OAR Assabet River Water Quality Testing 1992 - Final Report

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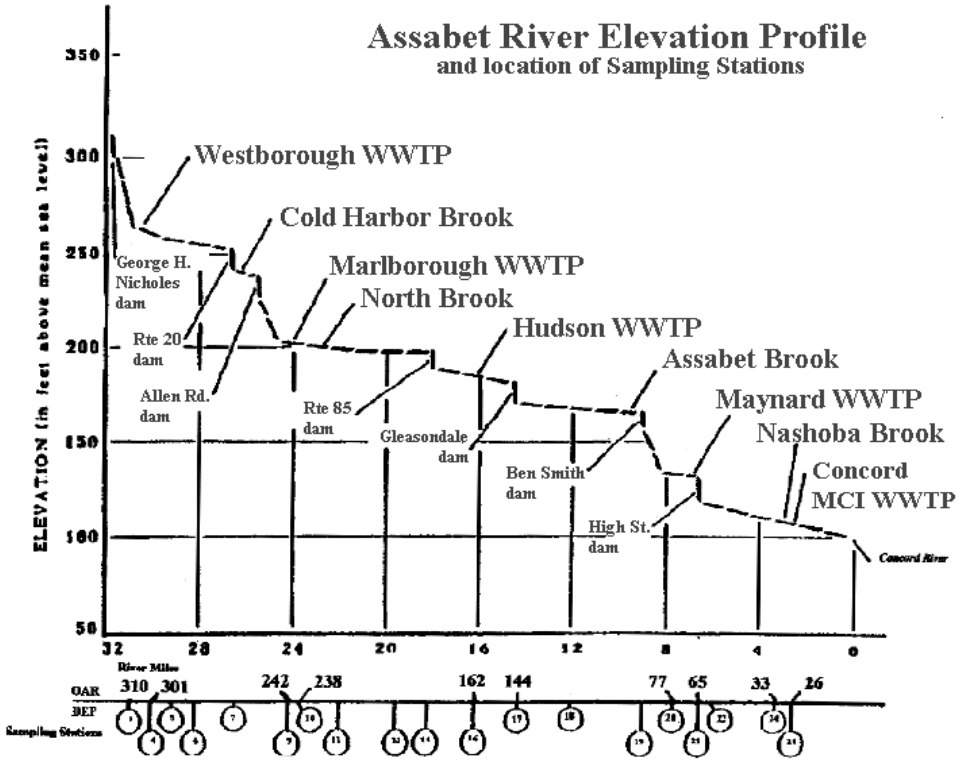
Summary

The Organization for the Assabet River has made a six-month study of the water quality of the Assabet River. The last complete study of the river was done by the Department of Environmental Protection in 1987 after existing sewage treatment plants on the river had been upgraded and a new facility had been built at Westborough. The objective of OAR's water quality assessment was to find out whether the gains achieved in 1987 have been maintained and strengthened, and to identify and help solve any water quality problems remaining. Assisted by the Massachusetts Water Watch Partnership and run by trained adult and student volunteers, OAR monitored dissolved oxygen, pH, temperature, alkalinity, and fecal coliform levels above and below the five sewage treatment plants located on the Assabet River. OAR's results affirm the Assabet's suitability for recreational use (swimming excepted). Fecal wastes from sources other than wastewater treatment plants are entering the river and preventing its use for swimming. The study has been helpful in locating one source of contamination and OAR will work with local officials to eliminate it. Excessive plant growth and low oxygen levels in slow-moving sections of the river suggest that nutrients in sewage plant effluents should be reduced further to improve the aesthetic quality and enhance the habitat for fish and other aquatic life. OAR is investigating ways to promote these changes.

Figure 1: Assabet River Elevation Profile



Introduction

The Organization for the Assabet River has for many years played an active role in enhancing the environmental quality of the Assabet River Watershed. The water quality of the Assabet River has been an object of continuing concern. Algal blooms, fueled by nutrients from sewage treatment plant discharges and nonpoint sources, continue to plague portions of the fiver during the hot summer months. Since the bulk of fiver flow consists of treated sewage effluent from five wastewater treatment plants (WWTPs), water quality is determined in large part by the quality and quantity of their discharges. Assabet water quality has not been monitored since 1987 when the lack of state funding curtailed regular testing by the Massachusetts Department of Environmental Protection. As a result, we no longer have an adequate record of the impact of treated sewage on the river environment and the extent to which current discharge practices[1] support Class B water quality goals[2] for the river. Class B waters are designated as a habitat for fish, other aquatic life, and wildlife, and for primary (swimming) and secondary contact (boating) recreational use.

To fill this information gap, OAR, with the help of the Massachusetts Water Watch Partnership (MassWWP), began a modest water quality assessment program on the Assabet River in May 1992; monthly tests were conducted through October.

Procedures

River samples were collected at ten sites above and below each of the five wastewater treatment plants, as shown in Figure 1. Samples were tested for dissolved oxygen, temperature, pH, alkalinity, and fecal coliform bacteria, following Mass WWP's written procedures based on standard water testing methods. Mass WWP's quality control standards for dissolved oxygen, pH, and alkalinity were analyzed with the samples in all test sequences. Chemical tests were performed in the science laboratory facilities of Acton-Boxborough Regional High School. Fecal coliform samples were analyzed by Thorstensen Laboratories of Westford and by Wheelabrator, Inc. of Westborough. The U.S. Geological Survey supplied mean flow rates for the Assabet River as measured at the its gauging station in Maynard on each of the test days (Table 1).

Results

Selected results of OAR's 1992 water quality study are presented in Table 2 and Figures 2 and 3. The mean water temperatures on each of the test days are shown in Table 2. Figure 2 details the dissolved oxygen found above and below each wastewater treatment facility. Fecal coliform levels at each test site are present in Figure 3. For comparison, data from the 1987 Department of Environmental Protection survey, conducted in 1987 at the same sampling sites, have been added to Figures 2 and 3.

Table 1: River Flow

Date	River Flow (cfs)
May 16, 1992	159
June 16	100
July 14	82
August 18	231
September 20	48
October 18	n.a.

Table 2: Water Temperature

	Water Temperature (° C)	
Date	Mean	Range
May	17.5	16-19
June	21.5	18-24
July	23.5	21-25
August	19.0	18-20
September	20.0	18-22
October	12.0	9-13

The pH (water acidity) of the Assabet River was remarkably constant with a mean of 7.00 for all tests; 97% of the results were in the range 6.75 - 7.25. The test site below the Westborough WWTP differed most with a mean of 6.80 for the season. Alkalinity (acid neutralizing capacity) is a measure of acid ram tolerance. The seasonal mean upstream from the first wastewater treatment plant (Westborough) was 21 mg/L. Downstream from the Westborough WWTP the seasonal mean was 29 mg/L, with 90% of all results in the range of 21 mg/L - 37 mg/L.

Discussion

The results of the season's water quality testing were, on the whole, encouraging. All parameters except dissolved oxygen and fecal coliform counts met the Class B. river quality standards. In the following discussion, the OAR test results are compared with the Class B river quality criteria, the discharge permit limits (NPDES) of the wastewater treatment facilities, and the September 1987 data reported by DEP in the Assabet River 1989 Water Quality Management Plan[1]. The interpretation of results requires that water temperatures (Table 2) and river flow (Table 1) be considered as well. In addition, the WWTP effluent volume in relation to the natural river flow needs to be considered. The potential impact on water quality is greatest at Westborough.

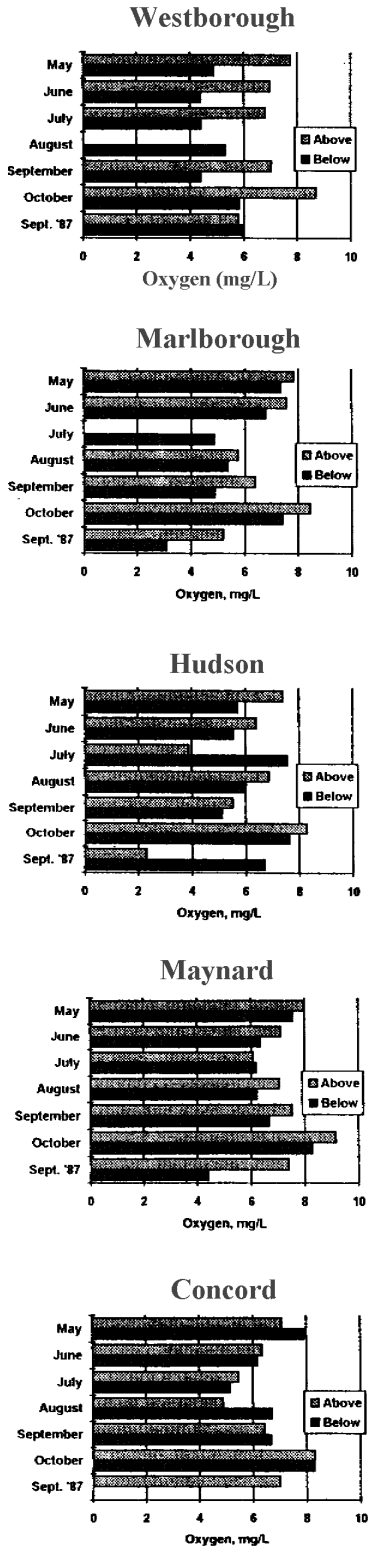
pH (water acidity)

The Class B water quality goals are: pH in the range 6.5 - 8.3 units, and not more than 0.5 units outside of the background range. The diversity of aquatic life decreases as waters become more acidic (6.5) or more basic (>8.3) than the recommended range. Discharges into the river disrupt aquatic life if the pH of the discharge differs from the pH of the river (background). The OAR test results indicate that the Assabet has a pH range of 6.75 - 7.25, well within the recommended range. The impact of WWTP effluent, as measured by the pH difference above and below each WWTP, is also within the recommended 0.5 unit limit. The greatest difference, 0.3 pH units (seasonal mean above 7.06, below 6.80) was measured at Westborough.

Alkalinity (Acid Neutralizing Capacity)

No water quality standards have been developed for this parameter. The natural waters of New England are poor in minerals that can neutralize acid rain. Alkalinity values (21 mg/ L) upstream from the first WWTP are typical for local waters. A mean of 29 mg/L down river from Westborough suggests that sewage effluent discharges increase the alkalinity of the river and provide extra protection from the effects of acid rain.

Figure 2: Dissolved Oxygen



Temperature

Water temperatures met the warm water criteria of the Class B standards. The months of June, July, and September had the warmest water, as shown in Table 2. August was unusual because it had high levels of flow and unusually cool water temperatures due to a prolonged rainy spell. Ninety-seven percent of the time, temperature differences between waters above and below sewage treatment plants were less than 2°C.

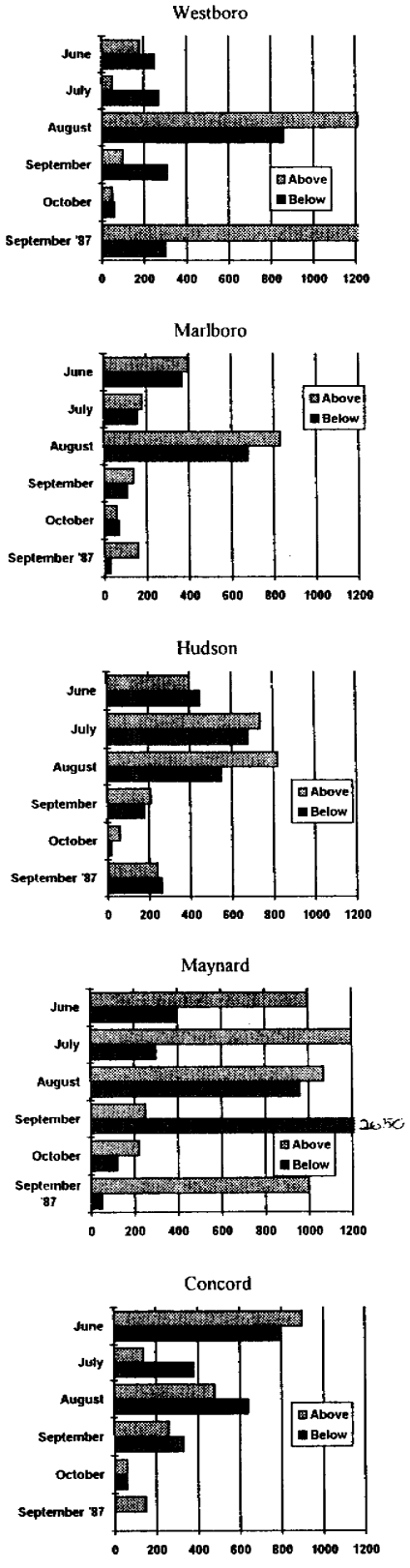
Dissolved Oxygen

Class B goals for warm water fisheries, like the Assabet River, are oxygen levels no lower than 5.0 mg/L, unless background conditions are lower. Oxygen saturation should not be less than 60% due to a discharge. When oxygenation decreases below this level, the variety of fish and aquatic invertebrates that can tolerate these conditions drops off sharply.

As Figure 2 shows, dissolved oxygen was borderline or below recommended levels for much of the summer at Westborough, Marlborough, and Hudson. Oxygen levels below the Westborough plant were consistently less than the recommended 60% saturation, even in October. Compared to September 1987, the situation seems to be about the same at Hudson, improved at Marlborough and worse at Westborough.

Several factors come into play to reduce dissolved oxygen below levels required to support normal species diversity. In a fast-moving stream, water is constantly aerated and oxygen consumed by growing organisms is readily replenished. In a pond or slow-moving stream aeration occurs more slowly. Much of the Assabet is pond-like, impounded behind seven dams in its 32-mile course. Aquatic plant growth is prolific in these sections, fed by high nutrient levels (nitrogen and phosphorus compounds) of the WWTP nutrient levels (nitrogen and phosphorus compounds) of the WWTP effluents. With prolific plant growth, dissolved oxygen becomes severely depleted at night, particularly at lower water depths. Two test sites showed particularly severe problems. Plant growth completely choked the channel above the Hudson WWTP during the summer months and the lowest oxygen level of the season (3.9 mg/L) was recorded in July. Prolific growth and odor problems were noted above the Powder Mill Dam (Maynard) in September, although a water sample taken near the river surface tested normal for oxygen (6.7 mg/L).

Figure 3: Fecal Coliform
(Colonies/100 ml)



Fecal Coliform Bacteria

Fecal coliform bacteria are present in all human and animal wastes. Fecal coliform counts are thus a useful indicator of the presence of raw sewage and the harmful organisms it contains. The test results shown in Figure 3 indicate that the Assabet River is not suitable for primary contact recreational use (swimming). Swimming is limited to waters containing less than 200 colonies per 100 mi. Discharge limits for the wastewater treatment facilities are also set at less than 200 colonies per 100 mi. With few exceptions, the data show that bacterial counts are less in waters below the wastewater treatment facilities than upstream, indicating the effectiveness of current sewage treatment practices. The remaining causes of fecal wastes entering the river are secondary or nonpoint sources, such as faulty septic tanks, leaking sewer pipes, and agricultural runoff. The high counts observed in August were measured after a prolonged rainy spell, when river flow was at its highest and runoff from the watershed was at its maximum. Further testing upstream from the Maynard plant during September and October has localized the source of sewage responsible for the persistent high bacterial counts observed at the sampling site above the Maynard plant. OAR members will work with the local authorities to help identify and eliminate this source. A cause has not been determined for the high count (2650 colonies /100 mi) observed below the Maynard plant in September.

Conclusions

OAR has concluded its first season of baseline water quality testing on the Assabet River. The test results affirm the Assabet's suitability for recreational use, swimming excepted. Fecal wastes from secondary sources are still entering the river and preventing its use for swimming. The study has been helpful in locating one of these sources and OAR will work with local officials to eliminate it. Excessive plant growth and low oxygen levels in slow-moving sections of the river suggest that nutrients in wastewater treatment plant discharges should be reduced further to improve the river's aesthetic quality and to enhance the habitat for fish and other aquatic life. OAR is investigating ways to promote these changes. The baseline study will be repeated in 1993.

Acknowledgments

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gratefully acknowledges the use of the Acton-Boxborough Regional High School science laboratory for the chemical testing. OAR wishes to thank Thorstensen Laboratories of Westford and Wheelabrator, Inc., of Westborough for their services in conducting the fecal coliform counts.

To the many OAR volunteers who participated in the taking of field samples and the laboratory testing, OAR extends a special thank you for their time and effort. In addition, the help of students from Acton-Boxborough Regional High School, Algonquin Regional High School, and the Hillside School in Marlborough is gratefully acknowledged. We thank volunteers Carolyn Spodick, Jack Wallace, Tom Kinsky, Jim Russell, Ed Linton, Gillie Page, and Gary Hopkins. Your dedication enabled us to learn more about the physical and chemical conditions of the river and to use that information to identify and address pollution problems. As a result of your efforts, our local environment is being improved.

[1] Assabet River 1989 Water Quality Management Plan, DEQE, DWPC, Publication #15957-84- 25- 5-89-C.R.

[2] NPDES Permit Limits for wastewater discharges at Westborough WWTP, Marlborough West WWTP, Hudson WWTP, and Maynard WWTP.

[3] Massachusetts Surface Water Quality Standards of 1990, DEP, DWPC, Publication #16,453-114-100-9-90-C.R.