Water Quality of Farm Creek

A Research Project

By

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**WATER QUALITY STUDY OF FARM CREEK**

**ROWAYTON, CONNECTICUT 2004**

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1. **INTRODUCTION**

Farm Creek is a small estuary that spans approximately four acres in Rowayton, Connecticut (Figure 1). The creek is flanked in the north by McKinley Street, the west by Roton Avenue, the south by Sammis Street, and the east by residential dwellings. In 1973-1974, William J. Kulze donated Farm Creek to the Nature Conservatory as the Kulze Preserve, and in 1981, the Conservatory completed a comprehensive survey of the creek, obtaining information about the creek’s hydrology, geology, and native flora and fauna. Recently, the local residents of the Farm Creek area have taken an interest in the health and preservation of the creek.

Harbor Watch / River Watch (a citizens’ water quality monitoring organization operating as part of Earthplace at Westport, CT) took the opportunity to fully explore this estuary on a request from Tia and Ian Sidey of 50 Roton Ave in Rowayton, CT.

While the efforts of Harbor Watch / River Watch represent a significant step forward in identifying possible sources of bacteria in Farm Creek, other point and non-point sources remain to be defined and eliminated. The concern here is whether society as a whole has the will and interest to begin the remedial efforts on Farm Creek, because conservation will be perpetual. Fixing the collapsing concrete culvert at site FC3, identifying sources of septic infiltration at site FC5, and public education about proper use of the land are examples of what actions can be taken to conserve the health of Farm Creek.

College interns do much of this work which helps them to appreciate and learn a practical scientific approach to water quality research. Several of these young volunteers go on to pursue environmental interests and careers based partly on their experiences with Harbor Watch / River Watch.

In conclusion, a role exists for trained citizens and monitoring groups such as Harbor Watch / River Watch to provide stewardship and continuous monitoring of streams like Farm Creek in a cost effective manner. This assumes, of course, that municipal and state environmental agencies will continue to step in when problems are identified and take the action necessary to assure cleaner waters.

By participating in the Harbor Watch / River Watch, I believe I can contribute in a meaningful way to keeping the environment healthy. In today’s society, I feel humans consume so much of the earth’s resources. When people think of conservation, many think of “saving the rainforest” and protecting endangered animals. While these are worthwhile causes, I think people may overlook the importance of maintaining local resources, such as the water quality of local rivers and streams. I think many people believe that one person cannot make a difference, but I have seen from Harbor Watch / River Watch that this assumption is not true.

1. **RATIONALE FOR WATER TESTING REGIME**

Fecal Coliform and E. coli Bacteria

Fecal coliform and E. coli bacteria levels were measured by the membrane filtration method to test for the presence of enteric bacteria; (E. coli and Klebsiella) from both human and animal sources according to Standard Methods 20th ED (9222D, 9222G). This test relies on these indicator organisms to signal the possible presence of pathogens in the waterways and is important because it demonstrates the availability of fresh fecal bacteria in the aquatic systems. Observed coliform (fecal and E. coli) bacteria levels swing widely according to precipitation and water temperature. It is also observed that coliform bacteria counts drop off substantially when water temperatures fall below 10°C during the winter months.

May’s monitoring effort measured only for fecal coliform bacteria for which the State’s Water Quality Standards provides a criterion for meeting Class B rivers. For the purposes of the balance of this study, E. coli bacteria levels were also reported. E. coli is one of the two bacteria components of the fecal coliform bacteria group, and it is now believed to be a more specific indicator of fecal material arising from humans and other warm-blooded animals. For recreational waters the US EPA now recommends the use of E. coli because it is a better indicator of a human health risk from water contact than fecal coliform bacteria.

The State of Connecticut Department of Environmental Protection (CT DEP) initially based water quality on fecal coliform bacteria criteria, “As an indicator of general sanitary quality, fecal coliform shall not exceed a geometric mean of 200 orgamisms/100 mLs in any group of samples nor shall 10% of the samples exceed 400 organisms/100 mLs.” (CT DEP, 1997).

E. coli bacteria will be evaluated under a newly released CT DEP standard (CT DEP, 12/17/02). The CT DEP E. coli criterion for Class AA, A, and B water is established at three levels (Table 2.1)

Table 2.1 CT DEP criterion for E. coli bacteria levels as applied to recreational use, effective 12/17/02

|  |  |  |  |
| --- | --- | --- | --- |
| **Designated Use** | Class | Indicator Bacteria | Criteria |
| Recreation Designated swimming | AA, A, B | Escherichia coli | Geometric mean less than 126 CFUs1/100 mLs; single sample maximum 235 CFUs/100 mLs |
| Non-designated swimming | AA, A, B | Escherichia coli | Geometric mean less than 126 CFUs/100 mLs; single sample maximum 410 CFUs/100 mLs |
| All other recreational uses | AA, A, B | Escherichia coli | Geometric mean less than 126 CFUs/100 mLs; single sample maximum 576 CFUs/100 mLs |

1 CFU = colony-forming unit; each single bacterium will grow into a visible colony with the correct heat range and media. This allows the bacteria to be counted.

Based on E. coli criterion (Table 2.1), Farm Creek will be evaluated under “non-designated swimming” and will be evaluated under the criterion. For the purpose of this report both fecal coliform and E. coli bacteria will be reported in Appendix 1. Appendix 2 contains a brief summation of each indicator bacteria type presently used by DT DEP in evaluating Connecticut waters.

This study chose to use fecal and E. coli bacteria as indicators for the estuary portion of Farm Creek because the FCA still uses these organisms as indicator markers for saltwater shellfish beds.

Table 2.2 Classification of E. coli bacteria concentrations in Farm Creek

|  |  |
| --- | --- |
| **Designation** | **E. coli colonies / 100 mLs** |
| Low | < 125 |
| Moderate | 126 – 500 |
| High | > 500 |

Conductivity

Conductivity, or electrical conductance, is a measure of the total ionic strength of fresh water as measured in microsiemens (uS). One uS is a measure of electrical conductance the sample would show if measured between opposite faces of a one-centimeter cube. The norm for a relatively unpolluted freshwater stream ranges from 75-100 uS. Factors that may influence an elevated conductivity reading are yard products from residential dwellings, rusting metals in and near the water, parking lot runoff, and stream bank erosion. In saltwater, normal salinity would range from 22-26 psu1 (ppt).

1preferred salinity unit

Dissolved oxygen

Dissolved oxygen (DO) was routinely measured at all sites to gain better insight as to overall stream health. Low DO levels (under saturated) can result from heavy organic loading, hot weather conditions, the die off of a heavy phytoplankton bloom, and ongoing nitrification in the waterway. An elevated DO level (saturated) can result from aquatic plant life producing oxygen as a byproduct of photosynthesis.

Table 2.3 Dissolved oxygen 100% saturation values (examples) according to temperature for fresh and salt water.

|  |  |  |  |
| --- | --- | --- | --- |
| Fresh Water | | Sea Water | |
| Temperature C | ppm | Temperature C | ppm |
| 1 | 14.20 | 1 | 10.78 |
| 5 | 12.80 | 5 | 9.81 |
| 10 | 11.30 | 10 | 8.81 |
| 15 | 10.20 | 15 | 8.03 |

Meteorological Conditions and Observations

Meteorological conditions and observations such as air, water temperature, and rainfall data were taken in the survey to illustrate the impact of natural phenomena on Farm Creek. In the first few hours of rainfall, water conditions tend to be more polluted due to the initial slug of land runoff entering the storm drain systems.

1. **METHODS AND PROCEDURES**

Water quality monitoring is carried out under the protocol of an EPA approved Quality Assurance Project Plan (QAPP) as approved on August 26, 2002 for the Norwalk River. All bacteria testing is performed in the Earthplace laboratory, which is certified by the Connecticut State Health Department for analysis of surface waters. (LAB #PH0262)

A water quality team leaves Earthplace in Westport between 9:30 and 10:00 AM, and returns in early afternoon. The team is comprised of Pete Fraboni (associate director of Harbor Watch / River Watch), Dick Harris (staff scientist of Earthplace and director of Harbor Watch / River Watch), and Emmy Cullen (Harbor Watch / River Watch summer intern). Water samples are collected at five (Figure 1) monitoring sites along Farm Creek. These sites are chosen to be characteristic of the estuary, and to obtain an accurate representation of the estuary’s health.

The following tests were run *in situ*: dissolved oxygen (QAPP appendix A3.1) and conductivity (QAPP appendix A3.5). Water and air temperatures, as well as general observations and storm events are also recorded at each site visit. Observations are recorded (QAPP appendix 5) on the HW/RW data sheets.

Upon return to the lab, fecal coliform bacteria membrane filtration tests to test for the presence of E. coli (QAPP appendix A3.10) are performed and analyzed accorded to Standard Methods 20th edition (9222D & 9222G) and recorded (QAPP 5) on the HW/RW bacteria log. The frequency of which water quality monitoring for bacteria concentrations occurs is separated into two seasonal testing periods. For the period May 1st to September 30th monitoring is done two times per month. For the colder season when bacteria counts are reduced (October 1st to April 30th) monitoring is done monthly. Bacteria counts are thought to be reduced during these months because the bacteria have difficulty surviving in colder temperatures.

Farm Creek does not have an official rating; however, for purposes of this report, Farm Creek will be assigned a Class B rating, as the CT DEP considers a Class C rating temporary, i.e. the local health and conservation departments will undertake efforts to raise a Class C rating to a Class B rating.

1. **FARM CREEK**

Background

Farm Creek is a small estuary that spans approximately four acres in Rowayton, Connecticut (Figure 1). The creek is flanked in the north by McKinley Street, the west by Roton Avenue, the south by Sammis Street, and the east by residential dwellings. Recently, the local residents of the Farm Creek area have taken an interest in the health and preservation of the creek, and on a request from Tia and Ian Sidey of 50 Roton Ave, Rowayton, CT, the Harbor Watch / River Watch program (a citizens’ water quality monitoring organization operating as part of Earthplace at Westport, CT) has taken the prospect to study this small estuary to determine the creek’s overall health.

Objectives and Strategy

The initial objectives of the Farm Creek research effort were to:

1. Establish a baseline survey along physical, chemical, and bacteriological parameters to determine the overall stream health in relation to DEP water quality criteria.
2. Locate point sources for bacterial input (if any) and delineate possible non-point source areas for future study.
3. Observe general conditions concerning riparian buffered areas, watershed composition, and the presence or absence of wildlife.

To meet these objectives, five strategically placed testing sites were established along the Farm Creek water course beginning where a storm drain network enters into a freshwater pond. The pond discharges to the toe of a small salt water estuary which flows approximately 1/3 mile into Long Island Sound.

The following sites were established

1. Site FC1 is the mouth of the estuary, where the tidal creek drains into Long Island Sound.
2. Site FC2 is the midpoint of the estuary, marked by a small wooden bridge.
3. Site FC3 is the toe of the estuary at McKinley Street. There is seldom any salt water above this site.
4. Site FC4 is the outlet of the freshwater pond.
5. Site FC5 is the inlet (comprised of a large storm drain basin network discharge) of the freshwater pond, and a source of future investigation, as high bacteria counts have been observed at this site on multiple occasions.

Findings (compared to the State of Connecticut’s Class B river rating system)

* Site FC1 (mouth of Farm Creek Estuary) meets the CT DEP *E. coli* criterion for the geomean[[1]](#footnote-1) and the single sample maximum (SSM)[[2]](#footnote-2) for non-designated swimming (Table 2.1, Figure 1a, Figure 2). The *E. coli* bacteria counts at all other sites FC2, FC3, FC4 and FC5 exceed the CT DEP freshwater criterion for non-designated swimming areas both for the geomean and the SSM. CT DEP *E. coli* criterion (Figures 1g, 1c, 1d, 1e, Figure 2).
* All water quality monitoring sites demonstrate a sensitivity to rainfall and associated stormwater runoff (Figure 3, Appendix 1).
* The dissolved oxygen (D.O.) meets the CT DEP criterion of 5mg/L or greater at all sites (Figure 4).
* The conductivity values observed for the fresh water pond are elevated when compared to that of a healthy fresh water pond, of 75 to 100 µS (Figure 5).
* Conductivity values observed for the estuary portion (Sites FC3, FC4 and FC5) are elevated[[3]](#footnote-3) as would be expected in salt water (Figure 5, Appendix 1).

Discussion

The elevated levels of *E. coli* bacteria at Site FC5 (Figure 1e, Figure 2) could be due to possible septic infiltration during the time period when the creek is routed underground and before it re-emerges into the pond. Waterfowl and pet fecal waste being discharged in the pond could contribute to raised E. coli concentrations at sites FC4 (Figure 1d, Figure 2) and FC3 (Figure 1c, Figure 2). Significant rainfall prior to sampling can raise the E. coli levels at sites FC2, FC3, FC4, and FC5 (Figures 1a, 1b, 1c, 1d, Figure 3) due to the ability of stormwater runoff to carry septic infiltration, terrestrial animal waste, and roadway runoff into the water (Figure 2).

An unusual situation occurred in September in that Florida hurricane remnants (heavy rains) inflated *E. coli* bacteria counts. This is very evident at most of the five test sites on 9/29 when testing occurred one day after 2 inches of rain (Appendix 1). An even greater rain of 3.60 inches occurred on 9/8, although water quality monitoring did not take place until 9/14 or six days later. Based on elapsed time between rainfall and testing, the bacteria counts were not as high as what occurred on 9/29, because runoff had subsided (Appendix 1).

Roadway runoff and lawn products, such as pesticides and fertilizers, could increase the ionic strength of the water and be the cause of the elevated conductivity values observed at sites FC3, FC4, and FC5. (Appendix 1)

All sites had DO measurements well above the CT DEP standard of 5 mg/L. The raised DO level at site FC4 (Figure 5b) is possibly due to the excessive aquatic plant life undergoing photosynthesis, and releasing oxygen into the water as a byproduct of that reaction. Turbulence of water in the spillway leaving the pond also increases the oxygen content at site FC4.

The salinity concentrations are normal for an estuary. As per Merriam Webster, an estuary is defined to be “a semi-enclosed body of seawater with a freshwater source.”

* 1. **RECOMMENDATIONS FOR IMPROVEMENT**

Future research and work will be oriented as follows:

1. An ongoing attempt to find sources for fecal coliform and E. coli bacteria, which will require the selection of more testing sites upstream from FC5. This may require a concerted effort involving Harbor Watch / River Watch, the Norwalk Conservation Commission, and the Norwalk Health Department.
2. Reporting findings to the CT DEP, the health departments, and conservation commission of Norwalk.

Recommendations for improving the water quality of Farm Creek are as follows:

1. Survey the watersheds of Farm Creek and renew the status of all deteriorating concrete pipes (especially where rebar enforcement is showing) for possible replacement.
2. Encourage pet owners to pick up their pets’ waste from the park bordering the freshwater pond. Pets’ fecal waste can run into the pond during rain, possibly contributing to elevated fecal bacteria and E. coli levels in the water.
3. Advise residents to refrain from feeding the local geese and ducks. Feeding these birds encourages them to proliferate and nest, and their waste can dramatically contribute to elevated bacteria levels in the pond.
4. Educate homeowners about the proper use of their land:

* Limiting the use of lawn fertilizers and pesticides could lower the high conductivity levels in the pond and provide a chemical-free environment for the native flora and fauna.
* Retracting lawns away from the pond’s edge will decrease the amount of pesticide and fertilizer runoff into the pond during periods of rain.

**APPENDIX 1**

**Site Information**

### **Farm Creek: Site FC1**

Site FC1 is at the mouth of the estuary where the tidal creek empties into Long Island Sound. The sampling point is off the bridge to Belle Island across from the Rowayton Yacht Club.

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### **Farm Creek: Site FC2**

Site FC2 is the midpoint of the estuary. The sampling point is off a wooden bridge that is part of a small footpath between Roton Avenue and Farm Creek Avenue.

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**Farm Creek: Site FC3**

Site FC3 is the toe of the estuary at the intersection of McKinley Street and Roton Avenue. The sampling point is at the opening of a broken steel culvert where the creek re-emerges after being routed under McKinley Street.

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**Farm Creek: Site FC4**

Site FC4 is the outlet of the freshwater pond at Rowayon Fields Park. The sampling point is off a small wooden bridge that is part of a footpath established around the pond.

(space for picture)

**Farm Creek: Site FC5**

Site FC5 is the inlet (composed of a large storm drain basin network discharge) of the freshwater pond at Rowayton Fields Park. The sampling point is at the opening of the storm drain basin network discharge, where the estuary enters the pond.

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**APPENDIX 2**

**Indicator Bacteria Information**

**Total coliforms and fecal coliforms**

Both the total coliforms and the fecal coliforms are “tried –and-true” indicators, used since the 1920s by agencies charged with protecting public health. The total coliforms are a group of closely related bacterial genera that all share a useful diagnostic feature: the ability to metabolize (ferment) the sugar lactose, producing both acid and gas as byproducts.

The total coliform group is not very useful for testing recreational or shellfishing waters. That’s because some species in this group are naturally found in plant material or soil, so their presence doesn’t necessarily indicate fecal contamination. (Total coliforms are useful for testing drinking water, where contamination by soil or plant material would be a problem.)

A more fecal-specific indicator is the fecal coliform group, which is a subgroup of the total coliforms (However, even this group includes some species that can have a nonfecal origin – for example, Klebsiella pneumonia, which grows well in paper pulp and is sometimes found in high concentration near paper mills.) Fecal coliforms are widely used to test recreational waters, and they are the only indicator approved by the FDA’s National Shellfish Sanitation Program (NSSP) for classifying shellfishing waters.

In the lab, fecal coliforms are distinguished from total coliforms by their ability to carry out lactose fermentation at 44.5°C. (Tests for total coliforms are incubated at 35°C. The 44.5°C incubation temperature inhibits all except the fecal group.) The temperature must be maintained within narrow limits (+0.2°)

## E. coli

Total coliform group

Fecal coliform group

E. coli (a single species)

E. coli is a single species within the fecal coliform group. As an indicator, it has two advantages over the fecal coliforms: (1) It is more fecal-specific (E. coli occurs only in the feces of warm-blooded mammals); and (2) EPA studies (EPA 1986) showed that in fresh water E. coli correlated more closely with swimming-related illness. For these reasons, EPA began recommending in 1986 that states use E. coli as an indicator for freshwater recreational areas. (In spite of EPA’s recommendation, many states still use fecal coliforms – partly for the sake of continuity, so that new data can be directly compared with historical data.)

## Enterococci

The enterococci are another group of bacteria found primarily in the intestinal tract of warm-blooded animals. They are unrelated to the coliforms (for one thing, enterococci are spheriod whereas coliforms are rod-shaped). EPA recommends enterococci for testing marine recreational waters because of the superior correlation with swimming-related illness. However, as far as we are aware, no volunteer monitoring programs are currently using this indicator – perhaps in part because the EPA-approved method for enterococci requires incubation at 41°C (so if you want to test for fecal coliforms or E. coli in addition to enterococci, you need two separate incubators), and the medium is expensive and contains a toxic ingredient.

**APPENDIX 3**

**Glossary of Terms**

**APPENDIX 4**

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**APPENDIX 5**

**Pictures**

(space for pictures (starting at Figure 6 and on) and descriptions)**APPENDIX 6**

**Acknowledgements**

This project was made possible by the generous funding and monumental support of Tia and Ian Sidey of 50 Roton Ave., Rowayton, CT.

The data collected in this report was made possible by the help and dedication of Tussy Alam and Paddy Gerety (Norwalk Health Department water quality interns), and the staff at Earthplace, The Nature Discovery Center in Westport, Connecticut.

I would like to thank Mr. Dick Harris, Earthplace Staff Scientist, and Mr. Pete Fraboni, Earthplace Naturalist, for their undying encouragement, support, and mentorship during this study. And finally we wish to thank The Rivers Alliance of Connecticut and the CT DEP for providing vital updated computer hardware for the production of this report.

1. The *E. coli* geomean for non-designated swimming areas is >126 CFU (Colony Forming Units)/100mLs. [↑](#footnote-ref-1)
2. The single sampling maximum for non-designated swimming areas is 410 CFU/100mLs. [↑](#footnote-ref-2)
3. Conductivity measurements for Site FC3, FC2, and FC1 are also displayed as preferred salinity units in Appendix 1. [↑](#footnote-ref-3)