

Phase I SJRBC Water Quality Testing Program

Phase I of a three phase water testing program began in April 2014 and ended March 2015. The following parameters were collected on a monthly basis for a total of 12 collection cycles: pH, temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), chlorides, conductivity, total dissolved solids (TDS), nitrates-nitrites, total phosphorus, turbidity, total suspended solids, flow (cf/s), and *E.coli*. During the field portion of the project, data for the physical parameters of pH, temperature, DO, conductivity, TDS, turbidity, and flow were collected immediately at each location. Temperature, pH, DO, conductivity, and TDS were measured using HACH sensION meters with detection limits of 0.1°C, 0.1 standard units (pH), 0.1 mg/l (DO), 0.1 µS/CM (conductivity), and 0.1g/l (TDS). Turbidity was collected using a HACH 2100P turbidity meter with a detection limit of 0.1 NTU. Velocity measurements were taken with the 6712 HOBO Monitor with a detection limit of 0.01 fps.

Discharge or flow was calculated using the following formula:

$$\text{Discharge} = \frac{(\sum di) w * v}{(n+1)}$$

where d equals stream depth, i equals individual depths, n equals the number of stream depths measured, w equals the width of the stream, and v equals the velocity of the stream (0.9 times the fastest velocity recorded).

Grab samples were collected at each location for laboratory analysis of BOD, chlorides, nitrates-nitrites, total phosphorus, total suspended solids, and *E.coli*. The samples were collected in 500ml plastic bottles and 250ml BOD glass dark bottles. Grab samples were collected from stream center at an approximate depth of 6 inches when possible. The pole mounted collection bottle was rinsed three times at the collection site before laboratory bottles were filled to minimize cross site contamination and bias.

Laboratory analysis of samples was completed immediately upon return from the field. This procedure produces the most accurate data values for nutrient and chloride parameters. A HACH DR 2500 and DR 2800 Laboratory Spectrophotometer was used to analyze chlorides,

nitrites/nitrites, total phosphorus, and total suspended solids. Each procedure requires a strict set of protocols clearly outlined in the instruments handbook. All reagents used in the process were checked before use each month to insure they fall within the shelf life date. In addition, standards and blanks were employed for each parameter to insure accuracy. Standards are using a "known" concentration that is ran through the reagent process to validate the accuracy of the equipment. Blanks use deionized water in the process to apply corrections for the reagent stock being used for each parameter. If after applying blank corrections any parameter data still seemed to be above expected levels, a "spike" test was performed to validate the data curve of the spectrophotometer. If the curve was off a correction procedure for the instrument was employed.

BOD bottles were placed in a dark area for a five day digestion period. The DO was again taken to determine the consumption rate. This rate is recorded by mg/l and by percentage. The percentage value is for quick reference to determine if any particular site is degraded. Essentially, the lower the percentage value the better. Anything over 50% is considered degraded.

E. coli plates using the Coliscan Easygel technique developed by Micrology Laboratory were employed to determine bacterial contamination. The procedure is widely accepted around the world. Prepared plates, using 1 ml samples, were placed into an incubator for 24 hours. Since there is keen interest in this procedure a detailed explanation taken directly from the Micrology Laboratory website is below:

Coliscan Easygel

Coliform bacteria are members of the family Enterobacteriaceae and are defined as gram negative, non-spore-forming rods which ferment the sugar lactose with the evolution of gas and acids. Many coliforms are normally found in soil and water and do not necessarily indicate the presence of fecal contamination, but Escherichia coli (E. coli) is a primary bacterium in the human and animal intestinal tract and its presence in food or water indicates fecal contamination. Therefore, E. coli is the coliform that is used as an indicator for fecal contamination. Other coliform genera include Citrobacter, Enterobacter and Klebsiella. The USEPA acknowledges that E. coli is the best indicator of health risk in fresh water and is currently recommending testing for E. coli instead of fecal coliforms. The term "fecal coliform" indicates coliforms which will grow at a temperature of 44.5° C. This is not an accurate designation as there are coliforms of non-fecal origin that will grow at 44.5° C and there are strains of E. coli that will not grow at 44.5° C.

Traditional tests for coliforms and E. coli or fecal coliforms require the inoculation of media containing lactose, incubation under carefully controlled temperatures, and examination for the presence of gas from lactose fermentation. Additional special media must then be inoculated and incubated at elevated, carefully controlled temperatures to confirm the presence of E. coli or fecal coliforms. All these require extra equipment and careful regulation of time and temperature. This approach is not only expensive and time consuming, but can be less than precise in indicating the numbers of specific organisms present.

As a result of the difficulties and lack of precision inherent in the older technology, new approaches have been developed and are being used very successfully. One of the best approaches is based on the fact that in order for coliforms to ferment lactose, they must produce certain enzymes which can be identified and used to verify the presence of the coliforms. General coliforms produce the enzyme galactosidase in lactose fermentation and *E. coli* produces the enzyme glucuronidase in addition to galactosidase.

Coliscan takes advantage of these facts to give you a simple, accurate and quantitative way to identify and differentiate coliforms and *E. coli* (true fecal coliform) from other bacteria in water or other types of samples. This patented method incorporates two special chromogenic substrates which are acted upon by the presence of the enzymes galactosidase and glucuronidase to produce pigments of contrasting colors. All that is needed to identify the presence and numbers of coliforms and *E. coli* is to add a test sample to the medium, pour it into a petri dish and incubate it at room temperature or at a higher controlled temperature (35° C is suggested). General coliforms will produce the enzyme galactosidase and the colonies that grow in the medium will be a pink color. *E. coli* will produce both galactosidase and glucuronidase and will therefore grow as dark blue to purple colonies in the medium. It is simple to count the blue/purple colonies (*E. coli*) which indicate the number of *E. coli* per sample. The pink colonies indicate the number of general coliforms per sample. The combined general coliform and *E. coli* number equals the total coliform number. Any non-colored colonies which grow in the medium are not coliforms, but may be members of the family Enterobacteriaceae. Since the Coliscan contains inhibitors, most other bacterial types will not grow. It is best for the Coliscan to be incubated at a temperature higher than room temperature so that the organisms will grow faster. The suggested temperature range is between 30-37° C (85-99° F). The coliform/*E. coli* organisms will grow faster at this temperature range than at room temperature, so that results can be counted at 24-48 hours incubation time instead of about 24 hours later if incubated at room temperature, 22-27° C (72-80° F).

Micrology Laboratories can provide information on homemade or inexpensive commercial incubators.

The beauty of the Coliscan method is that it uses proven and accepted technology to allow anyone to do effective coliform/*E. coli* testing. For water testing, you can add up to a 5 mL sample of water to the bottle of medium that makes one petri plate. This will detect as small a number of coliforms or *E. coli* as one living bacterium in five milliliters of water. The method is also easily adapted for large samples with membrane filter use. Beware of copycat methods by other manufacturers who claim similar red and blue colors for coliforms and fecal coliforms, but whose results are unreliable due to inferior technology. They cannot legally copy the patented Coliscan technology.

Coliscan has a shelf life of 1 year and should be kept frozen until used. You may refrigerate for up to 2 weeks, but freezing is best in order to maintain color intensity throughout the 1 year period.

Analysis Procedure:

Introduction

The Coliscan Easygel medium is a patented formulation for water testing. It contains a sugar linked to a dye which, when acted on by the enzyme β -galactosidase (produced by coliforms including *E. coli*), turns the colony a pink color. Similarly, there is a second sugar linked to a different dye which produces a blue-green color when acted on by the enzyme β -glucuronidase. Because *E. coli* produces both β -galactosidase and β -glucuronidase, *E. coli* colonies grow with a purple color (pink + blue). The combination of these two dyes makes possible the unique ability to use one test to differentiate and quantify coliforms and *E. coli*. (Because *E. coli* is a member of the coliform group, add the number of purple colonies to the number of pink colonies when counting total coliforms.)

Instructions

1. *Either collect your water sample in a sterile container and transport the water back to the test site, or take a measured water sample directly from the source and place directly into the bottle of Coliscan Easygel. Water samples kept longer than 1 hour prior to plating, or any Coliscan Easygel bottle that has had sample placed into it for transport longer than 10 minutes, should be kept on ice or in a refrigerator until plated.*
2. *Label the petri dishes with the appropriate sample information. A permanent marker or wax pencil will work.*
3. *Sterilely transfer water from the sample containers into the bottles of Coliscan Easygel (Consult the following table for rough guidelines for inoculum amount). Swirl the bottles to distribute the inoculum and then pour the medium/inoculum mixtures into the correctly labeled petri dishes. Place the lids back on to the petri dishes. Gently swirl the poured dish until the entire dish is covered with liquid (but be careful not to splash over the side or on the lid).*

Inoculation of Coliscan Easygel

Water Sources	Inoculum Amount
<i><u>Environmental:</u> River, lake, pond, stream, ditch</i>	<i>1.0 to 5.0 mL</i>
<i><u>Drinking water:</u> Well, municipal, bottled</i>	<i>5.0 mL</i>

4. *The dishes may be placed right-side-up directly into a level incubator or warm level spot in the room while still liquid. Solidification will occur in approximately 45 minutes.*
5. *Incubate at 35 C (95 F) for 24 hours, or at room temperature for 48 hours. (see Comments on incubation)*
6. *Inspect the dishes.*
 - a. *Count all the purple colonies on the Coliscan dish (disregard any light blue, blue-green or white colonies), and report the results in terms of E. coli or Fecal Coliform per mL of water.*

Note: To report in terms of E. coli or Fecal Coliform per 100 mL of water, first find the number to multiply by:

 1. *Divide 100 by the number of mL that you used for your sample.*
 2. *Multiply the count in your plate by the result obtained from #1.*

e.g. For a 3 mL sample, $100 / 3 = 33.3$. So 4 E. coli colonies multiplied by 33.3 will be equal to 133.2 E. coli per 100 mL of water.
 - b. *Count all the pink and purple colonies on the Coliscan dish (disregard any light blue, blue-green or white colonies) and report the results in terms of coliforms per mL of water.*
7. *Do one of the following prior to disposal in normal trash:*
 - a. *Place dishes and Coliscan bottles in a pressure cooker and cook at 15 lbs. for 15 minutes. (This is the best method.)*

- b. Place dishes and Coliscan bottles in an oven-proof bag, seal it, and heat in an oven at 300° F for 45 minutes.
- c. Place dishes and Coliscan bottles in a large pan, cover with water and boil for 45 minutes.
- d. Place 5 mL (about 1 teaspoon) of straight bleach onto the surface of the medium of each plate. Allow to sit at least 5 minutes. Place in a water-tight bag and discard in trash.

Comments on Incubation

Micrology Laboratories, LLC. in-house studies indicate that **Coliscan** can effectively differentiate general coliforms from **E. coli** when incubated at either room temperatures or at elevated temperatures (such as 90-98 F). However, some further explanation may be helpful.

There is no one standard to define room temperature. Most would consider normal room temperature to vary from 68-74 F, but even within this range the growth of bacteria will be varied. Members of the bacterial family **Enterobacteriaceae** (which includes coliforms and **E. coli***) are generally hardy growers that prefer higher than room temperatures, but which will grow at those temperatures. They tend to grow at a faster rate than most other bacterial types when conditions are favorable. It is therefore logical to try to place inoculated dishes in a "warm" place in a room for incubation if a controlled temperature incubator is not available. It is a very easy task to make an adequate incubator from a box with a 40-60 watt bulb in it to provide heat at an even rate. One can also use a heat tape such as is used to prevent the freezing of pipes in the winter as your heat source.

Our general instructions indicate that incubation times for coliforms (including **E. coli**) are generally 24-48 hours at elevated temperatures (90-98 F) and 48 or more hours at room temperatures. At elevated temperatures, no counts should be made after 48 hours as any coliforms present will be quite evident by that time and if new colonies form after 48 hours they are most likely not coliforms, but some other type of slow growing organism that should not be included in your data. At room temperatures, the best procedure is to watch the plates by checking them at 10-12 hour intervals until you observe some pink or purple colonies starting to form and then allowing another 24-30 hours for the maturation of those colonies. Since the coliforms (including **E. coli**) are generally the fastest growing organisms, these will be the first to grow and be counted. Colonies that may show up at a later time are likely to not be coliforms. As you can see, there are advantages to incubating your dishes at elevated temperatures. First, you can count the results earlier. At 95 F, it is often possible to do accurate counts at 18-20 hours of incubation. There is also less probability of variation from batch to batch when the incubation temperatures are kept at one uniform level. And a higher incubation temperature will tend to inhibit the growth of non-coliforms that may prefer lower temperatures.

***E. coli** is the primary fecal coliform, however, **Klebsiella** is sometimes of fecal origin. Other general coliform genera include **Enterobacter** and **Citrobacter**.

Interpretation of Results

This test method utilizes well established, widely accepted criteria for the recognition of coliforms and **E. coli** and proper application of the method will result in accurate results. Therefore, if you suspect that your water is dangerously contaminated based on the results you get using Coliscan Easygel, you should contact your local health department and ask for their help in performing an official assessment of the water.

Non-fecal coliforms are widely distributed in nature, being found both as naturally occurring soil organisms, and in the intestines of warm-blooded animals and humans. Fecal coliforms are coliforms

found naturally only in the intestines of warm-blooded animals and humans. Fecal coliform contamination is therefore the result of some form of fecal contamination. Sources may be either animal or human.

General Notes on Differentiating Coliforms and E. coli

Generally, water containing E. coli (the fecal contamination indicator organism) should not be used for drinking water unless it is sanitized in some manner. Contact your local health department for guidelines regarding E. coli and coliforms in recreational waters. Inform them if you suspect that contamination may be occurring from a specific source.

Colonies which have the blue-green color are not exhibiting any β -galactosidase activity (which is evidenced by the pink color). Because of this, they are not considered to be either coliforms or E. coli and therefore should be ignored when counting your coliform or E. coli colonies. Similarly, colonies which are white are exhibiting neither color-causing enzyme, and should also be ignored.

Colonies on the surface of the plate are exposed to the medium on only the underside of the colony. This causes these colonies to appear with much less of the indicator color. E. coli colonies may only have a slight purple tinge to them, and it may appear only in the center of the colony with the remainder of the colony being white. Similarly, coliforms on the surface may be light pink or white with a pink center.

The above explanation of using the Easygel technique (although very detailed) should alleviate any questions concerning the procedure.

Figure 1 is an overview map demonstrating the relative locations of all ten sites sampled during Phase I of the project. All of the locations were in Noble County and were selected by the SJRBC. The design was intended to capture data for the headwater regions of the North and South branches of the Elkhart River drainage. It concentrated along ditch systems in areas not already sampled by the Lagrange County Lakes Council (in LaGrange County) to prevent duplication of data sites. Data collected by the lakes council will be interpreted and included in the projects final analysis at a later date.

The sampling regime was conducted during the morning hours once each month for data consistency and bias reduction. The sampling process was generally completed in four hours with the laboratory analysis completed immediately upon return. The *E.coli* plates were read 24 hours after plate preparation and the BOD was completed after a five day incubation period.

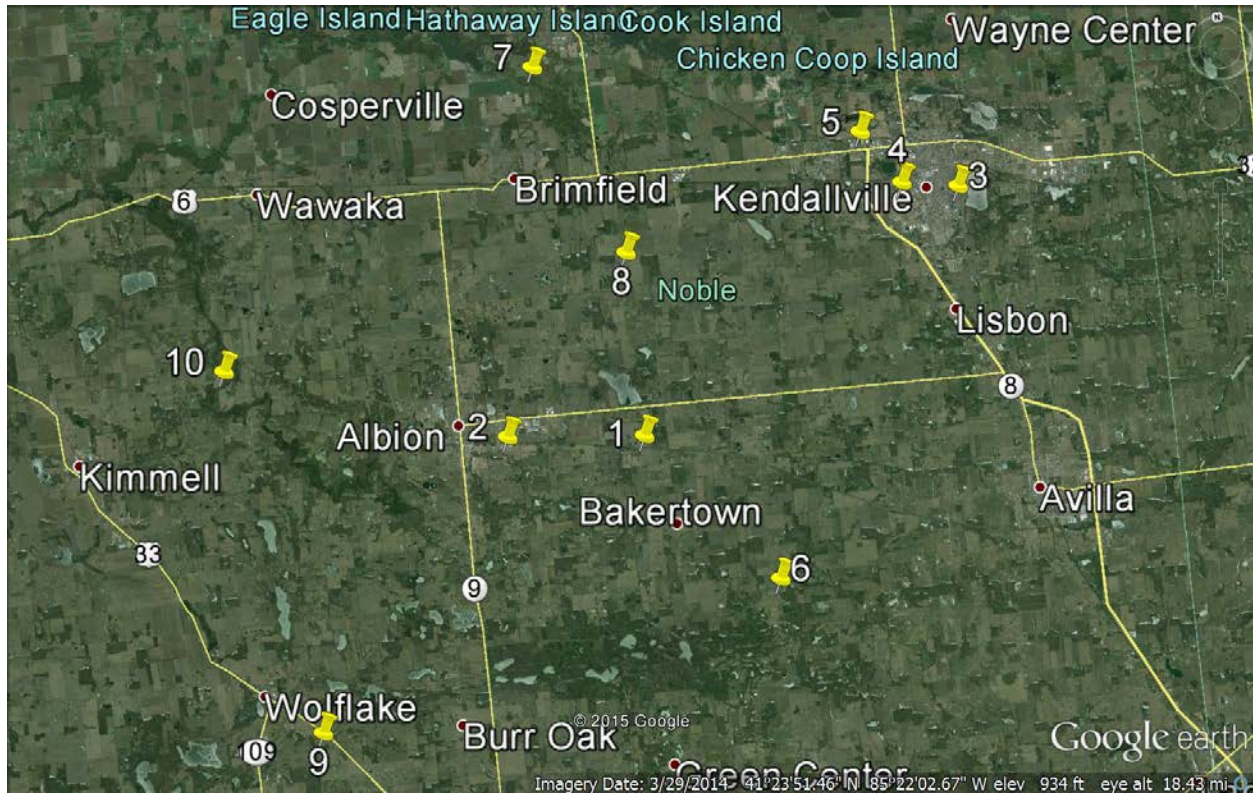


Figure 1: Overview map of Phase I sites.

It is important to discuss target parameters before interpreting individual site data. Table 1 shows the target values of each parameter. In most cases it is the maximum concentration considered acceptable. However, in many cases individual parameters may have several target concentrations depending on the information source. For example, total phosphorus in Ohio is ≤ 0.08 mg/l for the headwater regions of any river or stream system. In Indiana, < 0.3 mg/l is the number generally accepted by IDEM even though this target is not officially set in stone at this time. For the highly channelized and ditched lateral systems feeding into the main channels of any river in northern Indiana, the < 0.3 mg/l is a realistic target. Generally, these lateral systems are providing the major loading of Non-Point Source (NPS) pollutants that are reaching the Great Lakes.

With this target variation in mind, Table 1 signifies numbers accepted by IDEM in Watershed Management plan development based on years of research and recent water quality testing efforts in agrarian regions of northern Indiana. Since the preponderance of influence throughout the Phase I sites is agriculture, the target levels represented are realistic and are used in the data discussion to explain relative water quality at each test site.

Parameter	Target	Source
Dissolved Oxygen	> 6 mg/L and not > 9 mg/L	327 IAC 2-1-6/US EPA recommendation
Temperature	40-85 degrees F	MI – R.323.1075
<i>Escherichia coli</i>	< 235 CFU/100 ml per single sample and < 125 CFU/100 ml per the geometric mean of 5 equally spaced samples over a 30 day period	327 IAC 2-1.5-8
Turbidity	< 10.4 NTU	US EPA recommendation (2000)
Total Dissolved Solids	< 750 mg/L	MI – R.323.1051 / 327 IAC 2-1-6
Total Suspended Solids	< 25 mg/L	US EPA recommendation
Total Phosphorus	< 0.3 mg/L	IDEM 303d listing criteria
Nitrate	< 1.5 mg/L	US EPA reference level (2000)
Nitrate-Nitrite	< 1.5 mg/L	Dodds et al. (1998)
Biological Oxygen Demand	< 50%	IDEM/Purdue University
pH	> 6 or < 9	327 IAC 2-1-6
Chlorides	<25 mg/l	IDEM

Table 1: Target levels of tested parameters.

Site 1

Site 1 (Figure 2) is on the Rimmell Branch Ditch and is a culvert on CR300E just south of SR 8 (south of Skinner Lake). This location was moved from its original location due to a recent channelization that interfered with ditch flow allowing lake water bias in samples.

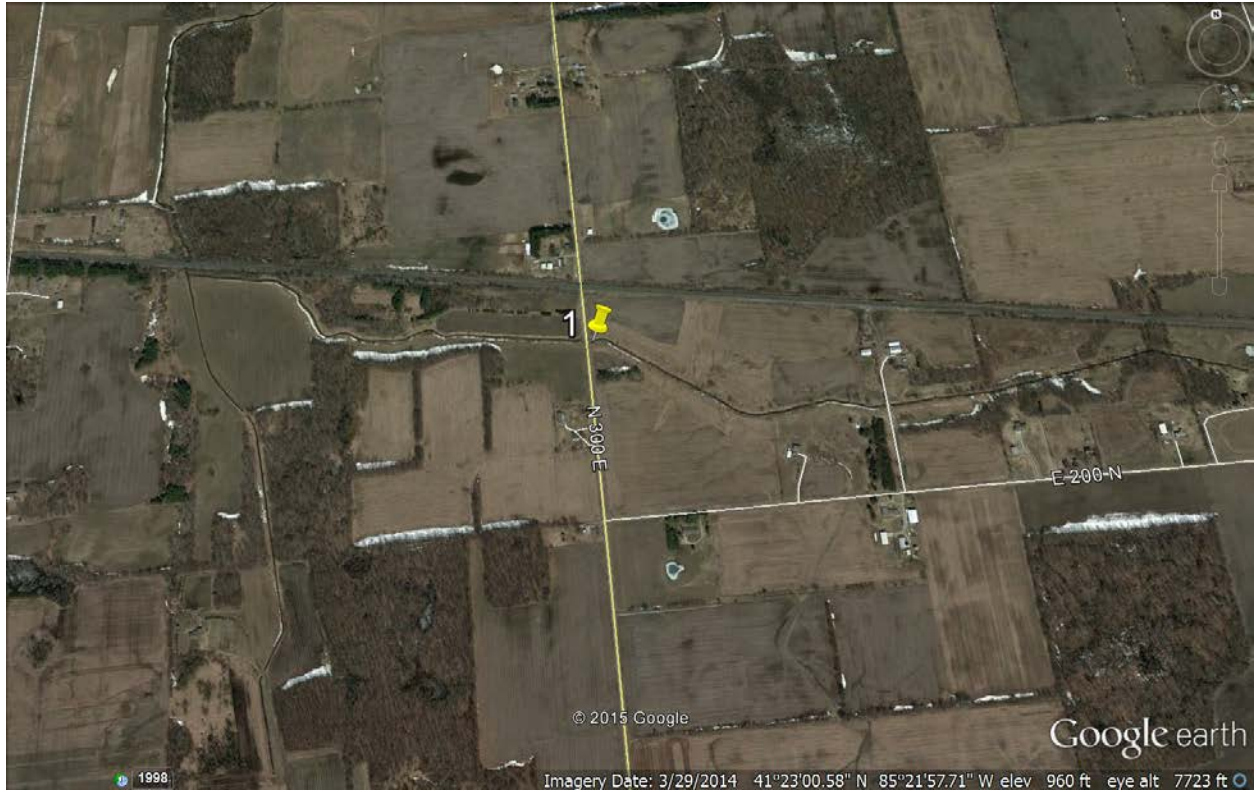


Figure 2: Site 1 location.

Table 2 displays the data for Site 1 and clearly shows this as a problematic site for *E.coli*, nitrates-nitrites, total phosphorus, turbidity and total suspended solids. *E.coli* target limits were exceeded 4 times or 33.33% of total samples taken, Nitrates-nitrites limits were exceeded 8 times or 66.66%, total phosphorus limits were exceeded 8 times or 66.66%, turbidity limits were exceeded 7 times or 58.33%, and total suspended solids limits were exceeded 8 times or 66.66% of total samples taken during phase I.

The contamination appears to be associated with large dairy operations upstream. Several locations allow livestock direct access into the ditch system and have barnyards with little or no buffering to prevent runoff. Skinner Lake receives this contaminated runoff which is certainly unhealthy for the lake. However, the lake does act a buffer to prevent or at least significantly reduce the contamination from moving further downstream.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
1	4/23/2014	Y	WW	7.60	8.9	9.14	0.7	8.6	16.7	564	288	0	4.8	0.35	3	31	1.755
1	5/29/2014	Y	WW	7.30	16.2	7.74	1.5	18.73	14.9	610	311	2400	10.1	0.62	70	99	4.577
1	6/27/2014	Y	WW	7.67	18.3	7.48	0	0	17.9	715	365	600	3.2	0.46	51	58	2.565
1	7/29/2014	N	BF	8.08	16.9	11.48	6.4	56.1	8.2	692	353	200	1.0	0.72	73	92	0.406
1	8/27/2014	Y	BF	8.02	21.2	4.78	1.4	28.87	19.7	711	363	0	0.8	0.42	68	72	0.117
1	9/25/2014	N	BF	8.10	13.3	6.49	0.4	18.03	11.3	745	380	500	2.5	0.59	32	98	0.108
1	10/29/2014	N	BF	8.16	10.1	7.80	1.3	16.15	9.2	721	368	100	1.2	0.09	21	45	0.115
1	11/24/2014	Y	WW	7.64	9.0	8.53	5.4	62.95	27.8	477	243	400	9.7	1.65	63	189	12.167
1	12/30/2014	N	BF	8.13	1.6	11.33	1.2	10.86	12.5	893	491	100	4.1	0.07	4	13	2.971
1	1/28/2015	N	BF	8.01	1.1	11.34	1.3	11.46	14.3	545	300	50	2.1	0.07	2	7	1.954
1	2/27/2015	N	BF	7.87	0.8	11.56	0.5	4.33	9.5	542	298	50	1.2	0.07	1	4	1.105
1	3/25/2015	Y	BF	7.89	5.5	10.07	0.7	6.95	16.3	562	309	200	2.8	0.24	3	5	2.481
Average				7.87	10.2	9.0	1.733333	20.2525	14.85833	648.0833333	339.0833	383.33333	3.625	0.44583333	32.58333	59.4166667	2.52675

Table 2: Site 1 data.

Site 2

Site 2 (Figure 3) is on Croft Ditch and is a bridge on 75E just south of SR 8. This location was moved approximately 1 mile west of the original site in order to capture dairy operation runoff during rain events.

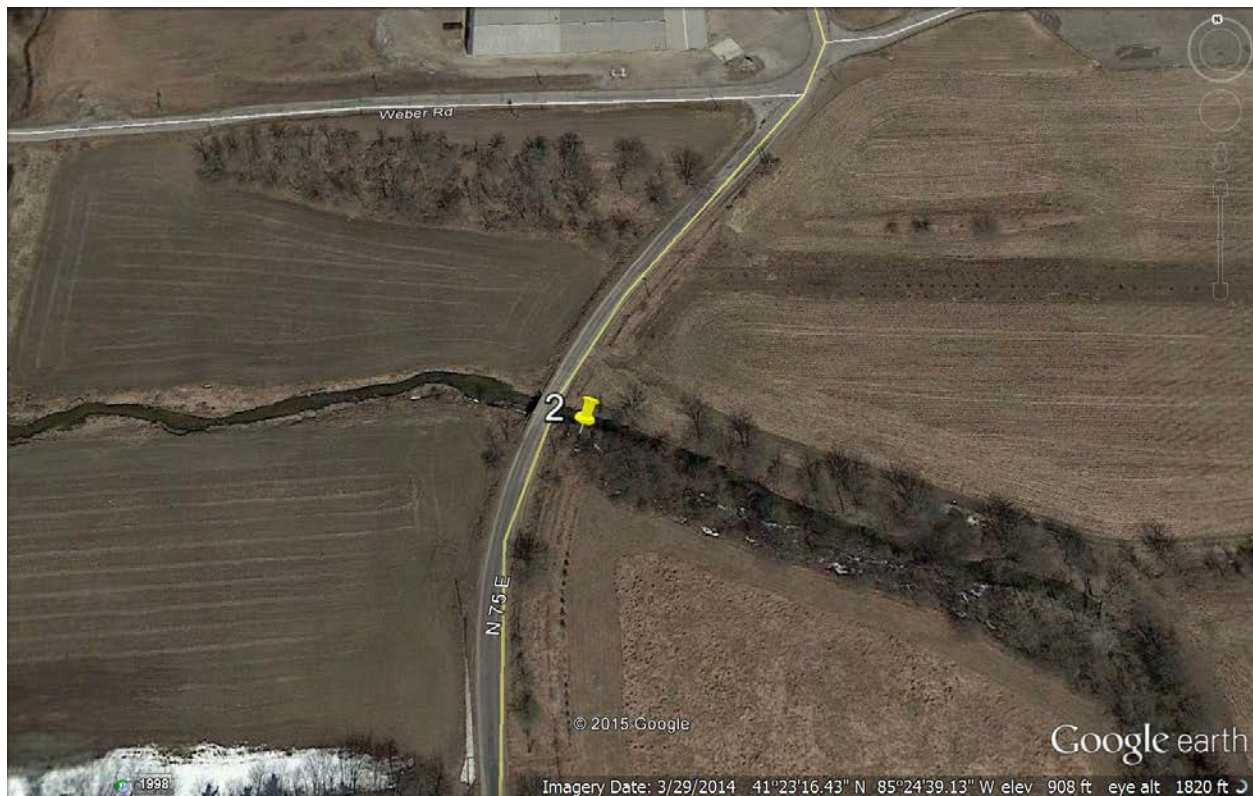


Figure 3: Site 2 location.

Table 3 displays the data for Site 2 and shows, as in Site 1, a likely livestock contamination problem for *E.coli*, nitrates-nitrites, total phosphorus, turbidity and total suspended solids. *E.coli* exceeded the target maximum loading 5 times or 45.45% of the samples taken, nitrates-

nitrites 7 times or 63.63%, total phosphorus 5 times or 45.45%, turbidity 4 times or 36.36%, and total suspended solids 3 times or 27.27% of the samples taken for analysis.

A dairy operation 1 mile upstream has a severely sloped barnyard that allows direct runoff into the stream. As expected, runoff caught during or immediately after a significant rain event captured the high NPS pollutant problem.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
2	4/23/2014	Y	WW	7.74	10.6	9.53	2.3	24.13	18.2	592	302	100	5.3	0.29	2	18	18.365
2	5/29/2014	Y	WW	7.89	21.2	7.98	3.1	38.85	11.0	553	282	8100	4.6	0.39	33	43	39.62
2	6/27/2014	Y	WW	7.92	22.2	7.31	2.0	27.91	6.5	538	274	4300	1.9	0.32	36	44	15.017
2	7/29/2014	N	BF	8.03	15.3	7.65	1.3	17.39	3.6	763	389	850	0.9	0.59	2	11	0.932
2	8/27/2014	Y	BF	7.83	19.4	6.03	0	0	16.5	768	392	0	1.2	0.30	15	12	0.792
2	9/25/2014	N	Road Closed														
2	10/29/2014	N	BF	8.06	9.9	8.08	1.8	22.64	8.3	711	363	200	2.2	0.11	5	4	2.422
2	11/24/2014	Y	WW	7.81	8.6	9.41	4.2	44.53	15.2	589	300	250	9.9	0.66	37	59	33.383
2	12/30/2014	N	BF	7.83	1.8	11.85	2.5	21.27	5.2	595	327	50	3.5	0.12	2	7	5.302
2	1/28/2015	N	BF	7.77	1.3	12.09	0.8	6.62	16.6	583	321	0	1.5	0.09	1	3	3.232
2	2/27/2015	N	BF	7.79	0.9	12.21	0.3	2.46	3.2	585	322	50	1.1	0.09	1	2	2.172
2	3/25/2015	Y	BF	7.81	6.2	10.29	1.2	11.66	18.7	582	320	350	3.1	0.22	1	2	3.019
Average				7.861818	10.67273	9.311818	1.772727	19.76909	11.18182	623.5454545	326.5455	1295.4545	3.2	0.28909091	12.27273	18.6363636	11.296

Table 3: Site 2 data.

Site 3

Site 3 (Figure 4) is located in Kendallville, next to East Noble High School and is a culvert on Bixler Lake Ditch approximately a quarter mile downstream of the lake outlet. Both sides of the site are sloped and maintained as grassways which will act as a buffer for runoff during rain events. The soils are muck and the ditch system is maintained to keep the soil well drained.

Table 4 shows Site 3 data and demonstrates some high levels of nitrates-nitrites, total phosphorus, turbidity, and total suspended solids. *E.coli* was found high on only 1 sample or 11.11% of samples taken. Nitrates-nitrates exceeded the target maximum threshold 5 times or 55.55%, total phosphorus 2 times or 22.22%, turbidity 2 times or 22.22%, and total suspended solids 2 times or 22.22% of total samples taken during the sampling cycle. An interesting note is that this ditch system maintains a rather large population of Carp year round. Except for the single high *E.coli* sample, mechanical disturbance of sediments is the likely cause of the higher readings during the sampling cycle. In every case where high numbers were recorded, Carp were observed disturbing the ditch sediments. The single high *E.coli* reading was likely caused by over 100 geese observed at the outlet to Bixler Lake.

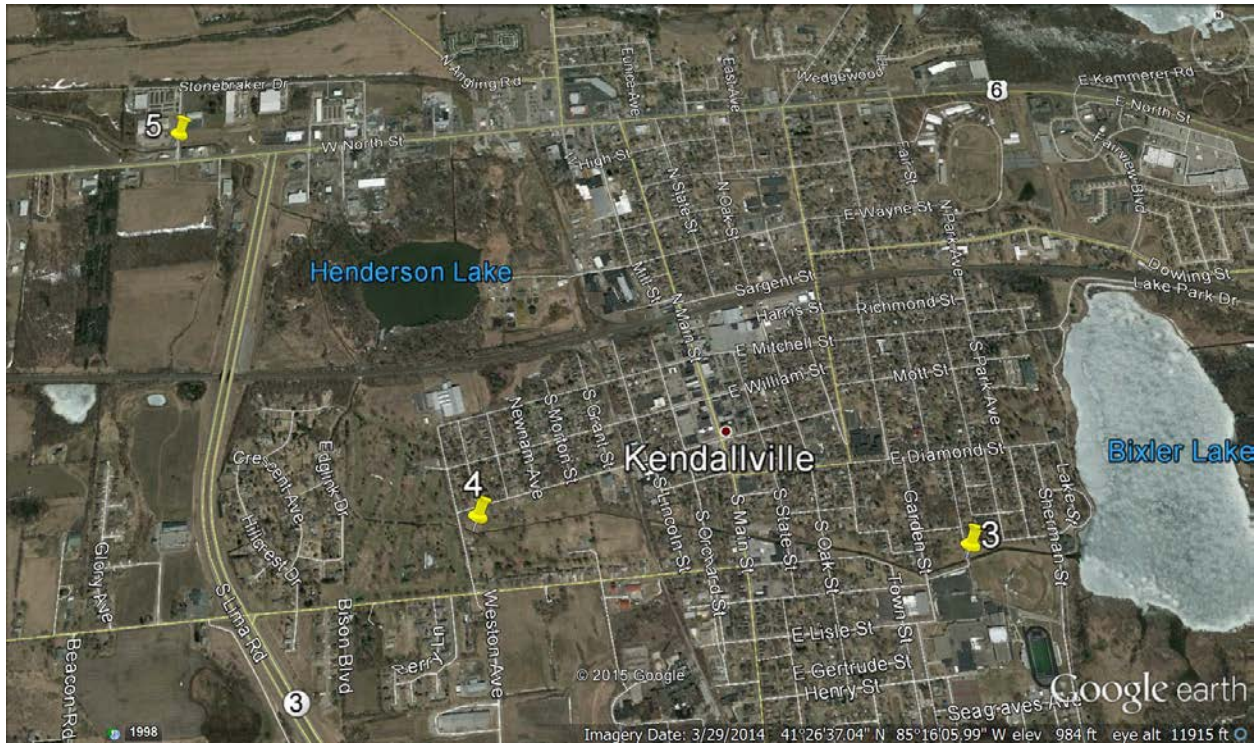


Figure 4: Sites 3, 4, and 5 locations.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
3	4/23/2014	Y	WW	8.04	10.9	10.19	2.4	24.04	23.8	567	289	0	1.9	0.27	2	10	10.800
3	5/29/2014	Y	WW	7.86	18.7	7.66	0.8	10.31	25.9	650	391	100	5.6	0.12	6	12	1.697
3	6/27/2014	Y	WW	7.76	23.3	5.78	0.8	13.67	25.0	630	321	200	0.9	0.27	23	27	0.802
3	7/29/2014	N	BF	7.83	16.7	3.94	2.7	69.04	12.5	651	332	400	0.1	0.48	13	15	0.864
3	8/27/2014	Y	No Flow														
3	9/25/2014	N	No Flow														
3	10/29/2014	N	No Flow														
3	11/24/2014	Y	WW	7.49	9.8	8.22	7.2	88.08	9.0	480	245	200	5.8	0.77	23	37	3.078
3	12/30/2014	N	BF	7.45	1.1	9.47	1.3	13.72	3.9	473	260	0	1.8	0.17	3	9	1.005
3	1/28/2015	N	BF	7.51	1.2	10.52	1.0	9.51	19.1	579	318	0	1.1	0.11	2	4	0.074
3	2/27/2015	N	BF	7.63	1.1	10.78	0.6	5.57	2.7	567	312	0	0.8	0.06	1	2	0.032
3	3/25/2015	Y	BF	7.71	6.1	9.58	0.9	9.39	23.2	571	314	100	1.5	0.22	3	4	0.396
			Average	7.697778	9.877778	8.46	1.966667	27.03667	16.1	574.2222222	309.1111	111.11111	2.166667	0.27444444	8.444444	13.3333333	2.083

Table 4: Site 3 data.

Site 4

Site 4 (Figure 4) is located in Kendallville just upstream of the Elks Golf Course and is a culvert located on Bixler Lake Ditch. A city park surrounds the site and acts as a buffer from runoff contaminants generated by the city.

Table 5 shows the data and demonstrates nitrates-nitrites as the most prevalent NPS contaminant by exceeding the target threshold 5 times or 41.66% of samples taken, followed by turbidity and total suspended solids each exceeding the target 2 times or 16.66%, and total phosphorus 1 time at 8.33% of total samples. Again, Carp were observed disturbing streambed

soils during sampling. Some of the high nitrates-nitrites can be explained with grass fertilizers at the Park. Fertilizer applications were directly observed.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
4	4/23/2014	Y	WW	8.20	10.6	9.40	3.8	40.85	21.3	466	238	100	2.1	0.29	17	28	5.481
4	5/29/2014	Y	WW	8.18	18.5	7.18	1.7	24.32	25.5	622	317	0	2.6	0.24	7	14	3.84
4	6/27/2014	Y	WW	7.96	22.6	7.34	0	0	17.6	680	340	150	1.1	0.17	5	6	1.620
4	7/29/2014	N	BF	7.93	16.1	8.87	1.5	16.8	8.6	855	436	0	0.1	0.21	2	1	0.292
4	8/27/2014	Y	BF	7.71	22.0	7.53	0	0	3.2	723	368	0	1.0	0.20	3	5	0.011
4	9/25/2014	N	BF	7.60	14.8	8.62	0	0	3.2	1074	548	0	0.8	0.11	0	4	0.091
4	10/29/2014	N	BF	7.75	9.9	9.12	2.5	27.52	2.4	987	503	150	1.5	0.10	2	3	0.326
4	11/24/2014	Y	WW	7.51	9.6	8.28	6.4	77.05	17.8	512	261	100	9.7	0.55	24	40	4.714
4	12/30/2014	N	BF	7.37	1.5	10.36	1.3	13.47	7.1	678	373	0	1.4	0.14	1	3	1.023
4	1/28/2015	N	BF	7.60	1.3	11.13	0.7	6.29	16.7	425	234	0	1.1	0.09	1	3	0.073
4	2/27/2015	N	BF	7.60	1.1	11.37	0.2	1.76	5.3	425	234	0	0.8	0.08	1	2	0.059
4	3/25/2015	Y	BF	7.94	5.9	10.13	1.4	13.82	20.4	487	268	100	1.7	0.25	2	4	0.641
			Average	7.78	11.15833	9.110833	1.625	18.49	12.425	661.1666667	343.3333	50	1.991667	0.2025	5.416667	9.41666667	1.51425

Table 5: Site 4 data.

Site 5

Site 5 (Figure 4) is located on the northwest side of Kendallville and is a culvert on Henderson Lake Ditch. This location is significant since it is downstream of the wastewater treatment plant for the city. Henderson Lake buffers the plant discharge and flows through the ditch system approximately 1 mile before reaching the sampling site.

Table 6 shows Site 5 data and demonstrates nitrates-nitrites as the highest NPS pollutant exceeding the target threshold 7 times or 58.33% of total samples taken, followed total phosphorus with 5 times or 41.66%, turbidity 2 times or 16.66%, and total suspended solids and *E.coli* 1 time each or 8.33% of total samples collected. Carp disturbance can explain on two of the sampling events with high numbers. The high *E.coli* was likely from several hundred geese observed at Henderson Lake outlet (only observed once during that particular sample collection). It is suspect some of the high nutrient readings could be associated with the discharge from the treatment facility, although this is speculation from a limited number of samples taken a significant distance downstream.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
5	4/23/2014	Y	WW	7.94	11.1	9.81	2.2	22.43	20.7	815	416	0	2.0	0.33	0	9	2.869
5	5/29/2014	Y	WW	7.91	19.7	6.74	2.4	35.31	26.5	831	424	500	6.2	0.26	9	13	4.536
5	6/27/2014	Y	WW	6.79	23.2	7.95	1.8	22.39	25.0	981	500	200	0.2	0.37	11	19	1.607
5	7/29/2014	N	BF	7.96	18.1	9.45	7.3	77.46	11.9	1157	590	0	1.1	0.43	6	16	1.559
5	8/27/2014	Y	BF	7.73	23.5	6.82	4.2	61.73	23.0	1356	692	0	2.1	0.34	13	8	0.557
5	9/25/2014	N	BF	7.70	16.7	7.68	0	0	11.6	1290	658	50	3.7	0.28	15	16	0.347
5	10/29/2014	N	BF	7.6	10.5	7.29	1.1	14.81	8.5	1078	550	100	2.3	0.21	2	2	0.549
5	11/24/2014	Y	WW	7.40	8.4	9.12	5.6	61.51	20.6	858	438	100	4.3	0.49	45	61	8.235
5	12/30/2014	N	BF	7.87	1.7	10.83	1.1	10.16	9.7	482	265	0	1.1	0.15	1	3	2.719
5	1/28/2015	N	BF	7.83	1.1	11.56	1.1	9.52	16.3	715	393	0	0.8	0.08	1	3	1.779
5	2/27/2015	N	BF	7.77	1.1	11.82	0.5	4.23	7.1	707	389	0	0.6	0.04	1	2	1.247
5	3/25/2015	Y	BF	7.88	5.9	10.05	1.7	16.92	20.1	759	417	100	1.5	0.27	3	5	2.563
			Average	7.70	11.75	9.093333	2.416667	28.03917	16.75	919.0833333	477.6667	87.5	2.2	0.27083333	8.916667	13.0833333	2.380583

Table 6: Site 5 data.

Site 6

Site 6 (Figure 5) is a culvert on Thumma Ditch located on 500E slightly over a quarter mile south of Baseline Road. Chain O' Lakes State Park is just west of the site. This ditch system flows into the state park's lake system.



Figure 5: Site 6 location.

Table 7 shows Site 6 data with nitrates-nitrites exceeding the target threshold 6 times or 50% of the total samples taken, followed by total phosphorus exceeding 3 times or 25%, and turbidity, total suspended solids, and *E.coli* each exceeding the target threshold 2 times or 16.66% of the total samples collected. All of these high values are likely from dairy operations upstream that have steep sloping barnyards and pastures next to the ditch that are totally denuded of vegetation from overgrazing. The lake system in Chain O' Lakes State Park is likely preventing the majority of these contaminants from flowing further downstream.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
6	4/23/2014	Y	WW	7.96	9.9	9.78	1.0	10.22	14.6	570	291	0	2.4	0.26	7	7	1.928
6	5/29/2014	Y	WW	8.04	18.6	7.79	0.9	11.81	12.7	583	297	300	5.8	0.29	11	15	1.706
6	6/27/2014	Y	WW	7.90	20.4	7.72	0	0	13.9	510	260	450	3.6	0.66	28	28	4.165
6	7/29/2014	N	BF	8.16	15.6	8.05	1.2	14.91	6.7	660	337	0	1.3	0.20	5	4	0.395
6	8/27/2014	Y	BF	8.13	20.7	6.25	0	0	8.5	658	336	0	0.7	0.51	4	4	0.024
6	9/25/2014	N	BF	8.17	13.7	8.91	0	0	4.7	660	337	0	1.5	0.08	2	6	0.037
6	10/29/2014	N	BF	8.14	9.5	9.56	1.9	19.87	3.2	645	329	100	1.4	0.08	2	3	0.277
6	11/24/2014	Y	WW	7.69	9.8	8.52	4.2	48.94	16.3	340	173	0	1.8	0.91	57	79	25.175
6	12/30/2014	N	BF	7.78	1.4	11.34	1.4	12.35	6.4	434	239	0	1.2	0.15	2	5	5.378
6	1/28/2015	N	BF	7.92	1.2	11.39	0.5	4.39	11.8	589	324	0	0.8	0.11	1	3	3.348
6	2/27/2015	N	BF	7.93	1.0	11.59	0.1	0.09	4.6	593	326	0	0.5	0.06	1	2	2.458
6	3/25/2015	Y	BF	7.97	6.1	10.21	1.4	13.71	14.2	554	304	200	1.8	0.26	1	3	4.254
Average				7.9825	10.65833	9.259167	1.1	11.3575	9.8	566.3333333	296.0833	87.5	1.9	0.2975	10.08333	13.25	4.095417

Table 7: Site 6 data.

Site 7

Site 7 (Figure 6) is a culvert on Clock Creek located on 175E just north of 850N. This stretch is heavily buffered by trees and swamp.

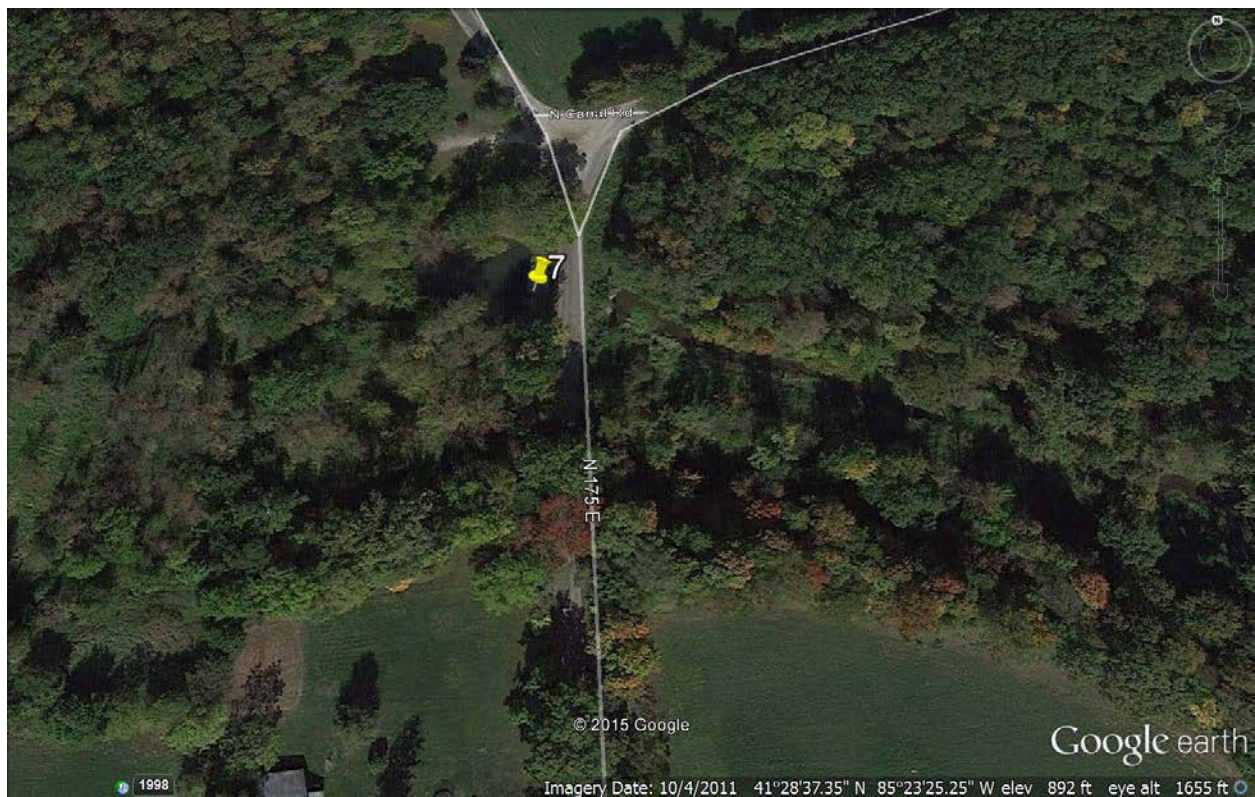


Figure 6: Site 7 location.

Table 8 shows Site 7 data with nitrates-nitrites exceeding the target threshold 9 times or 75% of the total samples taken, followed by total phosphorus exceeding 4 times or 33.33%, and turbidity, total suspended solids, and *E.coli* exceeding 2 times or 16.66% of the total samples collected. Turbidity and total suspended solids numbers can be explained by an observed large population of White Sucker and Carp. The nutrient and *E.coli* numbers can be explained by the

large livestock operations along the ditch and heavy manure spreading during the spring months.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
7	4/23/2014	Y	WW	7.56	10.5	9.19	1.02	11.10	13.3	582	297	0	3.2	0.68	0	4	4.095
7	5/29/2014	Y	WW	7.56	19.0	6.20	2.1	33.39	26.3	432	220	8400	5.4	0.86	45	46	32.076
7	6/27/2014	Y	WW	8.09	19.5	7.41	0	0	8.8	645	329	350	7.2	0.26	11	15	2.835
7	7/29/2014	N	BF	7.78	16.6	12.25	6.3	51.18	5.8	641	326	200	1.2	0.41	2	3	0.068
7	8/27/2014	Y	BF	7.95	19.6	6.28	0	0	6.3	635	324	200	2.0	0.28	11	8	0.216
7	9/25/2014	N	BF	8.26	13.8	12.61	0	0	2.8	660	337	50	1.6	0.21	0	8	2.814
7	10/29/2014	N	BF	8.02	9.7	7.98	1.6	19.55	2.1	651	332	50	1.4	0.18	1	2	3.683
7	11/24/2014	Y	WW	8.14	9.1	7.70	4.1	53.64	8.1	475	242	100	3.9	0.65	22	34	17.242
7	12/30/2014	N	BF	8.40	2.2	11.32	1.2	10.69	3.3	716	394	0	3.5	0.08	3	9	1.112
7	1/28/2015	N	BF	8.37	1.5	10.87	0.9	8.28	9.2	561	309	0	1.5	0.08	2	5	0.879
7	2/27/2015	N	BF	8.13	1.1	10.99	0.5	4.55	2.3	575	316	0	1.1	0.05	1	3	0.559
7	3/25/2015	Y	BF	8.49	6.2	9.54	1.1	11.53	12.7	583	321	100	2.2	0.28	3	5	3.888
Average				8.0625	10.73333	9.361667	1.568333	16.99	8.416667	596.3333333	312.25	787.5	2.85	0.335	8.416667	11.8333333	5.788917

Table 8: Site 7 data.

Site 8

Site 8 (Figure 7) is a culvert on Boughey/Dry Run Ditch located on 300E just north of 500N. It is surrounded by grain fields and has a heavy agricultural influence further upstream.

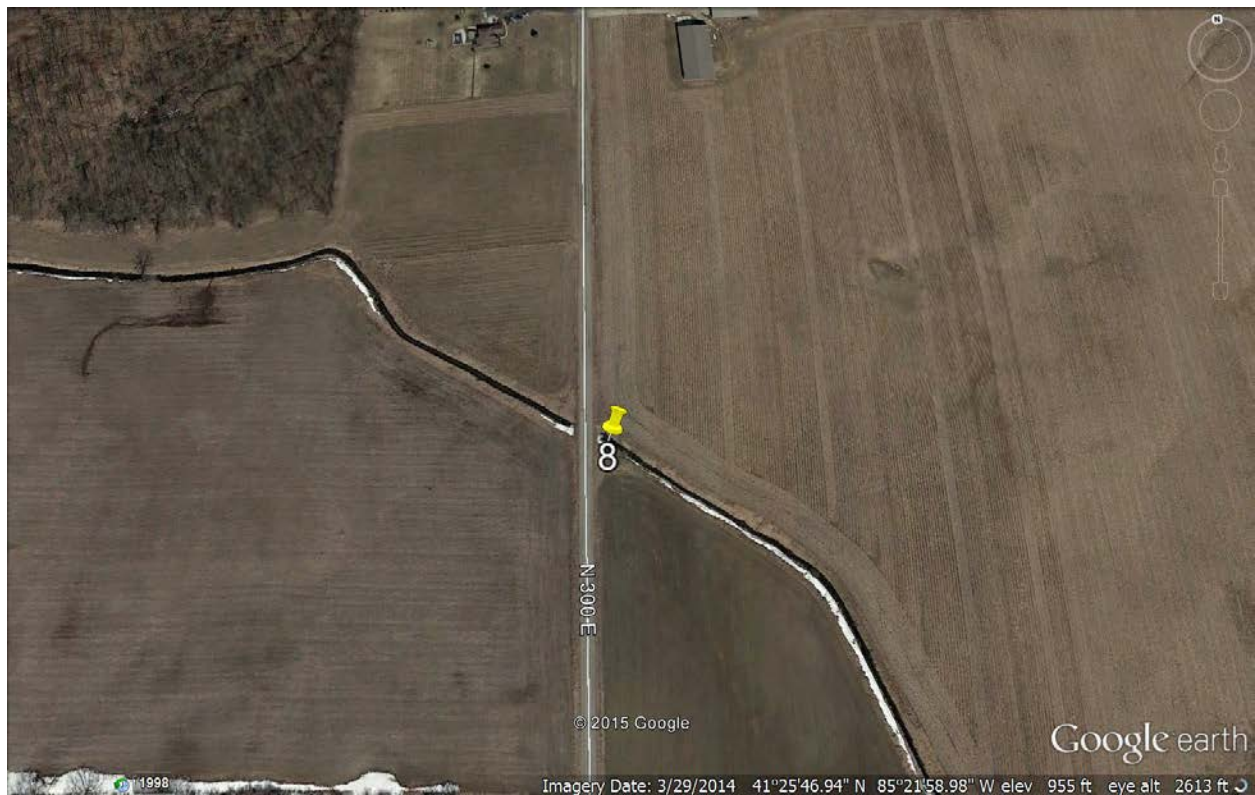


Figure 7: Site 8 location.

Table 9 shows Site 8 data with nitrates-nitrites exceeding the target threshold 8 times or 80% of total samples taken, followed by *E.coli* exceeding 4 times or 40%, total phosphorus 3 times or 30%, and turbidity and total suspended solids exceeding the target threshold 2 times or 20% of

the total samples collected. Again, these numbers can be explained by livestock operations and spring manure spreading on fields adjacent to the ditch.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
8	4/23/2014	Y	WW	7.97	8.9	7.17	0.9	13.25	12.1	659	336	0	3.0	0.16	3	6	0.496
8	5/29/2014	Y	WW	7.32	17.1	4.94	2.4	49.39	26.5	448	228	3900	5.3	0.83	65	62	5.427
8	6/27/2014	Y	WW	7.73	17.9	5.98	0	0	14.0	731	373	400	0.5	0.25	4	7	0.576
8	7/29/2014	N	BF	7.77	14.7	3.74	1.3	35.29	3.1	719	367	0	1.7	0.75	4	5	0.189
8	8/27/2014	Y	BF	7.79	15.3	6.03	1.3	35.29	4.5	755	385	0	1.1	0.29	5	5	0.128
8	9/25/2014	N	Dry														
8	10/29/2014	N	Dry														
8	11/24/2014	Y	WW	8.00	9.7	7.94	4.2	53.15	13.3	620	316	100	16.6	0.67	22	32	5.653
8	12/30/2014	N	BF	8.10	1.4	10.51	0.5	5.14	5.8	869	478	0	4.3	0.06	2	4	3.182
8	1/28/2015	N	BF	7.94	0.9	10.76	0.3	2.79	9.5	637	350	0	2.3	0.05	1	3	1.837
8	2/27/2015	N	BF	7.87	0.8	11.17	0.9	8.06	3.9	645	355	0	1.7	0.05	1	3	1.131
8	3/25/2015	Y	BF	8.11	5.7	9.41	0.9	9.56	12.3	672	370	250	2.5	0.11	2	3	2.673
			Average	7.86	9.24	7.765	1.27	21.192	10.5	675.5	355.8	465	3.9	0.322	10.9	13	2.1292

Table 9: Site 8 data.

Site 9

Site 9 (Figure 8) is a bridge on Carrol Creek located on S300 W57 just south of SR 33. This site was moved 1 miles east of the original location due to safety concerns from heavy vehicle traffic.

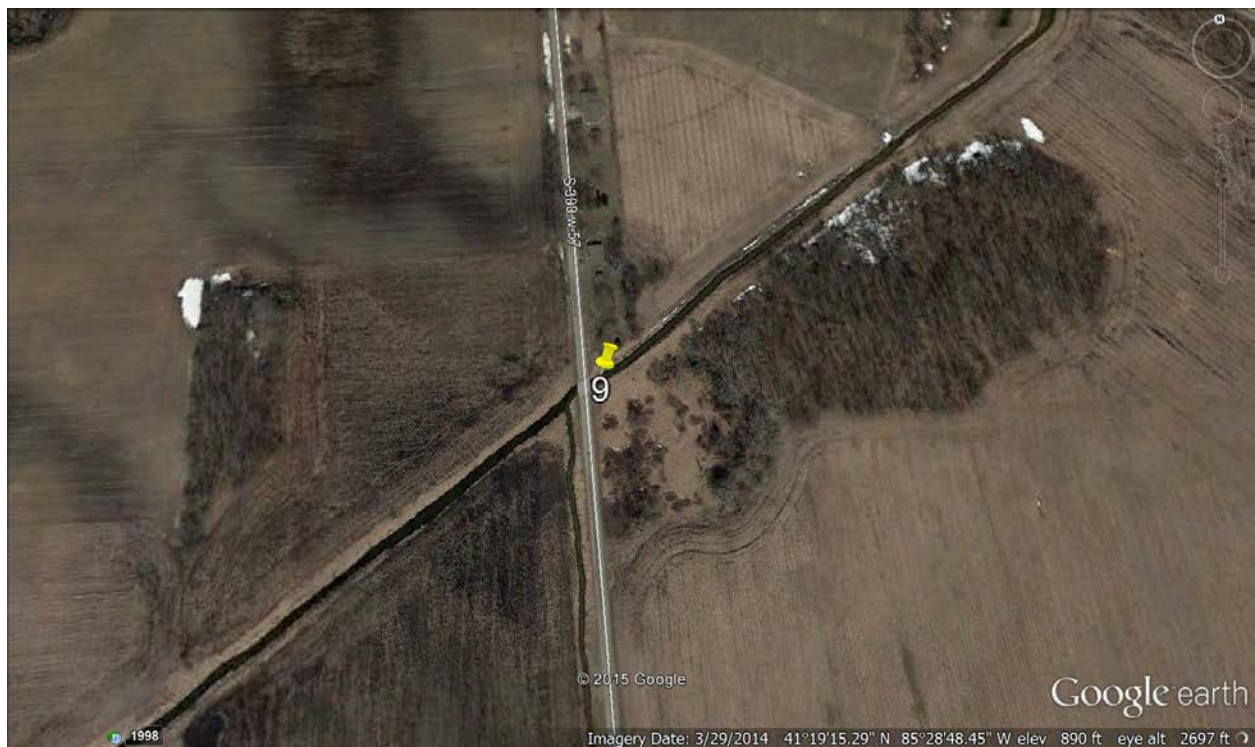


Figure 8: Site 9 location.

Table 10 shows Site 9 data with nitrates-nitrites exceeding the target threshold 11 times or 91.66% of the total samples taken, followed by total phosphorus exceeding 3 times or 25%,

turbidity 2 times or 16.66%, and total suspended solids exceeding 1 time or 8.33% of total samples collected. Turbidity and total suspended solids high numbers occurred during rain events along with most of the nutrient loading. Fields along this ditch had little or no buffering which was likely a major contributor of NPS pollutants found in the samples. Livestock operations were not found to be a major contributor.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
9	4/23/2014	Y	WW	7.95	10.1	8.91	1.2	13.13	12.2	677	345	0	4.1	0.14	0	8	6.851
9	5/29/2014	Y	WW	7.83	19.5	6.20	2.8	45.16	10.0	648	330	200	4.9	0.31	10	17	4.455
9	6/27/2014	Y	WW	7.71	21.1	5.89	0	0	5.9	664	339	100	0.1	0.24	9	11	5.054
9	7/29/2014	N	BF	7.77	15.4	9.52	4.1	42.86	6.4	716	365	200	1.5	0.29	6	5	3.402
9	8/27/2014	Y	BF	7.71	19.7	6.02	0	0	21.4	755	385	0	2.0	0.30	16	10	2.426
9	9/25/2014	N	BF	7.92	12.6	8.21	0	0	12.2	747	381	0	1.5	0.17	4	10	2.032
9	10/29/2014	N	BF	8.00	9.5	8.47	1.0	12.28	9.7	762	389	50	2.1	0.14	2	5	2.268
9	11/24/2014	Y	WW	7.49	9.5	7.43	6.2	83.45	23.2	525	268	0	13.4	1.13	56	73	80.899
9	12/30/2014	N	BF	8.08	2.1	10.97	1.4	12.79	8.7	740	407	0	3.1	0.07	3	7	6.728
9	1/28/2015	N	BF	7.99	1.5	11.07	1.1	9.94	8.3	657	361	0	2.1	0.06	1	4	4.921
9	2/27/2015	N	BF	7.98	1.1	11.35	0.9	7.93	5.7	623	343	0	1.7	0.06	1	2	3.904
9	3/25/2015	Y	BF	7.79	6.1	9.87	0.8	8.11	12.1	675	371	100	3.3	0.11	2	3	4.357
Average				7.851667	10.68333	8.659167	1.625	19.6375	11.31667	682.416667	357	54.166667	3.316667	0.25166667	9.166667	12.9166667	10.60808

Table 10: Site 9 data.

Site 10

Site 10 (Figure 9) is a bridge on Black Ditch on West Albion Road approximately one half mile west 350N. This stretch has heavy riparian buffer along with marsh and swamp.

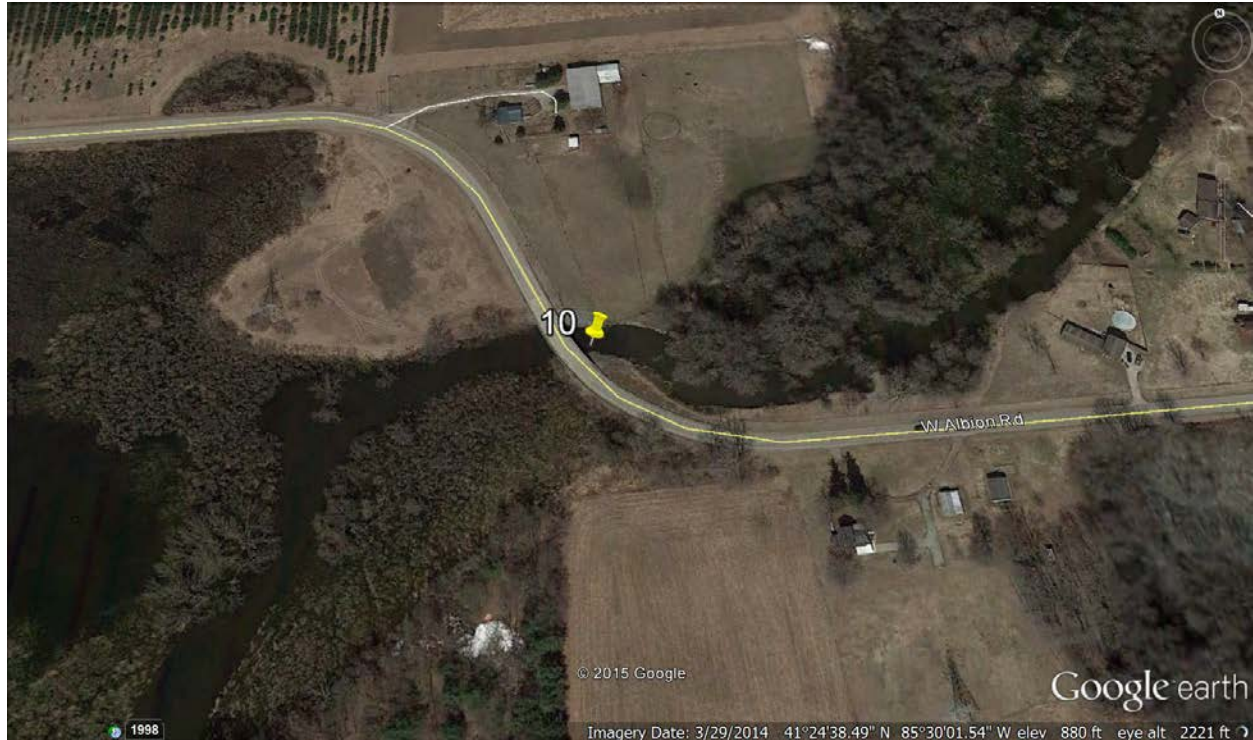


Figure 9: Site 10 location.

Table 11 shows Site 10 data with nitrates-nitrites exceeding the target threshold 5 times or 41.66% of the total samples taken, followed by total phosphorus exceeding 4 times or 33.33%, and total suspended solids and *E.coli* each exceeding the threshold 1 time or 8.33% of the total samples collected. The higher numbers are likely from lateral ditch input that have livestock influence. Black Ditch site may have some input from septic systems directly upstream.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
10	4/23/2014	Y	WW	7.88	12.2	7.89	2.2	28.26	12.1	554	283	0	1.5	0.32	10	34	70.389
10	5/29/2014	Y	WW	7.81	23.4	5.67	2.9	51.50	12.2	544	277	300	2.9	0.19	3	6	29.059
10	6/27/2014	Y	WW	7.72	24.2	4.07	2.0	47.91	17.0	576	294	100	0.1	0.76	3	4	13.986
10	7/29/2014	N	BF	7.74	19.0	3.72	1.6	42.47	6.4	565	288	50	1.3	0.48	3	2	25.378
10	8/27/2014	Y	BF	7.84	22.3	3.29	0.4	12.77	7.0	587	299	0	1.0	0.49	1	2	19.391
10	9/25/2014	N	BF	8.01	16.4	5.49	0	0	4.6	597	304	0	2.4	0.24	0	3	26.640
10	10/29/2014	N	BF	8.07	11.8	7.22	1.0	13.99	3.3	609	311	0	1.3	0.21	0	1	32.130
10	11/24/2014	Y	WW	7.89	7.5	8.26	2.9	35.47	13.6	615	314	100	5.2	0.26	8	18	116.748
10	12/30/2014	N	BF	8.25	0.15	11.68	2.3	20.03	3.1	633	348	0	2.3	0.14	2	6	98.500
10	1/28/2015	N	BF	8.27	1.1	12.19	1.5	12.31	7.2	521	287	0	1.3	0.09	1	2	81.471
10	2/27/2015	N	BF	8.21	1.1	12.44	0.7	5.63	2.8	555	305	50	1.1	0.04	2	3	75.273
10	3/25/2015	Y	BF	8.12	6.6	10.46	1.2	11.47	12.5	586	322	100	1.1	0.21	2	3	78.149
			Average	7.984167	12.14583	7.698333	1.558333	23.48417	8.483333	578.5	302.6667	58.333333	1.791667	0.28583333	2.916667	7	55.59283

Table 11: Site 10 data.

Phase II SJRBC Water Quality Testing Program

Phase II of a three phase water testing program began in April 2015 and ended March 2016. Figure 10 depicts site locations sampled within the Elkhart River drainage.

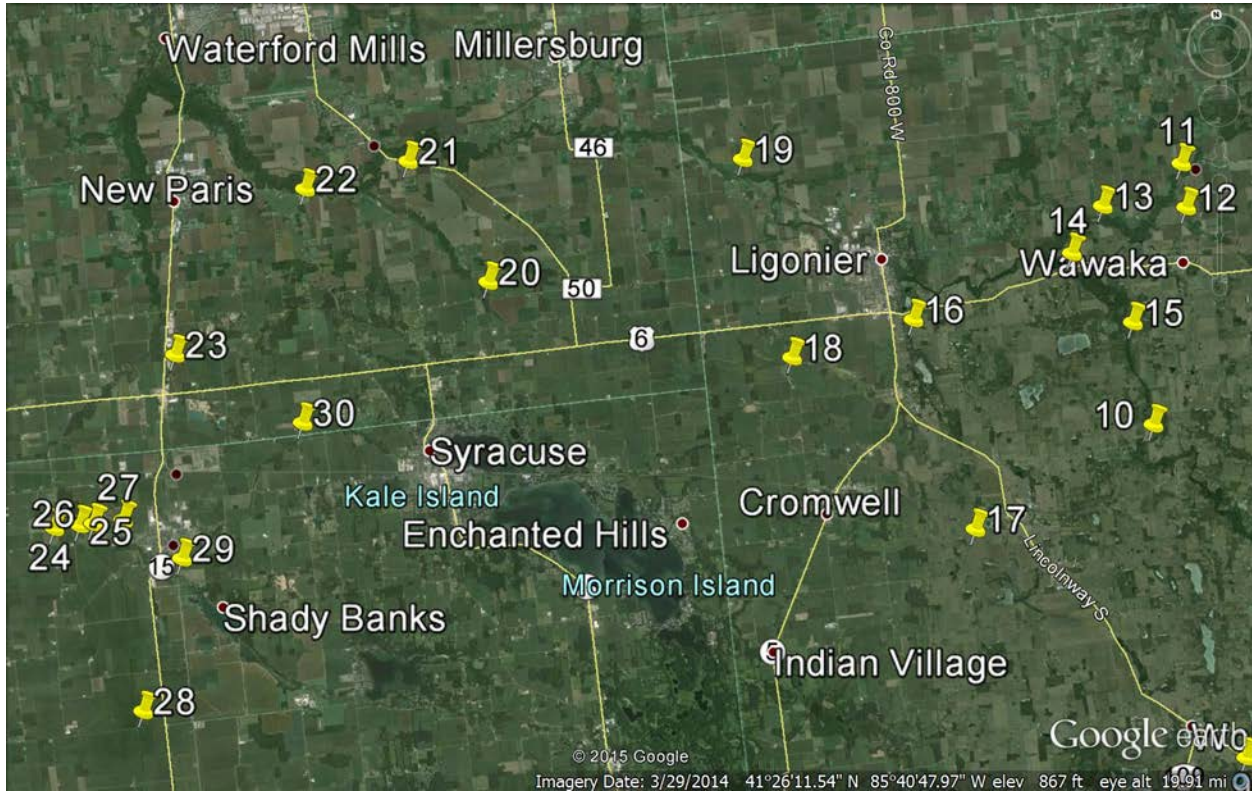


Figure 10: Phase II test site locations numbered 11-30.

Table 12 shows Site 11 data with nitrates exceeding target standards 4 times or 33.33% of samples taken and E.coli 2 times or 16.66% of samples taken. However the E.coli levels remained fairly high throughout the sampling cycle. The primary cause is likely due to several large livestock operations directly upstream.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
11	4/30/2015	N	BF	8.33	18.2	6.44	2.5	39.29	7.8	530	292	50	0.5	0.07	3	9	67.392
11	5/29/2015	Y	BF	8.27	21.6	4.79	1.5	31.31	7.3	545	300	50	0.5	0.06	2	5	26.481
11	6/28/2015	Y	WW	7.82	19.5	4.35	1.1	25.29	9.3	521	287	400	1.1	0.15	2	5	89.505
11	7/30/2015	N	WW	7.82	20.2	4.41	1.3	29.48	10.3	566	311	300	1.9	0.18	3	8	98.022
11	8/31/2015	N	WW	7.83	20.1	4.54	1.1	24.23	9.1	577	317	200	1.7	0.15	3	5	79.016
11	9/30/2015	Y	BF	8.21	16.8	6.06	0.9	14.85	7.8	503	277	150	1.5	0.11	2	4	39.688
11	10/30/2015	Y	BF	8.37	11.9	10.94	0.3	2.74	6.4	476	277	150	1.4	0.10	2	5	49.610
11	11/30/2015	Y	BF	8.09	7.9	11.32	0.5	4.42	7.3	456	251	150	1.3	0.09	3	9	53.739
11	12/30/2015	Y	WW	8.11	7.9	14.46	0.3	2.07	8.8	447	246	200	1.5	0.13	8	21	278.438
11	1/30/2016	Y	WW	8.47	7.3	14.83	0.2	1.35	10.3	456	251	100	1.1	0.09	3	6	116.146
11	2/29/2016	N	WW	8.29	7.1	12.42	0.3	2.42	13.5	466	256	200	1.1	0.11	5	12	121.703
11	3/29/2016	Y	WW	8.11	10.3	11.32	1.2	10.6	8.7	487	268	200	1.2	0.15	7	18	134.093
Average				8.143333	14.06667	8.823333	0.933333	15.67083	8.883333	502.5	277.75	179.16667	1.233333	0.11583333	3.583333	8.91666667	96.153

Table 12: Site 11 data.

Table 13 shows Site 12 data with nitrates exceeding target standards 6 times or 50% of samples taken, E.coli 2 times or 16.66%, and turbidity and total suspended solids 1 time or 8.33%. In the case of nitrates and E.coli, target levels were nearly reached on the majority of samples taken during the year. Turbidity and total suspended solids were at relatively high on several other occasions. This is likely due to a large livestock operation upstream and the unbuffered stream banks.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
12	4/30/2015	N	BF	8.17	14.5	8.58	1.2	13.75	6.4	766	421	100	3.4	0.04	1	2	2.843
12	5/29/2015	Y	BF	8.19	19.0	5.63	1.3	23.09	6.1	754	415	100	1.4	0.04	1	2	2.469
12	6/28/2015	Y	WW	7.86	16.8	6.93	1.2	17.32	7.1	678	373	500	1.8	0.10	10	18	22.378
12	7/30/2015	N	WW	7.81	19.2	6.76	1.2	17.75	9.8	690	380	500	2.1	0.13	11	17	25.780
12	8/31/2015	N	WW	7.85	19.1	6.57	1.1	16.74	9.4	670	369	200	1.7	0.11	4	10	18.792
12	9/30/2015	Y	BF	8.17	13.1	8.41	0.7	8.32	8.1	573	315	200	1.5	0.09	2	7	2.315
12	10/30/2015	Y	BF	8.23	9.3	10.51	0.3	2.85	6.9	528	315	150	1.3	0.09	2	6	2.904
12	11/30/2015	Y	BF	8.11	6.7	11.07	0.5	4.52	7.5	497	273	200	1.3	0.11	4	13	3.131
12	12/30/2015	Y	WW	8.05	6.7	9.08	0.4	4.41	7.9	458	252	200	1.6	0.17	18	25	35.269
12	1/30/2016	Y	WW	8.51	5.0	9.81	0.3	3.06	9.5	458	252	100	1.1	0.11	5	8	4.536
12	2/29/2016	N	WW	8.31	4.9	9.56	0.3	3.14	12.7	463	255	150	1.1	0.13	8	15	5.147
12	3/29/2016	Y	WW	8.21	8.2	8.79	1.1	12.51	8.3	471	259	200	1.2	0.19	10	24	7.577
Average				8.1225	11.875	8.475	0.8	10.62167	8.308333	583.8333333	323.25	216.66667	1.625	0.10916667	6.333333	12.25	11.095

Table 13: Site 12 data.

Table 14 shows data for Site 13 with nitrates exceeding target standards 3 times or 25% of samples taken, E.coli 2 times or 16.66%, turbidity 2 times, and total suspended solids 2 times. Again, this site is located directly downstream of several large livestock operations.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
13	4/30/2015	N	BF	7.94	16.9	6.85	2.2	31.68	6.9	541	298	150	0.7	0.08	2	5	208.328
13	5/29/2015	Y	BF	7.91	20.1	5.81	2.2	37.87	6.8	549	302	100	0.6	0.06	2	5	66.096
13	6/28/2015	Y	WW	7.44	18.2	5.84	21.8	30.82	7.9	571	314	400	1.4	0.11	8	11	154.302
13	7/30/2015	N	WW	7.53	20.4	5.82	1.5	25.77	9.6	573	315	450	1.8	0.13	7	15	167.442
13	8/31/2015	N	WW	7.47	20.3	5.76	1.6	27.78	9.1	571	314	200	1.5	0.11	3	9	139.496
13	9/30/2015	Y	BF	8.04	13.9	7.73	0.9	11.64	8.3	527	290	200	1.3	0.09	2	5	74.655
13	10/30/2015	Y	BF	8.11	9.2	9.84	0.4	4.07	6.5	502	290	150	1.1	0.09	2	5	90.120
13	11/30/2015	Y	BF	7.93	7.1	10.73	0.5	4.66	6.9	511	281	100	1.2	0.11	4	12	100.237
13	12/30/2015	Y	WW	7.81	7.1	10.28	0.4	3.89	8.1	469	258	200	1.5	0.15	21	31	123.750
13	1/30/2016	Y	WW	8.27	5.8	10.78	0.3	2.78	10.6	473	260	150	1.1	0.12	5	9	79.004
13	2/29/2016	N	WW	8.07	5.6	9.97	0.3	3.01	14.3	482	265	200	0.9	0.15	9	17	83.589
13	3/29/2016	Y	WW	7.89	8.6	8.34	1.2	14.39	9.2	489	269	200	1.4	0.21	13	31	91.892
Average				7.8675	12.76667	8.145833	2.775	16.53	8.683333	521.5	288	208.33333	1.208333	0.1175	6.5	12.916667	114.9093

Table 14: Site 13 data.

Table 15 shows Site 14 data with zero NPS contaminate parameters exceeding target standards. This is likely due to being located downstream of Mallard Roost WCA and a very large expanse of marsh. However, note that dissolved oxygen levels did fall very low during the spring and summer months.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
14	4/30/2015	N	BF	7.78	17.9	3.22	1.8	54.48	7.1	624	343	200	0.8	0.06	2	5	221.571
14	5/29/2015	Y	BF	7.74	20.3	2.47	0.8	32.38	6.7	621	342	200	0.6	0.06	2	5	132.701
14	6/28/2015	Y	WW	7.55	18.5	2.51	0.8	35.54	6.9	598	329	100	0.9	0.06	2	4	203.279
14	7/30/2015	N	WW	7.57	20.3	3.23	1.0	30.96	9.8	606	333	50	0.9	0.06	2	3	229.090
14	8/31/2015	N	WW	7.33	20.2	3.21	1.1	34.27	8.9	563	310	50	0.8	0.05	1	2	277.390
14	9/30/2015	Y	BF	7.89	14.6	5.61	0.7	12.48	7.4	515	283	50	0.8	0.05	1	2	67.781
14	10/30/2015	Y	BF	8.06	10.7	8.99	0.4	4.45	6.1	470	283	50	0.7	0.06	2	3	91.241
14	11/30/2015	Y	BF	7.88	6.3	10.36	0.4	3.86	6.2	475	261	50	0.8	0.07	3	6	103.094
14	12/30/2015	Y	WW	7.65	6.3	9.85	0.3	3.05	8.3	446	245	50	0.7	0.07	11	24	215.099
14	1/30/2016	Y	WW	8.25	3.6	10.31	0.2	1.94	10.1	462	254	50	0.6	0.06	4	7	105.447
14	2/29/2016	N	WW	8.01	3.5	9.88	0.2	2.02	13.4	479	263	100	0.7	0.08	6	13	110.381
14	3/29/2016	Y	WW	7.82	7.9	8.66	0.8	9.24	9.5	485	267	100	0.6	0.09	5	11	120.106
			Average	7.794167	12.50833	6.525	0.708333	18.7225	8.366667	528.666667	292.75	87.5	0.741667	0.06416667	3.416667	7.08333333	156.4317

Table 15: Site 14 data.

Table 16 shows data for Site 15 with zero NPS contaminate parameters exceeding target standards. However, note that dissolved oxygen levels did fall very low during the spring and summer months.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
15	4/30/2015	N	BF	7.51	17.9	3.11	1.7	54.66	7.3	614	338	150	0.9	0.04	2	4	109.231
15	5/29/2015	Y	BF	7.55	20.8	2.16	1.0	46.3	7.2	621	342	150	0.7	0.03	2	5	78.283
15	6/28/2015	Y	WW	7.45	18.7	2.75	0.9	31.73	7.9	598	329	50	0.9	0.07	2	3	141.329
15	7/30/2015	N	WW	7.43	20.3	3.65	1.1	30.14	10.0	617	339	50	0.9	0.06	2	3	154.104
15	8/31/2015	N	WW	7.43	20.2	3.44	1.1	31.98	9.2	623	343	50	0.8	0.05	1	2	121.297
15	9/30/2015	Y	BF	7.72	15.4	3.71	0.6	16.17	7.9	561	309	50	0.6	0.05	1	2	22.302
15	10/30/2015	Y	BF	8.04	10.7	8.95	0.4	4.47	6.3	513	309	50	0.6	0.04	2	2	82.137
15	11/30/2015	Y	BF	7.82	7.7	9.99	0.4	4.00	6.3	478	263	50	0.8	0.04	2	4	96.001
15	12/30/2015	Y	WW	7.66	7.7	8.87	0.4	4.51	7.8	451	248	50	0.7	0.06	8	15	229.500
15	1/30/2016	Y	WW	8.15	5.1	10.23	0.2	1.96	9.6	481	265	50	0.7	0.06	2	4	101.782
15	2/29/2016	N	WW	7.88	4.9	9.79	0.2	2.04	12.1	490	270	100	0.8	0.07	4	9	111.478
15	3/29/2016	Y	WW	7.74	8.2	8.45	0.6	7.10	8.3	503	277	100	0.8	0.09	5	10	123.337
			Average	7.698333	13.13333	6.258333	0.716667	19.58833	8.325	545.833333	302.66667	75	0.766667	0.055	2.75	5.25	114.2318

Table 16: Site 15 data.

Table 17 shows Site 16 data with zero NPS contaminate parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
16	4/30/2015	N	BF	7.66	16.7	6.37	2.1	32.97	6.6	695	382	100	0.7	0.01	2	5	1.026
16	5/29/2015	Y	BF	7.64	18.9	5.91	1.5	25.38	6.2	672	370	100	0.8	0.01	1	3	0.764
16	6/28/2015	Y	WW	7.39	18.3	6.09	1.3	21.35	6.3	614	338	100	1.1	0.09	4	7	4.137
16	7/30/2015	N	WW	7.46	19.4	6.45	1.3	20.16	9.1	628	345	100	0.9	0.08	3	5	7.492
16	8/31/2015	N	WW	7.37	19.2	6.47	1.2	18.55	8.2	599	329	50	0.7	0.07	2	2	5.445
16	9/30/2015	Y	BF	7.93	14.6	14.04	1.0	7.12	6.5	573	315	50	0.6	0.05	1	2	1.989
16	10/30/2015	Y	BF	8.07	10.8	14.22	0.5	3.52	6.5	519	315	50	0.5	0.04	1	3	2.459
16	11/30/2015	Y	BF	7.85	7.5	14.55	0.5	3.44	6.8	492	271	50	0.6	0.05	2	5	2.992
16	12/30/2015	Y	WW	7.86	7.5	13.21	0.4	3.03	8.2	480	264	50	0.8	0.06	4	11	12.192
16	1/30/2016	Y	WW	8.34	5.4	13.78	0.2	1.45	10.3	502	276	50	0.6	0.06	2	3	3.795
16	2/29/2016	N	WW	8.15	5.2	11.62	0.3	2.58	12.9	511	281	50	0.6	0.06	4	9	4.194
16	3/29/2016	Y	WW	8.02	8.4	9.39	0.6	6.39	8.8	522	287	50	0.7	0.07	4	10	7.003
			Average	7.811667	12.65833	10.175	0.908333	12.16167	8.033333	567.25	314.41667	66.666667	0.716667	0.05416667	2.5	5.41666667	4.457333

Table 17: Site 16 data.

Table 18 shows data for Site 17 with E.coli exceeding target standards 2 times or 16.66% and turbidity 1 time or 8.33%. This site was located in a low terrain relief, large row crop field complex with little buffering. The high E.coli occurred after manure application.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
17	4/30/2015	N	BF	7.67	16.0	6.57	1.9	28.92	7.5	737	405	450	1.1	0.12	1	3	20.121
17	5/29/2015	Y	BF	7.64	19.1	7.85	1.7	21.66	7.1	725	399	250	1.0	0.09	1	3	1.980
17	6/28/2015	Y	WW	7.88	20.4	7.82	1.4	17.90	7.1	698	384	100	1.3	0.11	14	23	12.623
17	7/30/2015	N	WW	7.77	21.3	7.79	1.5	19.26	9.9	698	384	100	1.1	0.09	9	17	15.331
17	8/31/2015	N	WW	7.81	21.1	7.79	1.3	16.69	7.3	679	373	50	0.9	0.08	3	8	11.616
17	9/30/2015	Y	BF	7.90	14.4	14.97	1.0	6.68	6.7	619	340	50	0.7	0.06	1	3	3.942
17	10/30/2015	Y	BF	8.03	10.3	14.56	0.6	4.12	6.7	534	340	50	0.5	0.06	1	3	5.103
17	11/30/2015	Y	BF	7.79	7.6	14.61	0.6	4.11	7.3	531	292	50	0.7	0.07	2	5	5.893
17	12/30/2015	Y	WW	7.81	7.6	12.78	0.3	2.35	8.2	545	300	50	0.8	0.07	6	13	23.295
17	1/30/2016	Y	WW	8.21	5.4	13.32	0.2	1.50	9.6	566	311	50	0.6	0.05	2	3	14.372
17	2/29/2016	N	WW	7.93	5.3	11.77	0.2	1.70	11.4	575	316	50	0.6	0.06	3	8	17.499
17	3/29/2016	Y	WW	7.77	8.7	9.27	0.7	7.55	7.9	567	312	50	0.7	0.08	4	9	25.829
Average				7.850833	13.1	10.8	1.0	11.03667	8.058333	622.833333	346.33333	108.33333	0.833333	0.07833333	3.916667	8.16666667	13.13367

Table 18: Site 17 data.

Table 19 shows Site 18 data with E.coli exceeding target standards 4 times or 33.33% of samples taken. This site is located upstream of a large livestock operation.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
18	4/30/2015	N	BF	7.78	16.1	6.28	1.6	25.48	7.1	746	410	500	1.1	0.11	1	3	20.439
18	5/29/2015	Y	BF	7.81	20.2	6.79	1.2	17.67	6.8	721	397	250	1.2	0.11	1	3	5.160
18	6/28/2015	Y	WW	7.91	18.4	7.57	1.3	17.17	7.7	725	399	400	1.4	0.18	12	21	25.231
18	7/30/2015	N	WW	7.92	21.5	7.81	1.4	17.93	9.3	713	392	300	1.1	0.11	9	18	29.099
18	8/31/2015	N	WW	8.01	21.4	7.79	1.4	17.97	6.5	694	382	150	1.1	0.09	3	11	22.001
18	9/30/2015	Y	BF	7.99	14.1	13.32	0.8	6.00	5.8	622	342	100	0.9	0.06	1	3	2.892
18	10/30/2015	Y	BF	8.21	9.9	13.65	0.4	2.93	5.4	537	342	50	0.7	0.06	1	3	4.306
18	11/30/2015	Y	BF	7.97	5.9	13.87	0.6	4.33	6.1	524	288	50	0.6	0.05	2	4	4.904
18	12/30/2015	Y	WW	7.84	5.9	12.43	0.3	2.41	7.5	553	304	50	0.7	0.06	5	13	22.501
18	1/30/2016	Y	WW	8.24	3.2	12.89	0.2	1.55	10.5	590	325	50	0.5	0.05	2	4	13.881
18	2/29/2016	N	WW	7.99	3.1	11.35	0.3	2.64	13.8	604	332	50	0.6	0.05	4	10	17.303
18	3/29/2016	Y	WW	7.86	7.6	9.45	0.5	5.29	8.9	589	324	50	0.6	0.06	4	11	24.382
Average				7.960833	12.275	10.26667	0.833333	10.11417	7.95	634.833333	353.08333	166.66667	0.875	0.0825	3.75	8.66666667	16.00825

Table 19: Site 18 data.

Table 20 shows data for Site 19 with E.coli exceeding target standards 1 time or 8.33% of samples taken. It is unclear why this occurred.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
19	4/30/2015	N	BF	7.82	17.2	7.13	2.1	29.45	6.5	598	329	350	1.3	0.09	3	8	205.335
19	5/29/2015	Y	BF	7.85	21.2	6.74	2.1	31.16	6.6	578	318	200	1.1	0.07	1	4	144.495
19	6/28/2015	Y	WW	7.81	19.4	6.89	1.9	27.58	6.8	561	309	200	1.3	0.12	5	10	392.400
19	7/30/2015	N	WW	7.86	19.8	6.88	1.7	24.71	8.9	601	336	150	1.2	0.08	3	7	434.329
19	8/31/2015	N	WW	7.81	19.5	6.93	1.6	23.09	6.9	597	328	100	1.1	0.07	1	3	324.809
19	9/30/2015	Y	BF	8.05	14.9	14.26	1.1	7.71	6.1	534	294	50	1.0	0.07	1	2	101.376
19	10/30/2015	Y	BF	8.21	10.1	14.58	0.7	4.80	5.5	490	294	50	0.9	0.06	1	2	127.391
19	11/30/2015	Y	BF	7.79	6.1	14.79	0.6	4.06	6.1	455	250	50	1.1	0.08	2	3	145.884
19	12/30/2015	Y	WW	7.85	6.1	13.65	0.4	2.93	7.9	477	262	100	1.3	0.11	8	19	499.101
19	1/30/2016	Y	WW	8.29	4.7	13.99	0.3	2.14	10.1	523	288	50	0.9	0.07	2	3	341.219
19	2/29/2016	N	WW	7.97	4.5	12.03	0.3	2.49	13.5	532	293	50	0.8	0.07	4	9	367.992
19	3/29/2016	Y	WW	7.83	8.1	10.72	0.5	4.64	8.9	544	299	50	0.7	0.06	5	10	405.997
			Average	7.928333	12.63333	10.71583	1.108333	13.73	7.816667	540.8333333	300	116.66667	1.058333	0.07916667	3	6.66666667	290.8607

Table 20: Site 19 data.

Table 21 shows Site 20 data with zero NPS contaminate parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
20	4/30/2015	N	BF	7.86	14.8	7.40	1.1	14.86	6.9	748	411	50	0.9	0.09	2	6	107.801
20	5/29/2015	Y	BF	7.85	18.6	7.85	1.3	16.56	6.8	735	404	50	1.1	0.07	1	4	12.920
20	6/28/2015	Y	WW	7.91	17.8	7.77	1.3	16.73	7.5	676	372	150	1.4	0.11	5	10	35.937
20	7/30/2015	N	WW	7.95	18.2	7.53	1.4	18.59	10.1	688	378	100	1.1	0.09	3	6	42.773
20	8/31/2015	N	WW	7.89	17.8	7.49	1.5	20.03	8.2	690	380	50	0.9	0.08	1	3	33.196
20	9/30/2015	Y	BF	8.14	14.1	14.24	1.1	7.72	7.4	627	345	50	0.8	0.07	1	2	24.356
20	10/30/2015	Y	BF	8.37	10.2	14.42	0.6	4.16	7.1	529	345	50	0.8	0.05	1	3	30.271
20	11/30/2015	Y	BF	8.19	7.3	14.81	0.7	4.73	8.4	478	263	50	0.7	0.06	2	4	34.113
20	12/30/2015	Y	WW	8.13	7.3	12.34	0.3	2.43	8.5	479	263	50	0.6	0.07	8	18	115.439
20	1/30/2016	Y	WW	8.54	5.7	12.74	0.2	1.57	10.9	516	284	50	0.6	0.05	2	4	81.392
20	2/29/2016	N	WW	8.33	5.4	11.84	0.2	1.69	14.4	536	295	100	0.8	0.08	5	11	84.661
20	3/29/2016	Y	WW	8.26	8.3	9.86	0.8	8.11	9.6	550	303	100	0.9	0.09	6	14	95.302
			Average	8.118333	12.125	10.69083	0.875	9.765	8.816667	604.3333333	336.91667	70.833333	0.883333	0.07583333	3.083333	7.08333333	58.18008

Table 21: Site 20 data.

Table 22 shows Site 21 data with nitrates exceeding target standards 2 times or 16.66 and E.coli 1 time or 8.33% of samples taken. This is likely associated with light field buffering and an extensive tiling network.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
21	4/30/2015	N	BF	7.84	14.8	7.21	2.1	29.13	8.2	666	366	150	1.9	0.04	2	4	1.579
21	5/29/2015	Y	BF	7.10	18.1	7.16	1.7	23.74	8.2	651	358	100	1.2	0.05	2	5	1.304
21	6/28/2015	Y	WW	7.84	17.3	10.50	1.9	18.10	9.8	634	349	350	1.7	0.09	3	6	4.828
21	7/30/2015	N	WW	7.79	18.1	9.80	1.9	19.39	12.5	647	356	150	1.4	0.07	2	5	7.808
21	8/31/2015	N	WW	7.74	17.9	8.79	1.5	17.06	9.3	634	349	50	1.2	0.07	1	2	5.773
21	9/30/2015	Y	BF	8.00	13.6	11.86	1.0	8.43	8.3	599	329	50	0.9	0.07	1	2	2.562
21	10/30/2015	Y	BF	8.19	8.9	12.06	0.4	3.32	8.1	547	329	50	0.9	0.05	1	2	3.284
21	11/30/2015	Y	BF	7.82	6.7	14.22	0.5	3.52	8.7	522	287	50	0.8	0.07	2	4	3.833
21	12/30/2015	Y	WW	7.78	6.7	13.09	0.4	3.06	9.1	547	301	50	0.7	0.07	7	15	14.885
21	1/30/2016	Y	WW	8.15	4.2	13.55	0.2	1.48	11.3	587	323	50	0.6	0.05	2	4	4.336
21	2/29/2016	N	WW	7.82	4.1	11.79	0.2	1.70	15.7	606	333	50	0.6	0.06	3	8	4.978
21	3/29/2016	Y	WW	7.69	7.9	9.45	0.5	5.29	10.7	602	331	50	0.7	0.07	4	11	7.441
			Average	7.813333	11.525	10.79	1.025	11.185	9.991667	603.5	334.25	95.833333	1.05	0.06333333	2.5	5.66666667	5.217583

Table 22: Site 21 data.

Table 23 shows Site 22 data with nitrates exceeding standards 4 times or 33.33% of samples taken. It is likely due to septic systems located near sampling site.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
22	4/30/2015	N	BF	8.02	14.8	8.80	2.3	26.14	8.5	674	371	100	1.8	0.09	2	5	0.486
22	5/29/2015	Y	BF	8.07	17.4	7.18	2.1	29.25	8.5	619	340	100	1.4	0.09	1	3	0.361
22	6/28/2015	Y	WW	7.88	17.1	11.65	2	17.17	9.4	579	318	200	1.8	0.14	11	17	2.309
22	7/30/2015	N	WW	7.93	19.0	9.47	1.8	19.01	12.7	590	325	100	1.5	0.11	7	13	4.382
22	8/31/2015	N	WW	7.97	18.7	8.47	1.6	18.69	9.7	571	314	50	1.2	0.09	2	4	2.995
22	9/30/2015	Y	BF	7.89	14.2	9.73	0.7	7.19	8.7	556	306	50	0.9	0.08	1	2	0.783
22	10/30/2015	Y	BF	8.01	9.1	9.88	0.3	3.04	8.1	517	306	50	0.7	0.06	1	2	1.478
22	11/30/2015	Y	BF	7.77	6.5	12.34	0.6	4.86	8.6	503	277	50	0.8	0.08	2	3	1.721
22	12/30/2015	Y	WW	7.88	6.5	11.98	0.4	3.34	9.9	521	286	50	0.9	0.07	8	17	9.327
22	1/30/2016	Y	WW	8.14	4.7	12.33	0.2	1.62	11.1	548	301	50	0.7	0.04	2	3	3.014
22	2/29/2016	N	WW	7.84	4.6	10.67	0.2	1.87	15.9	557	306	100	0.8	0.04	3	7	4.003
22	3/29/2016	Y	WW	7.71	8.4	9.13	0.6	6.57	10.3	578	318	100	1.0	0.11	4	9	6.995
			Average	7.925833	11.75	10.14	1.07	11.5625	10.11667	567.75	314	83.333333	1.125	0.08333333	3.666667	7.08333333	3.1545

Table 23: Site 22 data.

Table 24 shows Site 23 data with nitrates exceeding target standards 4 times or 33.33% of samples taken and E.coli 1 time or 8.33%. This is likely due to a large industrial complex located upstream.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
23	4/30/2015	N	BF	8.08	15.4	8.73	2.1	24.05	7.9	683	376	350	3.9	0.09	3	7	0.935
23	5/29/2015	Y	BF	8.07	19.1	7.51	1.5	19.97	7.4	685	377	150	2.1	0.05	1	4	0.673
23	6/28/2015	Y	WW	7.98	17.7	8.33	1.5	18.01	8.8	621	342	200	2.5	0.07	3	7	3.217
23	7/30/2015	N	WW	7.94	18.8	8.45	1.3	15.38	10.2	598	329	100	1.8	0.07	2	5	6.902
23	8/31/2015	N	WW	7.99	18.6	7.93	1.1	13.87	7.7	603	332	50	1.4	0.06	1	3	4.660
23	9/30/2015	Y	BF	8.14	14.6	10.80	0.9	8.33	7.1	519	281	50	1.1	0.05	1	2	1.031
23	10/30/2015	Y	BF	8.35	9.7	10.97	0.3	2.73	6.7	488	281	50	0.9	0.04	1	2	1.689
23	11/30/2015	Y	BF	8.21	6.5	12.32	0.3	2.44	7.8	497	273	50	1.1	0.04	2	4	1.907
23	12/30/2015	Y	WW	8.12	6.5	12.85	0.4	3.11	8.8	500	275	50	1.1	0.05	9	11	9.334
23	1/30/2016	Y	WW	8.37	4.1	13.19	0.2	1.52	10.2	522	287	50	0.8	0.03	2	3	3.423
23	2/29/2016	N	WW	8.11	3.9	11.06	0.2	1.81	13.3	535	294	50	0.8	0.04	4	9	4.103
23	3/29/2016	Y	WW	7.91	8.5	9.57	0.6	6.27	9.2	549	302	50	0.8	0.07	4	9	7.193
			Average	8.105833	11.95	10.1425	0.866667	9.790833	8.758333	566.666667	312.41667	100	1.525	0.055	2.75	5.5	3.755583

Table 24: Site 23 data.

Table 25 shows Site 24 data with nitrates exceeding target standards 3 times or 25%. This site is located in a very large row crop complex that is very heavily tiled.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
24	4/30/2015	N	BF	7.89	16.6	8.26	1.9	23.00	7.3	798	439	100	1.7	0.09	2	4	4.871
24	5/29/2015	Y	BF	7.84	20.4	6.98	1.5	21.49	7.4	789	434	50	1.5	0.06	2	4	3.938
24	6/28/2015	Y	WW	7.36	18.9	5.63	1.1	19.54	9.1	732	403	200	1.5	0.09	4	9	31.037
24	7/30/2015	N	WW	7.46	20.1	6.22	1.5	24.12	11.4	689	379	100	1.3	0.07	2	3	35.197
24	8/31/2015	N	WW	7.37	18.6	6.32	1.1	17.41	8.7	654	360	50	1.1	0.05	1	2	26.441
24	9/30/2015	Y	BF	8.00	15.8	15.15	1.2	7.92	7.3	578	318	50	0.8	0.05	1	1	1.441
24	10/30/2015	Y	BF	8.14	10.9	14.89	0.6	4.03	6.9	532	318	50	0.6	0.04	1	2	2.111
24	11/30/2015	Y	BF	7.90	7.9	14.65	0.3	2.05	8.1	531	292	50	0.9	0.04	2	4	2.579
24	12/30/2015	Y	WW	7.93	7.9	13.24	0.3	2.27	9.7	558	307	100	1.2	0.09	7	12	14.232
24	1/30/2016	Y	WW	8.11	5.9	13.62	0.1	0.73	11.6	582	320	50	0.8	0.04	2	3	4.873
24	2/29/2016	N	WW	7.72	5.6	12.17	0.2	1.64	14.8	593	326	50	0.8	0.04	4	9	5.936
24	3/29/2016	Y	WW	7.62	9.4	10.19	0.7	6.87	9.9	613	337	100	0.9	0.06	4	9	8.479
			Average	7.778333	13.16667	10.61	0.875	10.92	9.35	637.4166667	352.75	79.166667	1.091667	0.06	2.666667	5.16666667	11.76125

Table 25: Site 24 data.

Table 26 shows site 25 data with turbidity exceeding target standards 1 time or 8.33%. This site has large buffers along the banks and very low terrain relief. The high turbidity was due to a large carp concentration.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
25	4/30/2015	N	BF	7.95	16.1	10.02	1.5	14.97	8.5	782	430	50	0.9	0.05	3	7	2.663
25	5/29/2015	Y	BF	7.97	20.0	9.45	1.3	13.76	8.3	767	422	50	0.9	0.06	2	5	1.332
25	6/28/2015	Y	WW	7.54	18.1	6.84	1.2	17.54	8.3	754	415	50	0.9	0.08	2	6	13.892
25	7/30/2015	N	WW	7.54	20.2	6.89	1.5	21.77	10.5	722	397	50	1.0	0.07	2	3	17.307
25	8/31/2015	N	WW	7.48	19.9	6.71	1.3	19.37	6.9	733	403	50	0.8	0.05	1	2	13.972
25	9/30/2015	Y	BF	8.04	14.4	9.48	1.1	11.60	6.2	642	353	50	0.8	0.04	1	1	1.912
25	10/30/2015	Y	BF	8.22	9.5	9.77	0.5	5.12	5.6	579	353	50	0.8	0.04	1	2	2.501
25	11/30/2015	Y	BF	7.93	7.8	11.78	0.6	5.09	7.8	536	295	50	0.9	0.03	2	3	2.938
25	12/30/2015	Y	WW	7.86	7.8	10.56	0.3	2.84	9.7	560	308	100	1.2	0.09	11	21	13.979
25	1/30/2016	Y	WW	8.39	6.1	10.86	0.1	0.92	11.9	591	325	50	0.9	0.07	2	3	4.903
25	2/29/2016	N	WW	8.24	5.8	9.54	0.2	2.10	14.6	614	338	100	0.9	0.09	3	8	6.275
25	3/29/2016	Y	WW	8.15	9.6	8.77	0.5	5.70	9.9	628	345	100	0.9	0.09	4	9	9.721
Average				7.9425	12.94167	9.2225	0.841667	10.065	9.016667	659	365.333333	62.5	0.908333	0.063333333	2.833333	5.83333333	7.61625

Table 26: Site 25 data.

Table 27 shows site 26 data with zero NPS parameters exceeding target standards. This field complex was heavily buffered.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
26	4/30/2015	N	BF	7.91	16.1	8.58	0.9	10.96	8.5	831	457	50	0.8	0.01	2	5	6.244
26	5/29/2015	Y	BF	7.93	20.6	7.33	1.1	15.01	8.5	831	457	50	0.7	0.01	2	3	3.704
26	6/28/2015	Y	WW	7.57	18.7	7.02	1.1	15.67	8.4	799	439	50	0.7	0.02	2	4	35.971
26	7/30/2015	N	WW	7.51	19.9	7.23	1.3	15.67	8.5	769	423	50	0.8	0.03	2	4	41.333
26	8/31/2015	N	WW	7.55	19.7	7.34	1.2	16.35	6.8	772	425	50	0.8	0.03	1	2	32.118
26	9/30/2015	Y	BF	7.91	14.3	9.57	1.1	11.49	6.3	659	362	50	0.7	0.03	1	1	6.077
26	10/30/2015	Y	BF	8.11	9.4	10.05	0.7	6.97	5.8	563	362	50	0.7	0.03	1	2	8.238
26	11/30/2015	Y	BF	7.81	7.7	11.19	0.6	5.36	7.3	529	291	50	0.6	0.05	2	3	9.783
26	12/30/2015	Y	WW	7.77	7.7	10.01	0.3	3.00	8.3	535	294	100	1.3	0.09	11	21	37.618
26	1/30/2016	Y	WW	8.09	5.8	10.35	0.2	1.93	11.2	574	316	50	0.7	0.06	2	4	15.623
26	2/29/2016	N	WW	7.64	5.7	9.29	0.2	2.15	15.1	605	333	100	0.7	0.09	3	9	18.444
26	3/29/2016	Y	WW	7.62	9.5	8.63	0.6	6.95	11.4	619	340	100	0.9	0.09	4	9	24.202
Average				7.785	12.925	8.8825	0.775	9.2925	8.841667	673.8333333	374.91667	62.5	0.783333	0.045	2.75	5.58333333	19.94625

Table 27: Site 26 data.

Table 28 shows Site 27 data with zero NPS parameters exceeding target standards. This was directly downstream of the Milford Wastewater Plant.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
27	4/30/2015	N	BF	7.82	16.2	8.13	2.6	31.10	7.7	598	329	200	0.3	0.01	4	9	19.335
27	5/29/2015	Y	BF	7.81	19.1	6.85	2.1	30.66	7.7	594	327	200	0.4	0.01	3	7	16.641
27	6/28/2015	Y	WW	7.78	18.9	10.28	2.2	21.40	8.3	598	329	200	0.7	0.03	4	10	434.853
27	7/30/2015	N	WW	7.66	19.6	9.31	1.9	21.40	8.3	569	313	100	0.7	0.03	4	10	167.387
27	8/31/2015	N	WW	7.50	19.5	8.72	1.7	19.50	6.5	571	314	50	0.6	0.03	2	4	132.784
27	9/30/2015	Y	BF	7.77	14.1	8.51	0.9	10.58	6.1	549	302	50	0.6	0.03	1	2	14.742
27	10/30/2015	Y	BF	7.99	8.9	8.81	0.3	3.41	6.1	521	302	50	0.6	0.03	1	2	19.002
27	11/30/2015	Y	BF	7.79	6.3	9.58	0.5	5.22	8.3	491	270	50	0.6	0.03	2	3	22.336
27	12/30/2015	Y	WW	7.78	6.3	9.22	0.3	3.25	8.9	515	283	100	1.1	0.07	10	19	93.226
27	1/30/2016	Y	WW	8.03	4.9	9.88	0.1	1.01	10.4	552	304	50	0.7	0.06	2	4	59.403
27	2/29/2016	N	WW	7.62	4.7	8.97	0.2	2.23	14.2	577	317	50	0.7	0.06	3	7	64.089
27	3/29/2016	Y	WW	7.61	8.9	8.04	0.6	7.46	10.3	597	328	100	0.8	0.08	4	8	73.738
			Average	7.763333	12.28333	8.858333	1.116667	13.10	8.566667	561	309.83333	100	0.65	0.03916667	3.333333	7.08333333	93.128

Table 28: Site 27 data.

Table 29 shows Site 28 data with E.coli and nitrates exceeding target standards 1 time each or 8.33% of samples taken. This was likely due to little buffering and tiling.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
28	4/30/2015	N	BF	7.87	16.1	8.47	2.1	24.79	12.3	672	370	250	2.5	0.11	2	3	2.673
28	5/29/2015	Y	BF	7.86	18.8	8.24	1.6	19.42	8.5	589	322	50	0.8	0.01	3	8	5.292
28	6/28/2015	Y	WW	7.55	18.3	8.09	1.2	14.83	7.5	591	325	100	1.1	0.03	2	5	28.319
28	7/30/2015	N	WW	7.61	19.7	8.10	1.7	14.83	8.3	578	318	100	1.1	0.03	2	5	40.011
28	8/31/2015	N	WW	7.46	19.6	8.19	1.8	21.98	6.6	569	313	50	0.8	0.04	1	2	31.979
28	9/30/2015	Y	BF	8.24	14.1	9.45	0.8	8.47	5.7	513	282	50	0.6	0.04	1	1	1.904
28	10/30/2015	Y	BF	8.46	8.9	9.73	0.4	4.11	5.6	513	282	50	0.6	0.04	1	3	1.783
28	11/30/2015	Y	BF	8.28	6.1	11.32	0.5	4.42	7.7	479	263	50	0.6	0.04	2	5	2.013
28	12/30/2015	Y	WW	8.22	6.1	11.18	0.4	3.58	8.4	499	274	50	0.6	0.05	5	11	8.771
28	1/30/2016	Y	WW	8.55	4.2	11.47	0.2	1.74	10.3	531	292	50	0.5	0.04	2	3	2.194
28	2/29/2016	N	WW	8.29	3.9	10.04	0.2	2.00	13.4	574	316	50	0.6	0.05	3	7	3.202
28	3/29/2016	Y	WW	8.19	8.2	8.99	0.8	8.90	9.2	599	329	50	0.7	0.08	4	9	5.302
			Average	8.048333	12	9.439167	0.975	10.75583	8.625	558.9166667	307.16667	75	0.9	0.04666667	2.333333	5.16666667	11.12026

Table 29: Site 28 data.

Table 30 shows Site 29 data with zero NPS parameters exceeding target standards. A lake complex directly upstream likely captured NPS runoff.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
29	4/30/2015	N	BF	8.03	18.2	7.94	1.8	22.67	7.8	530	292	100	1.1	0.02	2	5	0.964
29	5/29/2015	Y	BF	8.01	24.3	7.79	1.8	23.11	7.6	545	300	100	1.2	0.04	3	7	0.773
29	6/28/2015	Y	WW	7.21	22.9	8.23	1.8	21.87	7.5	565	311	100	1.2	0.05	3	6	12.016
29	7/30/2015	N	WW	7.42	23.1	8.27	1.8	21.77	7.5	552	304	100	0.9	0.03	2	5	17.399
29	8/31/2015	N	WW	7.51	23.1	8.23	1.4	17.01	6.3	553	304	50	0.7	0.04	2	5	14.329
29	9/30/2015	Y	BF	8.32	19.1	8.23	0.7	8.51	5.2	517	284	50	0.6	0.04	1	2	1.529
29	10/30/2015	Y	BF	8.42	14.3	8.95	0.3	3.35	5.1	517	284	50	0.6	0.04	1	2	2.579
29	11/30/2015	Y	BF	8.29	10.3	9.72	0.5	5.14	7.0	505	278	50	0.7	0.04	2	3	2.819
29	12/30/2015	Y	WW	8.21	10.3	9.98	0.4	4.01	8.1	517	284	50	0.6	0.05	5	10	11.295
29	1/30/2016	Y	WW	8.53	8.3	10.38	0.2	1.93	11.1	547	301	50	0.4	0.04	2	3	3.994
29	2/29/2016	N	WW	8.26	7.9	9.71	0.2	2.06	13.6	559	307	50	0.6	0.06	3	7	4.993
29	3/29/2016	Y	WW	8.22	10.3	8.61	0.9	10.45	13.6	559	307	50	0.7	0.07	4	8	7.142
			Average	8.035833	16.00833	8.836667	0.983333	11.82333	8.366667	538.8333333	296.33333	66.666667	0.775	0.04333333	2.5	5.25	6.652667

Table 30: Site 29 data.

Table 31 shows Site 30 data with zero NPS parameters exceeding target standards. This site is along the outlet for Lake Wawasee and had a very nice riparian buffer along the banks. The bottom was sand with rock and a very nice pool and riffle complex which explains the excellent oxygen levels.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	<i>Escherichia coli</i>	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
30	4/30/2015	N	BF	7.72	16.2	8.09	1.6	19.78	7.3	578	318	100	0.3	0.01	3	9	18.769
30	5/29/2015	Y	BF	7.74	21.5	7.99	1.5	18.77	7.3	555	305	100	0.3	0.01	3	9	13.887
30	6/28/2015	Y	WW	7.45	20.7	8.14	1.4	17.20	8.1	523	288	200	0.7	0.07	5	12	45.893
30	7/30/2015	N	WW	7.51	21.4	8.03	1.3	16.19	8.5	549	302	100	0.7	0.07	3	9	51.362
30	8/31/2015	N	WW	7.39	21.2	7.99	1.2	15.02	6.8	519	285	50	0.6	0.06	1	2	40.231
30	9/30/2015	Y	BF	7.97	14.2	13.57	1.1	8.11	6.2	478	263	50	0.6	0.04	1	1	17.344
30	10/30/2015	Y	BF	8.12	9.0	13.42	0.5	3.73	5.9	478	263	50	0.6	0.04	1	2	21.883
30	11/30/2015	Y	BF	7.86	6.6	14.03	0.5	3.56	7.1	436	240	50	0.7	0.04	1	2	24.312
30	12/30/2015	Y	WW	7.89	6.6	13.27	0.3	2.26	8.6	471	259	50	0.6	0.04	4	8	129.011
30	1/30/2016	Y	WW	8.49	3.3	13.71	0.1	0.73	10.9	499	274	50	0.4	0.04	2	3	32.237
30	2/29/2016	N	WW	8.26	3.1	11.89	0.2	1.68	13.1	522	287	50	0.6	0.06	3	7	35.776
30	3/29/2016	Y	WW	8.16	7.9	9.88	0.5	5.06	13.1	522	287	50	0.6	0.07	4	8	42.344
			Average	7.88	12.64167	10.83417	0.85	9.340833	8.575	510.8333333	280.91667	75	0.558333	0.04583333	2.583333	6	39.42075

Table 31: Site 30 data.

Phase III SJRBC Water Quality Testing Program

Phase III of a three phase water testing program began in April 2016 and ended March 2017. Figure 11 depicts site locations sampled within the Elkhart River drainage.

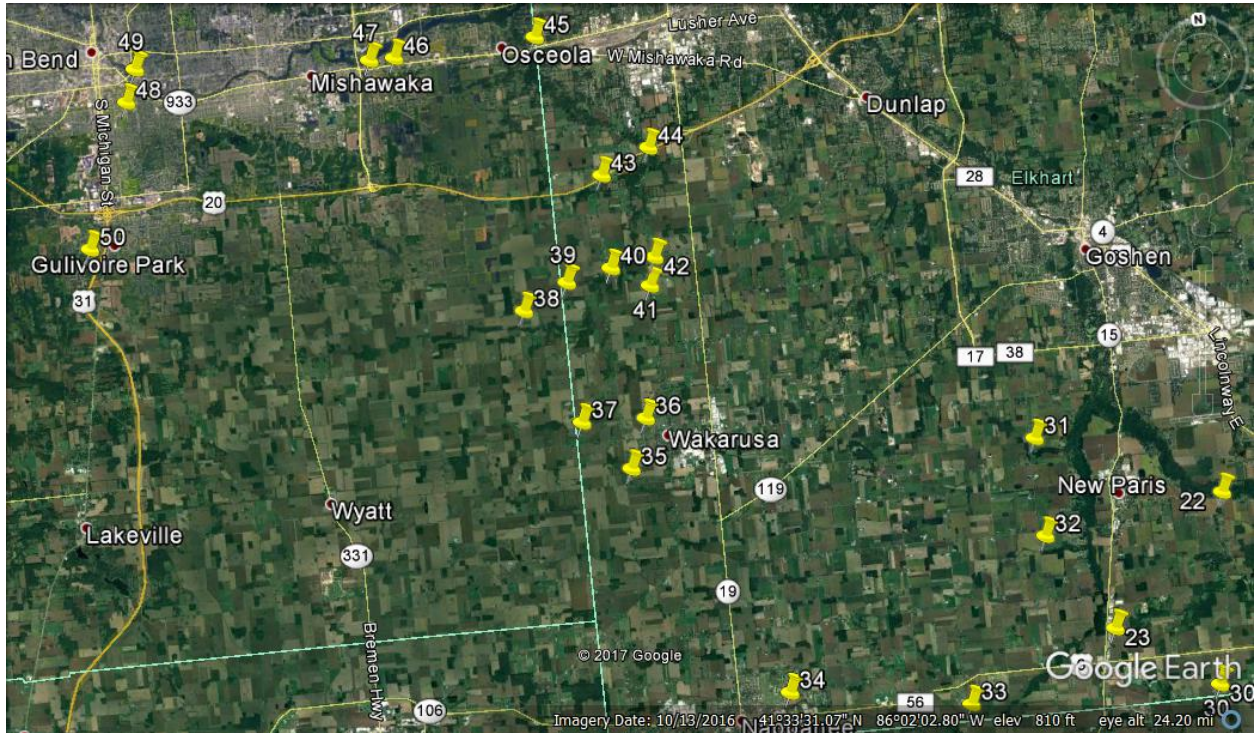


Figure 11: Phase III sampling sites 31-50.

Table 32 shows Site 31 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s	
31	4/30/2016	Y	WW	8.11	14.6	8.70	1.3	14.94	8.3	477	262	100	0.9	0.07	3	8	9.068	
31	5/31/2016	N	BF	8.05	16.5	8.23	1.4	17.01	8.1	468	257	100	0.8	0.07	2	6	8.104	
31	6/30/2016	N	BF	7.23	17.7	7.56	1.3	17.2	8.1	477	262	100	0.6	0.06	2	4	7.934	
31	7/31/2016	N	BF	7.70	24.5	7.14	1.4	19.61	7.9	473	260	50	0.4	0.05	1	2	0.027	
31	8/31/2016	Y	WW	7.29	22.5	5.02	1.3	25.89	7.5	467	257	100	0.5	0.07	2	4	3.890	
31	9/30/2016	Y	WW	7.21	20.3	6.09	1.1	18.06	7.1	455	250	100	0.4	0.05	1	2	2.992	
31	10/31/2016	Y	WW	7.53	15.1	6.78	0.7	10.32	6.9	434	239	100	0.4	0.04	1	2	2.103	
31	11/30/2016	Y	WW	7.45	12.7	7.98	0.6	7.51	6.5	423	233	50	0.4	0.04	1	2	1.892	
31	12/29/2016	N	WW	7.46	2.4	8.89	0.4	4.50	8.7	434	239	50	0.4	0.03	1	2	1.983	
31	1/31/2017	Y	WW	7.42	2.3	11.26	0.4	3.55	8.3	427	235	100	0.7	0.07	3	8	3.902	
31	2/28/2017	Y	WW	7.28	6.1	10.97	0.7	6.38	8.1	425	234	200	0.7	0.07	4	9	6.061	
31	3/31/2017	Y	WW	8.01	11.4	8.89	0.8	8.99	8.1	435	239	200	0.8	0.07	5	12	9.454	
				Average	7.561667	13.84167	8.13	0.95	12.83	7.8	449.5833333	247.25	104.16667	0.583333	0.06	2.166667	5.08333333	4.784

Table 32: Site 31 data.

Table 33 shows Site 32 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
32	4/30/2016	Y	WW	7.93	14.8	8.56	1.3	15.19	8.1	481	265	200	1.2	0.11	3	8	4.082
32	5/31/2016	N	BF	7.91	16.9	8.27	1.3	15.72	7.8	471	259	150	1.1	0.11	2	7	3.874
32	6/30/2016	N	BF	7.09	18.1	7.47	1.3	17.40	7.3	471	259	100	0.8	0.08	2	4	3.475
32	7/31/2016	N	BF	7.31	24.5	7.49	1.3	17.36	7.1	470	259	50	0.6	0.06	1	2	0.351
32	8/31/2016	Y	WW	7.22	22.5	6.01	1.3	21.63	7.1	470	259	100	0.6	0.06	2	4	4.092
32	9/30/2016	Y	WW	7.21	20.2	6.23	1.1	17.66	7.1	467	257	50	0.4	0.05	1	2	3.104
32	10/31/2016	Y	WW	7.49	15.2	6.87	0.8	11.64	6.8	463	256	50	0.4	0.04	1	2	2.582
32	11/30/2016	Y	WW	7.41	11.9	7.88	0.6	7.61	6.5	445	245	50	0.4	0.04	1	2	2.231
32	12/29/2016	N	WW	7.43	2.1	8.73	0.3	3.44	7.9	453	249	50	0.4	0.04	1	2	2.540
32	1/31/2017	Y	WW	7.46	2.0	9.34	0.3	3.21	7.3	448	246	200	1.2	0.09	3	8	4.307
32	2/28/2017	Y	WW	7.31	5.8	9.27	0.7	7.55	7.4	443	244	200	1.2	0.09	4	10	4.002
32	3/31/2017	Y	WW	7.89	11.5	8.77	0.9	10.26	8.1	452	247	200	1.2	0.11	5	11	4.271
			Average	7.471667	13.79167	7.91	0.93	12.38917	7.375	461.1666667	253.75	116.66667	0.791667	0.07	2.166667	5.1666667	3.243

Table 33: Site 32 data.

Table 34 shows Site 33 data with E.coli exceeding target standards 4 times or 33.33% of samples taken. This was due to heavy manure spreading.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
33	4/30/2016	Y	WW	7.70	14.9	10.28	1.2	11.67	8.7	479	263	250	1.2	0.11	6	14	13.038
33	5/31/2016	N	BF	7.76	17.2	9.45	1.3	13.76	8.4	473	260	200	1.1	0.11	4	11	11.668
33	6/30/2016	N	BF	7.01	18.4	7.13	1.2	16.83	7.8	474	261	150	0.9	0.07	2	7	10.989
33	7/31/2016	N	BF	7.96	24.5	7.96	1.3	16.33	7.5	471	259	50	0.6	0.06	1	2	1.175
33	8/31/2016	Y	WW	7.79	22.5	5.94	1.3	21.89	7.3	471	259	100	0.6	0.07	2	5	2.341
33	9/30/2016	Y	WW	7.56	20.4	6.11	1.2	19.64	7.1	466	256	50	0.5	0.05	1	2	2.117
33	10/31/2016	Y	WW	7.61	15.2	6.67	0.8	11.99	6.9	459	252	50	0.5	0.05	1	2	1.550
33	11/30/2016	Y	WW	7.59	12.0	7.69	0.6	7.80	6.6	453	249	50	0.4	0.05	1	2	1.179
33	12/29/2016	N	WW	7.57	2.1	8.34	0.3	3.60	8.1	459	252	50	0.4	0.03	1	2	1.306
33	1/31/2017	Y	WW	7.75	1.8	9.56	0.3	3.12	7.7	453	249	250	1.2	0.08	5	11	3.113
33	2/28/2017	Y	WW	7.56	6.5	9.54	0.6	6.29	7.5	451	248	250	1.2	0.09	5	14	11.391
33	3/31/2017	Y	WW	7.63	11.4	10.32	0.8	7.75	8.5	467	257	250	1.2	0.11	6	14	13.794
			Average	7.624167	13.90833	8.25	0.91	11.7225	7.675	464.6666667	255.41667	141.66667	0.816667	0.07	2.916667	7.1666667	6.138

Table 34: Site 33 data.

Table 35 shows Site 34 data with E.coli exceeding target standards 4 times or 33.33%. The cause was likely due to manure runoff from roads.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
34	4/30/2016	Y	WW	7.64	15.6	8.52	1.1	12.91	8.4	489	269	250	1.1	0.15	4	11	5.840
34	5/31/2016	N	BF	7.71	17.9	8.34	1.3	15.59	8.1	479	263	200	0.9	0.13	3	9	5.231
34	6/30/2016	N	BF	7.11	19.1	7.37	1.3	17.64	7.3	481	265	150	0.6	0.09	2	6	4.785
34	7/31/2016	N	BF	7.96	24.5	8.34	1.4	16.79	7.1	484	266	50	0.5	0.06	1	2	0.436
34	8/31/2016	Y	WW	7.77	22.4	8.23	1.3	15.8	7.1	484	266	100	0.6	0.07	2	4	4.786
34	9/30/2016	Y	WW	7.61	20.2	8.45	1.2	14.20	6.9	463	255	100	0.4	0.06	1	2	4.558
34	10/31/2016	Y	WW	7.88	14.9	8.83	0.7	7.92	6.6	461	254	50	0.4	0.05	1	2	3.121
34	11/30/2016	Y	WW	7.69	12.6	9.45	0.6	6.35	6.2	457	251	50	0.4	0.05	1	2	2.879
34	12/29/2016	N	WW	7.63	2.3	10.34	0.4	3.87	8.4	462	254	50	0.4	0.04	1	2	2.989
34	1/31/2017	Y	WW	7.67	2.1	10.89	0.4	3.67	8.1	455	250	250	1.1	0.11	4	9	5.305
34	2/28/2017	Y	WW	7.51	6.4	10.63	0.7	6.59	7.9	455	250	250	1.3	0.11	4	10	5.003
34	3/31/2017	Y	WW	7.61	12.4	8.62	0.8	9.28	8.3	459	252	250	1.2	0.13	5	13	6.099
			Average	7.649167	14.2	9.00	0.93	10.88417	7.533333	469.0833333	257.91667	145.83333	0.741667	0.09	2.416667	6	4.253

Table 35: Site 34 data.

Table 36 shows Site 35 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
35	4/30/2016	Y	WW	8.10	14.5	9.83	1.2	12.21	8.8	489	269	50	0.8	0.08	3	9	6.048
35	5/31/2016	N	BF	8.14	16.9	8.79	1.2	13.65	8.2	467	257	50	0.8	0.07	2	7	5.787
35	6/30/2016	N	BF	7.45	17.9	7.68	1.3	16.93	7.6	455	250	50	0.6	0.07	2	6	5.235
35	7/31/2016	N	BF	7.91	22.8	5.54	1.4	25.27	7.4	463	255	50	0.5	0.06	1	2	1.553
35	8/31/2016	Y	WW	7.73	20.7	5.34	1.3	24.34	7.2	463	255	50	0.6	0.06	2	5	6.567
35	9/30/2016	Y	WW	7.65	19.1	6.03	1.1	18.24	6.9	453	249	50	0.6	0.04	1	3	5.669
35	10/31/2016	Y	WW	7.92	14.5	6.54	0.7	10.70	6.6	447	246	50	0.5	0.04	1	2	4.687
35	11/30/2016	Y	WW	7.88	11.9	7.73	0.6	7.76	6.1	441	243	50	0.4	0.04	1	2	3.902
35	12/29/2016	N	WW	7.79	1.9	8.52	0.4	4.69	8.3	456	251	50	0.4	0.04	1	2	4.003
35	1/31/2017	Y	WW	7.79	1.7	9.56	0.4	4.18	7.9	438	241	100	0.8	0.08	3	9	6.478
35	2/28/2017	Y	WW	7.63	6.7	9.38	0.8	8.53	7.9	436	240	150	0.8	0.08	3	9	5.477
35	3/31/2017	Y	WW	7.88	11.2	9.94	0.9	9.05	8.6	452	247	200	0.8	0.08	4	9	6.321
			Average	7.8225	13.31667	7.91	0.94	12.9625	7.625	455	250.25	75	0.633333	0.06	2	5.4166667	5.144

Table 36: Site 35 data.

Table 37 shows Site 36 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
36	4/30/2016	Y	WW	8.08	14.8	8.98	1.1	12.25	8.9	479	263	150	1.3	0.11	3	9	1.944
36	5/31/2016	N	BF	8.07	17.1	8.37	1.2	14.34	8.5	473	260	100	1.1	0.11	2	7	1.692
36	6/30/2016	N	BF	7.45	18.2	7.01	1.2	17.09	8.1	471	259	100	0.8	0.09	2	5	1.292
36	7/31/2016	N	BF	8.11	23.1	8.97	1.5	16.72	7.6	465	256	50	0.6	0.07	1	2	0.025
36	8/31/2016	Y	WW	8.08	21.3	8.56	1.3	15.19	7.7	465	256	100	0.7	0.08	2	5	2.442
36	9/30/2016	Y	WW	7.77	19.1	8.59	1.1	12.81	7.2	459	252	100	0.6	0.04	1	3	2.231
36	10/31/2016	Y	WW	7.97	14.7	9.03	0.6	6.64	6.8	455	250	50	0.5	0.04	1	2	1.634
36	11/30/2016	Y	WW	7.92	12.1	9.67	0.6	6.20	6.3	449	247	50	0.4	0.04	1	2	1.244
36	12/29/2016	N	WW	7.85	2.2	10.22	0.4	3.91	8.4	452	249	50	0.4	0.03	1	2	1.306
36	1/31/2017	Y	WW	7.86	2.1	11.01	0.4	3.63	8.2	446	245	150	1.1	0.11	3	9	3.819
36	2/28/2017	Y	WW	7.77	6.3	10.77	0.8	7.43	8.1	444	244	200	1.1	0.11	4	11	1.783
36	3/31/2017	Y	WW	7.97	11.4	9.17	0.9	9.81	8.7	461	254	200	1.1	0.11	4	10	2.120
			Average	7.908333	13.53333	9.20	0.93	10.50167	7.875	459.9166667	252.91667	108.33333	0.808333	0.08	2.083333	5.58333333	1.794

Table 37: Site 36 data.

Table 38 shows Site 37 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
37	4/30/2016	Y	WW	8.19	16.2	9.04	1.0	11.06	8.3	483	266	150	0.8	0.07	3	8	2.948
37	5/31/2016	N	BF	8.11	18.4	8.22	1.2	14.60	7.9	469	258	100	0.8	0.07	2	6	2.336
37	6/30/2016	N	BF	7.52	19.5	6.95	1.3	18.71	6.9	478	263	100	0.5	0.06	2	5	2.007
37	7/31/2016	N	BF	8.01	22.6	8.15	1.5	18.40	6.7	477	262	50	0.5	0.05	1	2	0.034
37	8/31/2016	Y	WW	7.95	20.9	9.21	1.5	16.29	6.5	477	262	100	0.7	0.06	2	5	3.241
37	9/30/2016	Y	WW	7.87	18.9	9.23	1.3	14.08	6.3	469	258	100	0.6	0.04	1	2	2.782
37	10/31/2016	Y	WW	8.05	13.3	9.44	0.5	5.30	6.1	459	252	50	0.5	0.04	1	2	2.205
37	11/30/2016	Y	WW	7.97	11.1	9.87	0.4	4.05	5.7	456	251	50	0.4	0.04	1	2	1.783
37	12/29/2016	N	WW	7.93	1.8	10.34	0.3	2.90	8.2	461	254	50	0.4	0.03	1	2	1.809
37	1/31/2017	Y	WW	7.96	1.7	10.67	0.3	2.81	7.7	457	251	150	0.8	0.08	3	8	3.267
37	2/28/2017	Y	WW	7.79	6.2	10.46	0.8	7.65	7.8	455	250	200	0.8	0.08	3	8	2.437
37	3/31/2017	Y	WW	7.92	12.8	9.22	0.9	9.76	8.1	473	260	200	0.8	0.07	4	9	3.193
			Average	7.939167	13.61667	9.23	0.92	10.4675	7.183333	467.8333333	257.25	108.33333	0.633333	0.06	2	4.9166667	2.337

Table 38: Site 37 data.

Table 39 shows Site 38 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
38	4/30/2016	Y	WW	8.01	15.1	9.31	1.2	12.89	8.7	497	273	100	0.9	0.09	4	11	17.617
38	5/31/2016	N	BF	7.98	17.8	8.18	1.2	14.69	8.3	487	268	100	0.8	0.08	3	9	15.586
38	6/30/2016	N	BF	7.24	18.9	6.57	1.3	19.79	6.5	492	271	100	0.6	0.06	2	6	14.704
38	7/31/2016	N	BF	7.87	24.8	7.09	1.4	19.75	6.5	489	269	50	0.6	0.04	1	2	0.297
38	8/31/2016	Y	WW	7.83	22.5	9.09	1.4	15.40	6.6	489	269	100	0.6	0.06	2	4	1.997
38	9/30/2016	Y	WW	7.73	20.1	9.14	1.2	13.13	6.3	473	260	50	0.5	0.05	1	2	1.445
38	10/31/2016	Y	WW	7.93	14.8	9.37	0.7	7.47	5.9	463	255	50	0.5	0.05	1	2	1.286
38	11/30/2016	Y	WW	7.83	11.8	9.53	0.5	5.25	5.8	461	254	50	0.5	0.05	1	2	0.978
38	12/29/2016	N	WW	7.84	1.9	10.18	0.3	2.95	7.3	467	257	50	0.4	0.04	1	2	1.112
38	1/31/2017	Y	WW	7.83	1.9	10.41	0.3	2.88	7.1	461	254	100	0.7	0.07	4	11	3.443
38	2/28/2017	Y	WW	7.68	5.9	10.22	0.7	6.85	7.2	460	253	150	0.8	0.08	4	11	15.442
38	3/31/2017	Y	WW	7.89	12.1	9.39	0.9	9.58	8.4	487	268	200	0.9	0.09	4	15	17.450
			Average	7.805	13.96667	9.04	0.93	10.88583	7.05	477.1666667	262.58333	91.666667	0.65	0.06	2.333333	6.41666667	7.613

Table 39: Site 38 data.

Table 40 shows Site 39 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
39	4/30/2016	Y	WW	8.07	14.6	9.76	1.2	12.30	8.9	503	277	100	0.9	0.11	3	8	2.227
39	5/31/2016	N	BF	8.02	16.9	8.78	1.4	15.95	8.3	494	272	100	0.8	0.09	2	6	2.003
39	6/30/2016	N	BF	7.37	17.6	6.33	1.4	22.12	6.5	494	272	100	0.7	0.07	2	4	1.684
39	7/31/2016	N	BF	7.56	24.3	7.65	1.4	18.30	6.5	491	270	50	0.6	0.05	1	2	0.154
39	8/31/2016	Y	WW	7.55	22.5	7.68	1.4	18.23	6.4	491	270	100	0.6	0.07	2	4	3.232
39	9/30/2016	Y	WW	7.48	20.1	7.79	1.2	15.40	6.1	479	263	100	0.5	0.05	1	2	2.978
39	10/31/2016	Y	WW	7.72	14.7	8.13	0.6	7.38	5.7	468	257	100	0.5	0.05	1	2	2.327
39	11/30/2016	Y	WW	7.66	12.3	8.89	0.5	5.62	5.7	464	255	50	0.5	0.04	1	2	1.572
39	12/29/2016	N	WW	7.61	1.9	9.91	0.3	3.03	7.1	471	259	50	0.4	0.03	1	2	1.706
39	1/31/2017	Y	WW	7.63	1.7	10.19	0.3	2.94	6.6	459	252	100	0.7	0.09	3	8	3.990
39	2/28/2017	Y	WW	7.61	6.2	10.06	0.7	6.96	6.8	453	249	100	0.8	0.09	3	8	2.016
39	3/31/2017	Y	WW	7.91	11.5	9.81	0.8	8.15	8.8	477	262	100	0.9	0.11	4	9	2.457
			Average	7.6825	13.69167	8.75	0.93	11.365	6.95	478.6666667	263.16667	87.5	0.658333	0.07	2	4.75	2.196

Table 40: Site 30 data.

Table 41 shows Site 40 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
40	4/30/2016	Y	WW	8.03	15.8	9.02	1.3	14.41	9.5	521	287	200	0.7	0.07	3	10	53.946
40	5/31/2016	N	BF	8.05	18.2	8.66	1.4	16.67	8.6	516	284	150	0.8	0.06	2	8	47.663
40	6/30/2016	N	BF	7.19	19.3	7.24	1.4	19.34	7.4	511	281	100	0.5	0.04	2	5	43.117
40	7/31/2016	N	BF	7.88	25.6	8.21	1.4	17.05	7.1	513	282	50	0.5	0.04	1	2	11.987
40	8/31/2016	Y	WW	7.79	23.6	8.21	1.3	15.83	6.9	513	282	100	0.7	0.05	2	4	39.344
40	9/30/2016	Y	WW	7.71	21.8	8.32	1.1	13.22	6.7	489	269	100	0.5	0.05	1	2	34.327
40	10/31/2016	Y	WW	8.01	15.6	8.55	0.7	8.19	6.3	477	262	100	0.5	0.05	1	2	29.899
40	11/30/2016	Y	WW	7.86	13.5	10.15	0.5	4.93	6.1	469	258	100	0.5	0.05	1	2	23.573
40	12/29/2016	N	WW	7.85	2.3	10.44	0.3	2.87	8.4	474	261	50	0.4	0.04	1	2	25.231
40	1/31/2017	Y	WW	7.88	2.2	11.23	0.3	2.67	7.9	462	254	200	0.7	0.07	3	9	34.011
40	2/28/2017	Y	WW	7.57	7.8	10.85	0.8	7.37	7.9	457	251	250	0.7	0.07	5	14	49.507
40	3/31/2017	Y	WW	7.78	12.2	9.27	0.9	9.71	9.2	486	267	200	0.8	0.07	3	12	55.336
			Average	7.8	14.825	9.18	0.95	11.02167	7.666667	490.6666667	269.83333	133.33333	0.608333	0.06	2.083333	6	37.328

Table 41: Site 40 data.

Table 42 shows Site 41 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
41	4/30/2016	Y	WW	7.99	15.8	9.74	1.3	13.35	9.1	518	285	100	1.1	0.14	3	9	4.731
41	5/31/2016	N	BF	8.02	18.3	8.97	1.3	14.49	8.7	502	276	100	1.1	0.13	2	8	4.119
41	6/30/2016	N	BF	7.31	19.2	7.11	1.4	19.69	7.7	512	282	100	0.9	0.11	2	5	3.803
41	7/31/2016	N	BF	7.98	26.4	8.23	1.4	17.01	7.1	509	280	50	0.6	0.08	1	2	0.388
41	8/31/2016	Y	WW	7.81	24.1	8.34	1.4	16.79	6.8	509	280	100	0.6	0.08	2	4	4.113
41	9/30/2016	Y	WW	7.59	21.9	8.41	1.3	15.46	6.4	492	271	50	0.5	0.06	1	2	3.801
41	10/31/2016	Y	WW	7.84	15.5	8.57	0.9	10.50	6.1	481	265	50	0.5	0.05	1	2	3.144
41	11/30/2016	Y	WW	7.73	13.1	9.13	0.7	7.67	5.9	476	262	50	0.5	0.04	1	2	2.592
41	12/29/2016	N	WW	7.69	2.4	10.16	0.5	4.92	8.2	483	266	50	0.5	0.04	1	2	2.631
41	1/31/2017	Y	WW	7.73	2.2	11.11	0.5	4.50	7.9	461	254	100	0.8	0.11	3	9	4.731
41	2/28/2017	Y	WW	7.66	7.5	10.74	0.8	7.45	8.1	452	249	100	0.9	0.11	4	11	4.194
41	3/31/2017	Y	WW	7.93	12.2	9.86	0.9	9.13	8.9	473	260	100	1.1	0.11	4	9	4.902
			Average	7.773333	14.883333	9.20	1.03	11.74667	7.575	489	269.16667	79.166667	0.7583333	0.09	2.083333	5.41666667	3.596

Table 42: Site 41 data.

Table 43 shows Site 42 data with E.coli exceeding target standards 4 times or 33.33% and nitrates 1 time or 8.33% of samples taken. However, on many samples nitrates and total phosphorus was quite high. This was due to very heavy manure spreading on terrain with moderate relief.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
42	4/30/2016	Y	WW	8.10	15.4	10.15	1.1	18.84	8.9	498	274	500	1.5	0.24	3	9	1.856
42	5/31/2016	N	BF	8.09	17.7	9.54	1.3	13.63	8.1	488	268	300	1.4	0.19	2	8	1.545
42	6/30/2016	N	BF	7.51	18.9	8.23	1.2	14.58	6.5	482	265	150	1.1	0.14	2	6	1.231
42	7/31/2016	N	BF	8.11	24.3	8.23	1.4	17.01	6.4	483	266	50	0.8	0.09	1	2	0.231
42	8/31/2016	Y	WW	8.01	22.2	8.33	1.3	15.61	6.3	483	266	100	0.9	0.09	2	5	2.679
42	9/30/2016	Y	WW	7.55	19.9	8.45	1.2	14.20	6.1	477	262	50	0.7	0.07	1	5	2.324
42	10/31/2016	Y	WW	7.84	14.9	8.79	0.7	7.96	5.9	467	257	50	0.6	0.06	1	3	1.784
42	11/30/2016	Y	WW	7.81	13.3	9.84	0.7	7.11	5.6	461	254	50	0.4	0.04	1	2	1.233
42	12/29/2016	N	WW	7.77	2.2	10.47	0.5	4.78	7.7	463	255	50	0.4	0.04	1	2	1.307
42	1/31/2017	Y	WW	7.76	2.1	11.76	0.5	4.25	7.4	443	244	250	1.1	0.16	3	9	3.004
42	2/28/2017	Y	WW	7.43	7.9	11.02	0.9	8.17	7.3	436	240	250	1.3	0.16	3	9	1.671
42	3/31/2017	Y	WW	7.86	12.1	10.27	1	9.74	8.6	459	252	200	1.3	0.21	3	9	2.010
			Average	7.82	14.24167	9.59	0.98	11.32333	7.066667	470	258.58333	166.66667	0.9583333	0.12	1.916667	5.75	1.740

Table 43: Site 42 data.

Table 44 shows Site 43 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
43	4/30/2016	Y	WW	8.20	15.2	10.15	1.3	12.81	8.7	513	282	150	1.1	0.17	3	9	1.886
43	5/31/2016	N	BF	8.17	17.5	9.39	1.3	13.84	8.1	503	277	150	0.9	0.15	2	7	1.197
43	6/30/2016	N	BF	7.65	18.7	8.34	1.4	16.79	6.8	497	273	100	0.6	0.11	2	4	0.994
43	7/31/2016	N	BF	8.11	25.4	8.56	1.4	16.36	6.4	499	274	50	0.5	0.09	1	2	0.994
43	8/31/2016	Y	WW	8.02	23.1	8.31	1.4	16.85	6.2	499	274	100	0.6	0.09	2	5	3.220
43	9/30/2016	Y	WW	7.81	20.8	8.56	1.2	14.02	5.9	484	266	50	0.4	0.07	1	5	2.775
43	10/31/2016	Y	WW	8.03	14.9	8.83	0.7	7.93	5.8	481	265	50	0.4	0.05	1	3	2.256
43	11/30/2016	Y	WW	7.97	13.3	9.96	0.7	7.03	5.5	478	263	50	0.4	0.05	1	2	1.347
43	12/29/2016	N	WW	7.81	2.3	10.26	0.4	3.90	7.9	485	267	50	0.4	0.03	1	2	1.511
43	1/31/2017	Y	WW	7.82	2.1	11.34	0.4	3.53	7.3	472	260	150	0.9	0.11	3	9	3.276
43	2/28/2017	Y	WW	7.60	7.6	10.89	0.9	8.26	7.4	468	257	200	0.9	0.11	3	9	1.304
43	3/31/2017	Y	WW	8.11	12.2	10.29	0.9	8.75	8.3	492	271	200	1.1	0.15	4	10	1.593
			Average	7.941667	14.425	9.57	1.00	10.83917	7.025	489.25	269.08333	108.33333	0.6833333	0.10	2	5.58333333	1.821

Table 44: Site 43 data.

Table 45 shows Site 44 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
44	4/30/2016	Y	WW	8.16	15.3	9.97	1.2	12.04	9.1	495	272	100	0.9	0.11	2	6	1.879
44	5/31/2016	N	BF	8.08	17.9	9.44	1.3	13.77	8.6	489	269	100	0.8	0.11	2	5	1.210
44	6/30/2016	N	BF	7.73	19.1	8.51	1.4	16.45	7.2	493	271	50	0.5	0.09	2	4	0.989
44	7/31/2016	N	BF	7.87	23.1	8.67	1.4	16.15	6.9	488	268	50	0.4	0.08	1	2	0.022
44	8/31/2016	Y	WW	7.86	21.3	8.55	1.3	15.20	6.7	488	268	50	0.6	0.08	2	5	2.998
44	9/30/2016	Y	WW	7.72	19.1	8.59	1.1	12.81	6.6	481	265	50	0.4	0.06	1	5	2.499
44	10/31/2016	Y	WW	8.00	14.7	8.92	0.6	6.73	6.4	479	263	50	0.4	0.04	1	4	1.893
44	11/30/2016	Y	WW	7.85	13.1	10.04	0.6	5.98	6.1	473	260	50	0.4	0.04	1	2	1.409
44	12/29/2016	N	WW	7.85	2.2	10.38	0.4	3.85	8.5	481	265	50	0.4	0.03	1	2	1.577
44	1/31/2017	Y	WW	7.86	2.1	11.29	0.4	3.54	8.1	469	258	100	0.7	0.09	2	6	3.330
44	2/28/2017	Y	WW	7.82	7.8	10.72	0.8	7.46	8.1	465	256	100	0.8	0.09	38	6	1.726
44	3/31/2017	Y	WW	8.02	12.2	10.05	1	9.95	8.7	489	269	100	0.8	0.11	4	7	2.100
			Average	7.901667	13.99167	9.59	0.96	10.3275	7.583333	482.5	265.33333	70.833333	0.591667	0.08	4.75	4.5	1.803

Table 45: Site 44 data.

Table 46 shows Site 45 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
45	4/30/2016	Y	WW	8.11	15.7	9.07	1.3	14.33	8.9	517	284	200	0.9	0.11	5	13	62.735
45	5/31/2016	N	BF	8.05	18.1	8.61	1.4	16.60	8.3	491	270	150	0.9	0.10	4	11	56.729
45	6/30/2016	N	BF	6.81	19.2	7.17	1.2	16.74	6.9	495	282	100	0.6	0.07	3	7	52.337
45	7/31/2016	N	BF	7.34	24.8	7.23	1.5	20.75	6.6	497	273	50	0.4	0.07	1	2	14.979
45	8/31/2016	Y	WW	7.29	22.3	7.56	1.3	17.20	6.6	497	273	100	0.6	0.08	2	3	43.213
45	9/30/2016	Y	WW	7.67	21.7	7.62	1.1	14.44	6.6	492	271	100	0.5	0.07	1	3	38.985
45	10/31/2016	Y	WW	7.96	15.9	7.99	0.6	7.51	6.5	482	265	100	0.4	0.06	1	3	32.767
45	11/30/2016	Y	WW	7.94	13.5	9.08	0.6	6.61	6.3	479	263	100	0.4	0.05	1	2	26.482
45	12/29/2016	N	WW	7.94	2.3	9.97	0.3	3.01	8.3	487	268	50	0.4	0.04	1	2	28.001
45	1/31/2017	Y	WW	7.96	2.1	10.55	0.3	2.84	8.1	457	251	200	0.9	0.09	4	13	39.999
45	2/28/2017	Y	WW	7.93	7.3	10.24	0.8	7.81	8.1	452	249	200	0.9	0.09	6	16	55.395
45	3/31/2017	Y	WW	8.03	12.3	9.31	0.9	9.67	8.8	479	263	200	0.9	0.09	5	14	67.011
			Average	7.7525	14.6	8.70	0.94	11.45917	7.5	485.4166667	267.66667	129.16667	0.65	0.08	2.833333	7.41666667	43.219

Table 46: Site 45 data.

Table 47 shows Site 46 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
46	4/30/2016	Y	WW	8.10	15.1	9.88	1.1	11.13	8.2	523	288	50	1.4	0.13	3	8	7.582
46	5/31/2016	N	BF	7.99	18.1	9.17	1.2	13.09	7.9	519	285	50	1.1	0.12	3	8	6.883
46	6/30/2016	N	BF	7.31	18.9	7.62	1.2	15.75	6.9	513	282	50	0.8	0.09	2	5	5.991
46	7/31/2016	N	BF	7.45	24.2	7.45	1.4	18.79	6.7	521	287	50	0.6	0.07	1	2	1.121
46	8/31/2016	Y	WW	7.23	22.1	7.49	1.3	17.36	6.7	521	287	50	0.6	0.08	2	3	6.741
46	9/30/2016	Y	WW	7.18	19.9	7.66	1.1	14.36	6.6	513	282	50	0.5	0.05	1	3	5.777
46	10/31/2016	Y	WW	7.35	15.1	9.94	0.6	6.04	6.3	503	277	50	0.5	0.05	1	3	4.802
46	11/30/2016	Y	WW	7.31	12.8	10.34	0.6	5.80	6.3	497	273	50	0.5	0.04	1	2	3.794
46	12/29/2016	N	WW	7.33	2.1	10.65	0.3	2.82	8.1	503	277	50	0.4	0.04	1	2	3.992
46	1/31/2017	Y	WW	7.38	1.8	10.93	0.3	2.74	7.8	488	268	100	0.7	0.11	3	8	5.507
46	2/28/2017	Y	WW	7.37	6.7	10.44	0.7	6.70	7.9	486	267	150	0.7	0.11	4	12	6.287
46	3/31/2017	Y	WW	8.01	12.1	10.12	0.9	8.89	7.9	499	274	150	1.2	0.11	4	9	7.907
			Average	7.50	14.075	9.31	0.89	10.28917	7.275	507.1666667	278.91667	70.833333	0.75	0.08	2.166667	5.41666667	5.532

Table 47: Site 46 data.

Table 48 shows Site 47 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
47	4/30/2016	Y	WW	7.99	14.8	10.15	1.1	10.84	8.2	519	285	50	0.8	0.09	2	6	7.946
47	5/31/2016	N	BF	7.97	17.3	9.66	1.3	13.46	7.7	501	276	50	0.8	0.09	2	5	7.237
47	6/30/2016	N	BF	7.15	18.3	8.21	1.2	14.62	6.8	504	277	50	0.6	0.07	2	4	6.593
47	7/31/2016	N	BF	7.29	24.5	8.34	1.4	16.79	6.5	511	281	50	0.4	0.07	1	2	1.978
47	8/31/2016	Y	WW	7.12	22.3	8.51	1.4	16.45	6.5	511	281	50	0.5	0.08	2	4	7.252
47	9/30/2016	Y	WW	7.11	19.9	8.52	1.1	12.91	6.4	507	279	50	0.4	0.05	1	2	6.638
47	10/31/2016	Y	WW	7.40	14.8	8.75	0.7	8.00	6.1	497	273	50	0.4	0.05	1	2	4.909
47	11/30/2016	Y	WW	7.27	12.2	9.45	0.6	6.35	5.8	494	272	50	0.4	0.04	1	2	3.799
47	12/29/2016	N	WW	7.29	1.9	10.27	0.4	3.89	7.2	511	281	50	0.4	0.04	1	2	3.994
47	1/31/2017	Y	WW	7.33	1.7	11.09	0.4	3.61	6.7	497	273	50	0.5	0.06	2	6	6.003
47	2/28/2017	Y	WW	7.21	7.1	10.63	0.7	6.59	7.1	494	272	100	0.7	0.07	3	7	7.205
47	3/31/2017	Y	WW	7.98	11.5	10.25	0.9	8.78	7.9	505	278	100	0.7	0.09	3	7	8.234
			Average	7.43	13.85833	9.49	0.93	10.19083	6.908333	504.25	277.33333	58.333333	0.55	0.07	1.75	4.08333333	5.982

Table 48: Site 47 data.

Table 49 shows Site 48 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
48	4/30/2016	Y	WW	8.41	16.3	9.82	1.3	13.24	9.2	573	315	100	1.3	0.14	2	6	2.457
48	5/31/2016	N	BF	8.28	18.6	9.32	1.3	13.85	7.9	555	305	100	1.1	0.13	2	5	2.219
48	6/30/2016	N	BF	7.76	19.8	7.88	1.3	16.50	7.9	548	301	50	0.9	0.11	2	4	1.895
48	7/31/2016	N	BF	7.89	24.2	7.99	1.5	18.77	7.3	545	300	50	0.5	0.07	1	2	0.899
48	8/31/2016	Y	WW	7.54	22.1	7.89	1.4	17.74	7.1	545	300	50	0.5	0.08	2	4	6.354
48	9/30/2016	Y	WW	7.46	18.7	7.97	1.1	13.80	6.8	537	295	50	0.5	0.06	1	2	5.557
48	10/31/2016	Y	WW	7.67	14.3	8.45	0.7	8.28	6.6	524	288	50	0.5	0.05	1	2	4.345
48	11/30/2016	Y	WW	7.66	11.9	9.51	0.6	6.31	6.4	517	284	50	0.4	0.04	1	2	3.661
48	12/29/2016	N	WW	7.62	1.8	10.33	0.4	3.87	7.9	523	288	50	0.4	0.04	1	2	3.829
48	1/31/2017	Y	WW	7.63	1.6	11.27	0.4	3.55	7.3	509	280	100	1.1	0.11	2	7	6.135
48	2/28/2017	Y	WW	7.42	7.2	10.75	0.8	7.44	7.3	497	273	100	1.1	0.11	3	8	2.290
48	3/31/2017	Y	WW	8.23	13.1	9.99	0.8	8.01	8.7	511	281	100	1.1	0.13	3	8	2.881
			Average	7.7975	14.13333	9.26	0.97	10.94667	7.533333	532	292.5	70.833333	0.783333	0.09	1.75	4.3333333	3.544

Table 49: Site 48 data.

Table 50 shows Site 49 data zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
49	4/30/2016	Y	WW	8.39	16.1	9.74	1.2	12.32	9.1	568	312	100	1.2	0.12	2	6	2.232
49	5/31/2016	N	BF	8.29	18.3	8.99	1.4	15.57	8.2	537	295	100	1.2	0.11	2	5	1.996
49	6/30/2016	N	BF	7.57	19.2	7.34	1.3	17.71	8.2	539	296	50	0.9	0.08	2	5	1.593
49	7/31/2016	N	BF	7.78	24.3	7.54	1.4	18.57	7.8	538	296	50	0.6	0.06	1	2	0.873
49	8/31/2016	Y	WW	7.61	22.1	7.54	1.4	18.57	7.4	538	296	50	0.6	0.08	2	3	6.335
49	9/30/2016	Y	WW	7.53	19.3	7.66	1.2	15.67	7.1	534	294	50	0.5	0.06	1	3	5.482
49	10/31/2016	Y	WW	7.71	14.4	8.17	0.8	9.79	6.9	522	287	50	0.4	0.06	1	2	4.333
49	11/30/2016	Y	WW	7.69	11.9	8.99	0.6	6.67	6.4	515	283	50	0.4	0.04	1	2	3.496
49	12/29/2016	N	WW	7.67	1.8	10.03	0.4	3.99	8.1	519	285	50	0.4	0.04	1	2	3.673
49	1/31/2017	Y	WW	7.69	1.7	10.86	0.4	3.68	7.6	492	271	100	1.2	0.11	2	6	5.997
49	2/28/2017	Y	WW	7.58	7.2	10.56	0.8	7.58	7.5	491	270	100	1.2	0.11	3	8	2.001
49	3/31/2017	Y	WW	8.27	13.1	9.83	0.9	9.16	8.8	517	284	100	1.2	0.11	3	6	2.704
			Average	7.815	14.11667	8.94	0.98	11.60667	7.758333	525.8333333	289.08333	70.833333	0.816667	0.08	1.75	4.1666667	3.393

Table 50: Site 49 data.

Table 51 shows Site 50 data with zero NPS parameters exceeding target standards.

Site Number	Date	Did it rain within 48 hrs. of sampling? (Y/N)	Baseflow or Wet Weather Flow (BF or WW)	pH	Temp °C	Dissolved oxygen mg/l	BOD mg/l	BOD %	Chlorides mg/l	Conductivity µS/CM	Total Dissolved Solids mg/l	Escherichia coli	Nitrate-Nitrite mg/l	Total Phosphorus mg/l	Turbidity ntu	Total Suspended Solids-mg/l	Flow cf/s
50	4/30/2016	Y	WW	8.39	17.1	10.27	1.2	11.68	8.4	497	273	100	1.1	0.11	3	9	1.932
50	5/31/2016	N	BF	8.27	19.5	9.33	1.4	15.01	8.1	492	271	100	1.1	0.11	2	7	1.644
50	6/30/2016	N	BF	7.55	20.3	7.25	1.3	17.93	8.1	502	276	50	0.8	0.08	2	5	1.439
50	7/31/2016	N	BF	7.83	24.3	7.34	1.4	19.07	7.7	504	277	50	0.6	0.06	1	2	0.434
50	8/31/2016	Y	WW	7.69	22.1	7.45	1.3	17.45	7.5	504	277	50	0.6	0.08	2	5	6.792
50	9/30/2016	Y	WW	7.62	19.4	7.66	1.1	14.36	7.2	494	272	50	0.5	0.06	1	3	6.111
50	10/31/2016	Y	WW	7.89	14.3	8.23	0.6	7.29	6.9	476	262	50	0.5	0.06	1	2	3.011
50	11/30/2016	Y	WW	7.82	11.8	8.93	0.6	6.72	6.5	471	259	50	0.4	0.04	1	2	2.403
50	12/29/2016	N	WW	7.79	1.9	10.17	0.4	3.93	8.3	482	265	50	0.4	0.04	1	2	2.652
50	1/31/2017	Y	WW	7.82	1.7	10.98	0.4	3.64	7.8	470	259	100	1.1	0.11	3	8	4.813
50	2/28/2017	Y	WW	7.79	7.1	10.53	0.7	6.65	7.9	461	254	100	1.2	0.11	4	11	1.769
50	3/31/2017	Y	WW	8.29	13.9	10.33	0.9	8.71	8.1	493	271	100	0.9	0.11	3	12	2.211
Average				7.895833	14.45	9.04	0.94	11.03667	7.708333	487.1666667	268	70.833333	0.766667	0.08	2	5.66666667	2.934

Table 51: Site 50 data.

SUMMARY

Overall the data indicates that the majority of the NPS contaminants to the Elkhart River drainage originates in the headwater regions in the east. Phase I sites contained the majority of large livestock operations which proved to be statistically significantly ($p < .001$) higher than other sites. The South Branch had higher terrain relief than all the other locations, coupled with a high livestock population the NPS pollution was high. Livestock with direct access or barnyards located on steep slopes next the streams were observed at many locations. Although the area has a large swamp/marsh complex, the stream flowed through very few. The marsh areas were contained, in most cases, as “potholes” surrounded by steep terrain. As a result they had little effect on helping to remove NPS contaminants.

Phase II and Phase III did contain some livestock operations and once again these sites demonstrated a higher NPS input into the Elkhart River system. The majority of agricultural operations during these phases were associated with crop production. Combined with very low terrain relief, sampling of these sites resulted and surprisingly low NPS values during the testing periods. Sites that had little streambank buffering did show a slightly higher NPS input. Another contributing factor, mainly for nitrates, is the area is very heavily tilled. The tiling complex mainly became in influence during manure spreading operations.

Only Phase III had sites in a large metropolitan environment. Surprisingly the NPS contamination levels were relatively low when compared to the rural sites. Elevated nutrient

levels seemed to occur during traditional lawn fertilization periods. Other rural sites with a concentration of homes having septic systems did show an elevated NPS input during wet weather conditions.

It is suggested that future mitigation to resolve NPS pollution inputs into the Elkhart River be concentrated within the agricultural community. Livestock issues should be the priority with streambank buffering along crop fields a secondary priority. Septic system education along with proper lawn care fertilization will also have a positive influence in reducing NPS inputs.