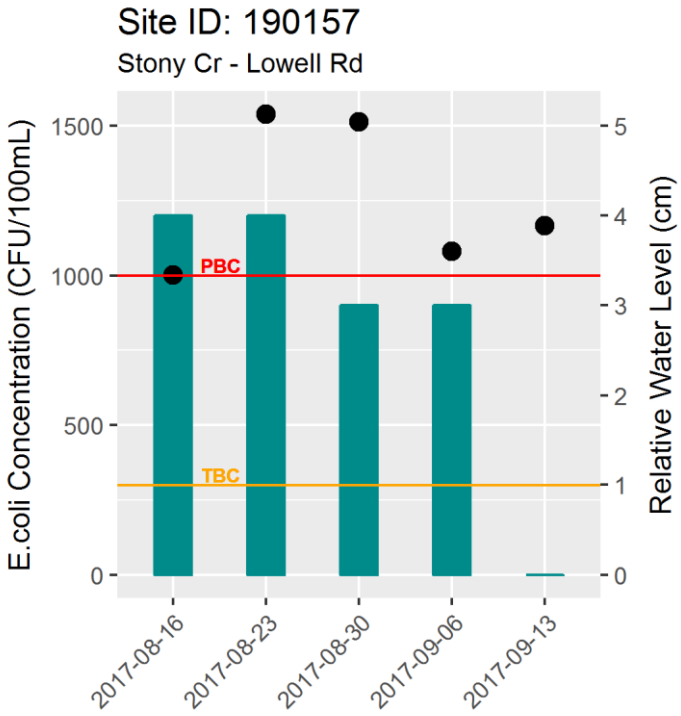

Site ID: 190202
S Br of Baker Cr - Ovid St
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

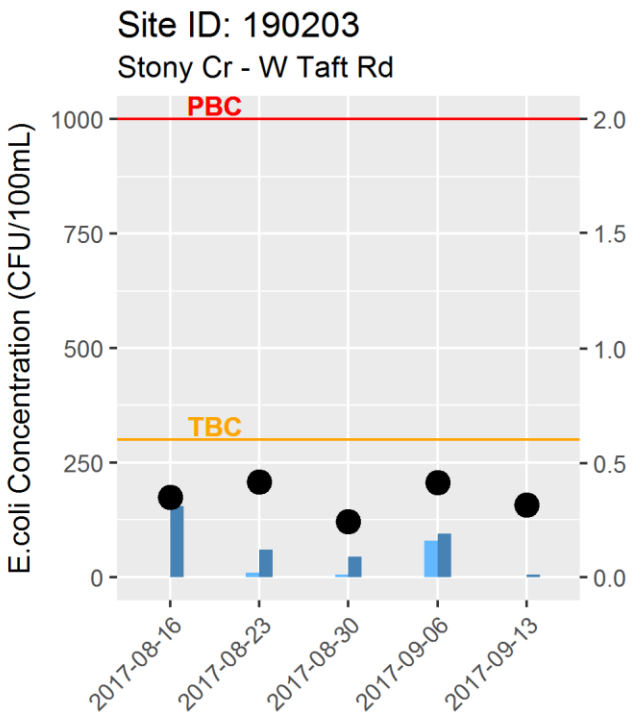

Site ID: 190202
S Br of Baker Cr - Ovid St
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-08-17
2017-08-24
2017-08-31
2017-09-07
2017-09-14

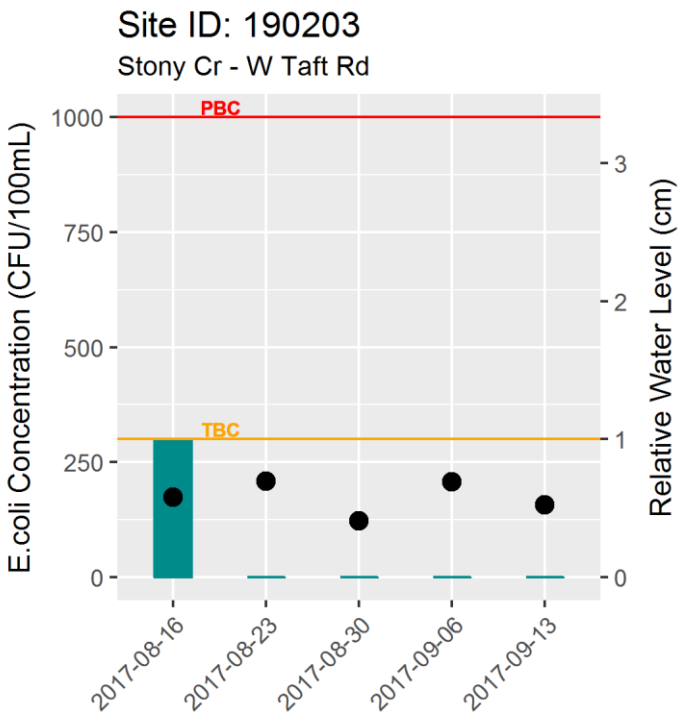

Site ID: 190194
Stony Cr - DeWitt Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
0
300
600
900
0.0
0.5
1.0
1.5
2.0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

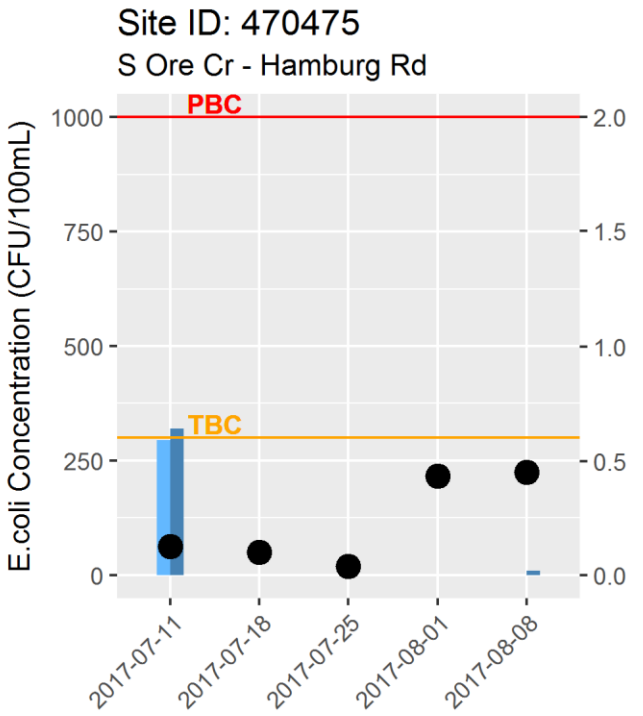

Site ID: 190194
Stony Cr - DeWitt Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
0
300
600
900
0
1
2
3
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

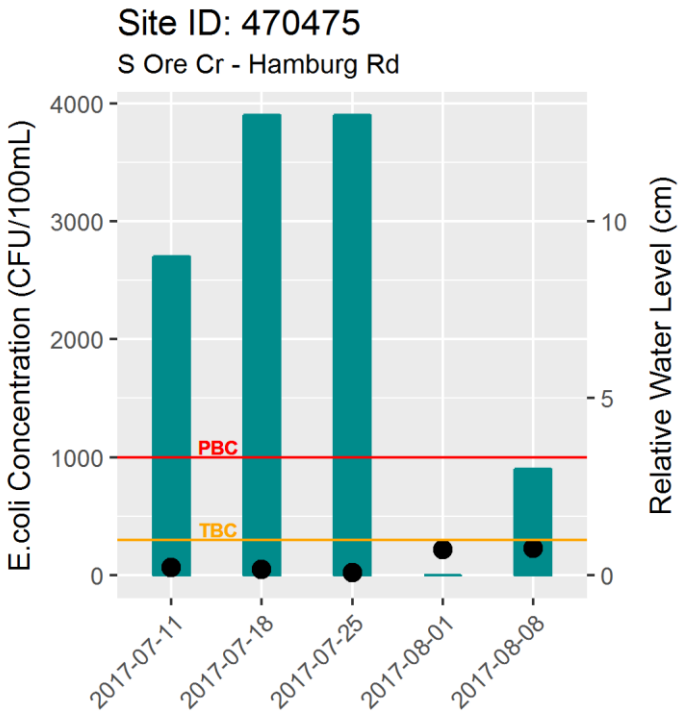

Site ID: 190157
Stony Cr - Lowell Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
0
500
1000
1500
0
1
2
3
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

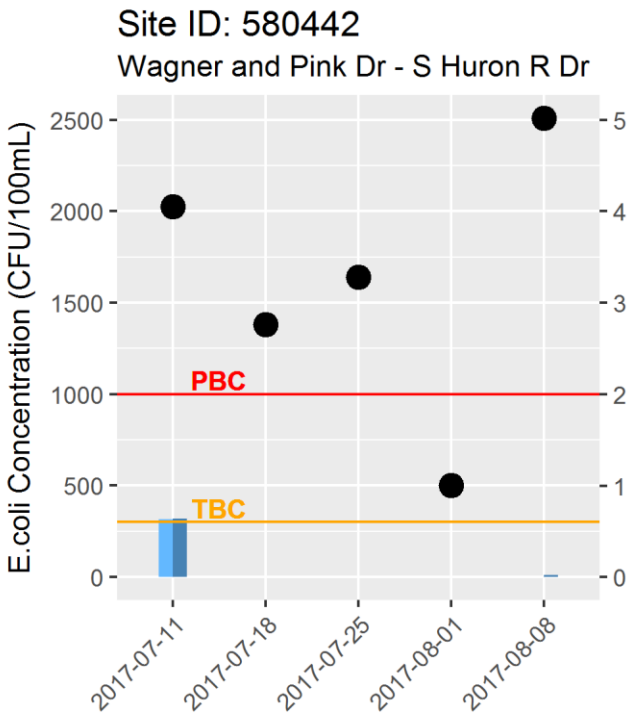

Site ID: 190157
Stony Cr - Lowell Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
0
500
1000
1500
0
1
2
3
4
5
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

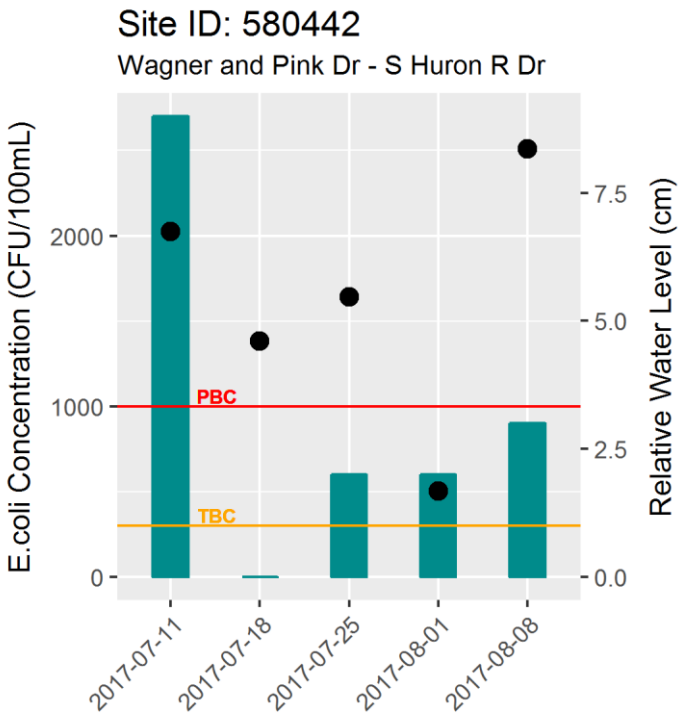

Site ID: 190203
Stony Cr - W Taft Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

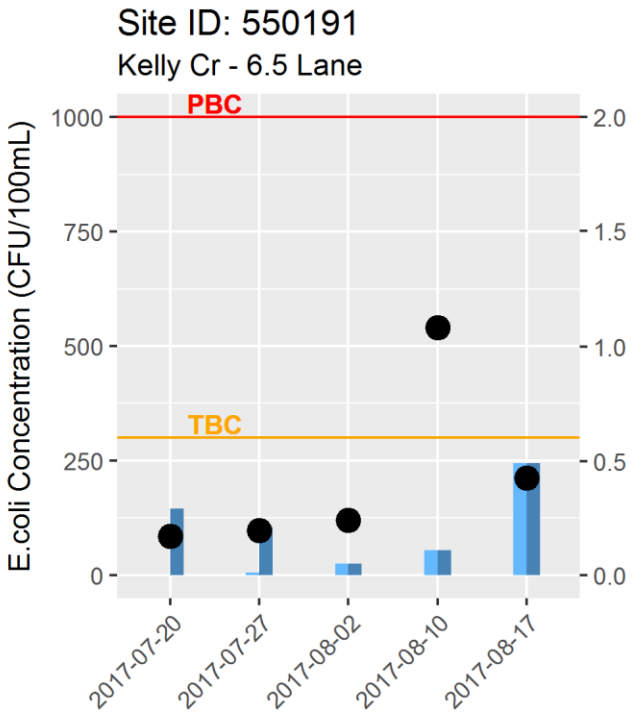

Site ID: 190203
Stony Cr - W Taft Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

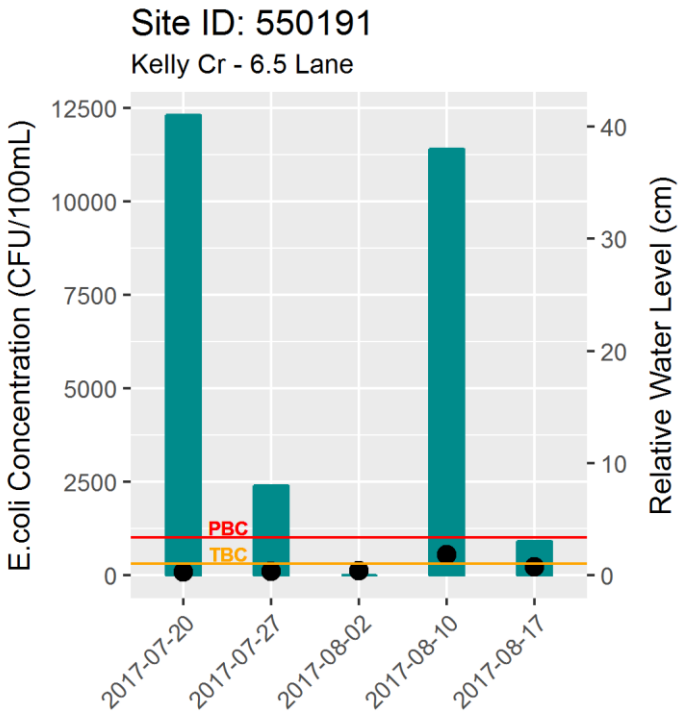

Site ID: 470475
S Ore Cr - Hamburg Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-11
2017-07-18
2017-07-25
2017-08-01
2017-08-08

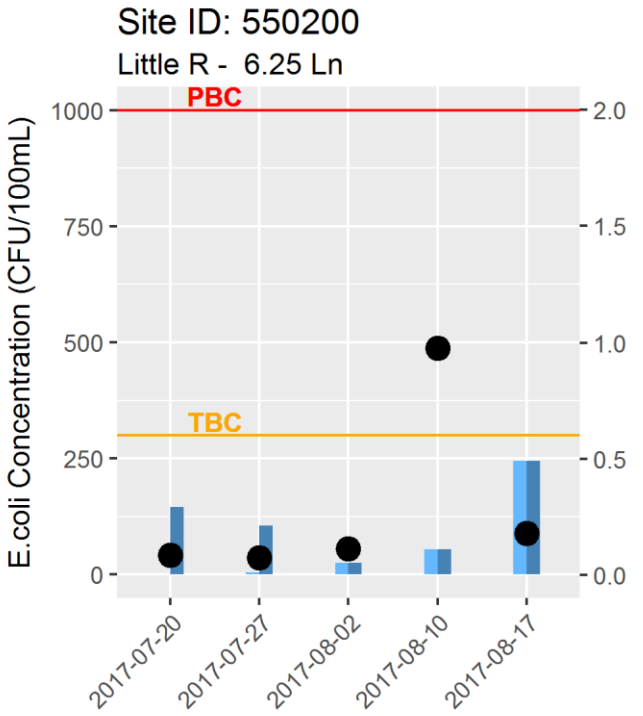

Site ID: 470475
S Ore Cr - Hamburg Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
4000
3000
2000
1000
0
10
5
0
2017-07-11
2017-07-18
2017-07-25
2017-08-01
2017-08-08

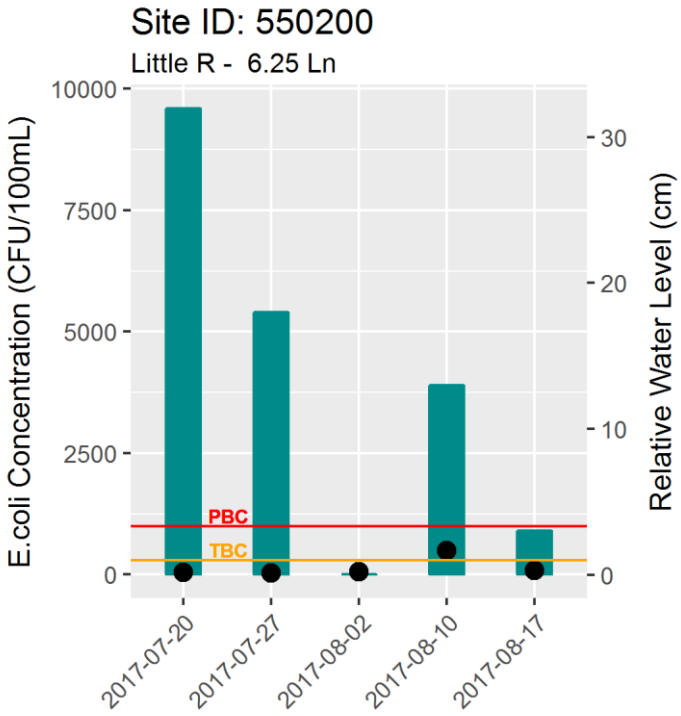

Site ID: 580442
Wagner and Pink Dr - S Huron R Dr
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
2500
2000
1500
1000
500
0
5
4
3
2
1
0
2017-07-11
2017-07-18
2017-07-25
2017-08-01
2017-08-08

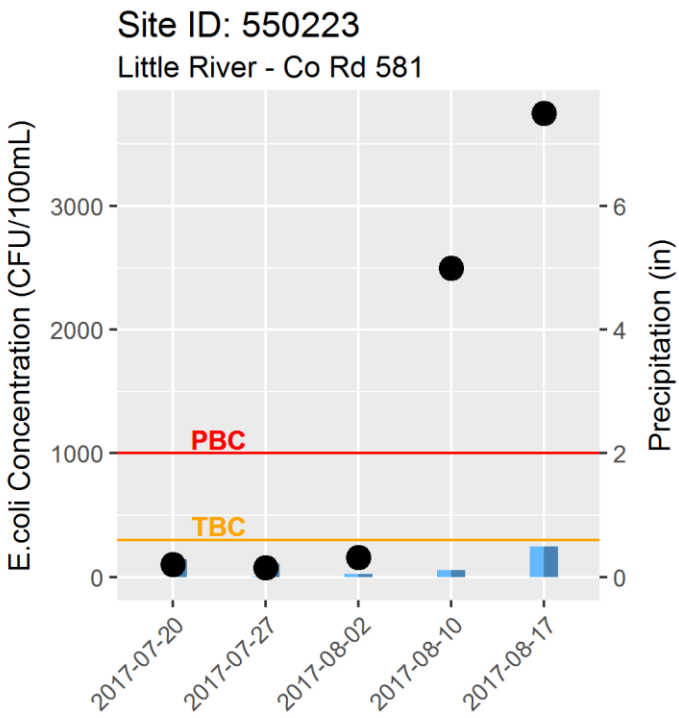

Site ID: 580442
Wagner and Pink Dr - S Huron R Dr
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2000
1000
0
7.5
5.0
2.5
0.0
2017-07-11
2017-07-18
2017-07-25
2017-08-01
2017-08-08

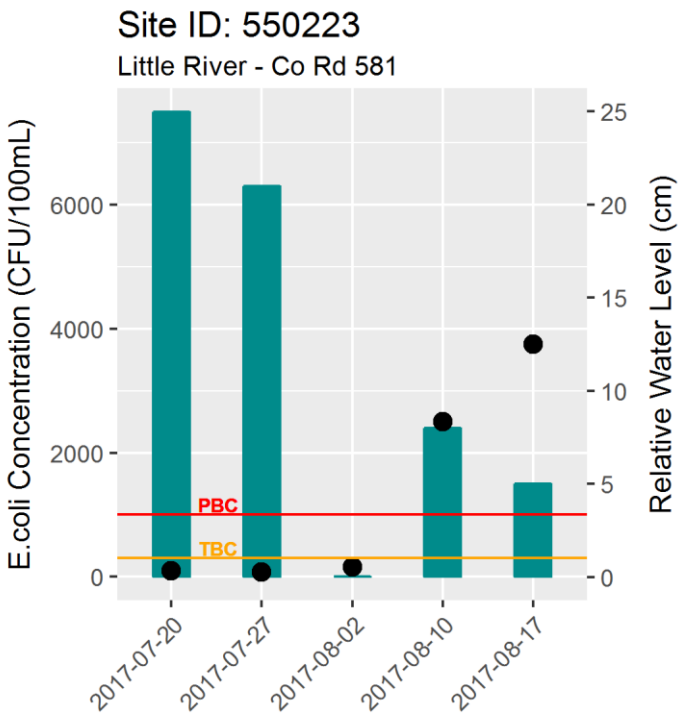

Site ID: 550191
Kelly Cr - 6.5 Lane
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-20
2017-07-27
2017-08-02
2017-08-10
2017-08-17

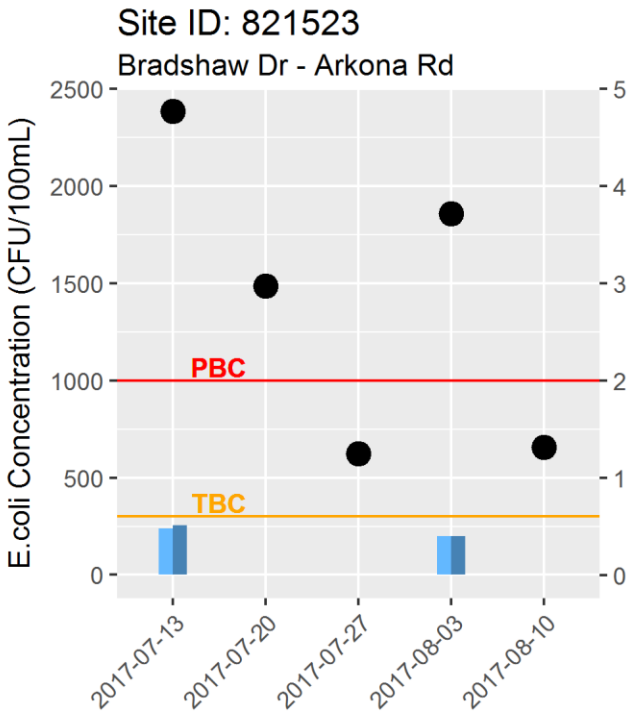

Site ID: 550191
Kelly Cr - 6.5 Lane
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
12500
10000
7500
5000
2500
0
40
30
20
10
0
2017-07-20
2017-07-27
2017-08-02
2017-08-10
2017-08-17

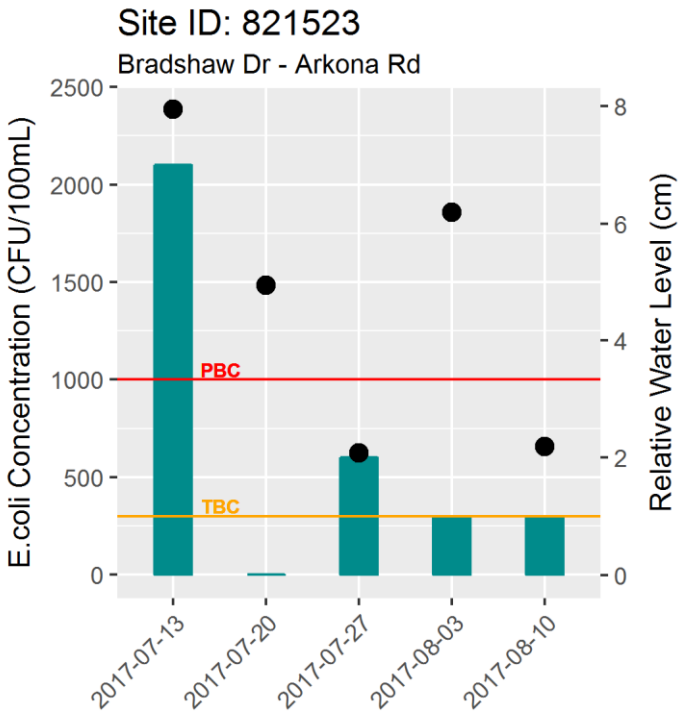

Site ID: 550200
Little R - 6.25 Ln
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-20
2017-07-27
2017-08-02
2017-08-10
2017-08-17

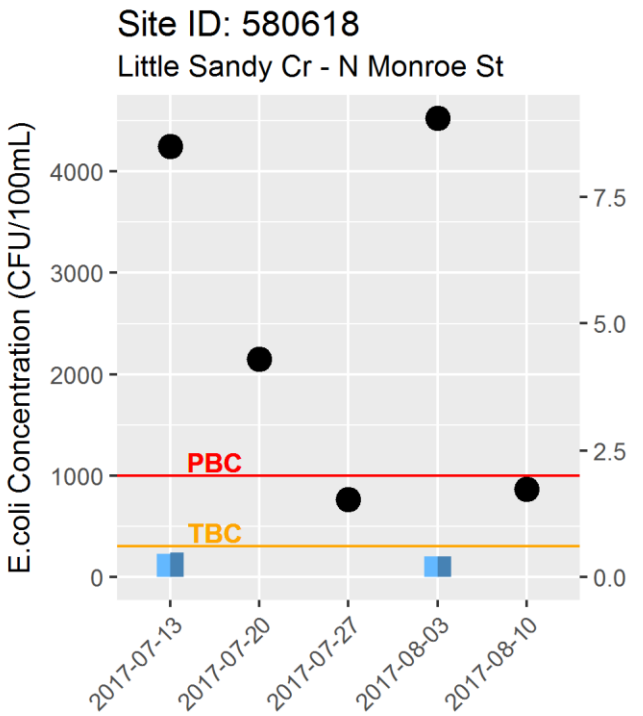

Site ID: 550200
Little R - 6.25 Ln
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
10000
7500
5000
2500
0
30
20
10
0
2017-07-20
2017-07-27
2017-08-02
2017-08-10
2017-08-17

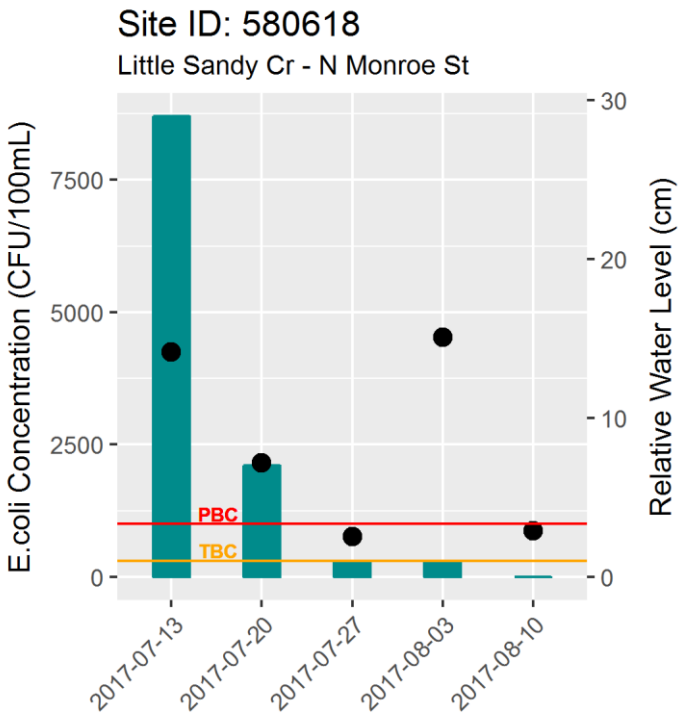

Site ID: 550223
Little River - Co Rd 581
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
0
1000
2000
3000
0
2
4
6
2017-07-20
2017-07-27
2017-08-02
2017-08-10
2017-08-17

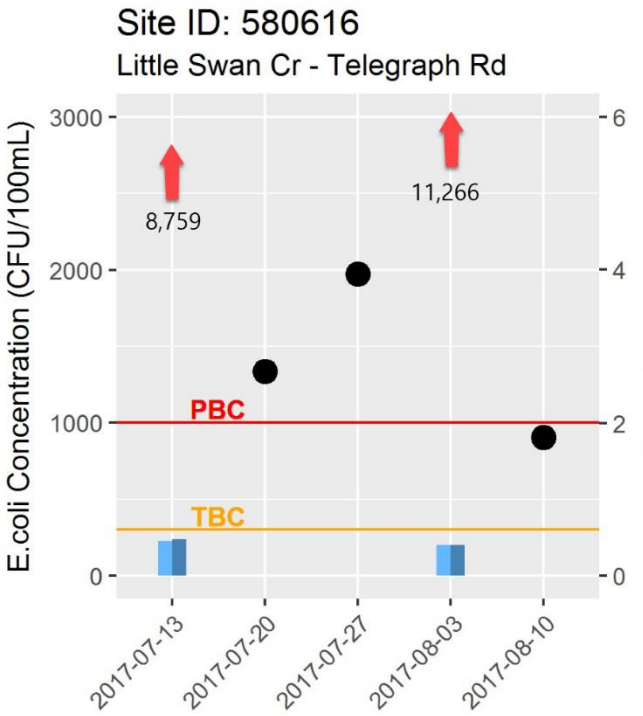

Site ID: 550223
Little River - Co Rd 581
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
0
2000
4000
6000
0
5
10
15
20
25
2017-07-20
2017-07-27
2017-08-02
2017-08-10
2017-08-17

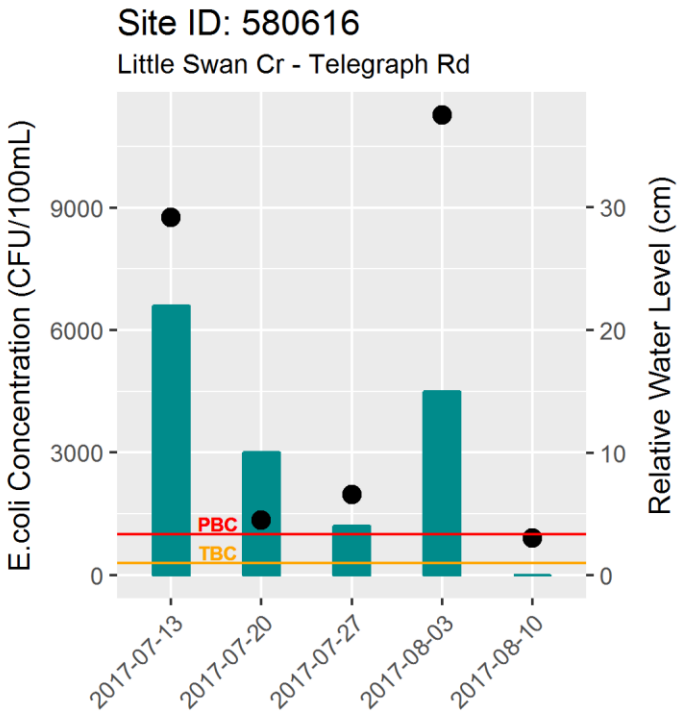

Site ID: 821523
Bradshaw Dr - Arkona Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

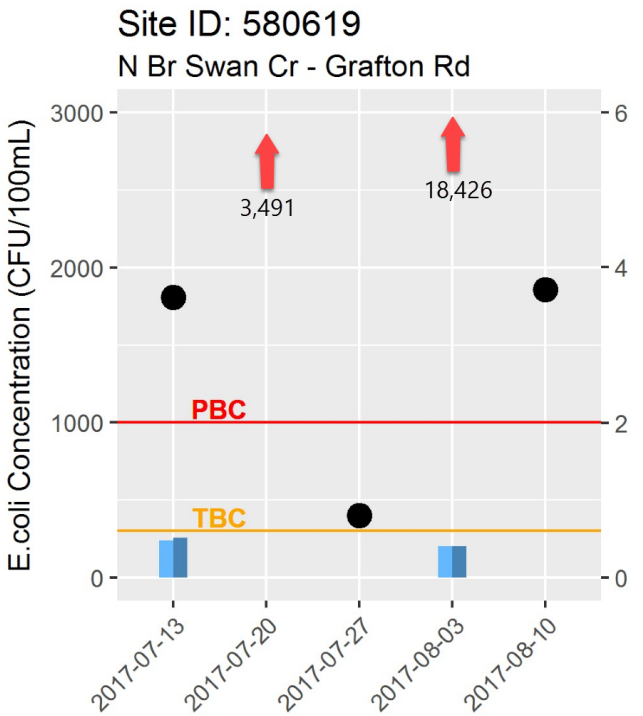

Site ID: 821523
Bradshaw Dr - Arkona Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

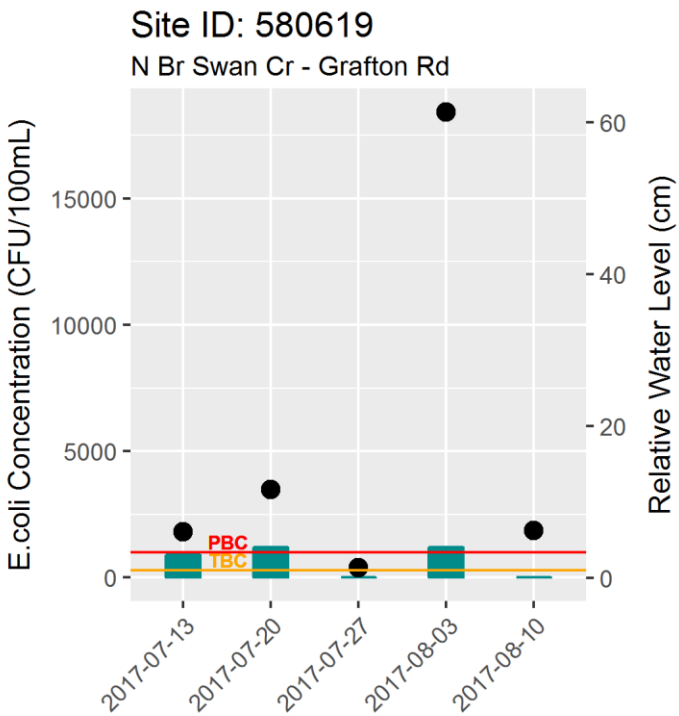

Site ID: 580618
Little Sandy Cr - N Monroe St
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

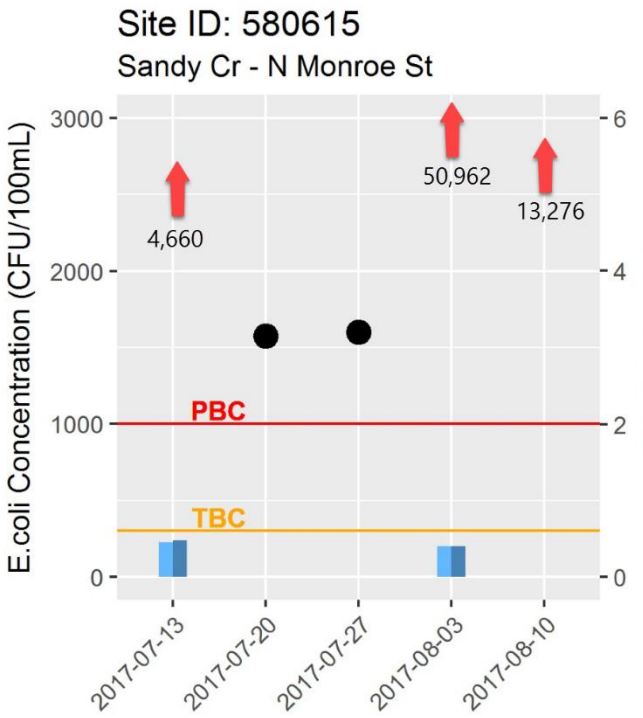

Site ID: 580618
Little Sandy Cr - N Monroe St
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

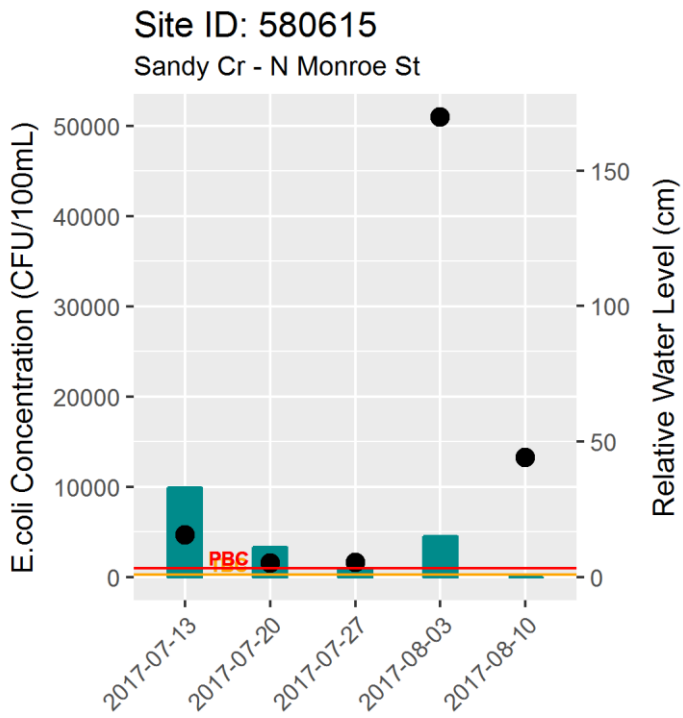

Site ID: 580616
Little Swan Cr - Telegraph Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
8,759
11,266
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

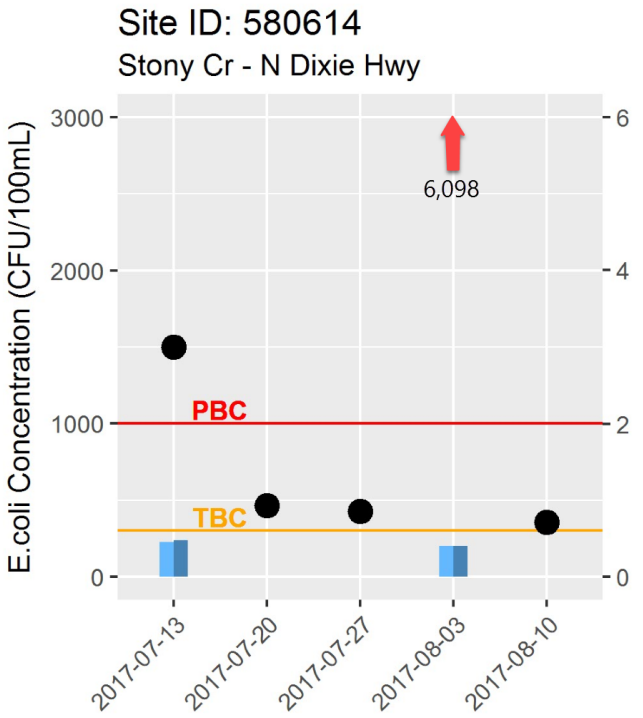

Site ID: 580616
Little Swan Cr - Telegraph Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

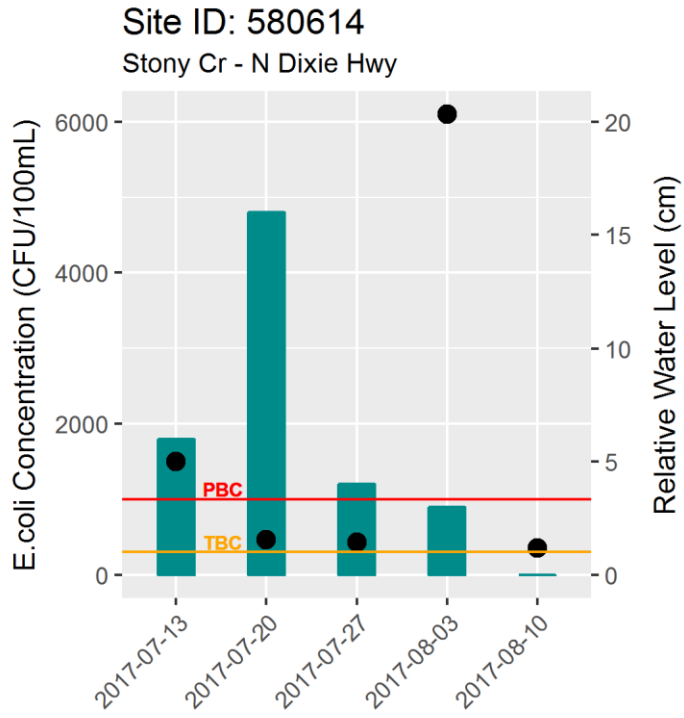

Site ID: 580619
N Br Swan Cr - Grafton Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
3,491
18,426
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

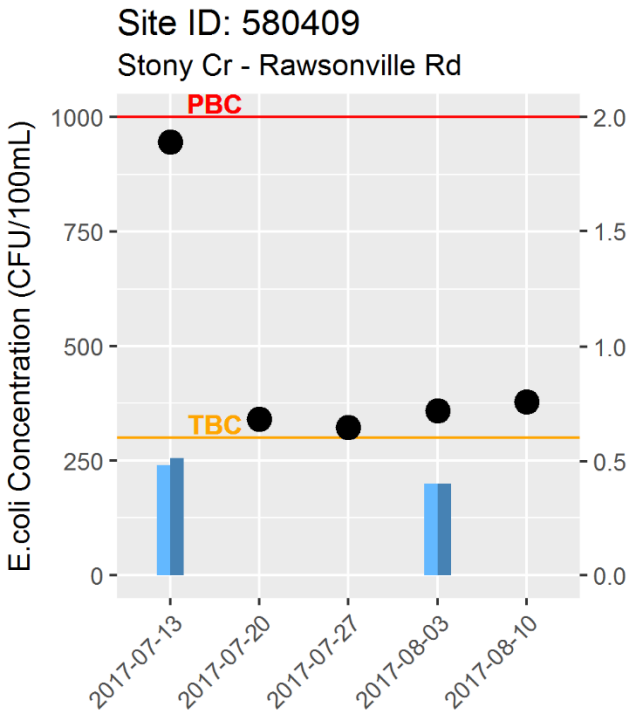

Site ID: 580619
N Br Swan Cr - Grafton Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

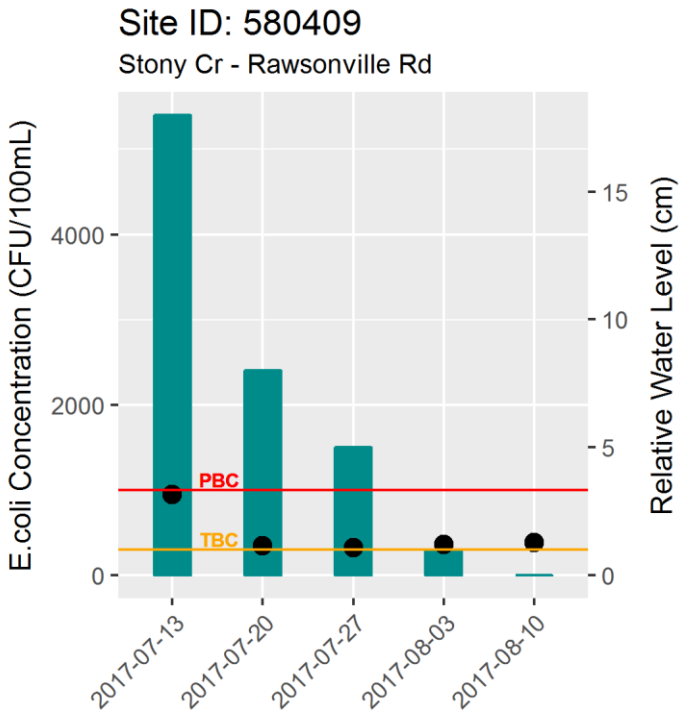

Site ID: 580615
Sandy Cr - N Monroe St
E.coli Concentration (CFU/100mL)
Precipitation (in)
4,660
50,962
13,276
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

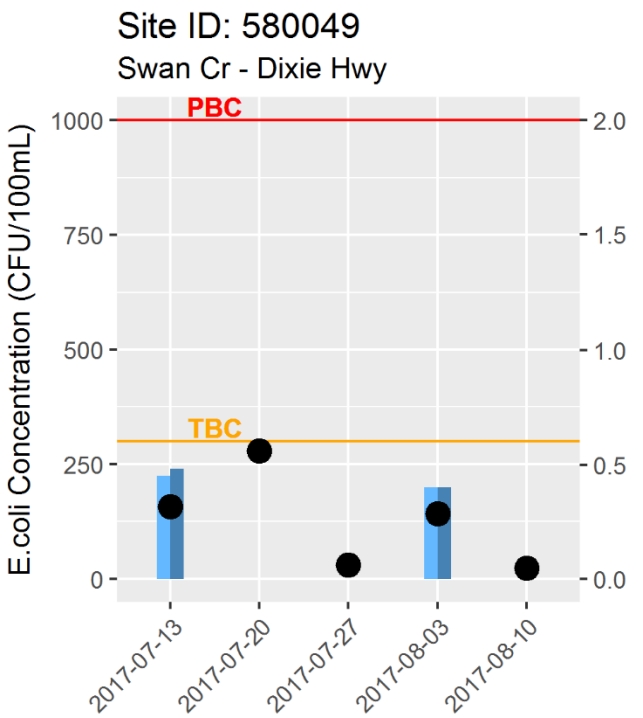

Site ID: 580615
Sandy Cr - N Monroe St
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

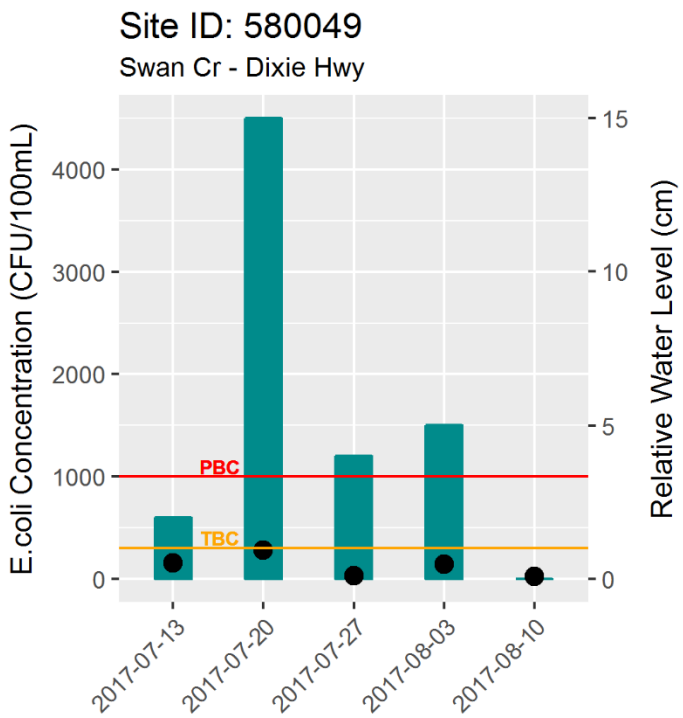

Site ID: 580614
Stony Cr - N Dixie Hwy
E.coli Concentration (CFU/100mL)
Precipitation (in)
6,098
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

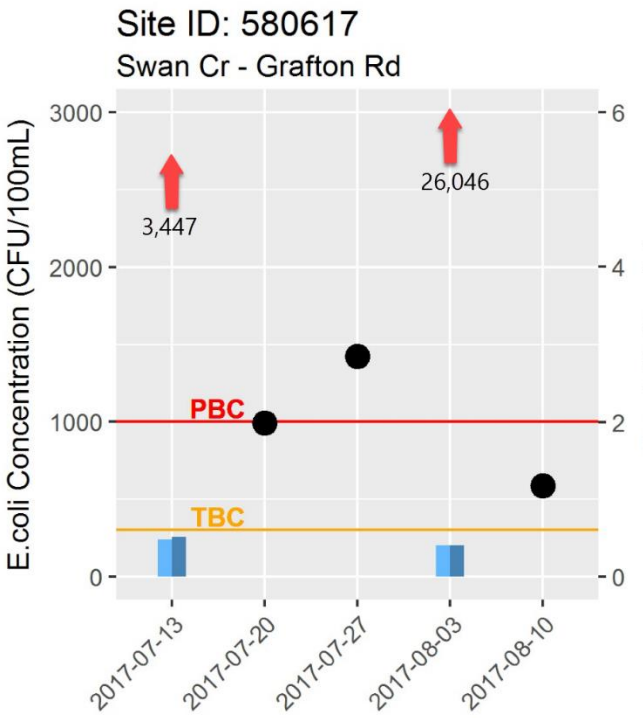

Site ID: 580614
Stony Cr - N Dixie Hwy
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

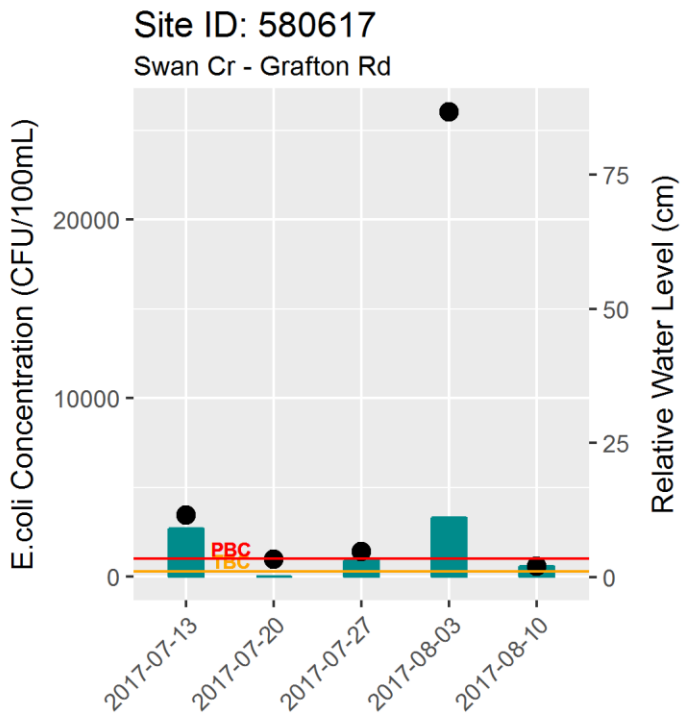

Site ID: 580409
Stony Cr - Rawsonville Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

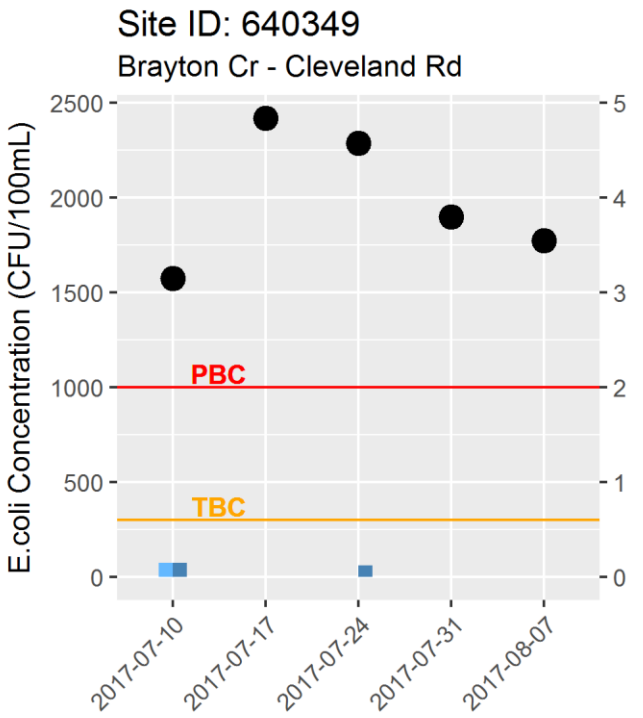

Site ID: 580409
Stony Cr - Rawsonville Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
4000
2000
0
15
10
5
0
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

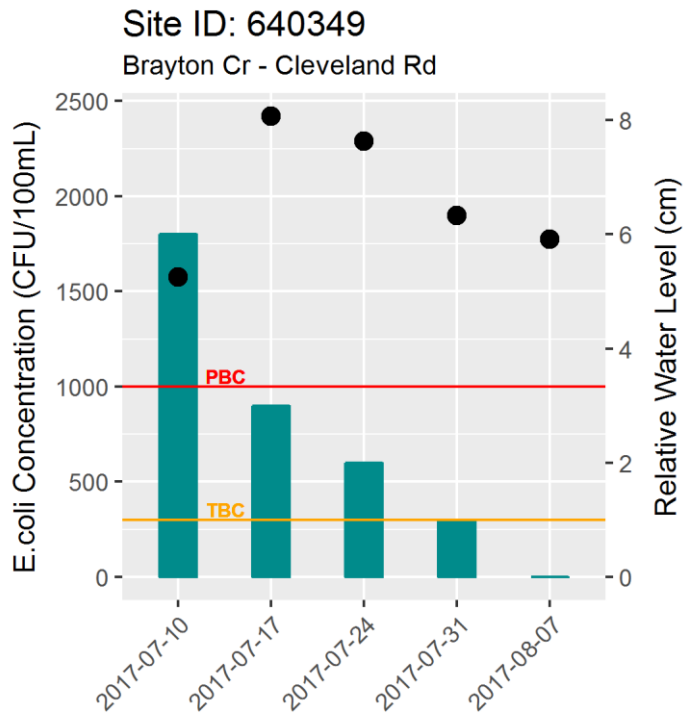

Site ID: 580049
Swan Cr - Dixie Hwy
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

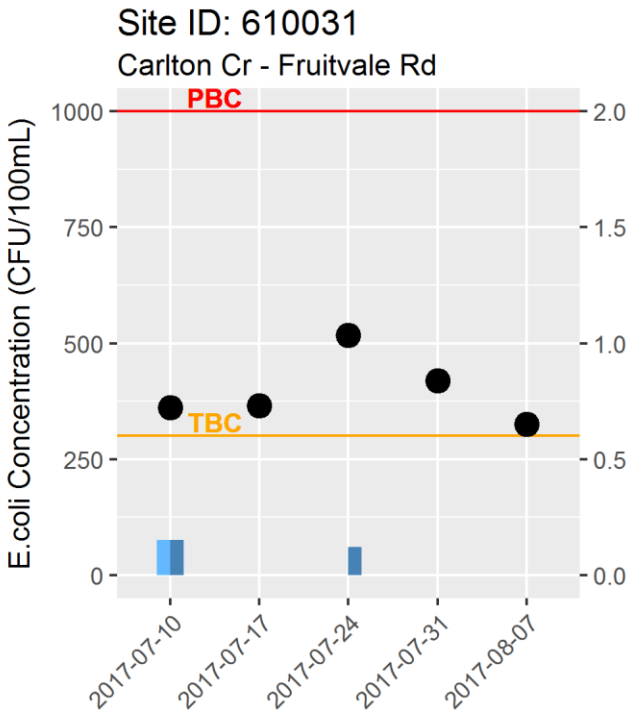

Site ID: 580049
Swan Cr - Dixie Hwy
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
4000
3000
2000
1000
0
15
10
5
0
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

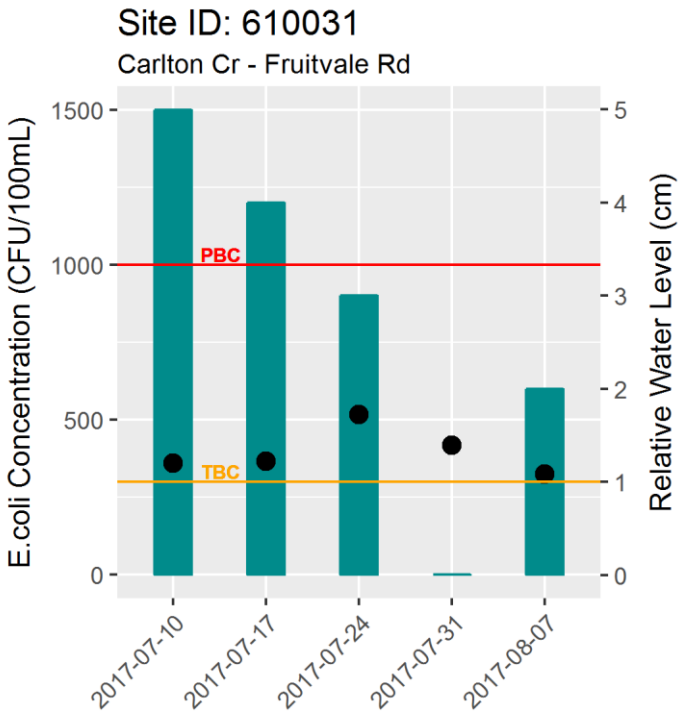

Site ID: 580617
Swan Cr - Grafton Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
3,447
26,046
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

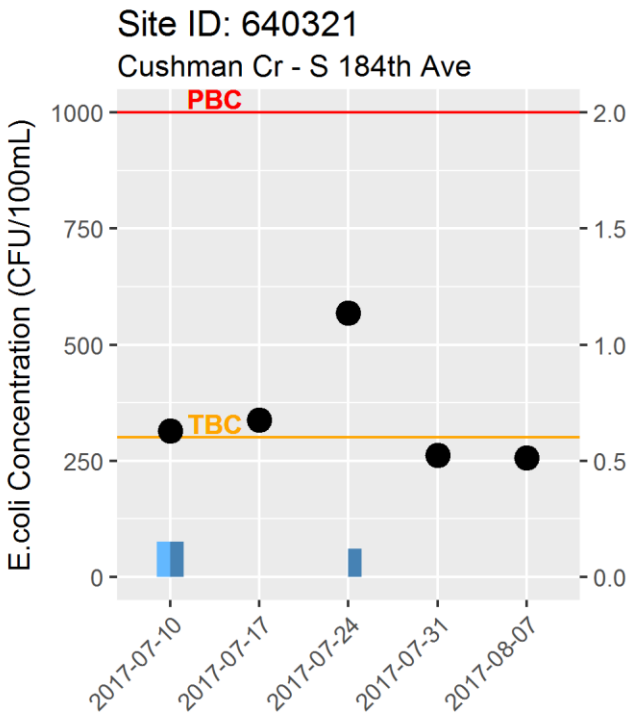

Site ID: 580617
Swan Cr - Grafton Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-13
2017-07-20
2017-07-27
2017-08-03
2017-08-10

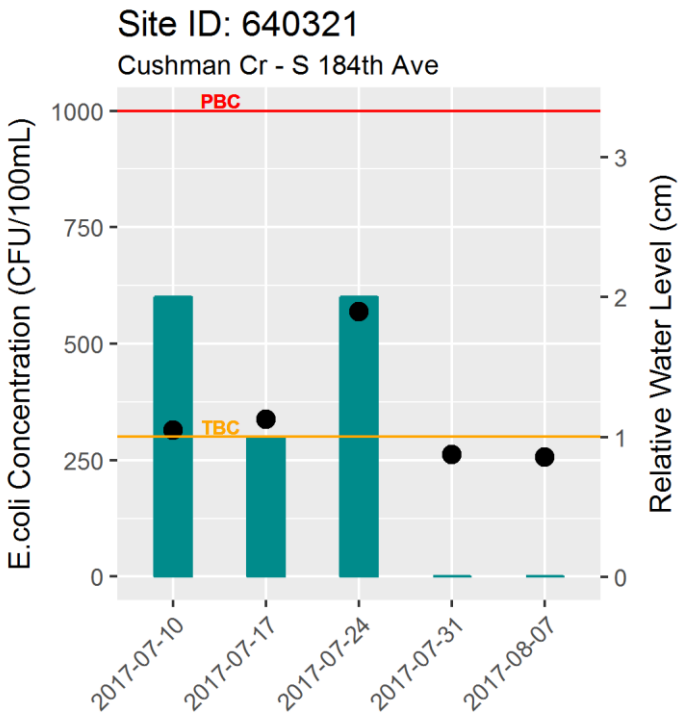

Site ID: 640349
Brayton Cr - Cleveland Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

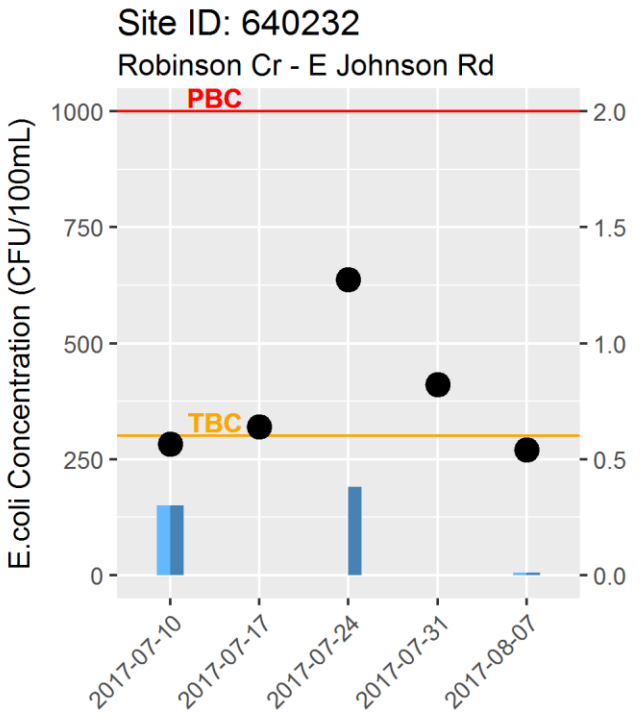

Site ID: 640349
Brayton Cr - Cleveland Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

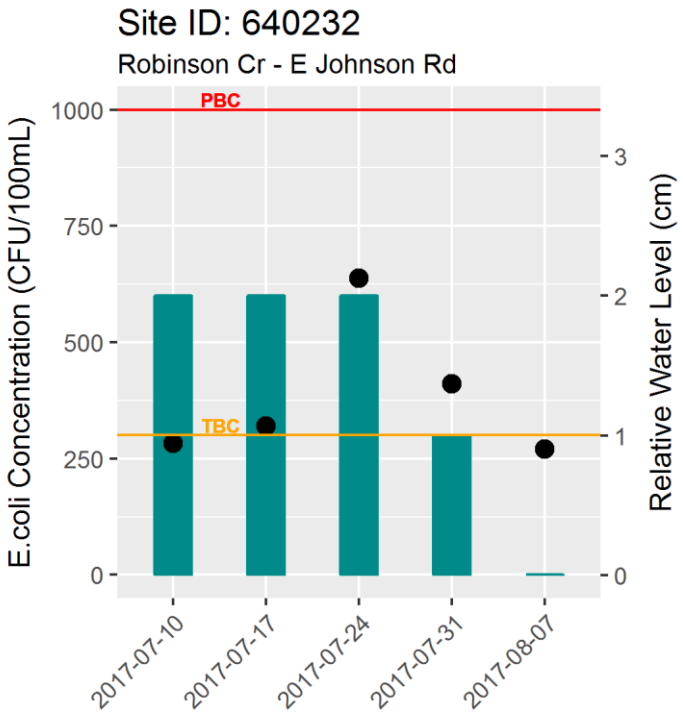

Site ID: 610031
Carlton Cr - Fruitvale Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

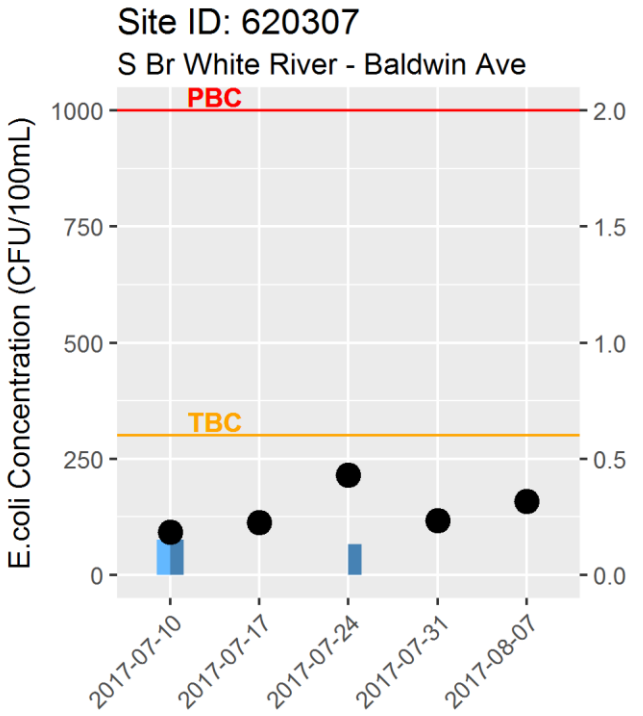

Site ID: 610031
Carlton Cr - Fruitvale Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1500
1000
500
0
5
4
3
2
1
0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

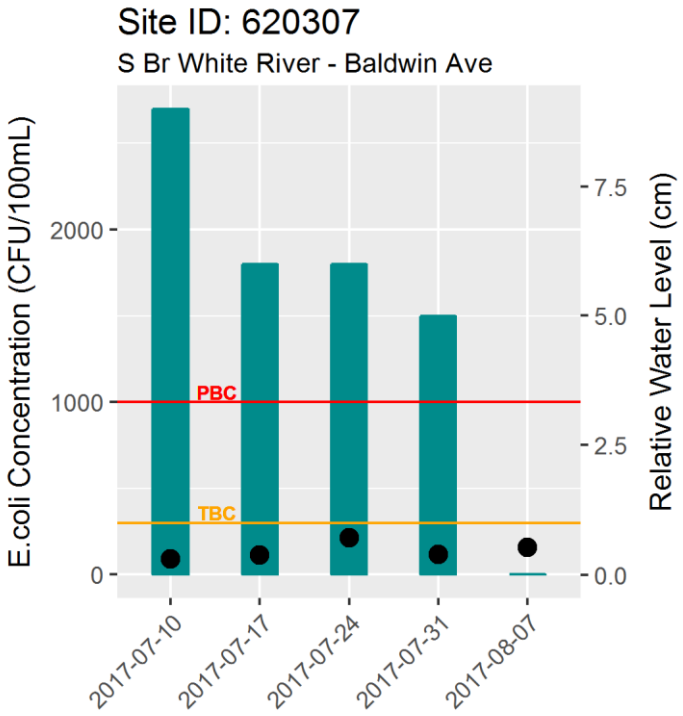

Site ID: 640321
Cushman Cr - S 184th Ave
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

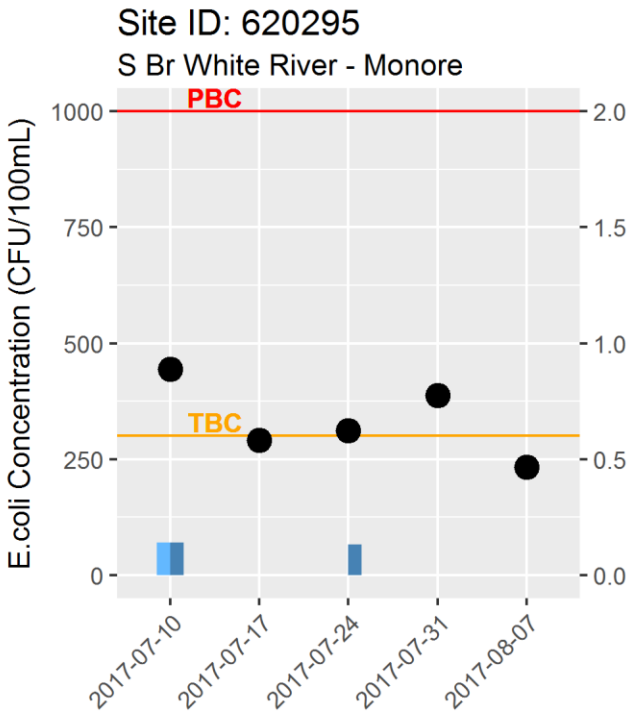

Site ID: 640321
Cushman Cr - S 184th Ave
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

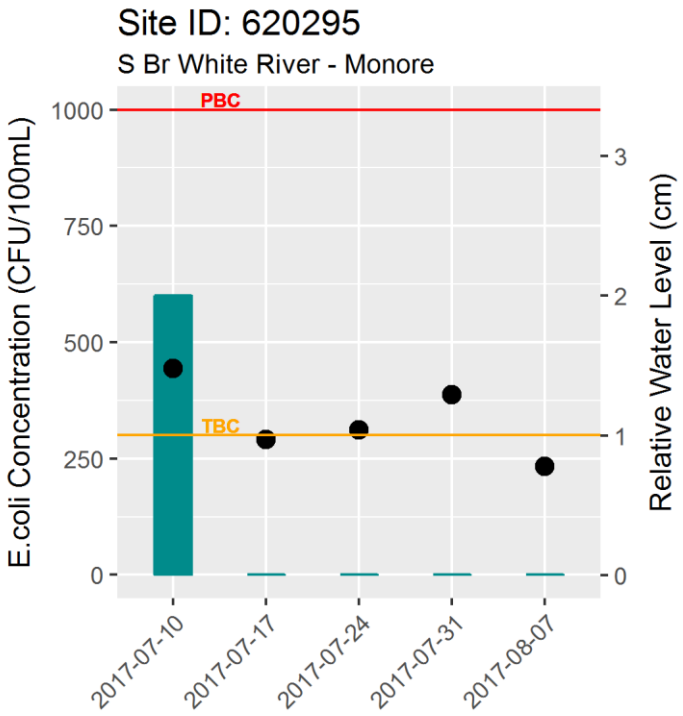

Site ID: 640232
Robinson Cr - E Johnson Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

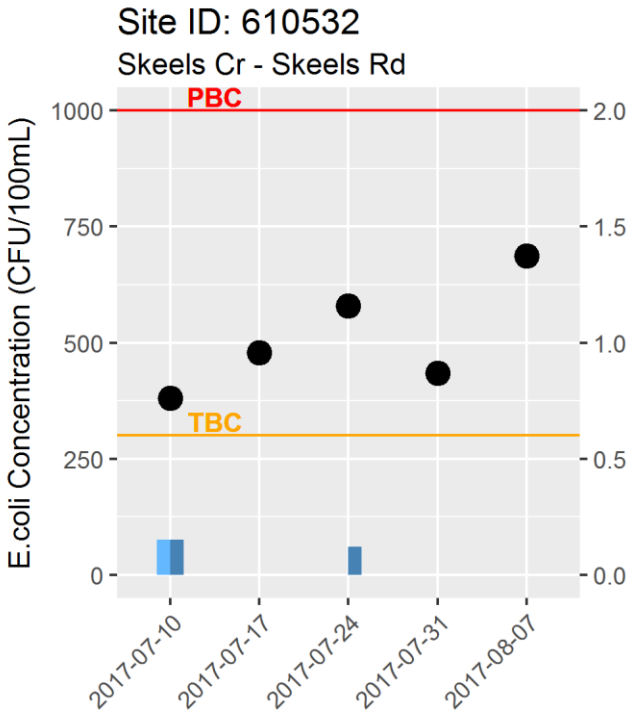

Site ID: 640232
Robinson Cr - E Johnson Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

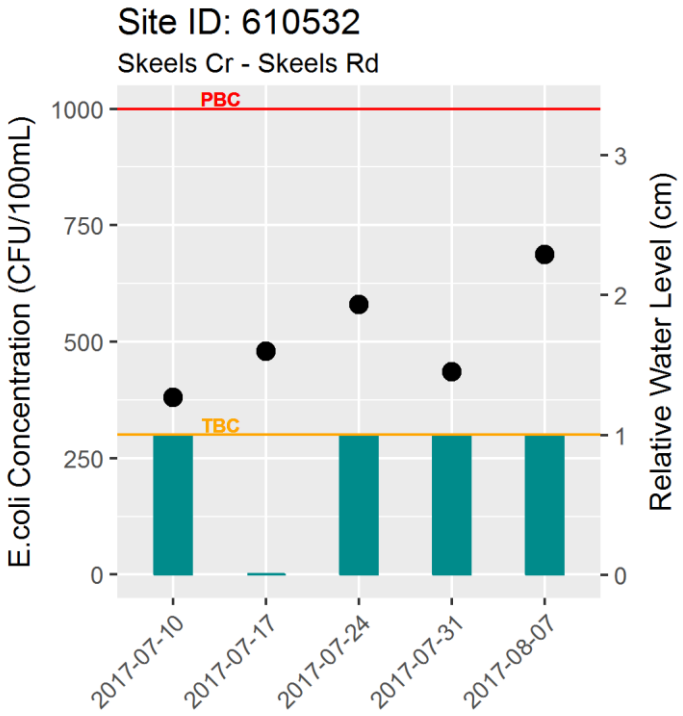

Site ID: 620307
S Br White River - Baldwin Ave
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

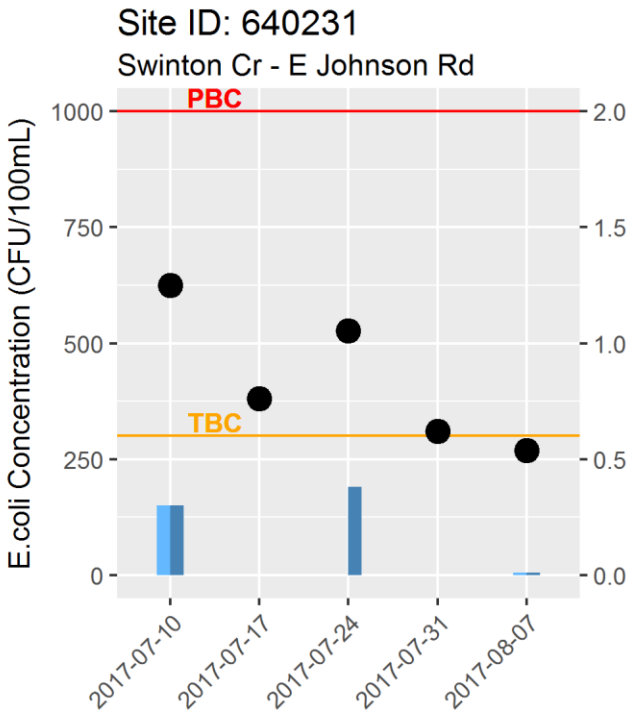

Site ID: 620307
S Br White River - Baldwin Ave
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
2000
1000
0
7.5
5.0
2.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

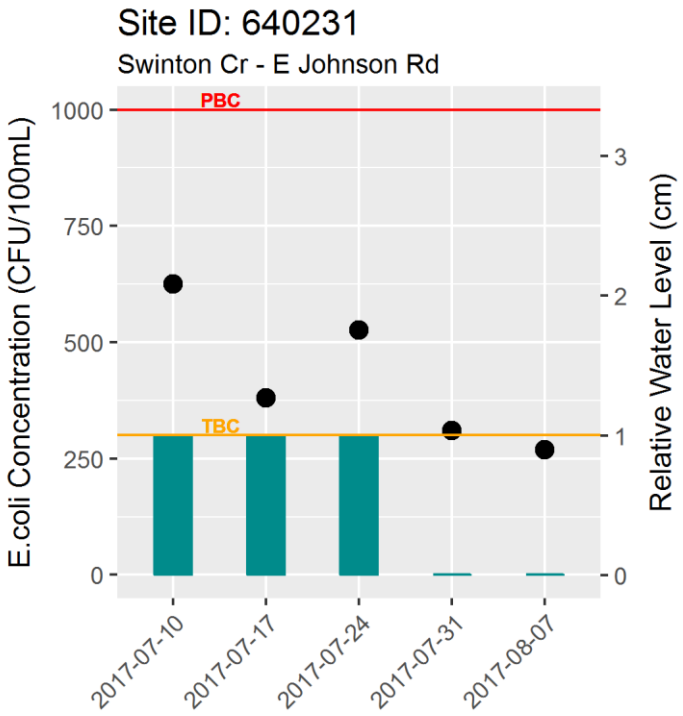

Site ID: 620295
S Br White River - Monore
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

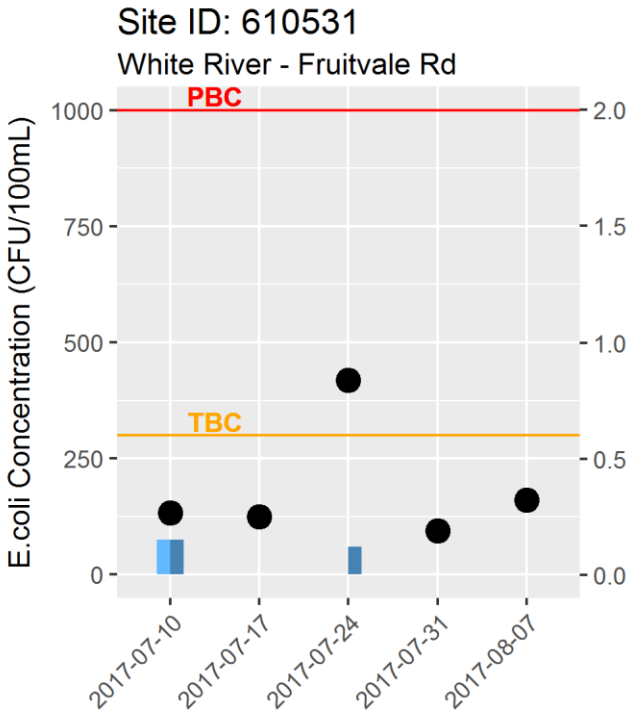

Site ID: 620295
S Br White River - Monore
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

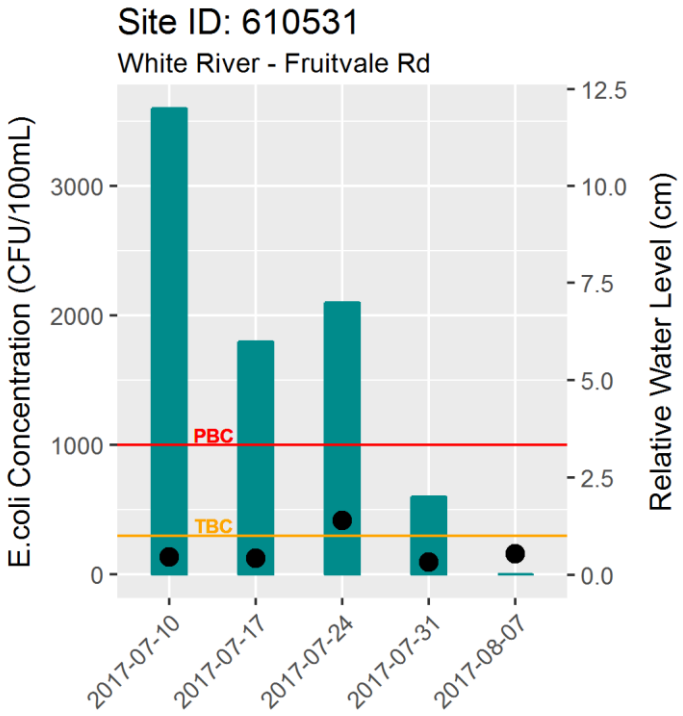

Site ID: 610532
Skeels Cr - Skeels Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

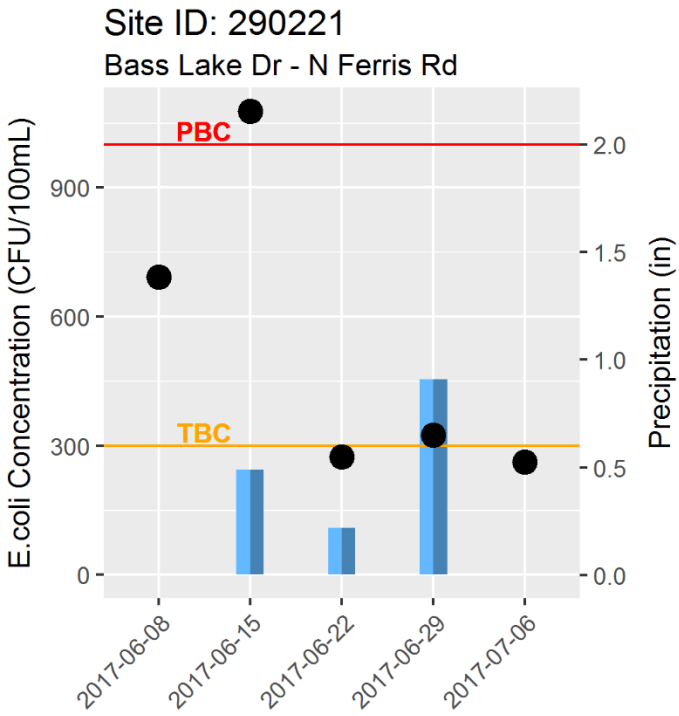

Site ID: 610532
Skeels Cr - Skeels Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

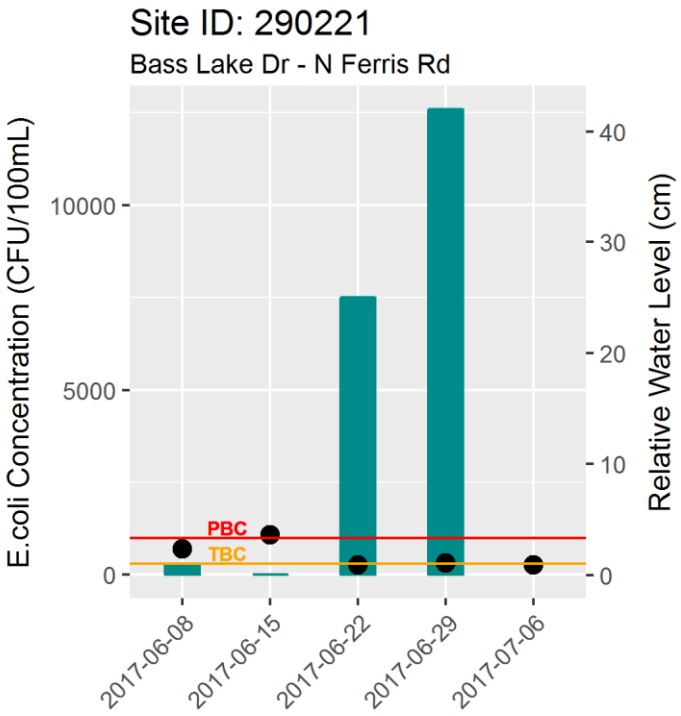

Site ID: 640231
Swinton Cr - E Johnson Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

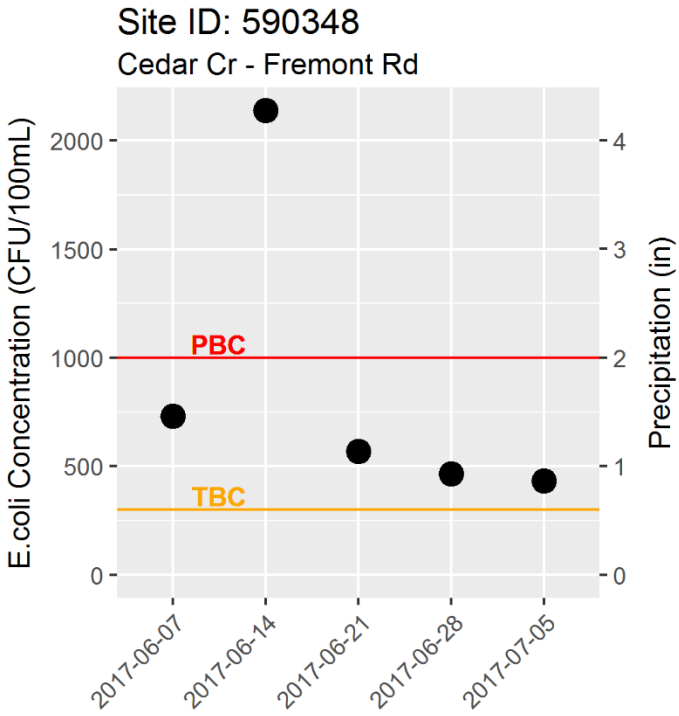

Site ID: 640231
Swinton Cr - E Johnson Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

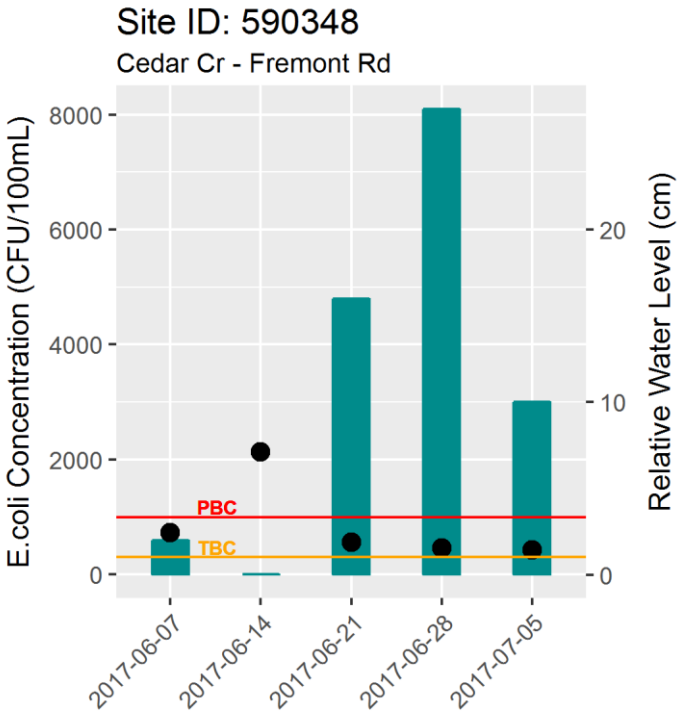

Site ID: 610531
White River - Fruitvale Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

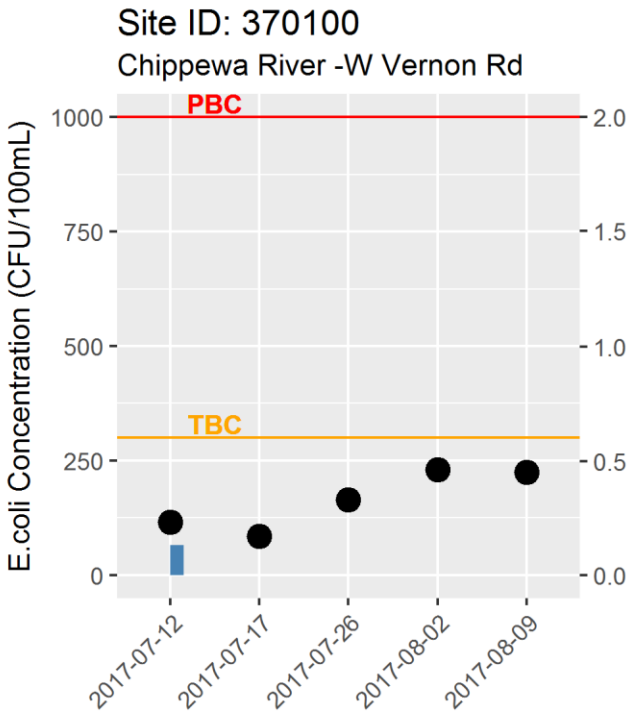

Site ID: 610531
White River - Fruitvale Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
3000
2000
1000
0
12.5
10.0
7.5
5.0
2.5
0.0
2017-07-10
2017-07-17
2017-07-24
2017-07-31
2017-08-07

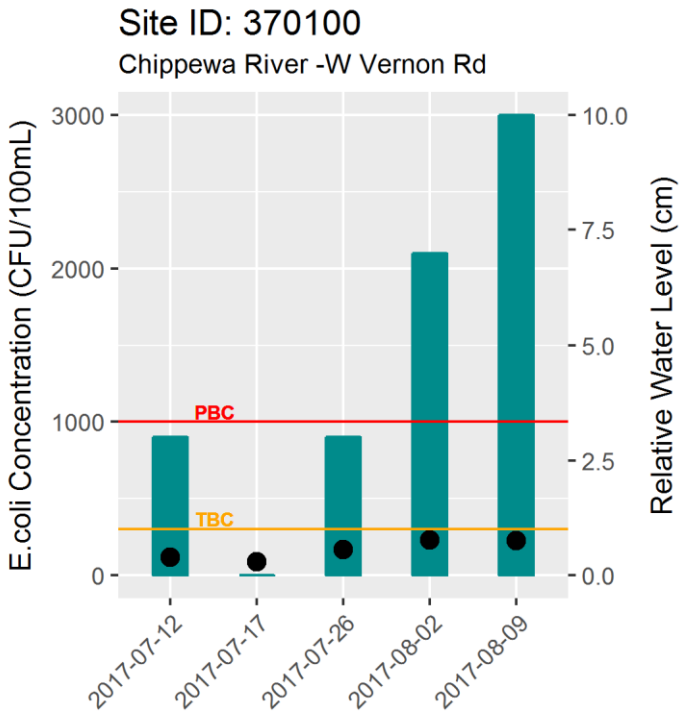

Site ID: 290221
Bass Lake Dr - N Ferris Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
0
300
600
900
0.0
0.5
1.0
1.5
2.0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

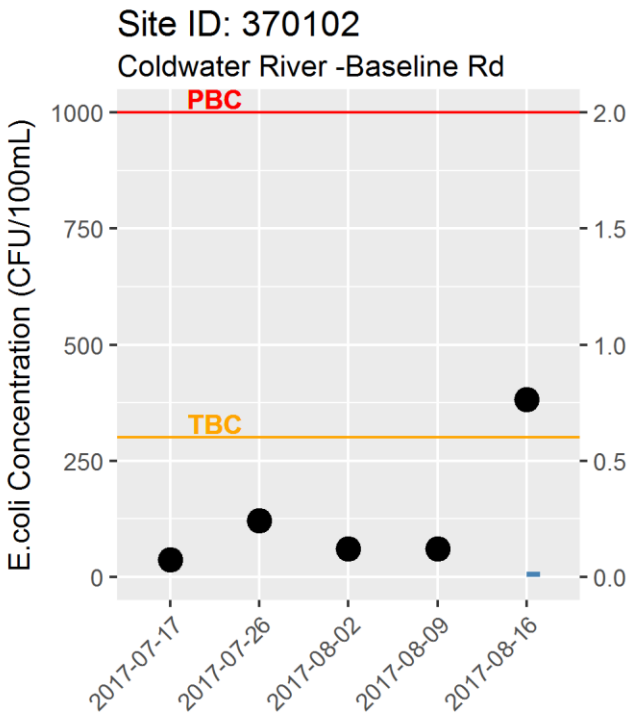

Site ID: 290221
Bass Lake Dr - N Ferris Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
0
5000
10000
0
10
20
30
40
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

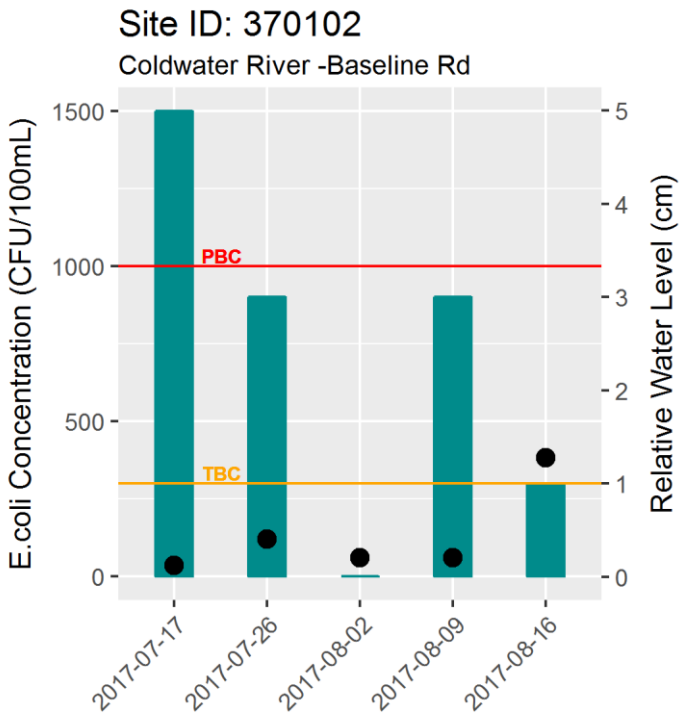

Site ID: 590348
Cedar Cr - Fremont Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
0
500
1000
1500
2000
0
1
2
3
4
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

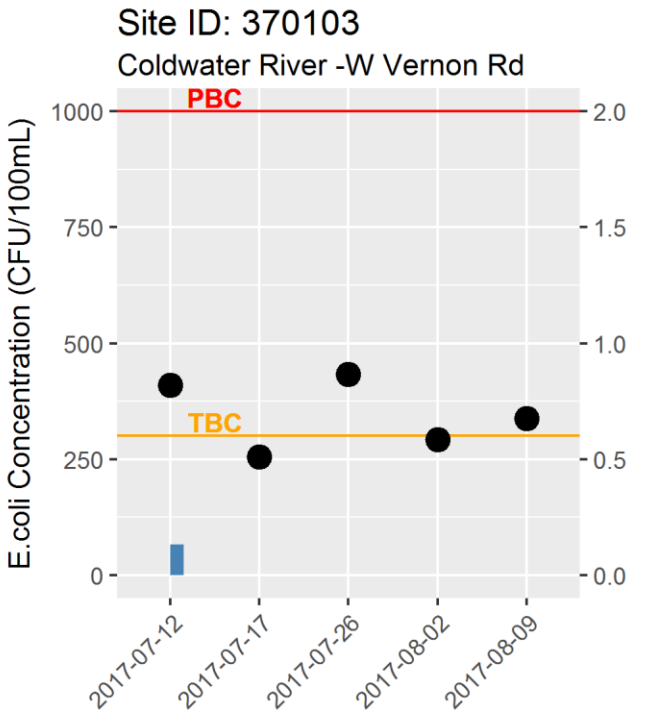

Site ID: 590348
Cedar Cr - Fremont Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
0
2000
4000
6000
8000
0
10
20
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

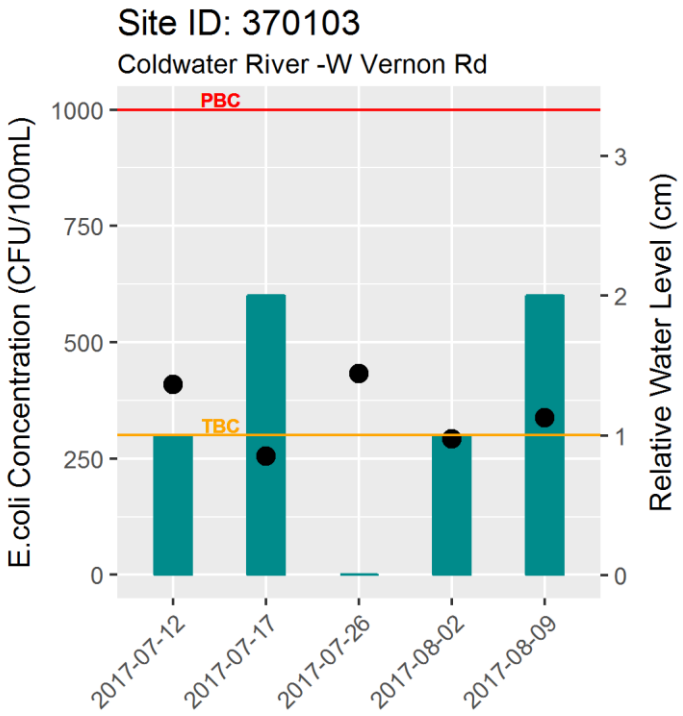

Site ID: 370100
Chippewa River -W Vernon Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

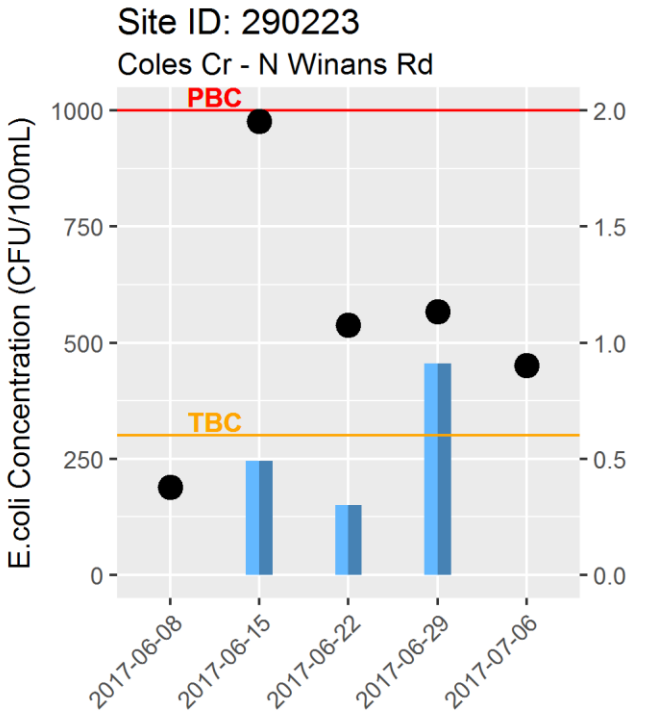

Site ID: 370100
Chippewa River -W Vernon Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
3000
2000
1000
0
10.0
7.5
5.0
2.5
0.0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09


Site ID: 370102
Coldwater River -Baseline Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-17
2017-07-26
2017-08-02
2017-08-09
2017-08-16


Site ID: 370102
Coldwater River -Baseline Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1500
1000
500
0
5
4
3
2
1
0
2017-07-17
2017-07-26
2017-08-02
2017-08-09
2017-08-16

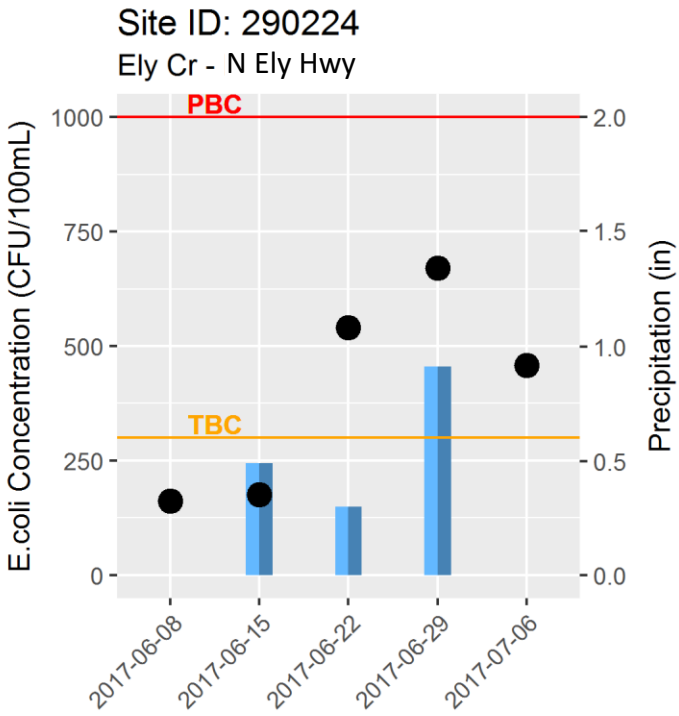


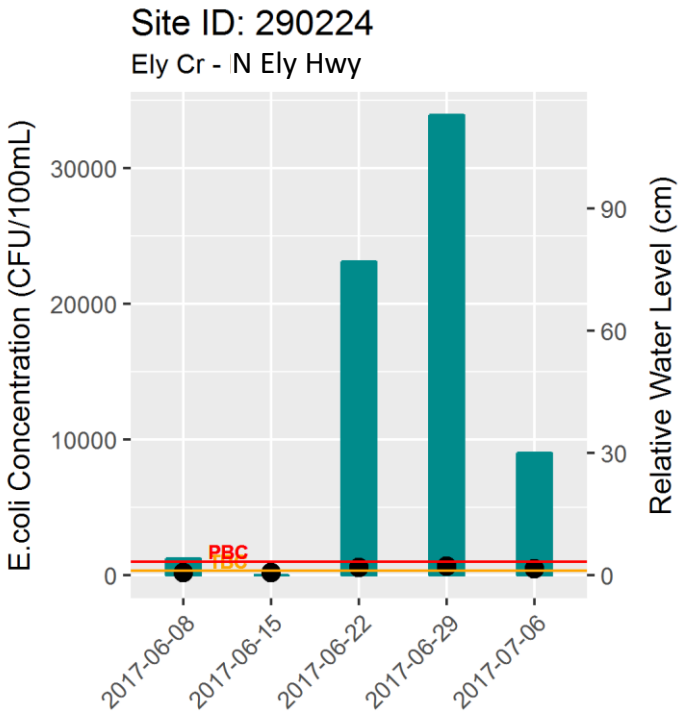


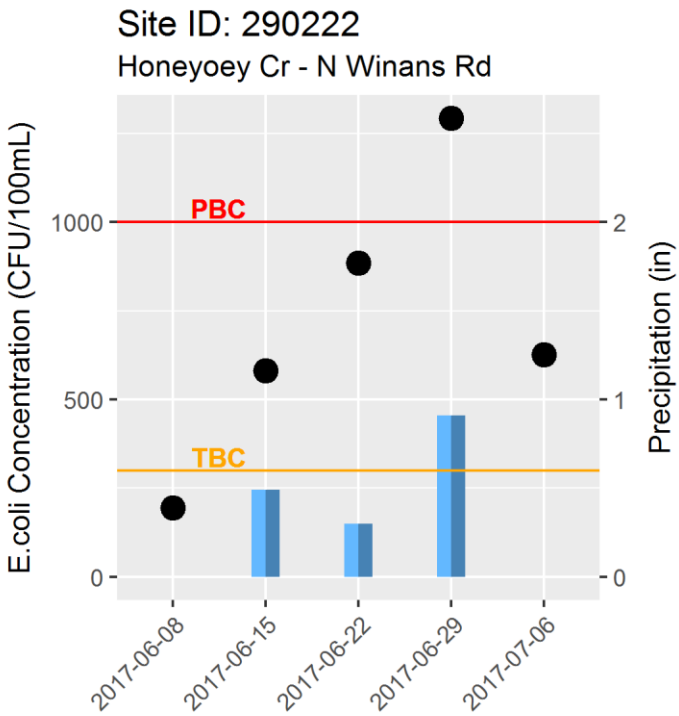


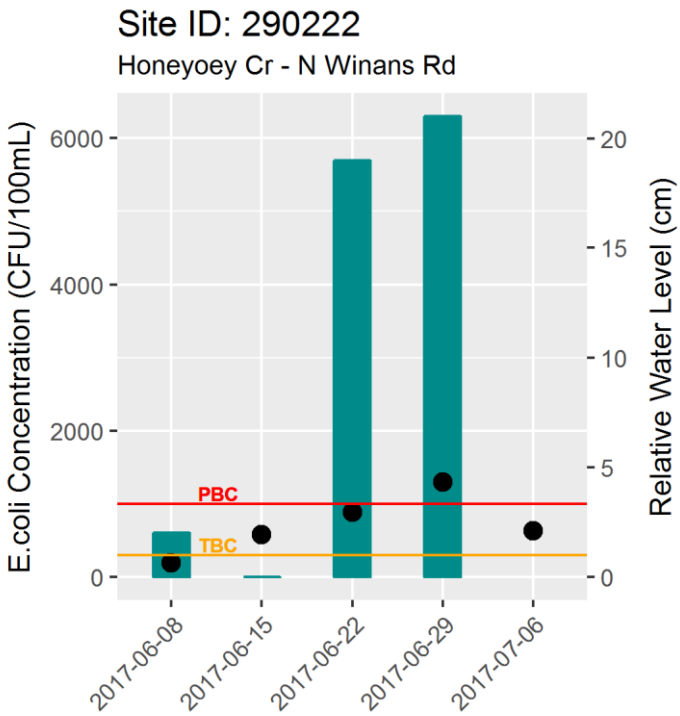
Site ID: 290223

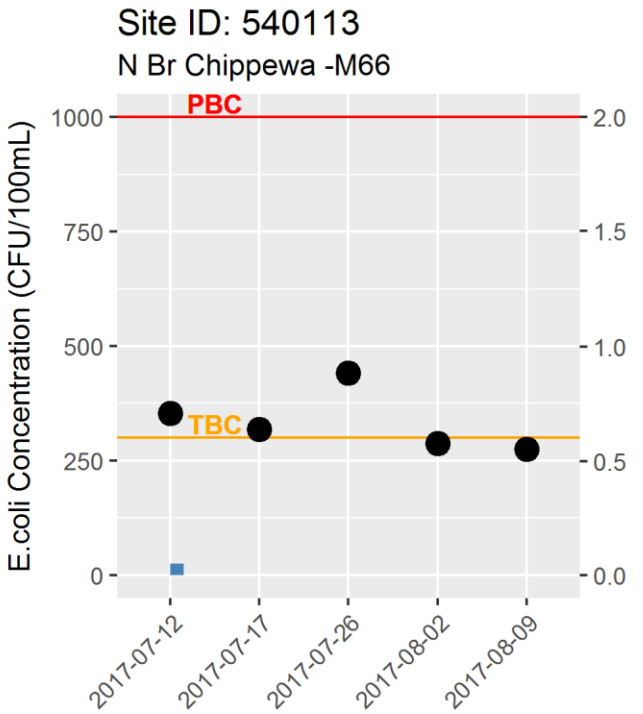
Water levels not available for this site; see Ely and Honeyoey Creek for general trends.

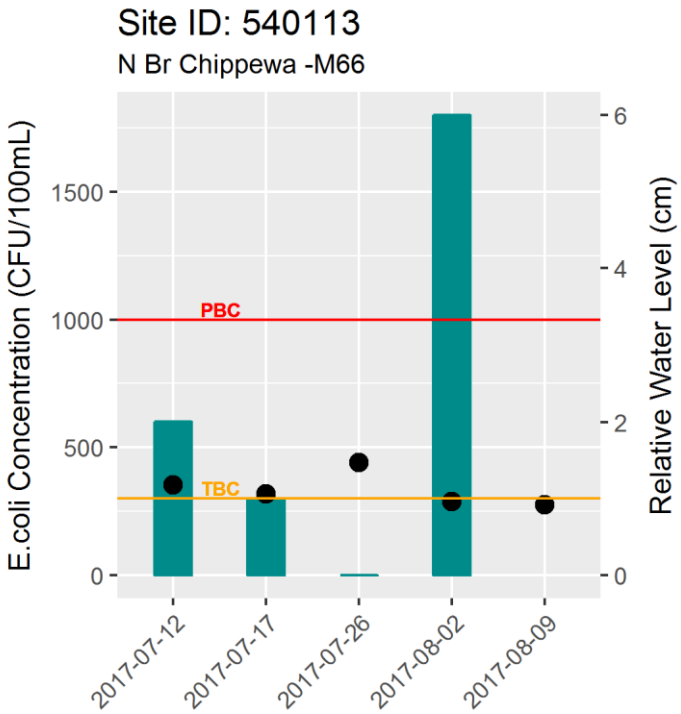

Site ID: 290224
Ely Cr - N Ely Hwy
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

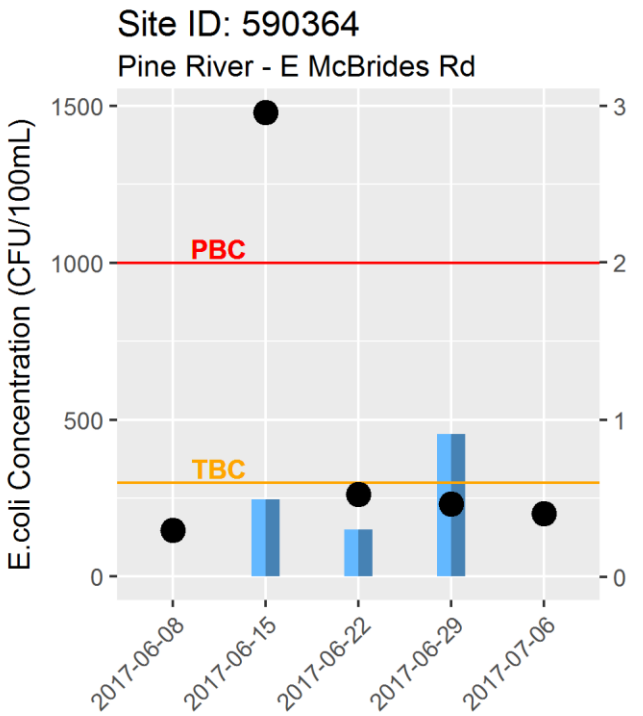

Site ID: 290224
Ely Cr - N Ely Hwy
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
30000
20000
10000
0
90
60
30
0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

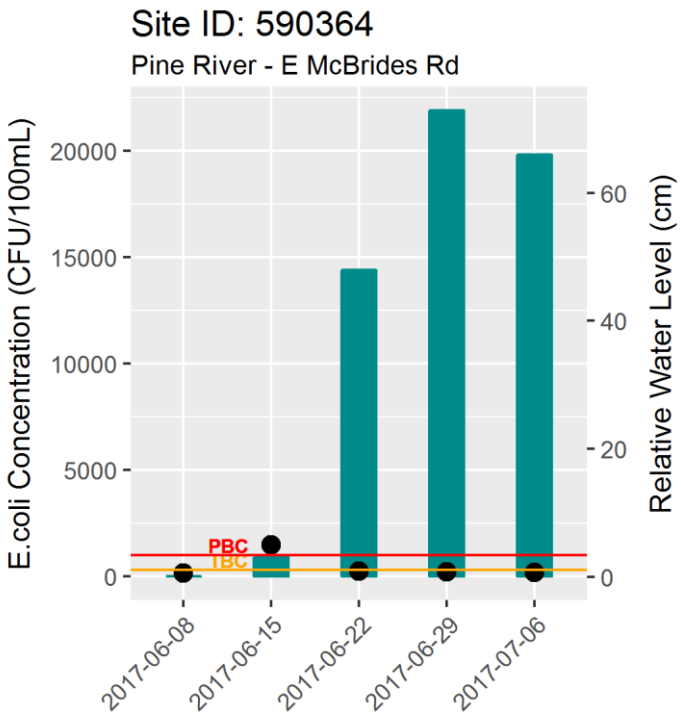

Site ID: 290222
Honeyoey Cr - N Winans Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
500
0
2
1
0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

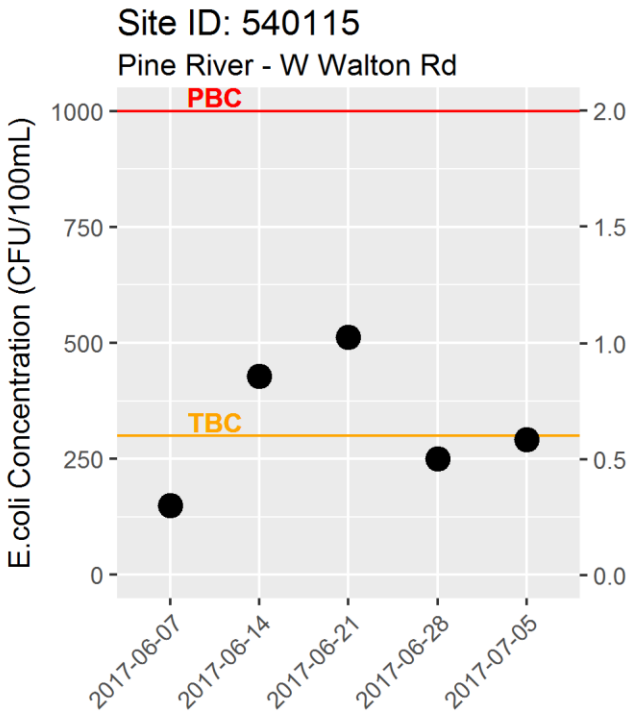

Site ID: 290222
Honeyoey Cr - N Winans Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
6000
4000
2000
0
20
15
10
5
0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

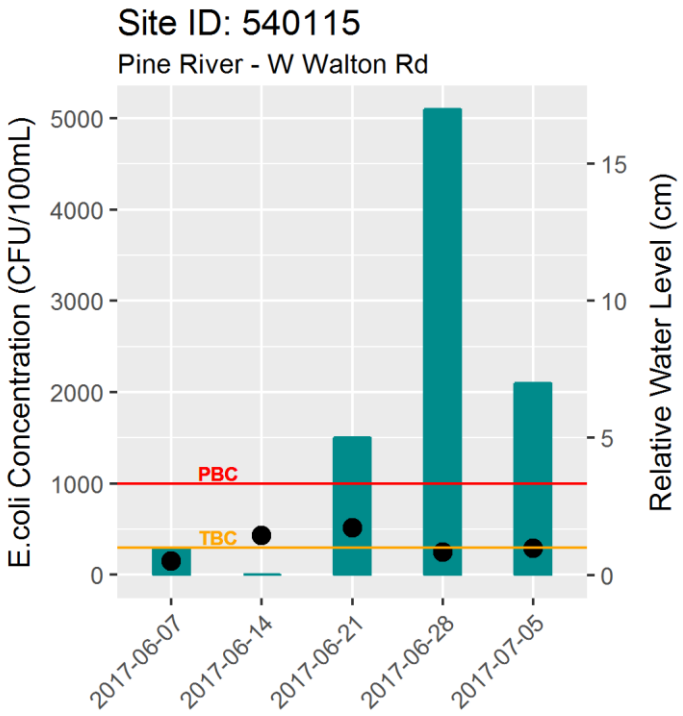

Site ID: 540113
N Br Chippewa -M66
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

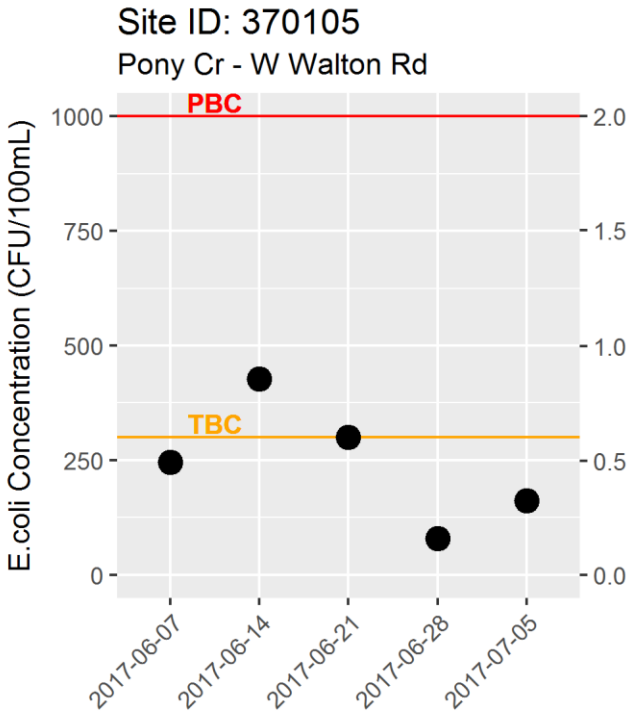

Site ID: 540113
N Br Chippewa -M66
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
1500
1000
500
0
6
4
2
0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

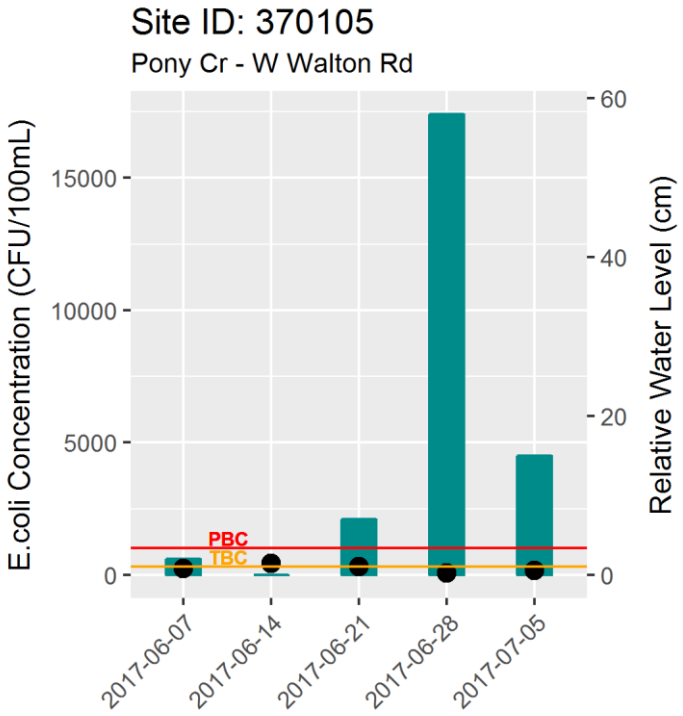

Site ID: 590364
Pine River - E McBrides Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1500
1000
500
0
3
2
1
0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

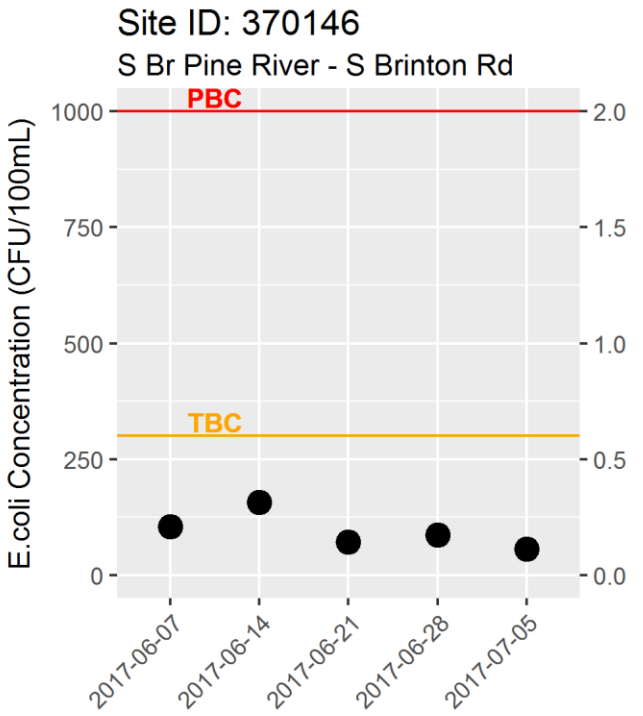

Site ID: 590364
Pine River - E McBrides Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
20000
15000
10000
5000
0
60
40
20
0
2017-06-08
2017-06-15
2017-06-22
2017-06-29
2017-07-06

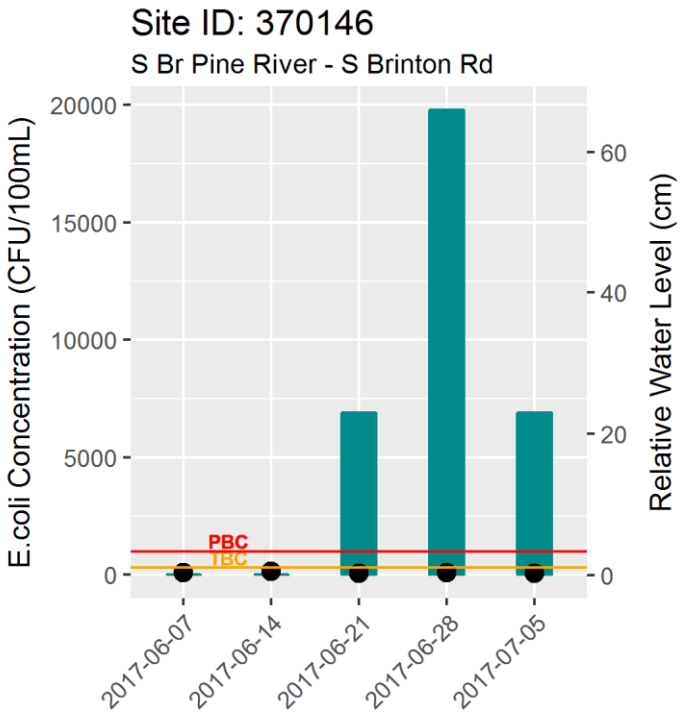

Site ID: 540115
Pine River - W Walton Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

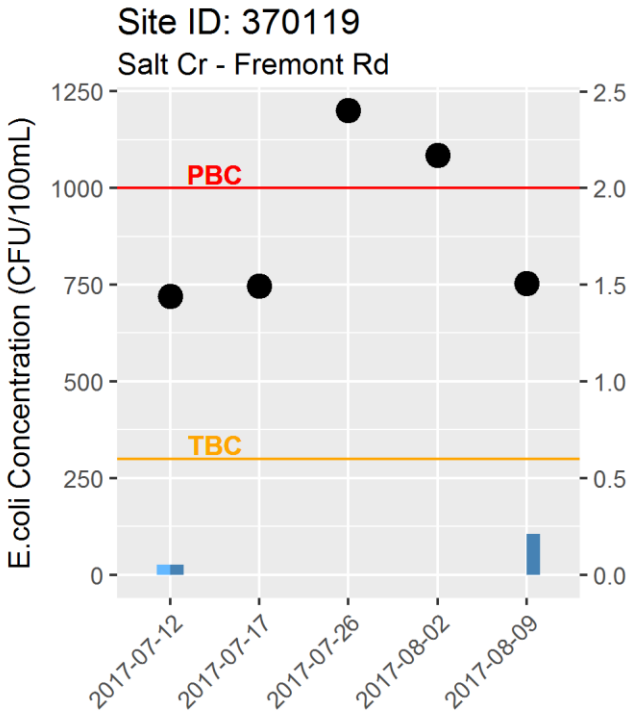

Site ID: 540115
Pine River - W Walton Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
5000
4000
3000
2000
1000
0
15
10
5
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

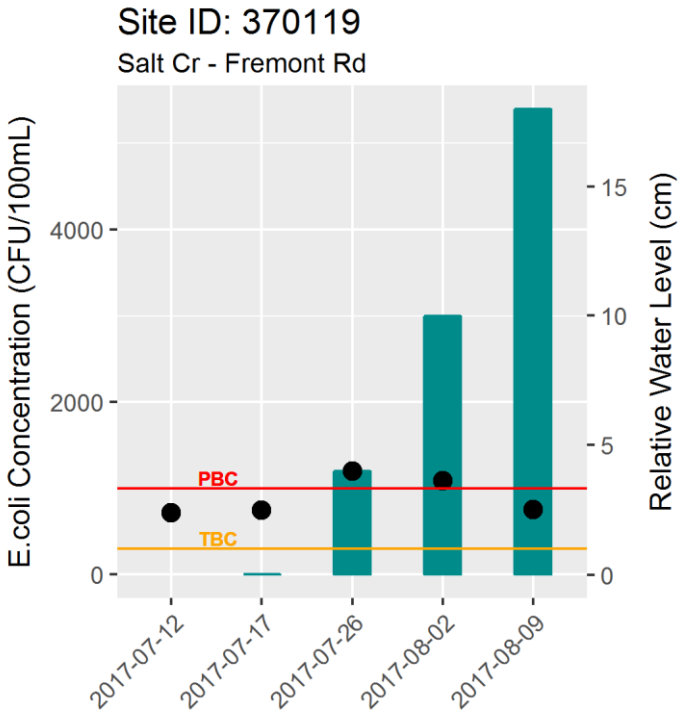

Site ID: 370105
Pony Cr - W Walton Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

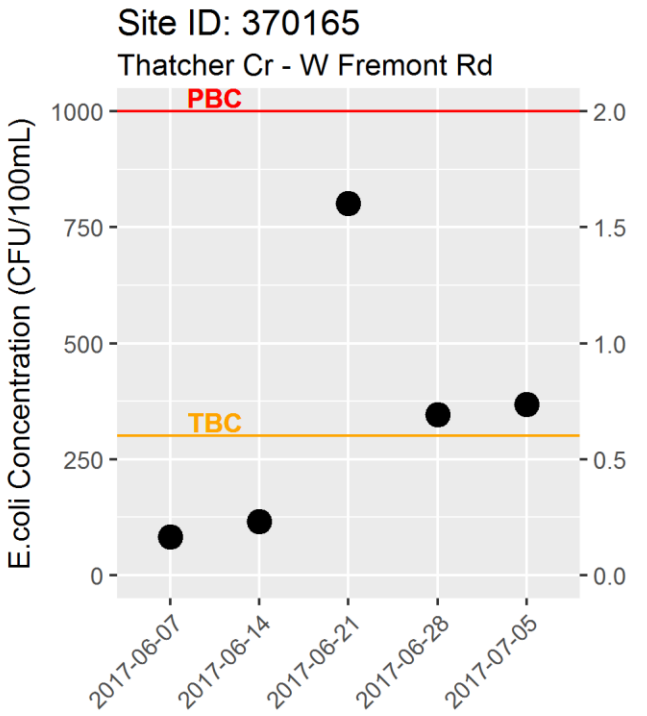

Site ID: 370105
Pony Cr - W Walton Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
15000
10000
5000
0
60
40
20
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

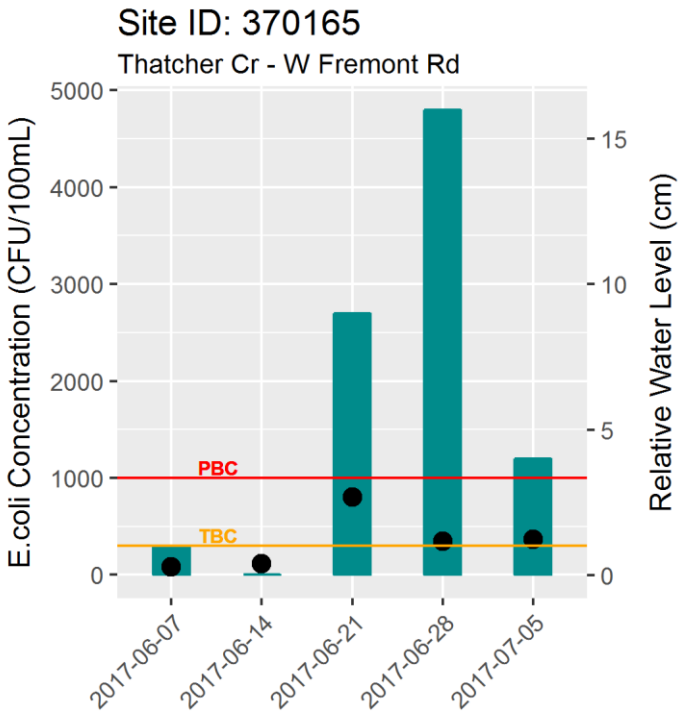

Site ID: 370146
S Br Pine River - S Brinton Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

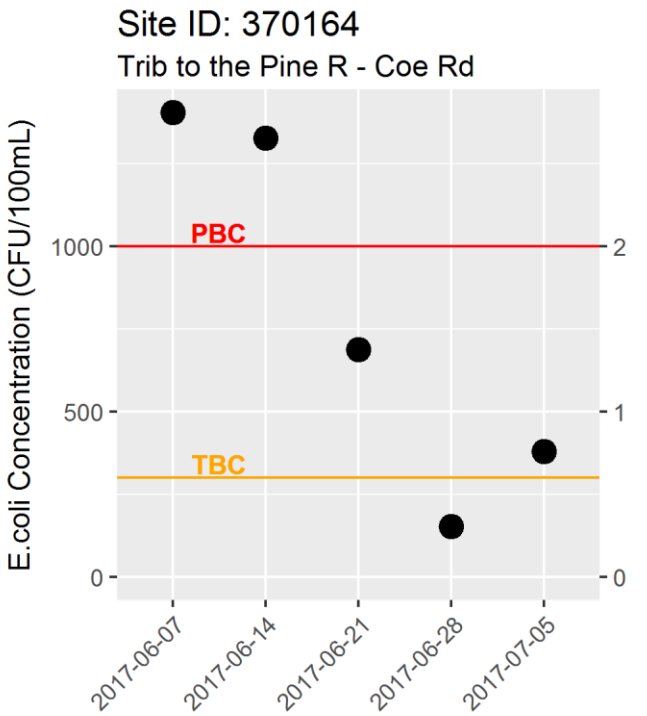

Site ID: 370146
S Br Pine River - S Brinton Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
20000
15000
10000
5000
0
60
40
20
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

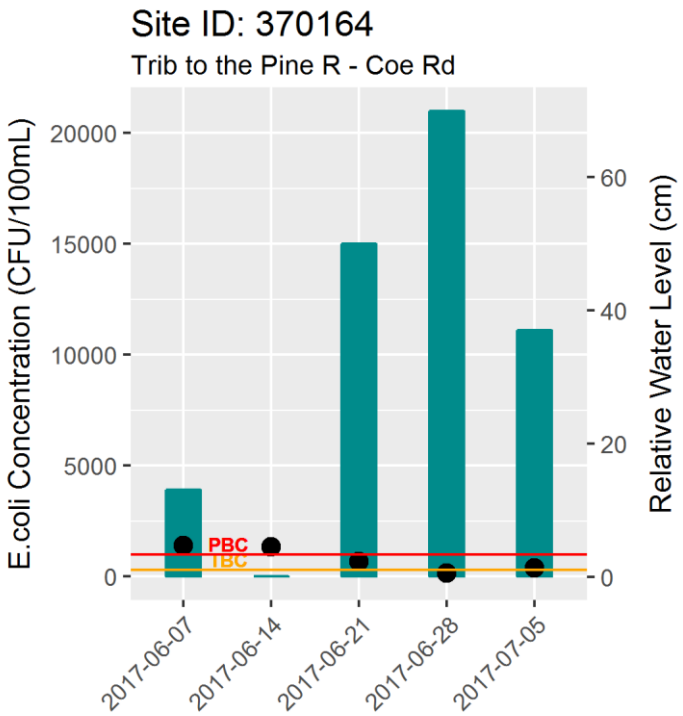

Site ID: 370119
Salt Cr - Fremont Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1250
1000
750
500
250
0
2.5
2.0
1.5
1.0
0.5
0.0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

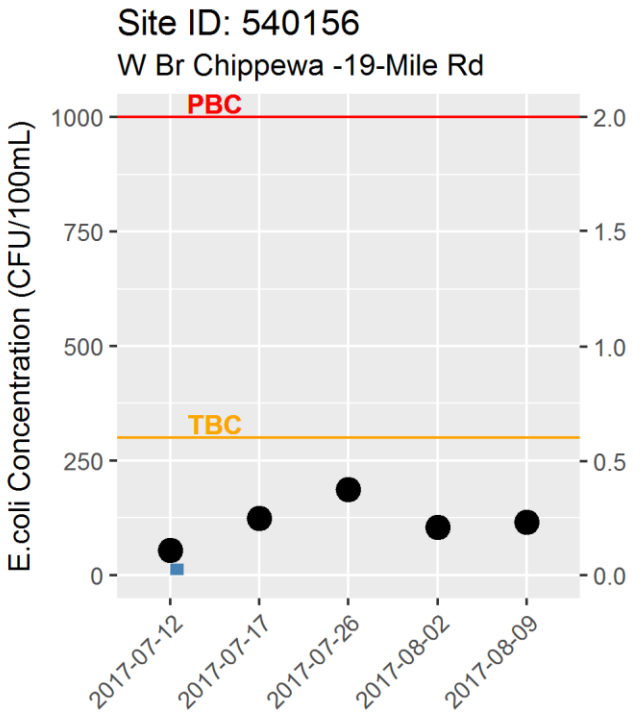

Site ID: 370119
Salt Cr - Fremont Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
4000
2000
0
15
10
5
0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

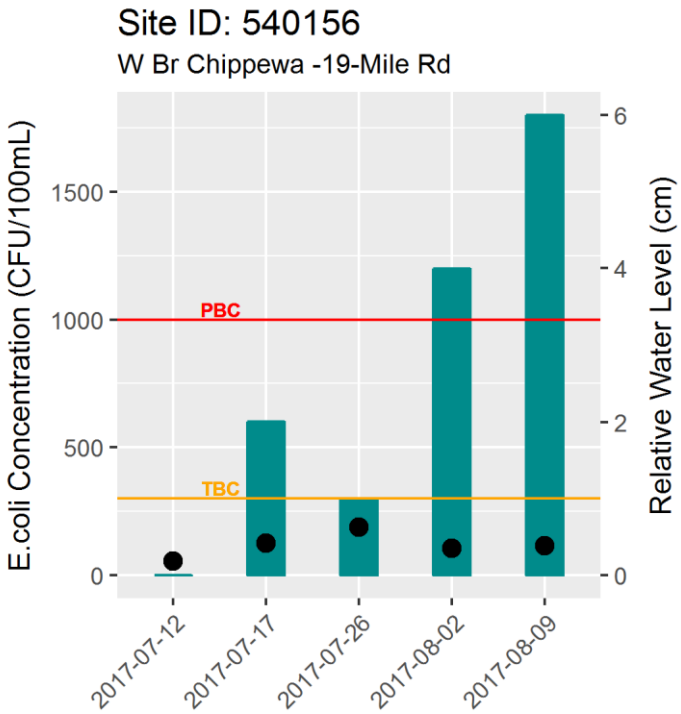

Site ID: 370165
Thatcher Cr - W Fremont Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

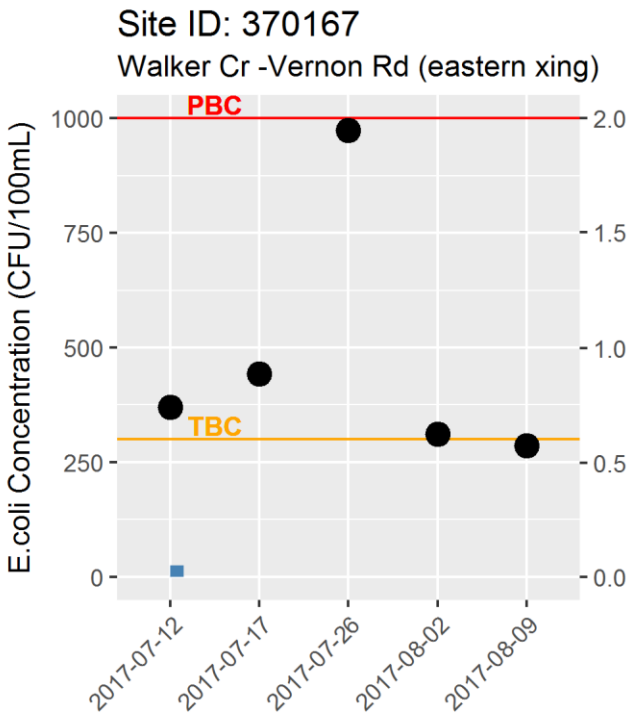

Site ID: 370165
Thatcher Cr - W Fremont Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
5000
4000
3000
2000
1000
0
15
10
5
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

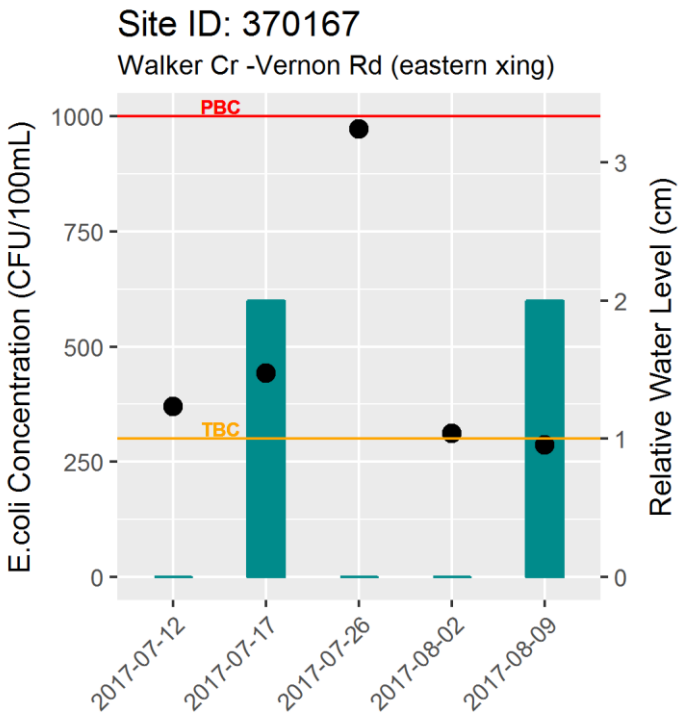

Site ID: 370164
Trib to the Pine R - Coe Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
500
0
2
1
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

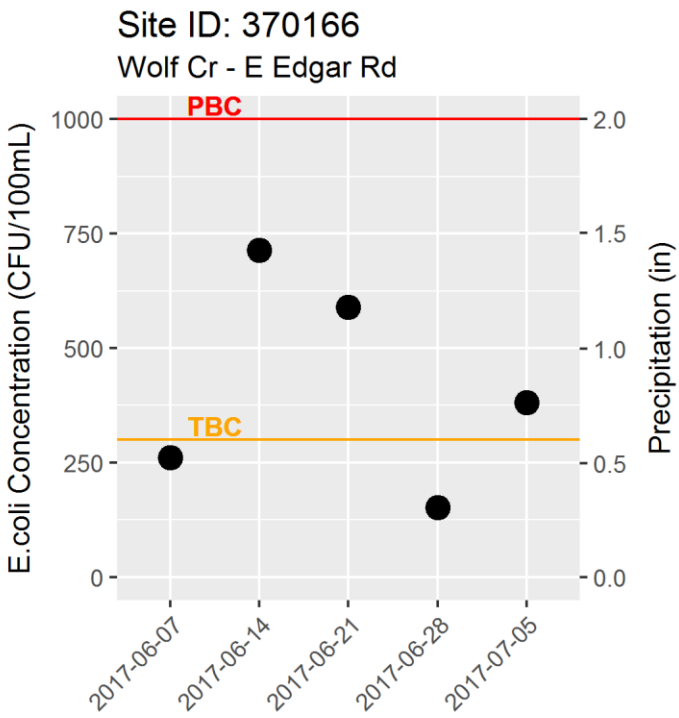

Site ID: 370164
Trib to the Pine R - Coe Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
20000
15000
10000
5000
0
60
40
20
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

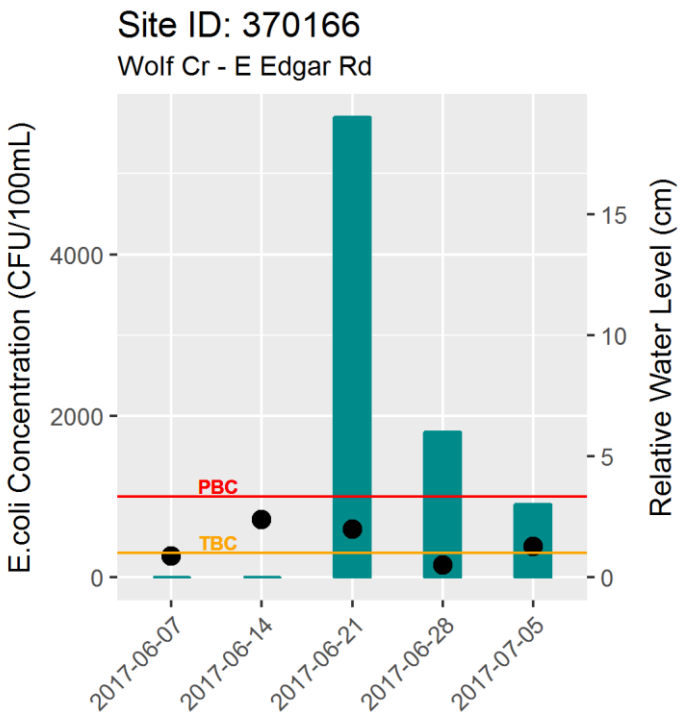

Site ID: 540156
W Br Chippewa -19-Mile Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

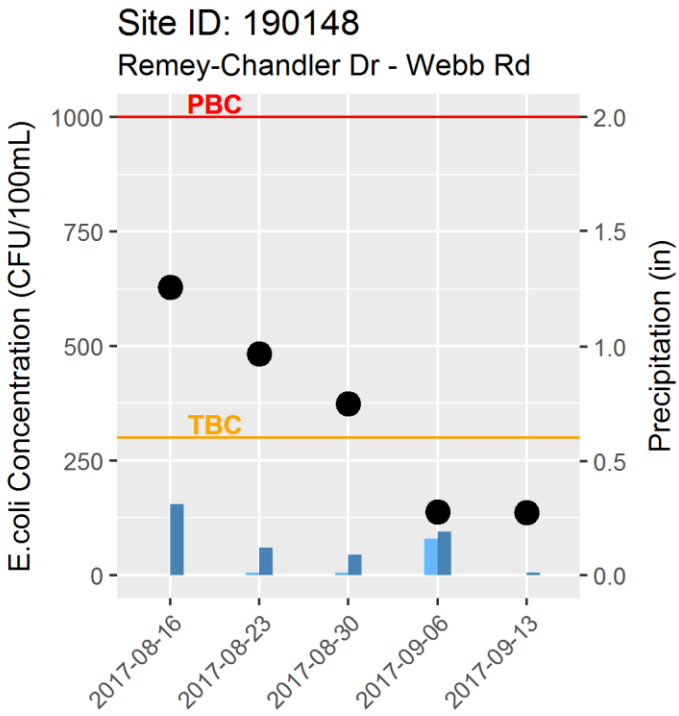

Site ID: 540156
W Br Chippewa -19-Mile Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1500
1000
500
0
6
4
2
0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

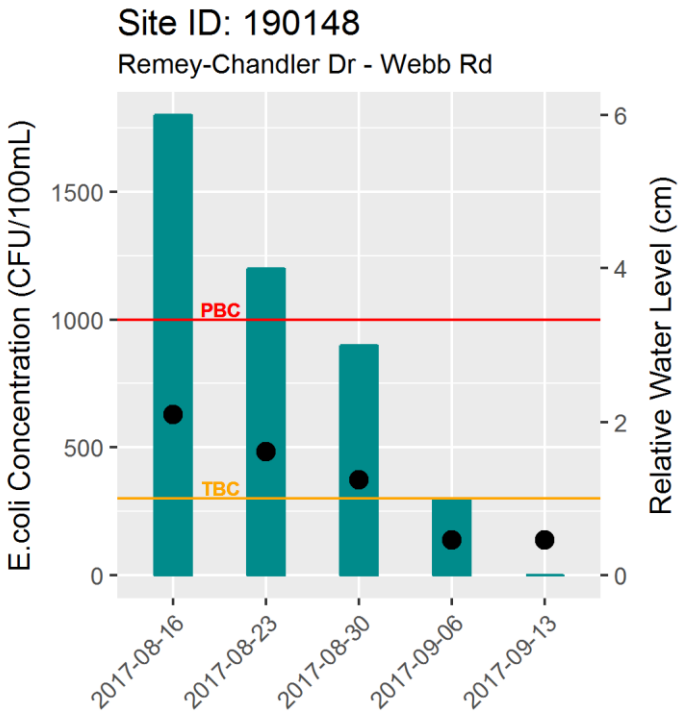

Site ID: 370167
Walker Cr -Vernon Rd (eastern xing)
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09


Site ID: 370167
Walker Cr -Vernon Rd (eastern xing)
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1000
750
500
250
0
3
2
1
0
2017-07-12
2017-07-17
2017-07-26
2017-08-02
2017-08-09

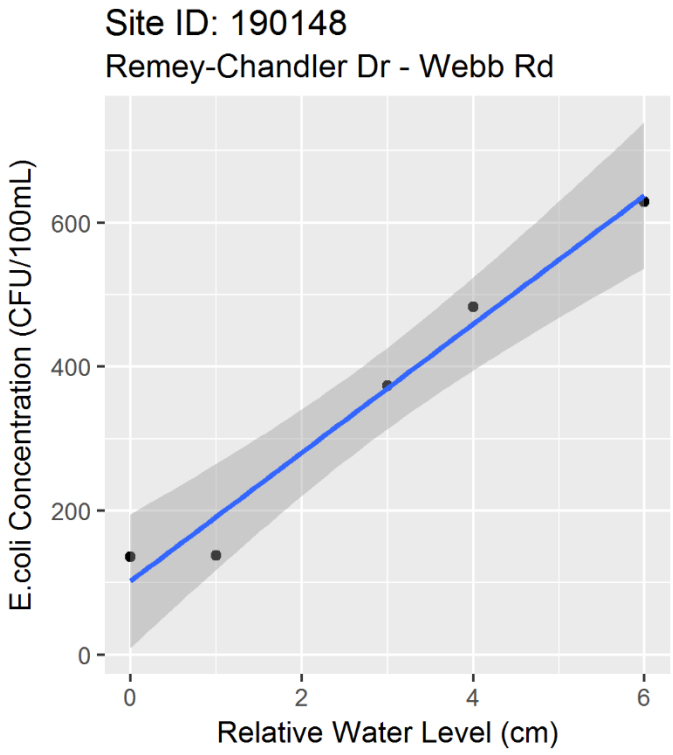

Site ID: 370166
Wolf Cr - E Edgar Rd
E.coli Concentration (CFU/100mL)
Precipitation (in)
PBC
TBC
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

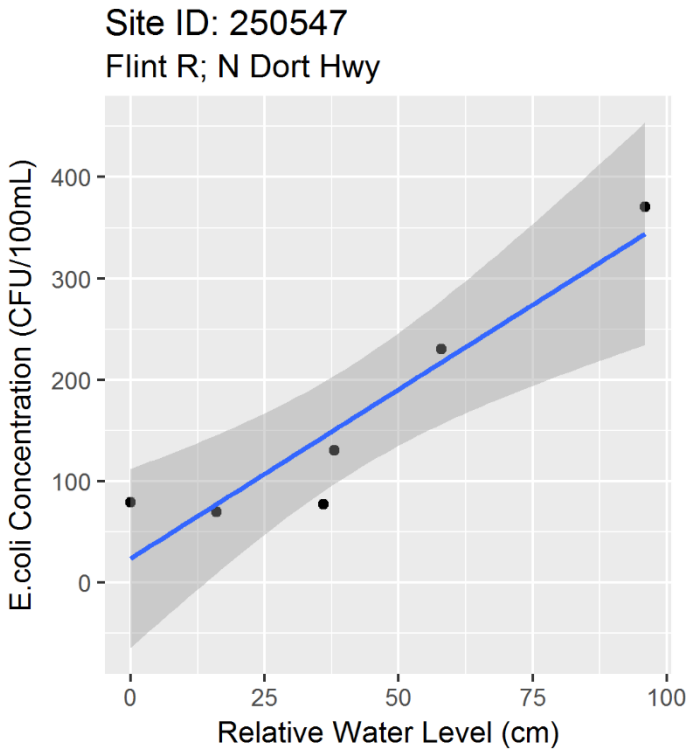

Site ID: 370166
Wolf Cr - E Edgar Rd
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
PBC
TBC
4000
2000
0
15
10
5
0
2017-06-07
2017-06-14
2017-06-21
2017-06-28
2017-07-05

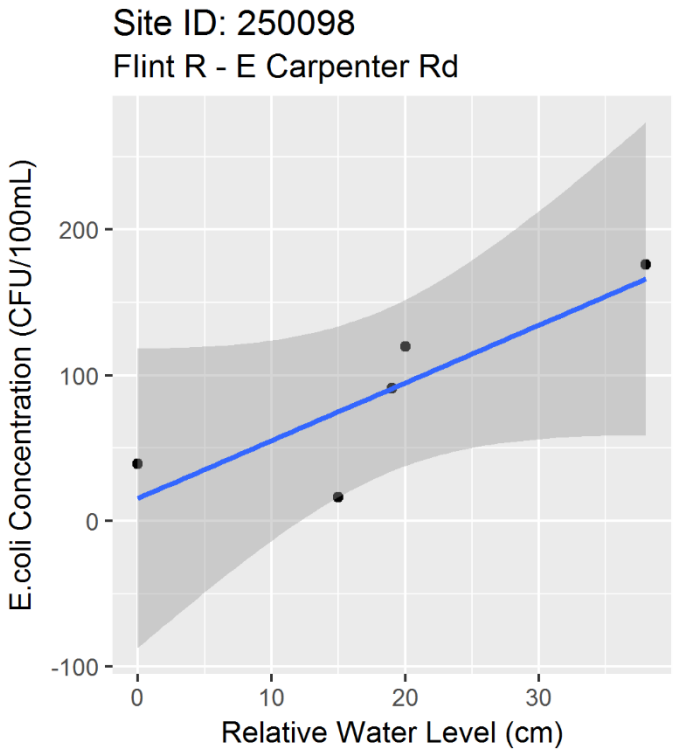

Site ID: 190148
Remey-Chandler Dr - Webb Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Precipitation (in)
1000
750
500
250
0
2.0
1.5
1.0
0.5
0.0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

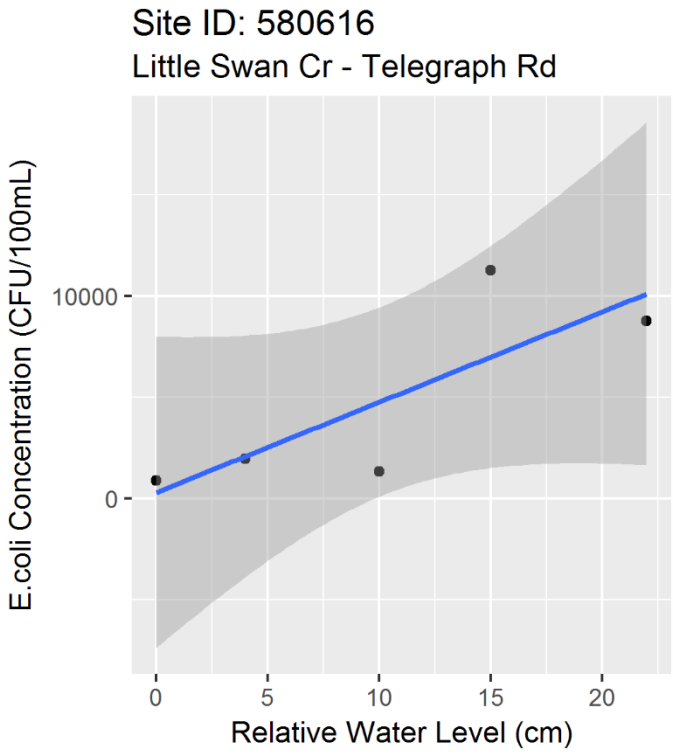

Site ID: 190148
Remey-Chandler Dr - Webb Rd
PBC
TBC
E.coli Concentration (CFU/100mL)
Relative Water Level (cm)
1500
1000
500
0
6
4
2
0
2017-08-16
2017-08-23
2017-08-30
2017-09-06
2017-09-13

Appendix 3. Relationships between *E. coli* and water levels for selected sites in the 2017 study. Water levels are relative to the lowest recorded water level during the study. The blue lines show statistical trends while the gray shaded area shows the confidence interval (the narrower the gray band, the more confidence in the relationship).

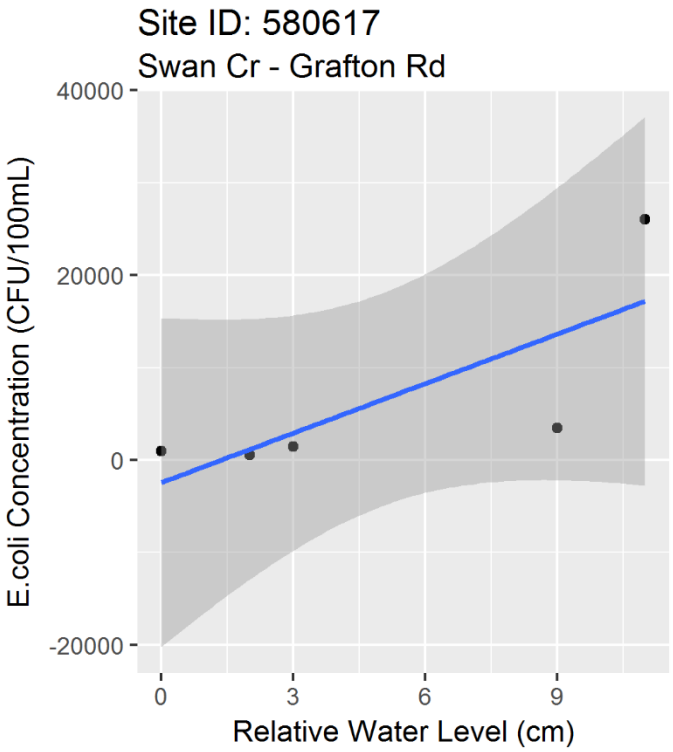


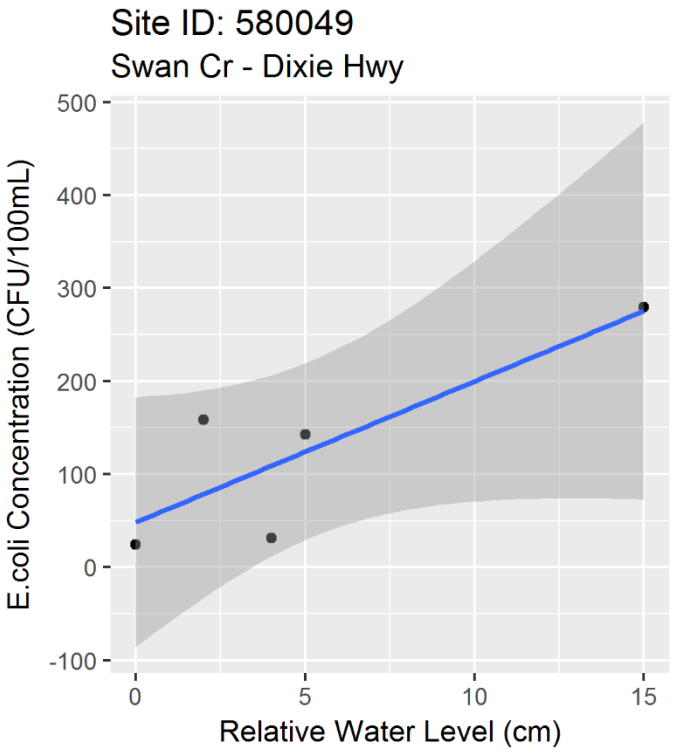


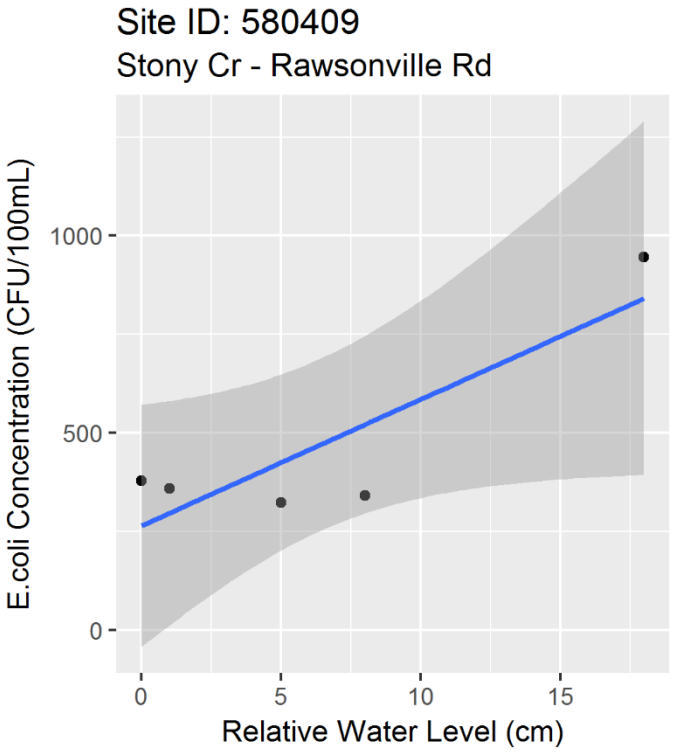


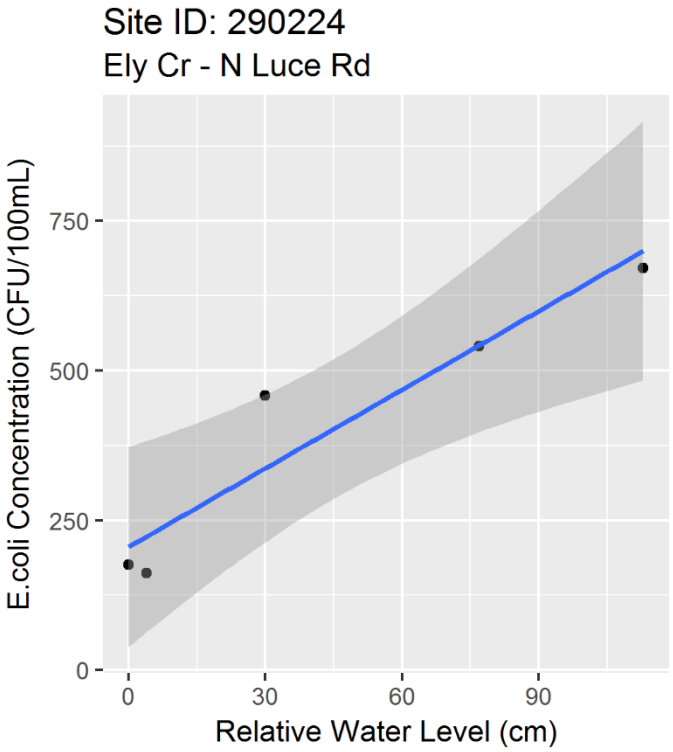


Appendix 3 (continued)









Appendix 3 (continued)