Analysis of the Water Quality of Eighteenmile Creek, Erie County, New York:

A Comparison of Water Quality Between 1970, 1973 and 2000

By:

Kristal Lynn Krasinski
Senior Student
Department of Geography/Planning
State University, College at Buffalo
1300 Elmwood Avenue
Buffalo, NY 14222

Prepared for:
Western New York Land Conservancy
21 South Grove Street, Suite 120
East Aurora, NY 14052
716-687-1225
www.wnylc.org
wnylc@wnylc.org

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Gerhard Paluca, Department of Health, Erie County Public Health Laboratory
Kim Irvine, Department of Geography & Planning, State University Collage at Buffalo
John Whitney, USDA Natural Resources Conservation Service
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John Daleo, Erie County Department of Public Health

Sampling Volunteers

Frank Mantione
Kathy Hughes
Mary Jane Bolo
David Stout
Mary Alice Tocke
Kathy Swank
Lisa Ishwardis
John Szydlowski

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INTRODUCTION

Eighteenmile Creek, Erie County, New York, flows from south to north then turns west to empty into Lake Erie (Figure 2.1). The watershed of Eighteenmile Creek includes parts of several communities including Eden, Evans, Hamburg, and Boston. The purpose of this research project is to: 1. Compare historical data to data from field samples collected in 2000 to determine if a change has occurred in the waterway and 2. Compare data from all sampling years to present day water quality sampling standards. Previous studies conducted by the Erie County Department of Health (ECDH) in 1970 and 1973 included testing for total coliforms, fecal coliforms, biological oxygen demand (BOD), orthophosphates, chlorides and nitrates. Therefore, the 2000 sample data collection concentrated on the above parameters to evaluate current water quality. The results of this study will help to describe or characterize the present state of the water quality at Eighteenmile Creek and provide information to the surrounding communities of Eden, Evans, Hamburg and Boston.

2. STUDY METHODS

2.1 Sample Sites

Water samples from Eighteenmile Creek were collected at eight sites (Figure 2.1). The site locations are summarized in Table 2.1. Sample Sites three through six were located on the North Branch of the creek and sample Sites seven and eight were located on the South Branch. Sites one and two were located on the Main Branch below the convergence of the North and South Branches. The eight sites were chosen by referencing the 1970, 1973 and 1976 water quality sampling efforts undertake by the Erie County Department of Public Health (ECDPH, 1970; ECDPH, 1973; ECDPH 1976). The sample sites were not located to target specific suspected contamination source areas. The sites were instead spaced out along the creek at points of easy access to give a generalized picture of the water quality of Eighteenmile Creek.

Table 2.1. Summary of Sample Sites

Site No.	Latitude	Longitude	Branch	Description	Municipality
1	42°42'44.8" N	78°57'59.3" W	Main	Bridge on Lake Shore Rd. near North Creek Rd.	Derby
2	42°41'45.1" N	78°56'8.9" W	Main	Bridge on US-20 near South Creek Rd.	Eden
3	42°42'24.3" N	78°50'56.5" W	East	Bridge on US-62 Next to Water Valley Inn	Hamburg
4	42°41'4.5" N	78°46'40.3" W	East	Bridge on Herman Hill Rd. near Back Creek Rd.	Hamburg
5	42°37'42.4" N	78°44'27.2" W	East	Bridge on Pfarner Rd. between Route 391 and Back Creek Rd.	Boston
6	42°35'24.0" N	78°42'15.4" W	East	Bridge near 10629 Springville Boston Rd.	Boston
7	42°40'36.3" N	78°52'27.3" W	West	Bridge on US-62 near Jennings Rd.	Eden
8	42°37'28.5" N	78°50'17.2" W	West	Bridge is near 9605 New Oregon Rd.	Eden

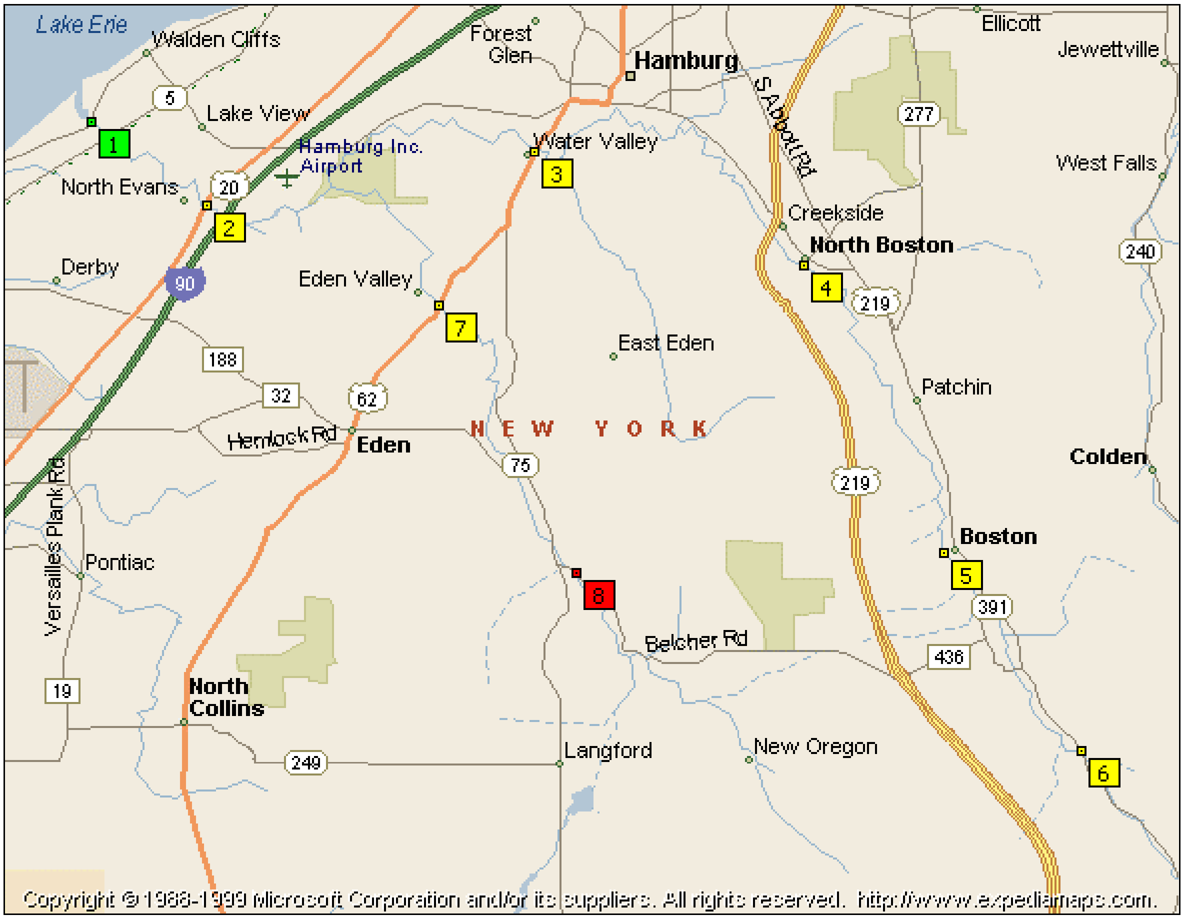


Figure 2.1. Map of Sample Site Locations, Eighteenmile Creek, NY

Note: The color green at site one and the color red at site 8 do not represent anything unique about the sample sites.

2.2 Sample Collection

The collection of the water samples for this project was conducted from April 2000 through December 2000. The samples were collected on the first Tuesday of each month. The second Tuesday of each month was used instead if the stream conditions were hazardous on the first Tuesday. The project manager was Amy Holt, Outreach Coordinator, from the Western New York Land Conservancy (WNYLC). Assisted by John Daleo of the Erie County Department of Public Health (ECDPH), volunteers were trained in sampling procedures in February of 2000 at the Water Valley Inn in Hamburg (Site three).

Water sampling procedures followed accepted standard methods recommended by the American Public Health and American Water Works Association (18^{th} edition) (APHA, 1992). The same equipment was used at each site for water sample collection. A 300ml sterile bottle was used to collect a sample for the fecal coliform and total coliform tests. A half gallon bottle was used to for the collection of sample water for BOD, orthophosphate, nitrate and chloride tests. All samples were taken at the middle point of the deepest portion of the stream with the collector standing downstream from where the sample would be taken from. At each site the collector removed the cap and submerged each bottle one at a time with the mouth of the bottle facing upstream. The sample was collected approximately six to twelve inches below the surface. When full, the collector replaced the cap and marked each bottle with the site number. The samples were kept in a cooler and transported to the ECDPH Laboratory by noon on the sample dates.

2.3 Laboratory Analysis

At the ECDPH Laboratory, Gerhard Paluca completed the analysis of the samples. The ECDPH Laboratory is a certified New York State E Lab with the National Environmental Laboratory Accreditation Council (NELAC). The water testing methods used in the year 2000 testing procedures compare closely with the procedures used in the 1970s (ECDPH, 1970; ECDPH, 1973; ECDPH, 1976). Fecal coliform testing was performed using membrane filtration with a standard method number of 9222-D. Total coliform testing was performed using membrane filtration as well with a standard method number of 9222-B. Chlorides were tested using an argentometric test with a standard method 4500-PE. Biological oxygen demand was tested using a 5-day test method with a standard method number of 5210 B. Nitrates were tested using the FIA flow injection methodology with a standard method number of 4500-NO31.

3. RESULTS AND DISCUSSION

3.1 Hydrology

The USGS gauge site 04215500 at Cazenovia in Ebenezer, New York was used to gather the daily mean discharge for the sample areas of Eighteenmile Creek (www.usgs.gov). This adjacent gauge site in the Cazenovia Creek watershed was used because there was not a gauge site located in the Eighteenmile Creek watershed. Therefore all discharge values will be approximate and will be used to help identify relative dry and wet (storm) periods that would have occurred on Eighteenmile Creek.

The 1970 discharge data are presented in Figure 3.1. These discharge data represent the whole year because exact dates of sample collection could not be determined (ECDPH, 1970). The 1973 discharge data are presented in Figure 3.2. These discharge data represent the period 6/17/73 through 9/7/73. The black dots represent sample dates showing the corresponding flow conditions in Cazenovia Creek when the Eighteenmile Creek samples were collected. The 2000 discharge data are presented in Figure 3.3. These discharge data represent the period of 4/1/00 through 12/1/00. Again the black dots represent the sample dates showing the corresponding flow conditions in Cazenovia Creek when the Eighteenmile Creek samples were collected.

The 1973 sample dates are summarized in Table 3.1. Most samples in 1973 were collected during dry weather, inter-event flow. These Eighteenmile Creek sampling dates had values of high daily mean discharge that ranged from 13 to 35 cubic feet per second in the Cezenovia Creek watershed. There were four sample dates (6/19/73, 6/20/73, 7/3/73, and 8/1/73) that were located on the falling limb of the Cazenovia Creek hydrograph. Sample dates 6/19/73 and 6/20/73 were somewhat higher than any other sample dates on the hydrograph. They had discharges of 95 and 63 cubic feet per second, respectively. These indicate that they were at the end of a larger runoff event. Eighteenmile Creek sample date 7/25/73 occurred on a

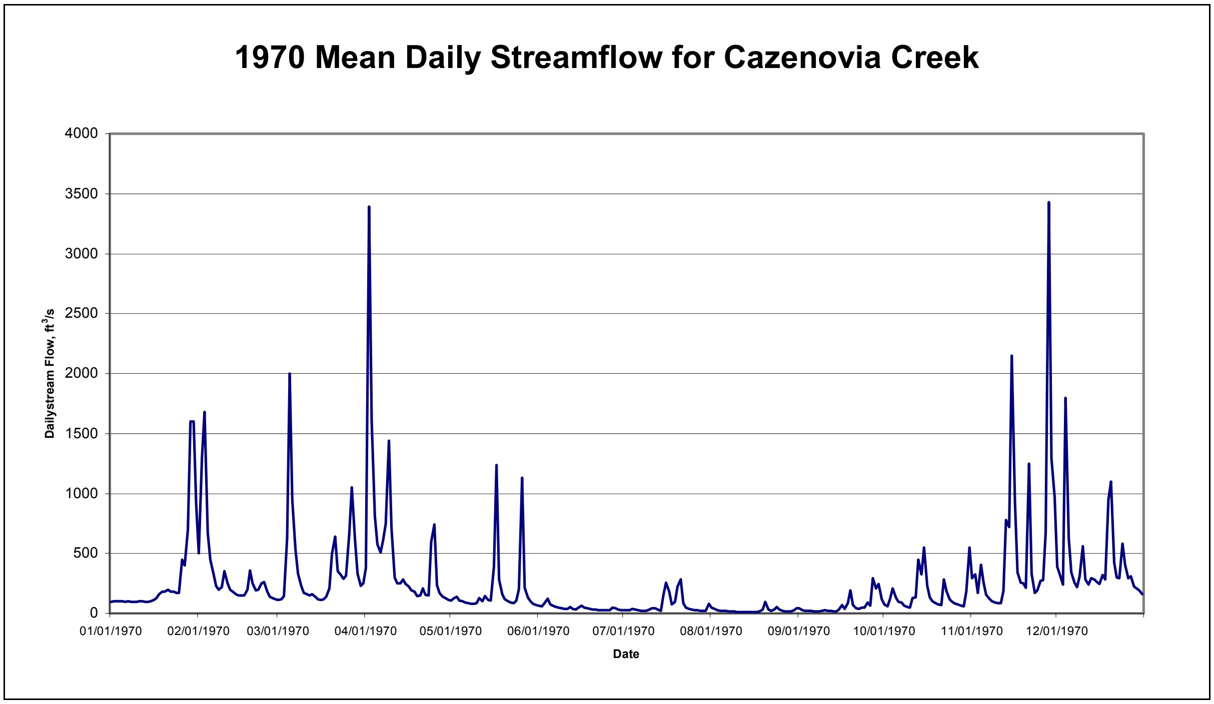


Figure 3.1. 1970 Mean Daily Streamflow Discharge for Cazenovia Creek, NY. (www.usgs.gov)

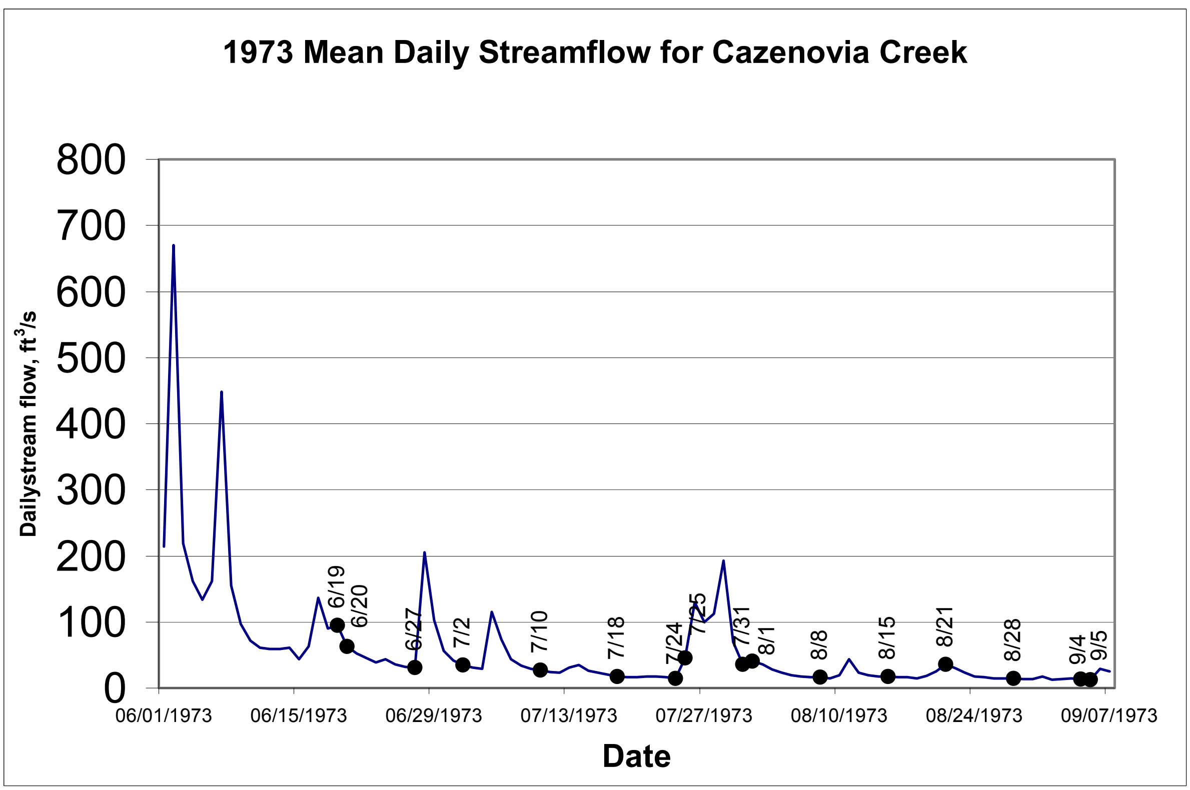


Figure 3.2. 1973 Mean Daily Streamflow Discharge for Cazenovia Creek. The black dots represent sample dates. (www.usgs.gov)

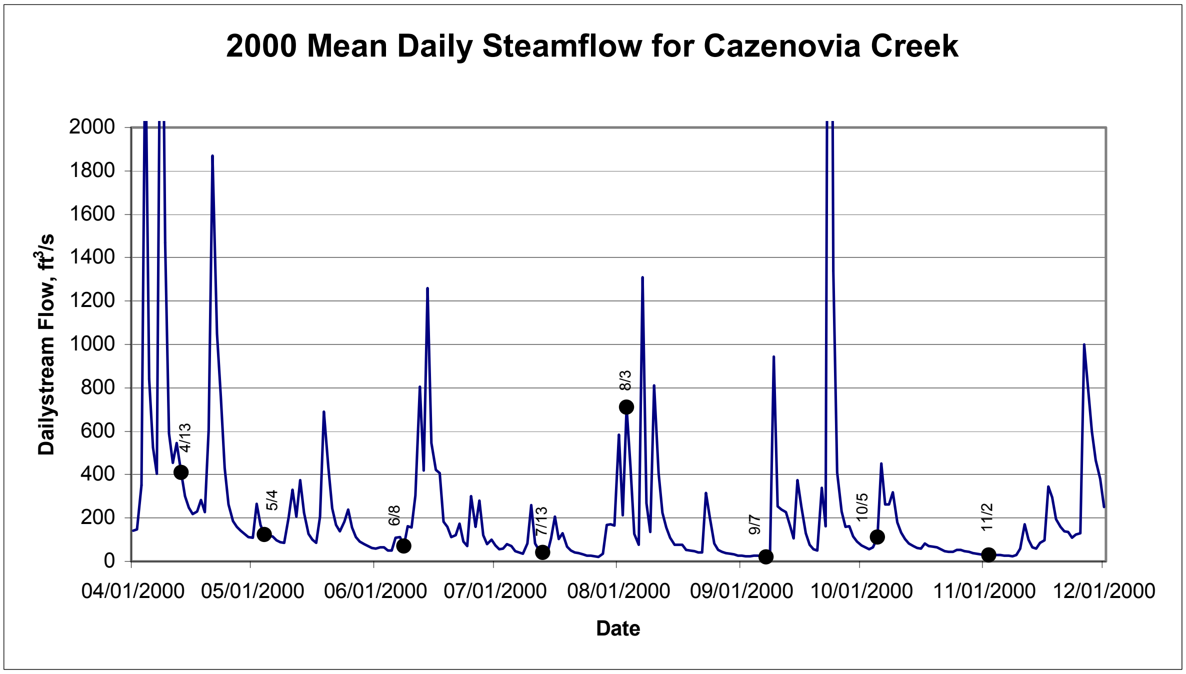


Figure 3.3. 2000 Mean Daily Streamflow Discharge for Cazenovia Creek. The black dots represent sample dates. (www.usgs.gov). The peaks of certain events in the hydrograph are cut off because I changed the axis scale. This was done so that the flow rates on the sample dates could be more easily viewed.

1973 Discharge Compared to Sample Date	
Sample Date	Discharge in ft^3/s
06/19/1973	95
06/20/1973	63
06/27/1973	31
07/02/1973	35
07/10/1973	27
07/18/1973	17
07/24/1973	15
07/25/1973	46
07/31/1973	36
08/01/1973	41
08/08/1973	16
08/15/1973	17
08/21/1973	36
08/28/1973	15
09/04/1973	14
09/05/1973	13

Table 3.1. 1973 Discharge Data

2000 Discharge Compared to Sample Date	
Sample date	Discharge in ft^3/s
04/13/2000	409
05/04/2000	125
06/08/2000	72
07/13/2000	41
08/03/2000	710
09/07/2000	21
10/05/2000	111
11/02/2000	29

Table 3.2. 2000 Discharge Data

rising limb of the Cazenovia Creek hydrograph indicating that it was sampled at the beginning of the event. Only one sample date on 8/21/73 occurred at a peak on the Cazenovia Creek hydrograph, with a cubic discharge of 36 cubic feet per second. Since it was a small runoff event with inter-event periods both before and after it the flow conditions do not vary much from the other sample dates.

The 2000 sample dates occurred across a variety of discharge events and had a greater variability than the 1973 samples. This is summarized in Table 3.2. Sample dates 6/8/00, 7/13/00, 9/7/00 and 11/2/00 were collected during relatively dry weather, inter-event flow. The two best examples of the dry weather, inter-event flow were sampling dates of 9/7/00 and 11/2/00 with a range of 21 to 29 cubic feet per second for the mean daily discharge in the Cazenovia Creek watershed. Sample dates 4/13/00 and 5/4/00 were located on a falling limb of the Cazenovia Creek hydrograph, with discharges of 409 and 125 cubic feet per second respectively. Eighteenmile Creek sample date 10/5/00 occurred on a rising limb of the Cazenovia Creek hydrograph suggesting that it was sampled near the beginning of an event. Sample date 8/3/00 was the only one that was collected during a peak in the Cazenovia Creek hydrograph. This had a discharge value of 710 cubic feet per second and indicated a higher flow compared to other sample dates.

3.2 Water Quality

Raw data for each parameter are presented in Appendix A. Data are summarized at each site and in most cases the parameters are presented in arithmetic mean, geometric mean, median and maximum depending on the standards for which the parameter was based on.

3.2.1 Total Coliforms

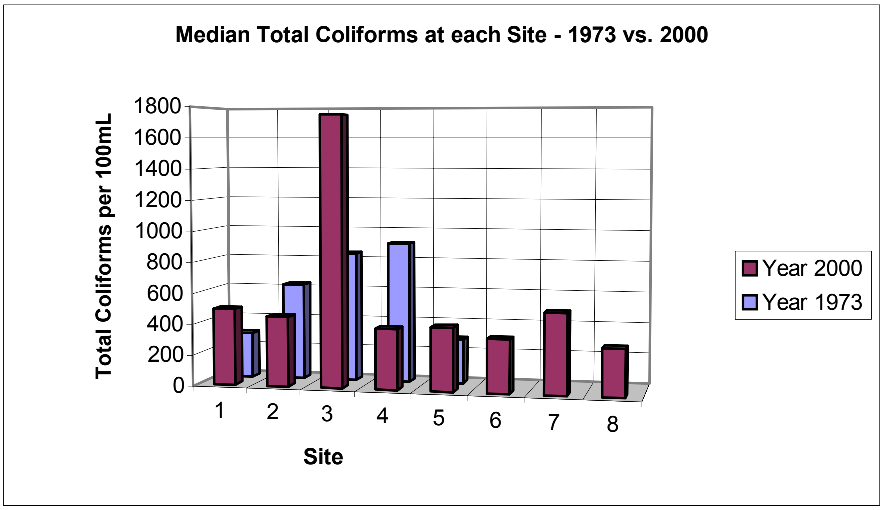
Total Coliforms are the combined total of coliform bacteria (including fecal coliforms) that are present in water samples (ECDPH, 1970). The New York State Department of Environmental Conservation (NYS DEC) water quality standards states that the median shall not exceed 2400/100mL and more than 20% of samples shall not exceed 5000/100mL for Class A and B streams (Gold Book, 2002). Total coliforms were measured as median values at various sites in 1973 and 2000 because that is what the water quality standards were based on (Figure 3.4). The graphs in Figure 3.4 summarize the total coliforms tested in 1973 and 2000 sampling.

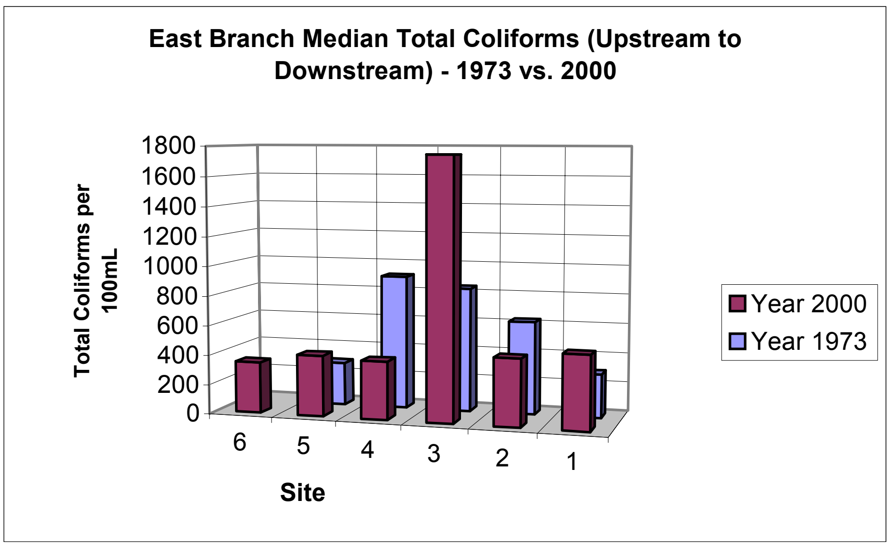
Table 3.3. Total Coliform - Sample Data from each Year and Percent Change

Median Total Coliforms (per 100mL) by Site								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1973	293	627	840	910	290			
2000	495	450	1750	390	410	345	520	305
% Change from 1973 to 2000	+68.9%	-28.2%	+108.3%	-57.1%	+41.4%			

There were five sites at which sampling occurred in both 1973 and 2000 (Sites: 1, 2, 3, 4, and 5). Sites two and four showed a 28.2 to 57.1 percent decrease in the median values of total coliforms from 1973 to 2000 (Table 3.3). Sites one, three and five showed a 41.4 to 108.3 percent increase in the median values of total coliforms (Table 3.3). Although there was an increase, the values still did not exceed the NYS DEC water quality standard of 2400/100mL (Gold Book, 2002). Site three had the largest increase at 108.3 percent from 1973 to 2000 (Table 3.3). This increase could be related to Site three's proximity to the Village of Hamburg. Site three is downstream from the Village of Hamburg and is located in a small valley before the creek moves westward (Figure 3.5). Therefore it is likely that most of the runoff from the Village of Hamburg will enter the creek near this location increasing total coliform levels in the vicinity of Site three.

Site one, which is a Class B stream, did not meet the second part of the NYS DEC standard that requires that 20 percent of samples shall not exceed 5,000/100mL (Gold Book, 2002). Testing done on 8/3/00 and 10/5/00 revealed total coliform at 10,000/100mL and 6,000/100mL, respectively. Therefore of eight samples collected at site one, 25 percent of the samples exceeded the 5,000/100mL limit. Both of these sample dates had high discharge values therefore indicating a storm event near the time of sampling. Since site one is located at the mouth of the creek, a possible explanation for the increase in total coliform levels is that Site one would receive a concentration of coliforms from the flushing of the upstream regions of the creek during high flow events. Although the above could apply there was a decrease at Site two and an increase at Site three showing that no strong trend was apparent between the sites from upstream to downstream values to support this. This could be caused by variability in the bacteria data or channel substrate characteristics or this could indicate that other sources of the coliform bacteria are being introduced into the waterway at some point near Site one.





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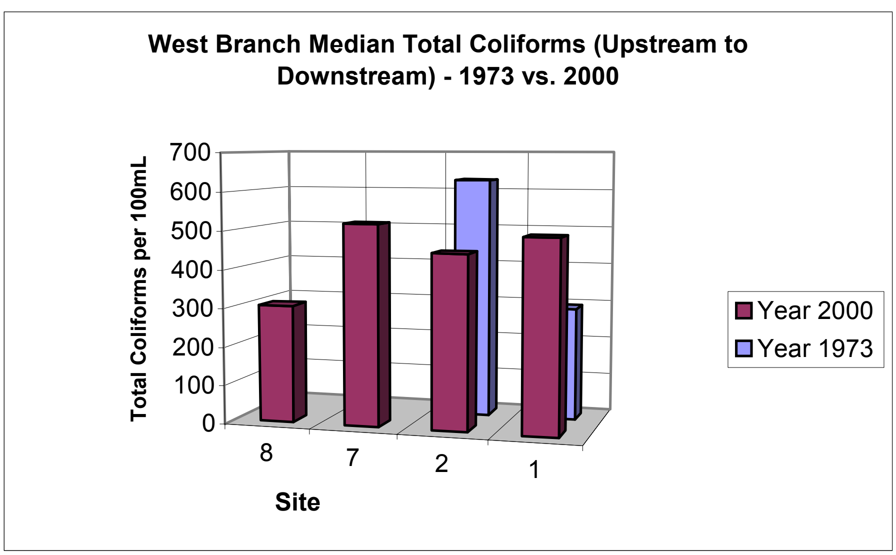

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Figure 3.4. 1973 and 2000 Total Coliform Sample Site Values

Figure 3.5. Map of Site Three in Reference to the Town of Hamburg
The red dot represents the location of Hamburg and the black dot represents the location of site three. This map clearly displays the down-slope trend from the Town of Hamburg to the valley at site three.
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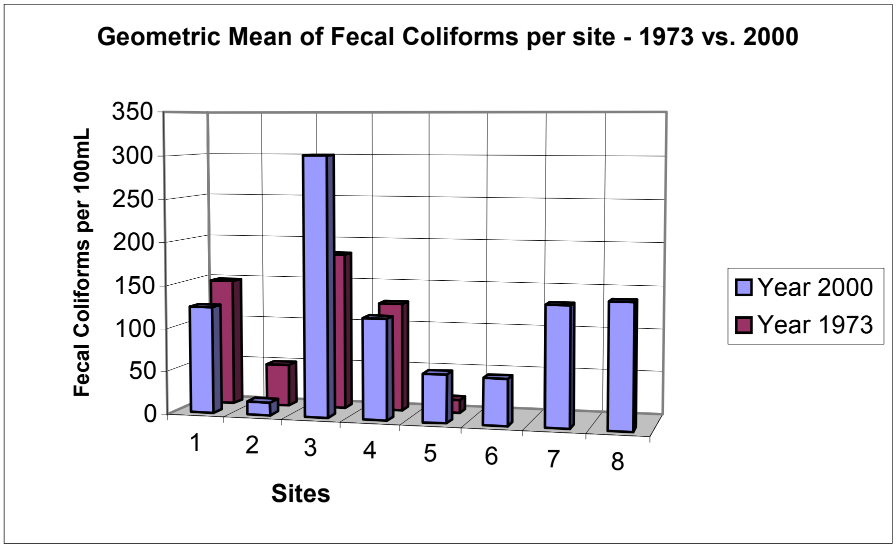
3.2.2 Fecal Coliforms

Fecal coliforms are contributed to a waterway because of human, wildlife or livestock waste (Irvine, 1996). NYSDEC water quality standard for fecal coliforms states that no geometric mean may exceed 200/100mL (Gold Book, 2002). Fecal coliforms were measured as geometric means at various sites in 1973 and 2000 because that is what the water quality standards are based on (Figure 3.6). The graphs in Figure 3.6 summarize the fecal coliforms tested in 1973 and 2000 sampling.

There were 5 sites at which sampling occurred in both 1973 and 2000 (Sites 1, 2, 3, 4 and 5). There has been a decrease of 7 and 69 percent at Sites one, two and four (Table 3.4). Sites two and four show a similar decreasing trend in the 2000 data as did the total coliform tested in 2000 at these sites. Site one on the other hand showed a decrease in fecal coliforms for 2000 but an increase in total coliforms. This could be caused by an increased addition of coliform bacteria at Site one that is not directly associated with feces or variation in the data. Site five has had a 271 percent increase since 1973 and the 2000 geometric mean was 56/100mL (Table 3.4). Even though there has been an increase in the levels, the 2000 data was sill below the NYS DEC water quality standards. Site three had a 65 percent increase since 1973 and the geometric mean was 301/100mL in 2000 (Table 3.4). This exceeds the NYS DEC standard of 200/100mL (Gold Book, 2002). This increase could be related to Site three's proximity to the Village of Hamburg as stated for total coliforms (Figure 3.5).

Table 3.4. Fecal Coliform - Sample Data from each Year and Percent Change

Geometric Mean for Fecal Coliforms (per 100mL) by Site								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1973	148	49	183	126	15			
2000	124	15	301	117	56	53	138	143
% Change from 1973 to 2000	-16%	-69%	+65%	-7%	+271%			



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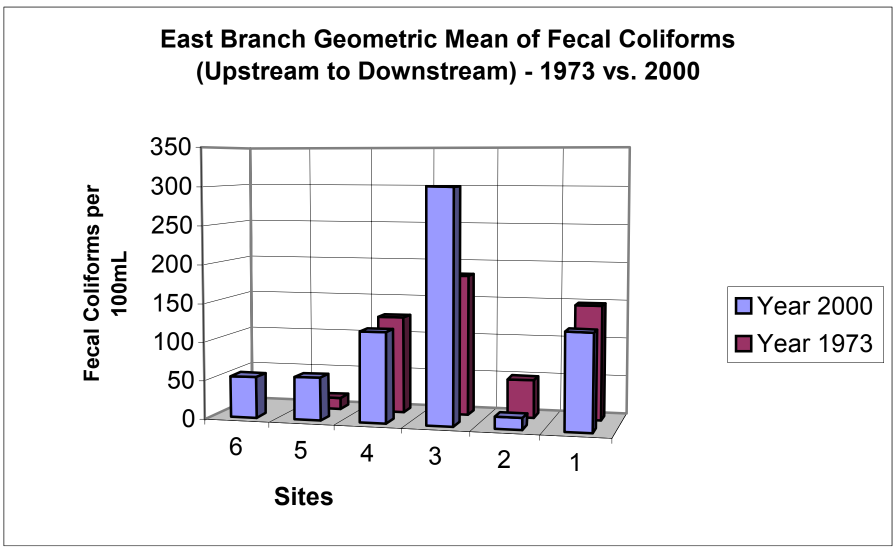

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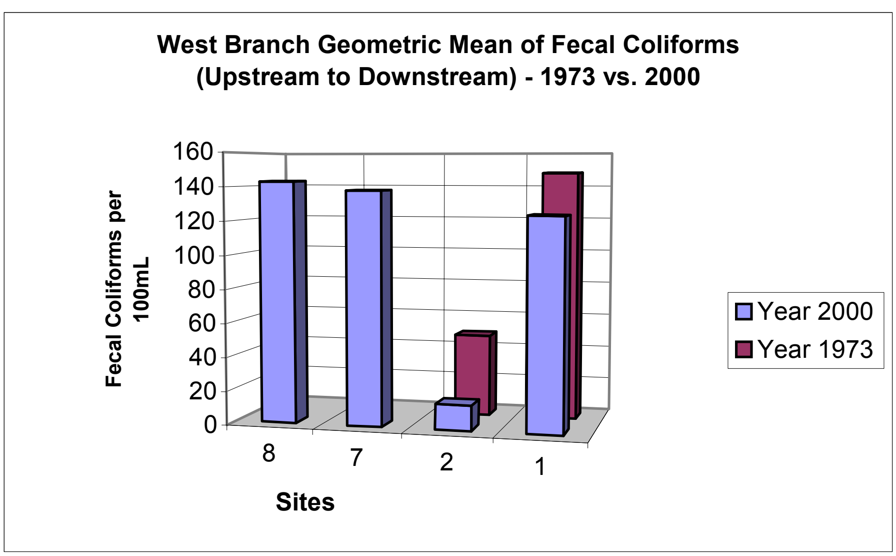

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Figure 3.6. 1973 and 2000 Fecal Coliform Sample Site Values

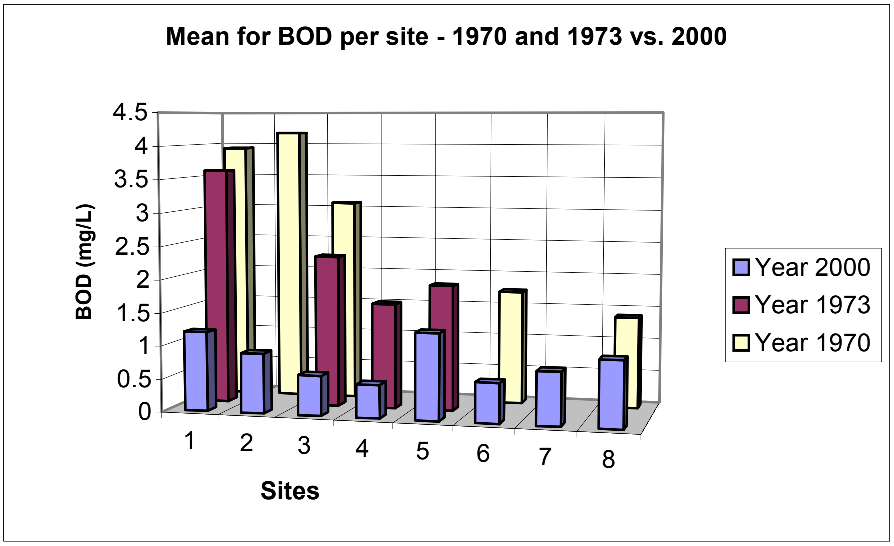
3.2.3 Biological Oxygen Demand (5-day)

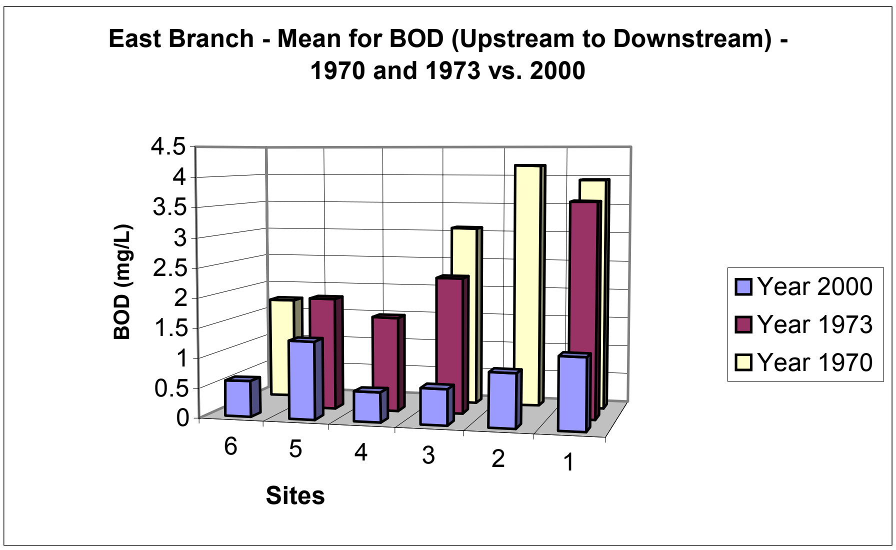
Biological Oxygen Demand (BOD_5) is useful for determining the extent of organic pollutants in a stream (ECDPH, 1970). BOD_5 represents the amount of oxygen that microbes require to break down organic matter (EEA, 2001). If the microbes are requiring a lot of oxygen the BOD_5 levels are higher indicating higher levels of organic matter are present including dead or decaying plant and animal life. There is no official water quality standard for BOD_5 but the indicator that is normally used states that a mean level of 2 mg/L and less indicates excellent water quality (EEA, 2001). Biological oxygen demand was measured as mean values at various sites in 2000, 1973 and 1970 because that is what the water quality standards were based on (Figure 3.7). The graphs in Figure 3.7 summarize the BOD_5 levels tested in 1970, 1973 and 2000 sampling.

Table 3.5. Biochemical Oxygen Demand - Sample Data from each Year and Percent Change

Mean for BOD (in milligrams per Liter) by Site								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1970	4.0	4.2	3.1			1.7		1.4
1973	3.6		2.3	1.6	1.9			
2000	1.2	0.9	0.6	0.5	1.3	0.6	0.8	1
% Change from 1970 to 2000	-69.5%	-78.5%	-80.5%			-65.5%		-28%
% Change from 1973 to 2000	-66.7%		-73.9%	-68.8%	-31.6%			

All sites in 2000, except Site seven, can be compared to previous data from 1973 and/or 1970 (Table 3.5). The 1970 data shows Sites one, two and three were over the accepted limit of 2 mg/L, ranging from 3.1 to 4.2 mg/L. Sits six and seven from 1970 were below the accepted limit ranging from 1.4 to 1.7 mg/L. The 2000 data showed improvements because all sites had lower BOD values. Sample Sites two, three and four had the largest percent decrease ranging from 68.8 to 80.5 percent. All 2000 samples were below the accepted limit of 2 mg/L therefore indicating a general improvement in water quality when considering biological oxygen demand. Sample Sites one to four show a weak increasing trend as you move downstream. This would indicate that there is a slow increase in organic matter concentration as you move downstream.





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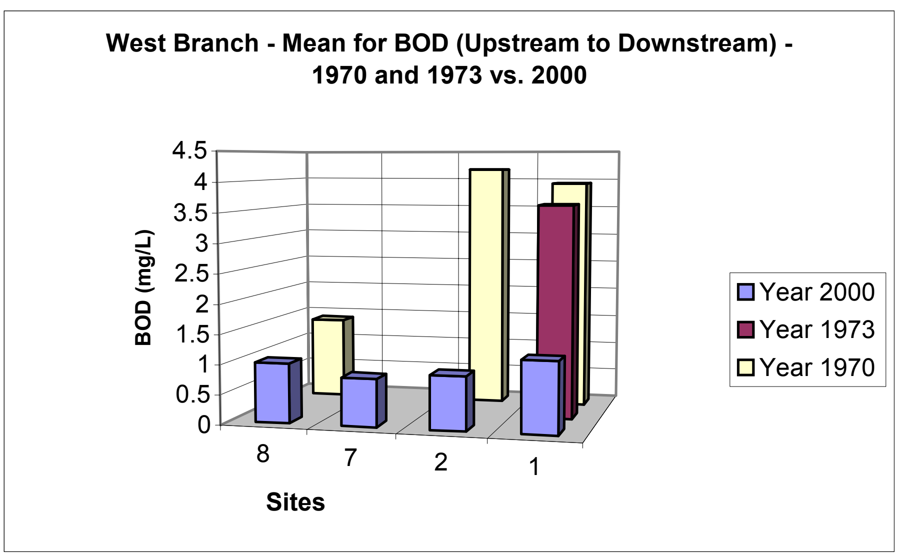

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Figure 3.7. 1970, 1973 and 2000 BOD Sample Site Values

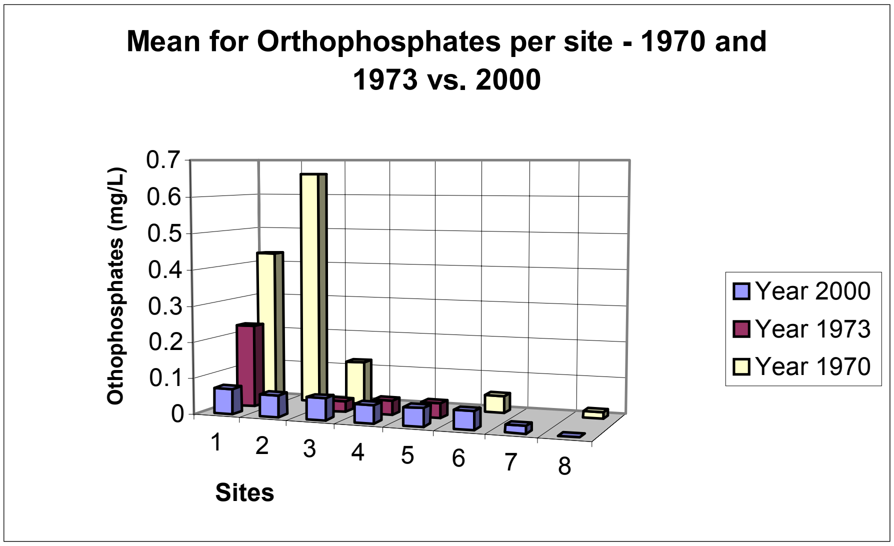
3.2.4 Orthophosphates

Orthophosphates, dissolved and inorganic, are a limiting factor that can affect the amount other nutrients can be consumed in a body of water (Sedgwick County, 2003). Excess orthophosphates can contribute to eutrophication of the water body (Sedgwick County, 2003). The Environmental Protection Agency (EPA) mean value recommendation limit for orthophosphates is 0.1 mg/L (EPA, 2003 (c)). Orthophosphates were measured as mean values a various sites in 1970, 1973 and 2000 because that is what the water quality standards were based on (Figure 3.8). The graphs in Figure 3.8 summarize the orthophosphate levels tested in 1970, 1973 and 2000 sampling.

Table 3.6. Orthophosphates - Sample Data from each Year and Percent Change

Mean for Orthophosphates (in milligrams per Liter) by Site								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1970	0.4	0.7	0.12			0.05		0.02
1973	0.23		0.03	0.04	0.04			
2000	0.07	0.06	0.06	0.05	0.05	0.05	0.02	0
% Change from 1970 to 2000	-83.7%	-90.9%	-50.3%			+7.1%		-100.0%
% Change from 1973 to 2000	-69.6%		+100.0%	+25.0%	+25.0%			

Every site in the year 2000, except Site 7, can be compared to previous data from 1970 and/or 1973 sample data (Table 3.6). The 2000 sample Sites one, two and eight have had a decrease in levels of orthophosphates ranging from 69.6 to 100 percent change from the 1970 and 1973 data. Sample Sites four, five and six from the year 2000 had an increase in the percent change ranging from 7.1 to 100 percent. Sample Site three decreased by 75 percent from 1970 to 1973 but increased by 100 percent from 1973 to 2000. Even though there was an increase, the measured value of 0.06 mg/L was still below the EPA standard of 0.1 mg/L. Both the North and South Branches show a weak increasing trend as you move downstream indicating that the orthophosphate inputs are entering the stream and slightly increasing along the waterway. The weak increasing downstream trend indicates general improvement in the water quality of Eighteenmile Creek in regards to orthophosphates. Three sites in 1970 and one site in 1973 were above the recommended limit. This could be due to the fact that the "Phosphorus Load Reduction Supplement to Annex 3" was not introduced until October of 1983 (EC, 1997). Levels would therefore decrease after this date as long as proper guidelines were followed that called for a decrease in phosphorus loads caused from detergents, fertilizer and manure. This idea is also supported by the Lake Erie total phosphorous downward trend from the 1960's and 1970's (EC, 1997).



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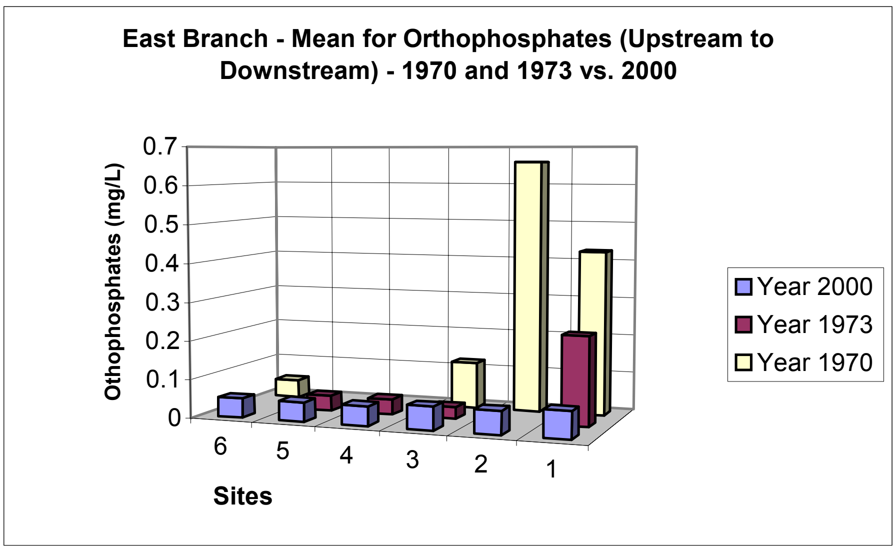

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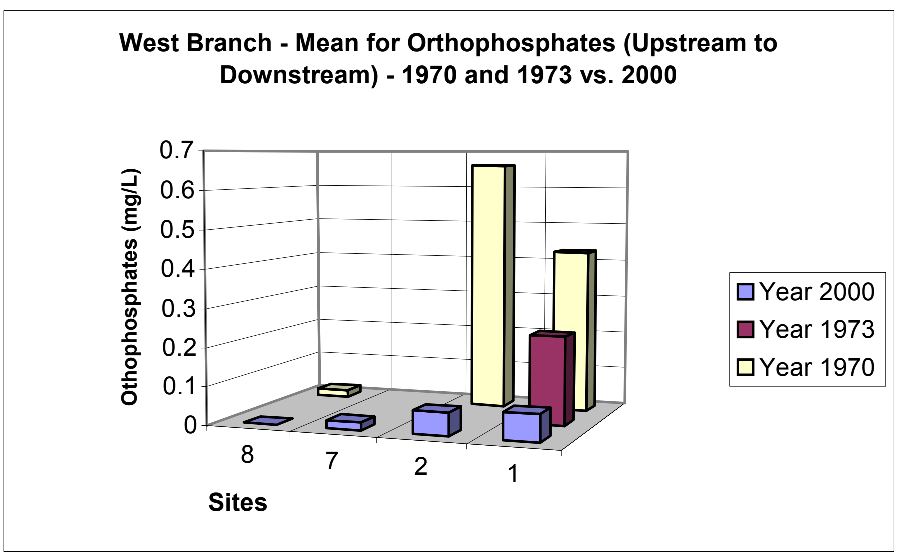


Figure 3.8. 1970, 1973 and 2000 Orthophosphates Sample Site Values

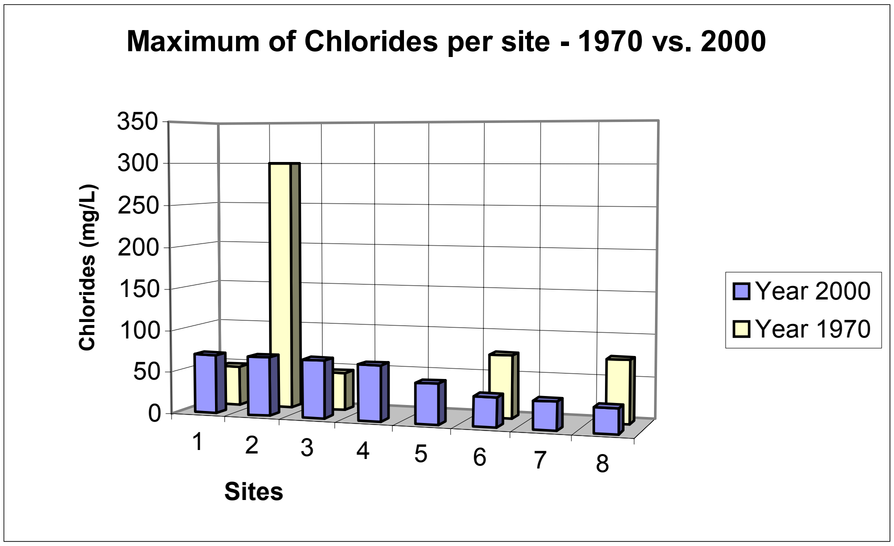
3.2.5 Chlorides

Chlorides are found in all natural waters and results from mineral decomposition, agricultural and industrial wastes, sewage and contaminated groundwater that leaches into the stream (ECDPH, 1970) in addition to roadside runoff. Chloride is not harmful to humans except in high concentrations (ECDPH, 1970). The NYS DEC water quality standard for chlorides states that no maximum levels shall exceed 250 mg/L in a Class A stream (Gold Book, 2002). The reason that the standard for Class A stream was used is because the Eighteenmile Creek is a mix of Class A and Class B streams. Therefore using the Class A standard is the most restrictive. Chlorides were measured as maximum values at various sites in 1970 and 2000 because that is what water quality standards were based on (Figure 3.9). The graphs in Figure 3.9 summarize the chloride levels tested in 1970 and 2000 sampling.

Table 3.7. Chlorides - Sample Data from each Year and Percent Change

Maximum of Chlorides (in milligrams per Liter) by Site								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1970	47.5	300	45.2			75		75
2000	70	70	69	65.9	47.8	35.2	33.5	29.2
% Change from 1970 to 2000	+45.4%	-76.7%	+52.7%			-53.1%		-61.1%

The 1970 and 2000 sample data and percent change can be found in Table 3.7. Sites two, six and eight have had a decrease of 53.1 to 76.7 percent from 1970. Sites one and three have increased by 45.4 to 52.7 percent but all 2000 levels are still below the water quality standard of 250 mg/L. The 2000 values also indicate a weak increasing trend as you move downstream. This indicates that chlorides are being added to the waterway gradually, which is increasing the concentrations downstream. Only one site in 1970 exceeded the standard. The chloride level at Site two in 1970 was 300 mg/L. This could have been caused by a high flow event but the actual cause is unknown because the 1970 sample dates could not be found. This makes it impossible to compare the chloride values to the actual discharge data.



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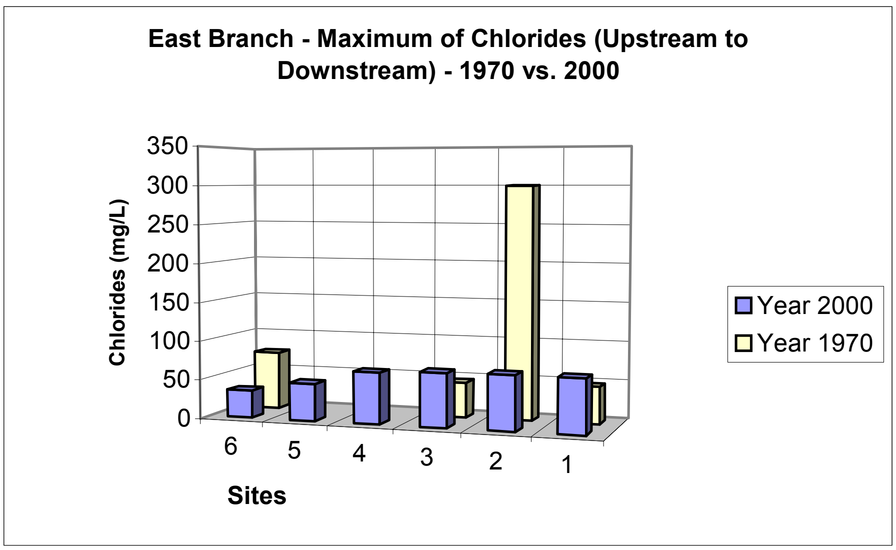


C)

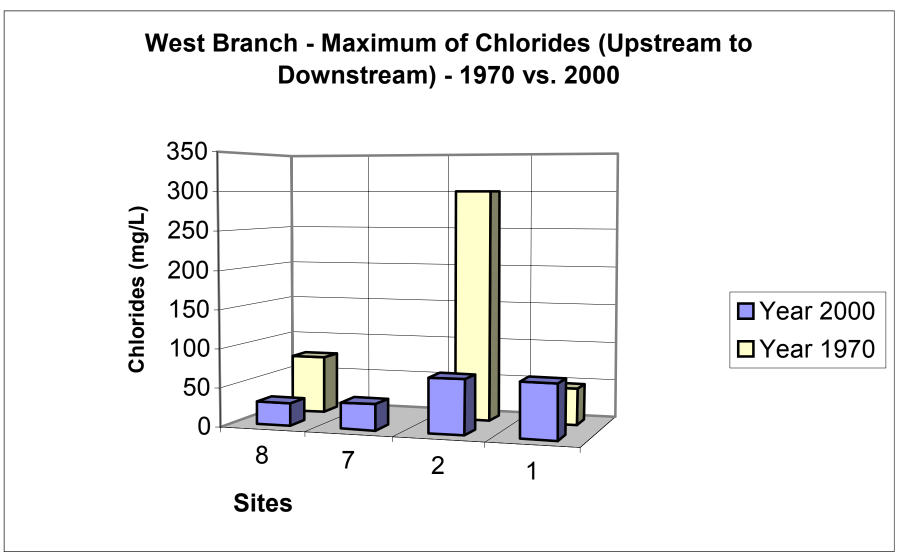


Figure 3.9. 1970 and 2000 Chlorides Sample Site Values

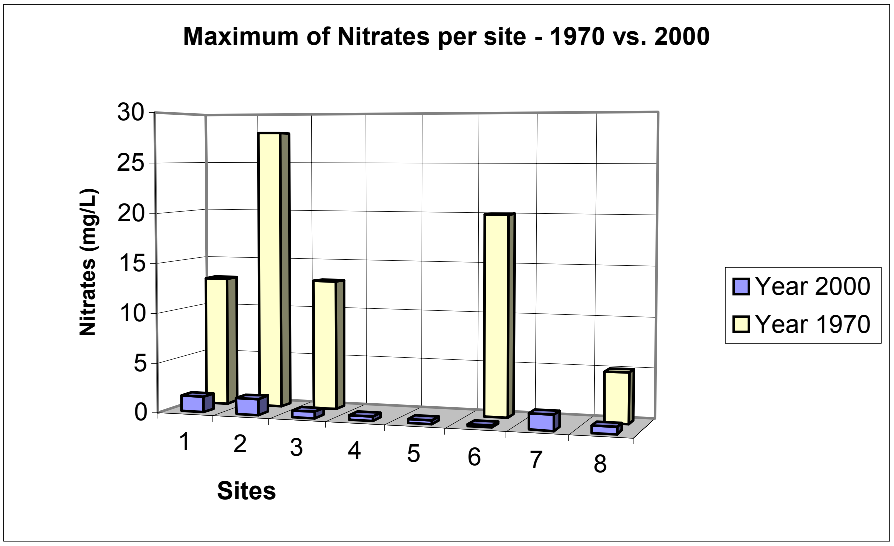
3.2.6 Nitrates

Nitrates can enter a water system by fertilizers, runoff, degradation of minerals and contaminated groundwater leaching (ECDPH, 1970). The NYS DEC water quality standard states that the maximum levels may not exceed 10 mg/L (Gold Book, 2002). Nitrates were measured as maximum values at various sites in 1970 and 2000 because that is what the water quality standards were based on (Figure 3.10). The graphs in Figure 3.10 summarize the nitrate levels tested in 1970 and 2000 sampling.

Table 3.8. Nitrates - Sample Data from each Year and Percent Change

Maximum of Nitrates (in milligrams per Liter) by Site								
Year	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1970	13	28	13			20		5
2000	1.56	1.62	0.64	0.46	0.37	0.21	1.55	0.68
% Change from 1970 to 2000	-88.0%	-94.2%	-95.1%			-98.95%		-86.4%

The 1970 data shows levels of nitrates that ranged from 5 to 28 mg/L (Table 3.8). The only site that was within the limits was Site eight in 1970 at 5 mg/L. The 2000 data showed a general reduction in nitrate levels. All sites in 2000 were within the standard and ranged from 0.21 to 1.62 mg/L. Therefore all sites decreased from 1970 to 2000 and the percent reduction ranged from 86.4 to 98.95 percent. There are many possible reasons for the reduction of nitrates from the higher values in 1970. First there has been a general reduction of farmland in the area. As urban sprawl continues less land is being used for farming (Krapac et al., 2002). The second possibility could be better land management practices being used by the owners on the remaining nearby farmland (Krapac et al., 2002). Farming generally involves the fertilization of fields. The fertilizers can leach into groundwater and eventually into streams and other bodies of water (Krapac et al., 2002) or contaminate surface runoff. Fertilizing and spreading manure following soil test recommendations and adjusting timing and application methods in accordance with nutrient management plans are possible factors in reducing nitrate loading. Also, residential lawn care practices may also be improving with a trend away from heavy nitrogen fertilization of lawns (USDA NRCS, personal correspondence).



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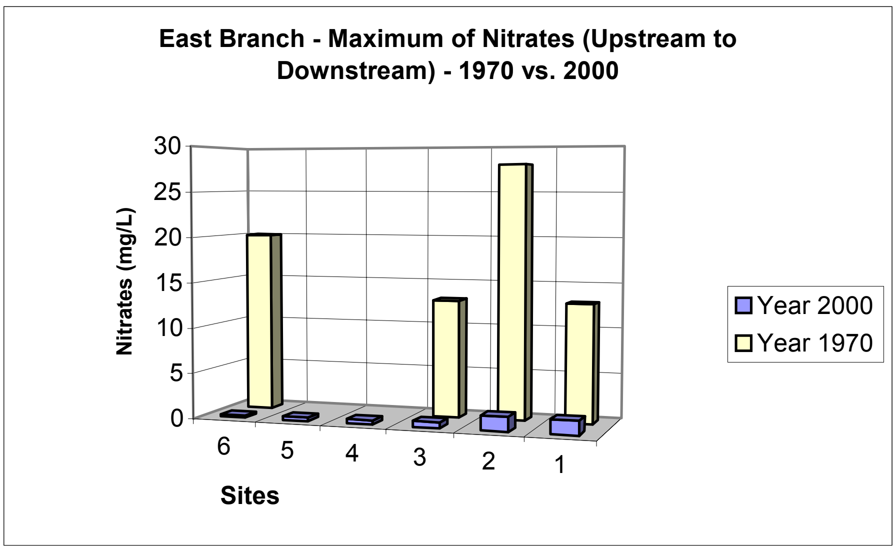

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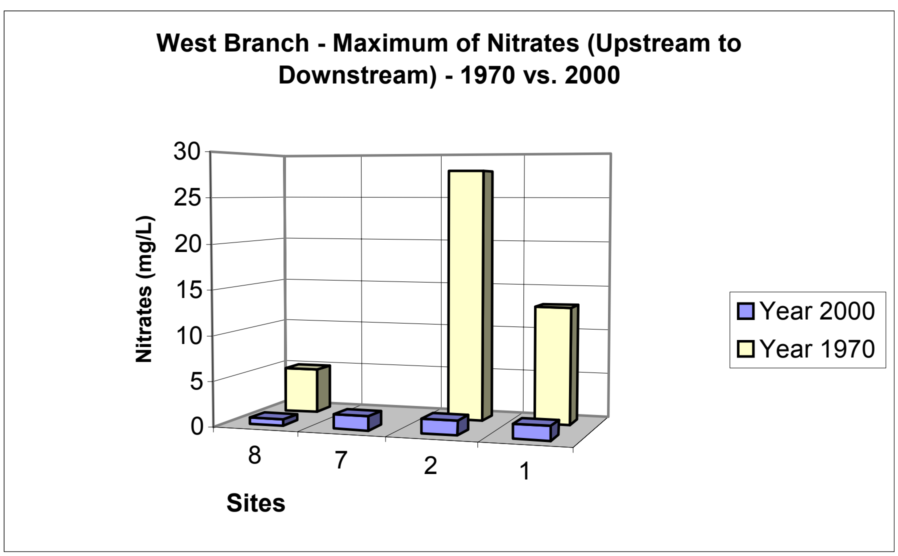

Figure 3.10. 1970 and 2000 Nitrates Sample Site Values

4. CONCLUSIONS AND RECOMMENDATIONS

The purpose of this research project was to: 1. Compare historical data to data retrieved from field samples collected in 2000 to determine if a change has occurred in the waterway and 2. Compare data from all sampling years to present day water quality standards.

1. The 2000 samples indicated that total coliform exceeded the NYS DEC water quality standards at Site one possibly due to a high flow or storm event. Other sites showed various increases and decreases from the historical data for total coliforms but they all are within the accepted limits of water quality standards.
2. The 2000 samples indicated that the fecal coliforms exceeded the NYS DEC water quality standards at Site three possibly due to the geographical location causing the site to receive runoff from the Village of Hamburg. All other sites were within the NYS DEC water quality standards for geometric mean fecal coliforms and the majority of the sites decreased compared to the historical data.
3. The 2000 samples indicated that the biological oxygen demand has had a general reduction compared to the 1970 and 1973 sample data. This indicates an improvement in water quality and a reduction of organic waste in the stream.
4. The 2000 samples indicate that orthophosphates have both increased and decreased at different sites compared to the 1970 and 1973 data. Although there has been variability all sites have improved through the years and all are below the EPA recommended limit of 0.1 mg/L. This indicates an improvement of water quality and a reduction of inorganic limiting factors in Eighteenmile Creek.

5. The 2000 samples indicate that chloride levels have both increased and decreased compared to 1970 and 1973 data. Although there have been various increases, all eight sites sampled in 2000 are still below the NYS DEC water quality standard of 250 mg/L. Most sites showed improvements in the water quality and very few had increases but none exceeded limits.

6. The 2000 samples indicate that nitrate levels have had a general reduction compared to 1970 sample data. This indicates an improvement in the water quality of the creek and a reduction in nitrate leaching.

All eight sites from 2000 have improved compared to the 1970 and 1973 data and in general, the water quality standards were not exceeded for the 2000 sampling. Future analysis would be useful on the total coliform levels at Site one and the fecal coliform levels at Site three to help determine possible reasons for the higher numbers beyond what has already been explored in this study. Monitoring should also address water quality during storm events. Since there is evidence that contamination levels are higher with higher flows, inter-event sampling likely underestimates the severity of the water quality problems in the watershed. General monitoring should also be considered on a long-term basis to monitor any changes in water quality in the Eighteenmile Creek area.

5. REFERENCES

Erie County Department of Public Health, *1970 Stream Survey on Eighteenmile Creek*. Retrieved from Amy Holt from the Western New York Land Conservancy. (Pp. 1-5, 10-12, 24, 28-32, 37, 51-54)

Erie County Department of Public Health, *1973 Stream Survey on Eighteenmile Creek*. Retrieved from Amy Holt from the Western New York Land Conservancy. (Pp. 172-191)

Erie County Department of Public Health, *1976 Stream Survey on Eighteenmile Creek*. Retrieved from Amy Holt from the Western New York Land Conservancy. (Pp. 3-6, 47-58, 75-84)

European Environment Agency (EEA) (2001). Biochemical Oxygen Demand in Rivers. Retrieved April 1st, 2003 from: http://themes.ees.eu.int/Specific_media/water/indicators/bod/index_html

New York State Department of Environmental Conservation. Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations ("Gold Book"). Retrieved from: http://www.dec.state.ny.us/website/regs/703.htm

Irvine, K.N. (1996). Cazenovia Creek Watershed Management Program: Baseline Water Quality Analysis. Department of Geography and Planning, State University, Collage at Buffalo.

Sedgwick County, KA Conservation District (2003). Nutrients are what is essential for life to exist and continue to develop. Retrieved April 1st , 2003 from: http://www.sedgwick.ks.us/environment/conservation/orthophosphates.html

United States Geological Survey. 2000 Daily Stream Flow for Cazenovia Creek at Ebenezer, NY. (USGS reference number 04125500) Retrieved on January 21st , 2003 from: http://waterdata.usgs.gov/ny/nwis/discharge

United States Geological Survey. 1970 Daily Stream Flow for Cazenovia Creek at Ebenezer, NY. (USGS reference number 04125500) Retrieved on January 21st , 2003 from: http://waterdata.usgs.gov/ny/nwis/discharge

United States Geological Survey. 1973 Daily Stream Flow for Cazenovia Creek at Ebenezer, NY. (USGS reference number 04125500) Retrieved on February 1st , 2003 from: http://waterdata.usgs.gov/ny/nwis/discharge

APPENDIX A

WATER QUALITY SAMPLE RESULTS PER SITE

SITE ONE

Raw Data By Date

Date	Total Coliform (per 100 mL)	Fecal coliform (per 100 mL)	BOD (mg/L)	Ortho - phosphate (mg/L)	Chlorides (mg/L)	Nitrates (mg/L)
6/19/1973	456	156				
6/27/1973	40	10				
7/2/1973	130	30				
7/10/1973	560	320				
7/18/1973	110	40				
7/25/1973	2000	1700				
8/1/1973	2000	1086				
8/8/1973	120	40				
8/15/1973	80	80				
8/21/1973	6000	5900				
8/28/1973	100	90				
9/5/1973	4000	60				
4/13/2000	870	110	1.4	0.07	60.7	1.12
5/4/2000	220	30	0	0.04	56	0.83
6/8/2000	260	20	0	0	39.5	0.73
7/13/2000	720	120	0	0	52.3	0.78
8/3/2000	10000	10000	5.2	0.37	43.6	0.97
9/7/2000	270	80	2.3	0	70	1.56
10/5/2000	6000	300	0	0.1	51.4	1.22
11/2/2000	170	30	1	0	54.5	0.86

Data by Year

	Year		
Parameter	**1970**	**1973**	**2000**
Total Coliforms - Median		293	495
Fecal Coliforms - Geometric Mean		148	124
BOD - Mean	3.9333	3.6	1.2
Orthophosphates - Mean	0.4282	0.23	0.07
Chlorides - Maximum	47.5		70
Nitrates - Maximum	13		1.56

SITE TWO

Raw Data By Date

Date	*Total Coliform (per 100 mL)*	*Fecal coliform (per 100 mL)*	*BOD (mg/L)*	*Ortho - phosphate (mg/L)*	*Chlorides (mg/L)*	*Nitrates (mg/L)*
6/19/1973	904	16				
6/27/1973	350	150				
4/13/2000	910	120	1.3	0.09	57.9	1.13
5/4/2000	330	50	0	0	43	0.87
6/8/2000	240	40	0	0	36	0.81
7/13/2000	570	100	0	0	54.2	1.04
8/3/2000	10000	10000	2	0.32	42.3	1
9/7/2000	240	160	2.6	0	70	1.62
10/5/2000	2500	290	1.1	0.07	51.6	1.15
11/2/2000	210	30	0	0	53.5	0.87

Data by Year

	Year		
Parameter	**1970**	**1973**	**2000**
Total Coliforms - Median		627	450
Fecal Coliforms - Geometric Mean		83	155
BOD - Mean			0.9
Orthophosphates - Mean	0.66		0.06
Chlorides - Maximum	300		70
Nitrates - Maximum	28		1.62

SITE THREE

Raw Data By Date

Date	*Total Coliform (per 100 mL)*	*Fecal coliform (per 100 mL)*	*BOD (mg/L)*	*Dissolved Oxygen (mg/L)*	*Ortho - phosphate (mg/L)*	*Chlorides (mg/L)*	*Nitrates (mg/L)*
6/19/1973	444	92					
6/27/1973	330	50					
7/2/1973	880	40					
7/18/1973	890	750					
7/24/1973	800	260					
7/31/1973	2000	390					
8/8/1973	400	170					
8/15/1973	260	60					
8/28/1973	2000	540					
9/4/1973	6500	550					
4/13/2000	410	70	0.5		0.1	67.2	0.64
5/4/2000	1500	330	0		0.05	61	0.35
6/8/2000	450	360	0		0	37.7	0.31
7/13/2000	2000	300	0		0	64.1	0.27
8/3/2000	10000	10000	0.7		0.29	50.3	0.34
9/7/2000	2400	220	2.7		0	69	0
10/5/2000	4200	410	0		0	54.6	0.34
11/2/2000	300	30	1		0	56.2	0

Data by Year

	Year		
Parameter	**1970**	**1973**	**2000**
Total Coliforms - Median		840	1750
Fecal Coliforms - Geometric Mean		183	301
BOD - Mean	3.0778	2.3	0.6
Orthophosphates - Mean	0.1208	0.03	0.06
Chlorides - Maximum	45.2		69
Nitrates - Maximum	13		0.64

SITE FOUR

Raw Data By Date

Date	*Total Coliform (per 100 mL)*	*Fecal coliform (per 100 mL)*	*BOD (mg/L)*	*Ortho - phosphate (mg/L)*	*Chlorides (mg/L)*	*Nitrates (mg/L)*
6/27/1973	120	10				
7/2/1973	720	180				
7/18/1973	2000	60				
7/24/1973	350	140				
7/31/1973	2000	780				
8/8/1973	1100	760				
8/15/1973	270	230				
9/4/1973	9000	30				
4/13/2000	210	20	0.9	0.08	65.9	0.46
5/4/2000	160	20	0	0.04	50.5	0.34
6/8/2000	420	220	0	0	31.5	0.22
7/13/2000	2000	300	0	0	60.1	0.19
8/3/2000	5400	410	0.3	0.17	48.6	0.22
9/7/2000	250	50	2.5	0	62	0
10/5/2000	3000	280	0	0.08	49.6	0.22
11/2/2000	360	230	0	0	50.5	0.14

Data by Year

	Year		
Parameter	**1970**	**1973**	**2000**
Total Coliforms - Median		910	390
Fecal Coliforms - Geometric Mean		126	117
BOD - Mean	1.7	1.6	0.5
Orthophosphates - Mean	0.11	0.04	0.05
Chlorides - Maximum			65.9
Nitrates - Maximum			0.46

SITE FIVE

Raw Data By Date

Date	Total Coliform (per 100 mL)	Fecal coliform (per 100 mL)	BOD (mg/L)	Ortho - phosphate (mg/L)	Chlorides (mg/L)	Nitrates (mg/L)
6/19/1973	2000	1800				
6/27/1973	290	70				
7/2/1973	170	0				
7/10/1973	190	10				
7/18/1973	100	60				
7/31/1973	510	50				
8/8/1973	20	10				
8/15/1973	2000	0				
9/4/1973	11000	130				
4/13/2000	270	10	1.2	0.11	47.8	0.37
5/4/2000	90	10	0	0.04	40.2	0.23
6/8/2000	420	100	0	0	30.3	0.15
7/13/2000	1900	210	1.3	0	40.4	0.16
8/3/2000	5300	210	0.5	0.17	37.3	0.19
9/7/2000	400	160	2.6	0	40.5	0
10/5/2000	470	130	0	0	33.8	0.2
11/2/2000	240	10	4.6	0.08	32.5	0.14

Data by Year

	Year		
Parameter	**1970**	**1973**	**2000**
Total Coliforms - Median		290	410
Fecal Coliforms - Geometric Mean		15	56
BOD - Mean	1.1	1.9	1.3
Orthophosphates - Mean	0.02	0.04	0.05
Chlorides - Maximum			47.8
Nitrates - Maximum			0.37

SITE SIX

Raw Data By Date

Date	Total Coliform (per 100 mL)	Fecal coliform (per 100 mL)	BOD (mg/L)	Dissolved Oxygen (mg/L)	Ortho - phosphate (mg/L)	Chlorides (mg/L)	Nitrates (mg/L)
4/13/2000	70	10	0.4		0.07	35.2	0.21
5/4/2000	140	40	0		0.06	27.5	0
6/8/2000	300	150	0		0.08	27.5	0
7/13/2000	1100	80	0		0	25.1	0
8/3/2000	4000	570	2.1		0.1	27.2	0.13
9/7/2000	390	30	2.6		0	20.5	0
10/5/2000	480	80	0		0	23.8	0
11/2/2000	290	10	0		0.06	21.5	0

Data by Year

	Year	
Parameter	**1970**	**2000**
Total Coliforms - Median		345
Fecal Coliforms - Geometric Mean		53
BOD - Mean	1.74	0.6
Orthophosphates - Mean	0.0467	0.05
Chlorides - Maximum	75	35.2
Nitrates - Maximum	20	0.21

SITE SEVEN

Raw Data By Date

Date	*Total Coliform (per 100 mL)*	*Fecal coliform (per 100 mL)*	*BOD (mg/L)*	*Ortho - phosphate (mg/L)*	*Chlorides (mg/L)*	*Nitrates (mg/L)*
4/13/2000	660	100	0.6	0.04	30.2	1.1
5/4/2000	310	50	1	0.01	27.5	0
6/8/2000	100	90	0	0	29	0.71
7/13/2000	2900	250	0	0	27.1	0.91
8/3/2000	10000	10000	2.5	0.09	23.7	0.47
9/7/2000	330	90	2.4	0	33.5	1.55
10/5/2000	4000	130	0	0	25.8	1.18
11/2/2000	380	10	0	0	27.5	0.52

Data by Year

	Year
Parameter	**2000**
Total Coliforms - Median	520
Fecal Coliforms - Geometric Mean	138
BOD - Mean	0.8
Orthophosphates - Mean	0.02
Chlorides - Maximum	33.5
Nitrates - Maximum	1.55

SITE EIGHT

Raw Data By Date

Date	*Total Coliform (per 100 mL)*	*Fecal coliform (per 100 mL)*	*BOD (mg/L)*	*Ortho - phosphate (mg/L)*	*Chlorides (mg/L)*	*Nitrates (mg/L)*
4/13/2000	310	120	2	0.02	27.7	0.68
5/4/2000	240	40	0	0	24.5	0.35
6/8/2000	210	110	0	0	29.2	0.29
7/13/2000	620	260	0	0	23.7	0.35
8/3/2000	10000	900	3.3	0.09	23.4	0.33
9/7/2000	210	50	2.5	0	29	0.14
10/5/2000	3400	710	0	0	25.8	0.44
11/2/2000	300	40	0	0	19.5	0.22

Data by Year

	Year	
Parameter	**1970**	**2000**
Total Coliforms - Median		305
Fecal Coliforms - Geometric Mean		143
BOD - Mean	1.3889	1
Orthophosphates - Mean	0.0182	0
Chlorides - Maximum	75	29.2
Nitrates - Maximum	5	0.68