Water Quality Data Report
For
The Norwalk River Watershed
October 2007 through April 2008

Submitted by:

Richard Harris, Principal Investigator, Staff Scientist/Director of the Harbor Watch/River Watch Program at Earthplace, Westport, CT, Phone (203) 227-7253

Peter Fraboni, Associate Director & QA/QC Officer for the Harbor Watch/River Watch program at Earthplace, Westport, CT

Funded by:
The Fairfield County Community Foundation, The Wilton Conservation Department, King Industries, Norwalk River Watershed Association, Inc.
and The Jeniam Foundation

To: The Wilton Inland Conservation Department; Norwalk River Watershed Association; The King Industries, The Fairfield County Community Foundation; and The Jeniam Foundation

From: Dick Harris, Principal Investigator, Earthplace, Harbor Watch/River Watch program

Date: June 26, 2008

Subject: The Norwalk River Watershed Project Water Quality Report for the period of October 1, 2007 through April 30, 2008

I. Introduction:

Purpose of Study: The Earthplace Harbor Watch/River Watch (HW/RW) Program was funded by the Connecticut Department of Environmental Protection (CT DEP) to conduct water quality monitoring on the Norwalk River for six years, June 1998 through June 2005. HW/RW collected and analyzed water samples for both fecal coliform bacteria and *Escherichia coli* (*E. coli*) bacteria at a total of ten sites, nine of them along the main stem of the Norwalk River and one on the Silvermine River (Figure A2, Figure A3).

Background: From June 1998 through May 1999, HW/RW conducted a first-year water quality monitoring study in the Norwalk River Watershed. This study was funded by the CT DEP and was intended to provide water quality information in support of the Norwalk River Watershed Initiative. The purpose of the study was to obtain data on the levels of fecal coliform bacteria, dissolved oxygen, and conductivity at selected locations in the Norwalk River and in its major tributaries (Silvermine River, Comstock Brook and Cooper Brook). The study indicated that fecal coliform bacteria levels frequently exceeded the state's water quality criterion for Class B water at a number of sites along the Norwalk River. Most sites met the dissolved oxygen level CT DEP criterion for Class B waters. The first year study also showed that conductivity levels were consistently higher in the upper reaches of the watershed than in the lower watershed. Based upon the water quality data collected, HW/RW determined that the water quality in the Norwalk River Watershed was moderately impaired.

During 2002, the CT DEP switched to *E. coli* bacteria as the indicator species. *E.* coli is one of the two bacteria components of the fecal coliform bacteria group, and it is a more specific indicator of fecal material arising from humans and other warm-blooded animals. For recreational waters, the US EPA recommends the use of *E. coli* because it is a better indicator of a human health risk from water contact than fecal coliform bacteria (Table 1).

The CT DEP and HW/RW executed a contract for the second year funding in September 1999; the second year monitoring period was from September 1, 1999 through November 30, 2000. HW/RW was authorized to begin testing for *E. coli* bacteria in November 1999. Sampling took place at 12 sites along the Norwalk River. Monthly reports were prepared and submitted to the CT DEP and disseminated to the seven towns comprising the Norwalk River Watershed as well as the Norwalk River Watershed Initiative Advisory Committee.

Funding was then made available by the CT DEP to continue testing on the Norwalk River for a third summer (April 1 to September 30, 2001) based on a continuing interest by Norwalk River Watershed Advisory Committees and the CT DEP. The same testing protocols used in 2000 by HW/RW were again used under the original QAPP, which was extended on April 25, 2001 to September 30, 2001 by the EPA's Office of Environmental Measurement and Evaluation.

Additional 319 funding was allocated to continue the HW/RW testing regime on the Norwalk River for twenty-three months beginning July 2002 and ending June 30, 2004. The last contract with the CT DEP expired on 6/30/05. Renewed testing of the Norwalk River and its tributaries began on May 1, 2005 based on the interest and generosity of the Town of Wilton, The Norwalk River Watershed Association, King Industries, Trout Unlimited and the Scallon Foundation. The Fairfield County Community Foundation and Norwalk's Daphne Culpepper Fund have provided additional funds for the 2007/2008 monitoring season.

Although these monthly reports are submitted to the CT DEP for review and comment, Harbor Watch/River Watch is solely responsible for the collection, analysis and interpretation of the water quality data.

II Methods and Procedures:

Water monitoring is carried out under protocols of an EPA approved and revised EPA Quality Assurance Project Plan (QAPP). Monitoring teams leave the Earthplace in Westport between 9:30AM and 10:00AM, and return in early afternoon. Each team is comprised of an experienced leader and one or two trained volunteers. Water samples are collected at 12 (Figure A2) of the original 23 monitoring sites within the watershed (QAPP Appendix A1.1). These sites, which represent the more impacted areas, were selected in concert with the CT DEP, because results from the first year's study consistently demonstrated elevated fecal coliform bacteria counts. In addition to focusing monitoring efforts at these sites, it was determined to analyze for both fecal coliform and *E. coli* bacteria.

The following tests are 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 Sheet.

Upon return to the lab, fecal coliform and *E. coli* bacteria membrane filtration tests (QAPP Appendix A3.10) are performed and analyzed according to Standard Methods, 20th edition (9222D & 9222G) and recorded (QAPP Appendix 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 when the three wastewater treatment plants (WTP) are required to disinfect their wastewater effluent (May 1st to September 30th) monitoring is done four times per month. For the period when effluent disinfection is not required (October 1st to April 30th) monitoring is done monthly.

E. coli bacteria will be evaluated using the criteria published in the CT DEP Surface Water Quality Standards, 12/17/02. The CT DEP *E. coli* criterion for Class AA, A, and B water is established at three levels (Table 1).

Table 1 CT DEP criterion for *E. coli* bacteria levels as applied to recreational use, effective 12/17/02

Designated Use **Recreation**	Class	Indicator	Criteria
Designated Swimming	AA, A, B	*Escherichia coli*	Geometric Mean less than 126 CFUs/100mLs; Single Sample Maximum 235 CFUs/100mLs
Non-designated Swimming	AA, A, B	*Escherichia coli*	Geometric Mean less than 126 CFUs/100mLs; Single Sample Maximum 410 CFUs/100mLs
All Other Recreational Uses	AA, A, B	*Escherichia coli*	Geometric Mean less than 126 CFUs/100mLs; Single Sample Maximum 576 CFUs/100mLs

The Norwalk River is classified by the CT DEP for "Non-designated swimming" because people still bathe in the river. The report will focus on *E. coli* bacteria levels, because it is the indicator bacteria of choice by the CT DEP. Fecal coliform bacteria levels are reported on Table B1 only as additional data for those who may be interested.

III. Results:

For the period of 10/11/07 through 4/3/2008 (the period when disinfection UV lights are turned off in the wastewater effluent streams at two of the upper Norwalk River wastewater treatment plants) E. coli bacteria levels exceeded the CT DEP criteria for E. coli bacteria for a Class B river (Table 1).

Sites NR23, NR22 (Ridgefield WTP effluent), NR21 and NR20 exceeded both the geometric mean of <126 CFU/100 mLs and the single sample maximum (SSM) of 410 CFU/100 mLs for 10% or more of the samples taken (Table 1, Table 2, TableB1, Figure 1).

Sites NR15, SM3 and NR1 also exceeded the SSM during the seven-month monitoring period (Table 1, Table 2, Table B1).

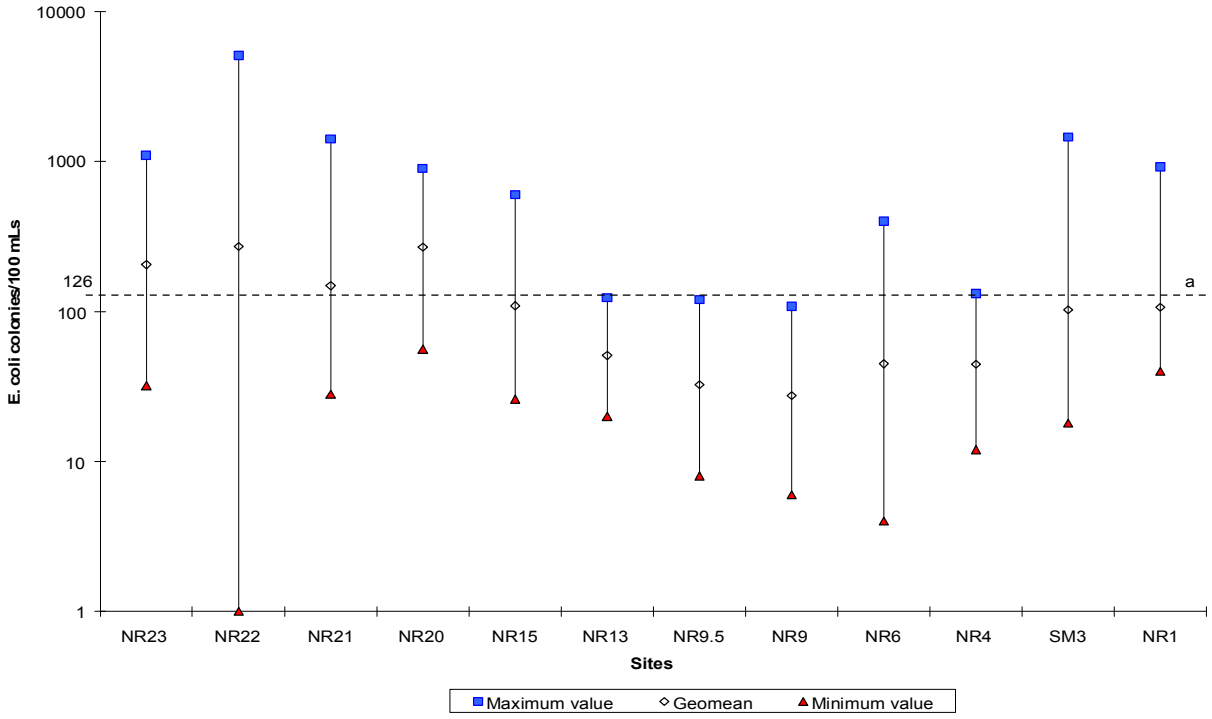
Observed dissolved oxygen (DO) means all met the CT DEP minimum DO criterion of 5mg/L. A single DO reading of 4.7 mg/L was observed on 10/11/07 at Site NR20 (Figure 2, Table B1). All other individual values met the CT DEP DO criterion (Figure 2, Table B1).

Observed conductivity means were at a maximum value of 708 µS at Site NR23 and a minimum value of 227 µS at Site SM3 (Silvermine River Site). Conductivity ranges at individual sites were extended in the upper river at a maximum range of 839 µS to 299 µS at Site NR21. A minimum range of 200 µS to 299 µS was observed at Site SM3 (Figure 3, Table B1).

Table 2 October 2007 through April 2008 *E. coli* bacteria concentrations, geometric means, and % frequency exceeding 410 colonies/100 mLs at 12 sampling sites in the Norwalk River Watershed for the period of time when the two Ridgefield and one Georgetown wastewater treatment facilities are not required by NPDES permit to disinfect sewage effluent

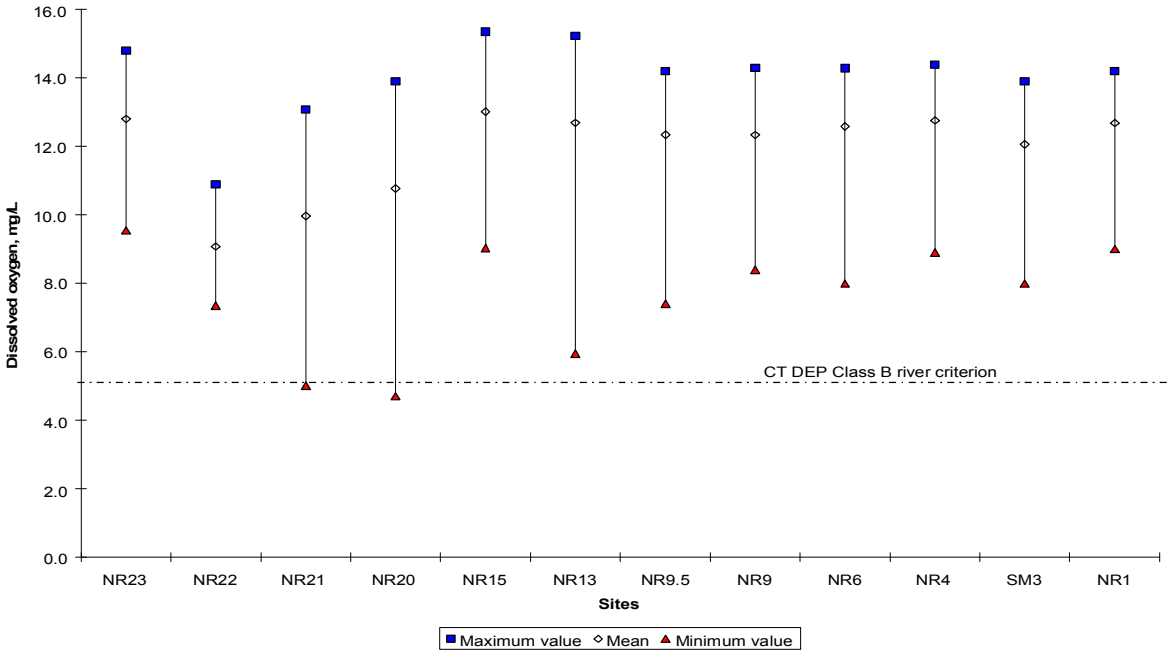
	Dates								
Sites	10/11/2007	11/1/2007	12/6/2007	1/10/2008	2/14/2008	3/6/2008	4/3/2008	**Geomean**	%frequency over 410 colonies/100mLs
NR23	1100	n/a	152	108	900	144	32	**205**	33.33%
NR22	1	137	n/a	1100	1900	5100	n/a	**271**	60.00%
NR21	1420	100	80	28	520	44	224	**149**	28.57%
NR20	640	56	80	180	296	900	740	**269**	42.86%
NR15	500	176	44	26	600	96	32	**109**	28.57%
NR13	88	96	48	20	124	40	22	**51**	0.00%
NR9.5	44	38	24	10	100	120	8	**33**	0.00%
NR9	96	10	16	20	108	60	6	**28**	0.00%
NR6	400	48	48	4	112	44	20	**45**	0.00%
NR4	56	132	92	24	112	12	16	**45**	0.00%
SM3	1460	380	44	40	120	56	18	**102**	14.29%
NR1	920	92	60	56	168	84	40	**107**	14.29%

Figure 1 Maximum, geometric means, and minimum values of *E. coli* bacteria concentrations at 12 monitoring sites in the Norwalk River Watershed from October 2007 through April 2008 when the two Ridgefield and one Georgetown wastewater treatment facilities are not required by NPDES permits to disinfect sewage effluent



[a]CT DEP geomean maximum value for a Class B river

Figure 2 Maximum, mean and minimum values for dissolved oxygen at 12 sampling sites on the Norwalk River Watershed from October 2007 through April 2008



[a]CT DEP minimum value for a Class B river

Figure 3 Maximum, geomean and minimum value for conductivity at 12 sampling sites in the Norwalk River Watershed from October 2007 through April 2008

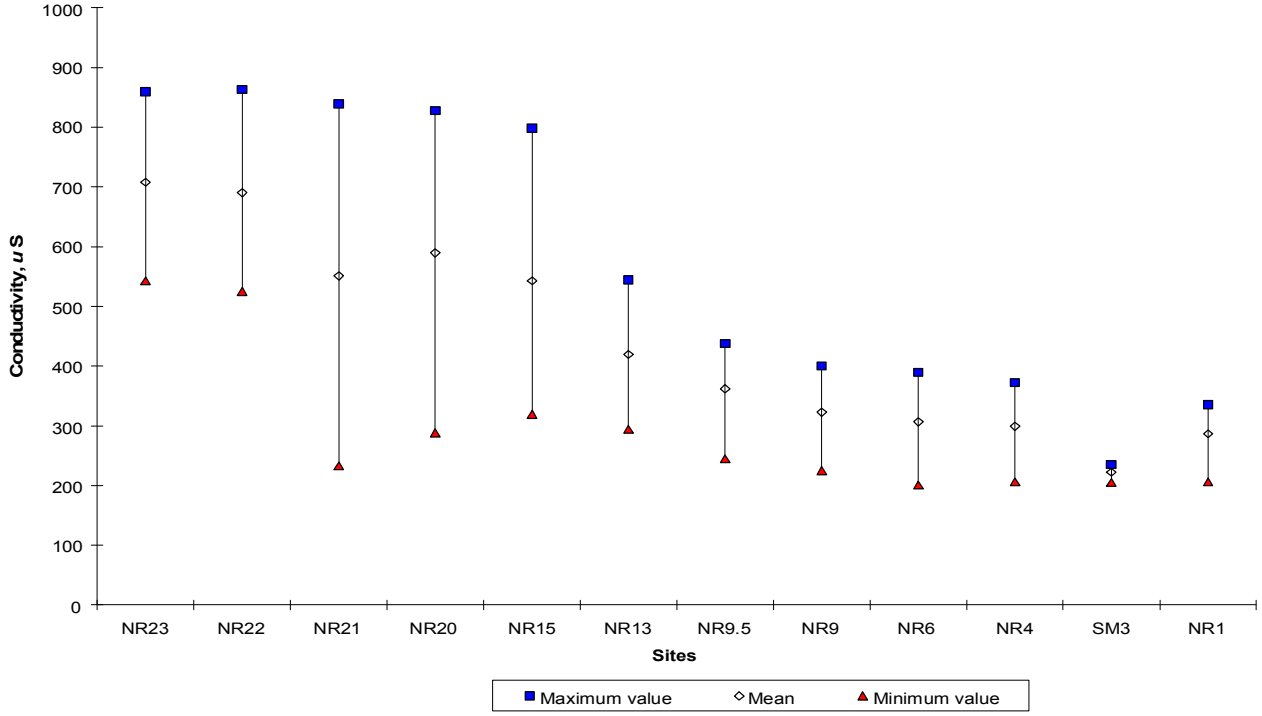
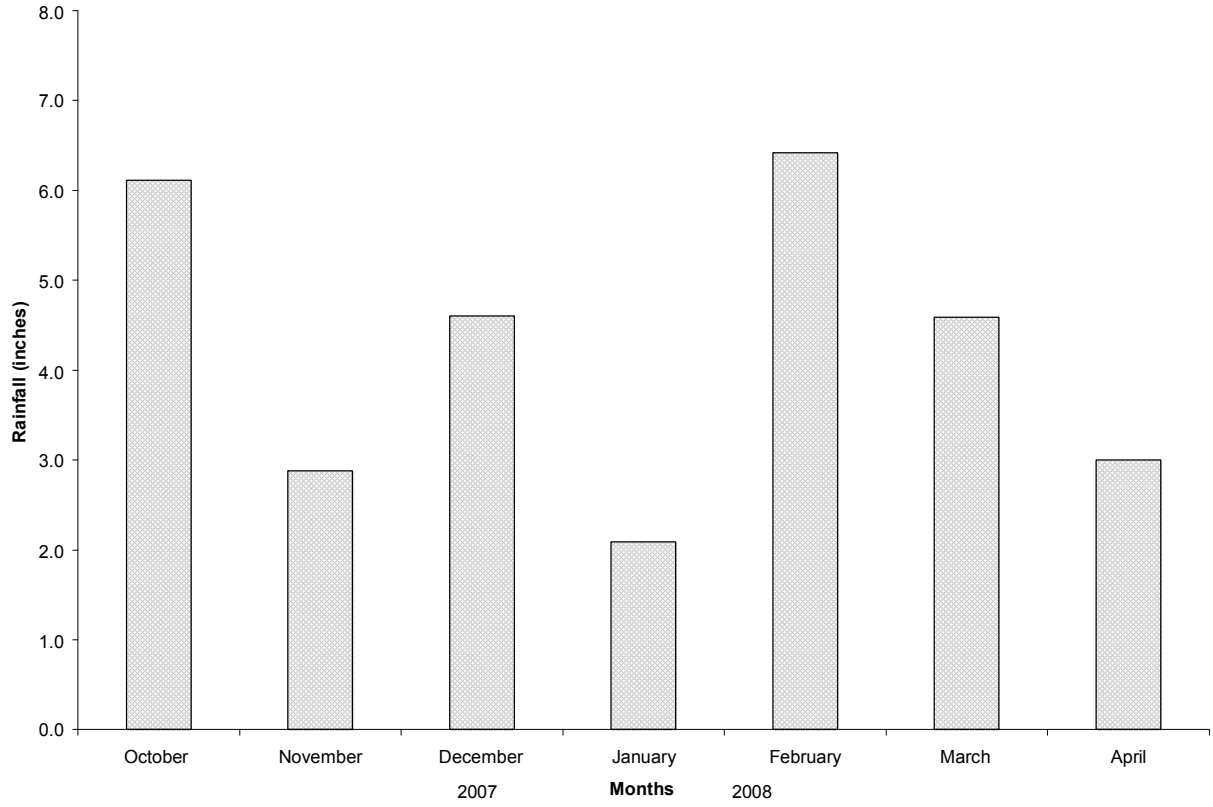


Figure 4 Monthly rainfall (inches) from October 2007 to April 2008



IV. Discussion:

Rainfall for the period of October 1 through April 30 averaged 4.24 inches per month, which is about average for this time of year (Figure 4). In just about every instance at least 50% of the rain received in each month arrived in storms exceeding one inch or more. On two monitoring dates, 10/11/07 and 2/14/08, HW/RW experienced precipitation of 2 inches just prior to sampling (Table B1), which resulted in the elevated bacteria counts shown on Table 2. The areas of the watershed receiving the highest bacteria counts are (1) the upper watershed at Ridgefield from Site NR23 downstream to Site NR15 and (2) the lower portion of the Norwalk River watershed at Sites SM3 and NR1 (Table 2, Figure 1).

Reasons for the elevated bacteria counts at Ridgefield are the elevated bacteria counts in Steep Brook[1] (Figure 5) and the elevated bacteria counts in the effluent from the Ridgefield WTP [2] during the winter months. Reasons for the elevated bacteria counts in the lower portion of the Norwalk River watershed (Sites SM3 and NR1) result from the combined input from several large storm drain discharges between Sites NR4 and NR1[3] as well as E coli concentrations entering from the Silvermine and the Norwalk Rivers (Table 2, Figure 1 and Table B1).

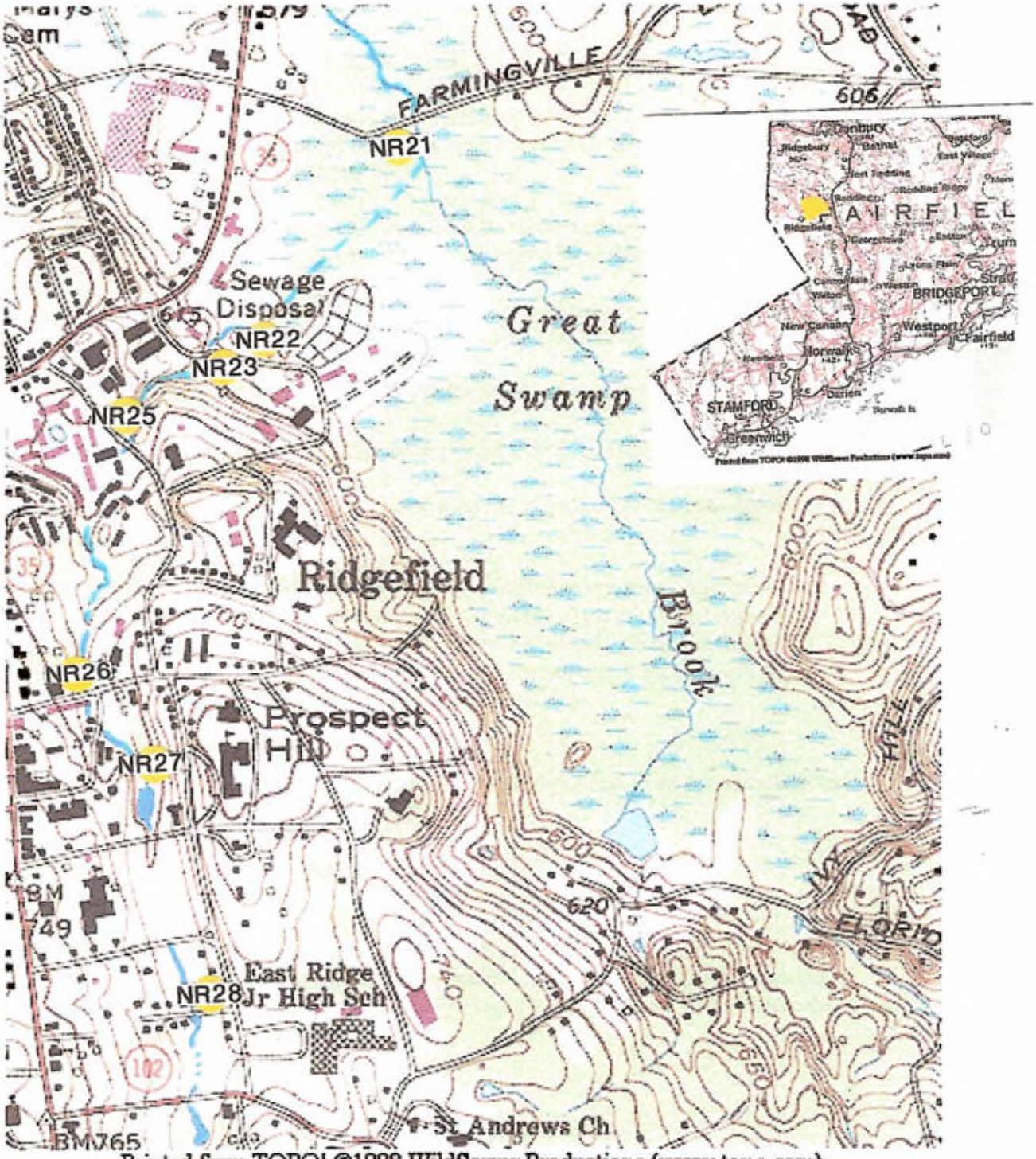
All dissolved oxygen (DO) means meet the CT DEP DO criterion of 5 mg/L or greater. A single DO sample of 4.7 mg/L on 10/11/07 at Site NR20 cannot be explained (Table 1, Figure 2) particularly in consideration of observed water temperatures at only 16ºC (Table B1).

Observed conductivity means and conductivity ranges were very close to what was noted in the last report (May 1, through September 30, 2007). River water in the upper watershed at Ridgefield is affected by limestone beds, which serve to add magnesium and calcium ions (Figure 3). Observed conductivity means range from 708 µS at Site NR23 down to 227 µS at Site SM3. The decline in conductivity results as major tributaries, i.e. Cooper Brook, Comstock Brook, Bennett Brook and the Silvermine River add their flows with reduced conductivity to the main stream of the Norwalk River (Figure 3). This aspect in conductivity reduction is very evident at Site NR13 downstream from Site NR15 where Cooper Brook enters the Norwalk River (Figure 3).

Thanks to a generous grant from NRG Corporation at the Manresa power plant in Norwalk, nutrient values (total nitrogen (TN) and total phosphorous (TP) will be evaluated at all twelve monitoring sites on four occasions throughout the summer. Added to the twelve sites will be Site NR9.8 (Georgetown's WTP effluent) and Site NR16 (Ridgefield's Rte. 7 WPT effluent).
It is hoped that sources of input can be already identified as well as gaining an indication as to how much TN and TP are entering Long Island Sound. The first two nutrient runs have been completed on 5/19 and 6/19, and results will be presented in the July Quarterly Report.

[1] Steep Brook runs through the center of Ridgefield, elevated *E. coli* counts are documented by HW/RW.
[2] It is our understanding that the Georgetown WTP leaves UV lights on during the entire year.
[3] Elevated bacteria counts at these storm drain discharges are well documented by HW/RW.

Figure 5 Map of Steep Brook flowing through Ridgefield showing sampling sites



Printed from TOPO! ©1998 Wildflower Productions (www.topo.com)

V. Index of Figures, Tables and Appendices:

VI. References

Harris, R. B. and P. J. Fraboni: Quality Assurance/Quality Control Plan for the Norwalk River Watershed Monitoring Project (QA No. CT00162) (re-approved October 2001 and extending to September 2002).

US Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria, US EPA 440/5-84-002, Washington, DC.

Harris, R. B. and P. J. Fraboni. 1999. Water Quality Data Final Report for the Norwalk River Watershed (June 1998 –May 1999).

Harris, R. B. and P. J. Fraboni.2000. Water Quality Data Final Report for the Norwalk River Watershed (July 1999–September 2000).

Harris, R. B. and P. J. Fraboni.2001. Water Quality Data Final Report for the Norwalk River Watershed (July 2001 –September 2001).

CT DEP, Water Quality Standard 12/17/02

VII. Reporting Period

Summary report for a five month monitoring period, October 2007 through May 2008

Monthly progress reports are available from June 1998 through September 2007

cc: Norwalk River Watershed Initiative Committee Co-Chairs
Norwalk River Watershed Association
Norwalk River Watershed Towns- Conservation Commissions- Norwalk, Wilton, Ridgefield, and Redding

Appendix A

Table A1 Site number identification, site location and town for sampling and testing (headwaters to mouth), *=tributary to the Norwalk River

Site No.	Site Area	Town	GPS Coordinates
NR21	Farmingville Road at the Great Swamp outlet	Ridgefield	Latitude: N 41° 17' 40.2" Longitude: W 73° 29' 18.5"
NR20	Route 35 at Fox Hill Condos	Ridgefield	Latitude: N 41° 17' 52.1" Longitude: W 73° 29' 32.2"
NR15	Stonehenge Road at the top of the dam	Ridgefield	Latitude N 41° 18' 32.0" Longitude: W 73° 28' 8.3"
NR13	Branchville at the railroad station (Route 7)	Ridgefield/Wilton	Latitude: N 41° 15' 55.8" Longitude: W 73° 26' 27.2"
NR 9.5	Downstream of the Georgetown Wastewater Treatment Plant -- Old Mill Road	Wilton	Latitude: N 41° 14' 46.0" Longitude: W 73° 26' 2.5"
NR9	School Road	Wilton	Latitude: N 41° 12' 15.3" Longitude: W 73° 25' 51.6"
NR6	Near Wolfpit Road in back of the Wilton Corporate Office Complex	Wilton	Latitude: N 41° 11' 0.1" Longitude: W 73° 25' 18.4"
NR4	Upstream of Route 15 (Glover Avenue) and downstream of the Merritt 7 Office Complex	Norwalk	Latitude: N 41° 8' 3.5" Longitude: W 73° 25' 35.8"
SM3*	James Street (on the Silvermine River)	Norwalk	Latitude: N 41° 8' 10.3" Longitude: W 73° 26' 4.0"
NR1	Post Road (US Route 1) adjacent to the Ash Creek Grille Restaurant	Norwalk	Latitude: N 41° 7' 10.8" Longitude: W 73° 25' 1.3"

Site No.	Site Area	Town	GPS Coordinates
NR23	Steep Brook next to South Street WTP	Ridgefield	Latitude: N 41° 17' 24.3" Longitude: W 73° 29' 35.6"
NR22	South Street WTP outfall	Ridgefield	Latitude: N 41° 17' 26.8" Longitude: W 73° 29' 29.6"

Appendix A2 Location of sampling sites located in the Norwalk River Watershed

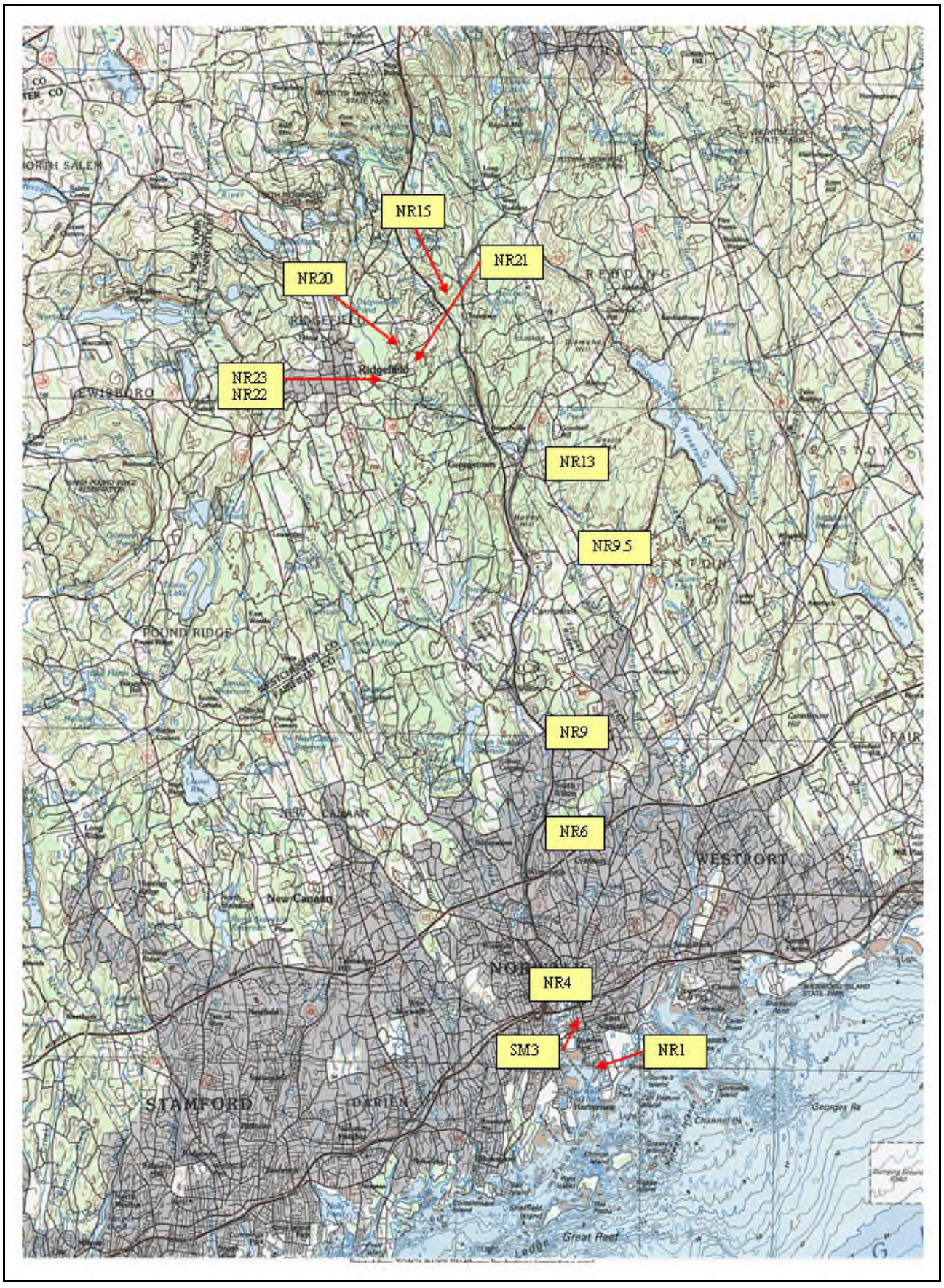


Table B1 Sampling site, date, time, air & water temperature, dissolved oxygen, conductivity, fecal coliform bacteria, *E. coli* bacteria, rainfall number of days prior to sampling, and QA/QC activity for monitoring events in the Norwalk River Watershed October 2007 through April 2008

			Air Temp.	Water Temp.	D.O.	COND.	Fecal Coliform.	E. coli	Amount of	Days prior		Fecal Coliform.
Site	Date	Time	° C	° C	mg/L	umho/cm	CFU/100 mL	CFU/100 mL	rain (in)	to sampling	QA/QC	CFU/100 mL
NR23	10/11/2007	1057	15.0	15.5	9.5	755	1600	1100	1.98	0		
NR22	10/11/2007	1107	15.0	19.5	7.4	863	0	0	1.98	0	Field Blank	0
NR21	10/11/2007	1112	15.0	16.9	5.0	839	2080	1420	1.98	0	Replicate	1800
NR20	10/11/2007	1121	16.0	16.2	4.7	828	820	640	1.98	0	Duplicate	700
NR15	10/11/2007	1135	16.0	16.6	9.0	798	560	500	1.98	0		
NR13	10/11/2007	1150	16.0	16.5	6.0	544	120	88	1.98	0		
NR9.5	10/11/2007	1150	17.0	16.8	7.4	399	52	44	1.98	0		
NR9	10/11/2007	1135	16.0	15.9	8.4	296	100	96	1.98	0		
NR6	10/11/2007	1122	16.0	16.6	8.0	291	500	400	1.98	0	Field Blank	0
NR4	10/11/2007	1102	17.0	16.7	8.9	261	288	56	1.98	0	Duplicate	272
SM3	10/11/2007	1050	17.5	17.1	8.0	205	1700	1460	1.98	0	Replicate	1460
NR1	10/11/2007	1030	17.0	17.5	9.0	304	1260	920	1.98	0		
NR23	11/1/2007	1032	16.0	12.2	10.1	743	32		1.06	5		
NR22	11/1/2007	1041	18.0	16.5	7.6	705	145	137	1.06	5	Field Blank	0
NR21	11/1/2007	1048	18.0	11.7	6.4	729	132	100	1.06	5		
NR20	11/1/2007	1056	18.0	11.2	8.9	686	72	56	1.06	5	Replicate	56
NR15	11/1/2007	1107	18.5	11.0	10.0	582	196	176	1.06	5	Duplicate	172
NR13	11/1/2007	1119	18.0	10.7	10.4	461	120	96	1.06	5		
NR9.5	11/1/2007	1135	18.0	11.0	11.5	429	42	38	1.06	5		
NR9	11/1/2007	1118	18.0	11.2	10.9	387	12	10	1.06	5		
NR6	11/1/2007	1110	17.0	11.6	10.7	378	64	48	1.06	5	Duplicate	72
NR4	11/1/2007	1045	18.0	12.1	11.3	366	180	132	1.06	5	Replicate	140
SM3	11/1/2007	1035	16.0	11.3	10.4	231	380	380	1.06	5	Field Blank	0
NR1	11/1/2007	1015	16.0	11.6	11.2	332	104	92	1.06	5		
NR23	12/6/2007	1036	-1.0	0.4	147.8	859	156	152	0.44	3		
NR22	12/6/2007	1043	-1.0	9.2	10.2	766	n/a	n/a	0.44	3	Field Blank	0
NR21	12/6/2007	1050	-1.0	0.8	11.8	664	104	80	0.44	3		
NR20	12/6/2007	1058	-3.0	0.7	11.4	714	108	80	0.44	3		
NR15	12/6/2007	1109	-2.0	0.2	14.8	647	68	44	0.44	3	Replicate	64
NR13	12/6/2007	1122	-1.0	0.7	15.0	512	64	48	0.44	3	Duplicate	60
NR9.5	12/6/2007	1156	0.0	1.2	14.2	438	34	24	0.44	3		
NR9	12/6/2007	1137	-1.0	1.2	14.3	400	22	16	0.44	3	Duplicate	28
NR6	12/6/2007	1126	0.0	1.1	14.0	389	52	48	0.44	3	Replicate	28
NR4	12/6/2007	1105	0.0	1.5	14.4	372	116	92	0.44	3	Field Blank	0
SM3	12/6/2007	1050	-1.0	1.0	13.6	235	44	44	0.44	3		
NR1	12/6/2007	1023	-2.0	1.7	14.0	335	60	60	0.44	3		
NR23	1/10/2008	1113	7.0	5.1	14.0	548	112	108	0.00	7		
NR22	1/10/2008	1122	8.0	10.7	9.0	554	2200	1100	0.00	7	Field Blank	0
NR21	1/10/2008	1127	8.0	1.9	11.6	520	32	28	0.00	7		
NR20	1/10/2008	1135	5.0	2.9	11.6	598	320	180	0.00	7	Duplicate	280
NR15	1/10/2008	1150	8.0	3.4	14.5	496	28	26	0.00	7	Replicate	24
NR13	1/10/2008	1207	8.0	4.0	13.3	384	20	20	0.00	7		
NR9.5	1/10/2008	1158	7.0	4.5	13.2	354	10	10	0.00	7		
NR9	1/10/2008	1144	7.5	4.7	13.2	330	22	20	0.00	7	Field Blank	0
NR6	1/10/2008	1126	8.0	4.5	14.3	327	16	4	0.00	7	Duplicate	14
NR4	1/10/2008	1107	9.0	4.7	13.9	324	32	24	0.00	7	Replicate	16
SM3	1/10/2008	1052	7.0	4.2	12.9	235	44	40	0.00	7		
NR1	1/10/2008	1025	9.0	5.0	13.7	299	88	56	0.00	7		

Table B1 (continued)

Site	Date	Time	Air Temp. ° C	Water Temp. ° C	D.O. mg/L	COND. umho/cm	Fecal Coliform. CFU/100 mL	E. coli CFU/100 mL	Amount of rain (in)	Days prior to sampling	QA/QC	Fecal Coliform. CFU/100 mL
NR23	2/14/2008	1035	0.0	2.0	14.6	543	1040	900	2.02	1		
NR22	2/14/2008	1045	1.0	7.0	10.9	525	3200	1900	2.02	1		
NR21	2/14/2008	1054	3.0	0.4	13.1	233	580	520	2.02	1	Field Blank	0
NR20	2/14/2008	1100	1.0	0.5	13.9	288	376	296	2.02	1		
NR15	2/14/2008	1112	0.0	0.7	15.4	319	900	600	2.02	1	Duplicate	760
NR13	2/14/2008	1128	0.0	0.8	15.2	294	176	124	2.02	1	Replicate	168
NR9.5	2/14/2008	1136	2.0	0.9	14.2	245	160	100	2.02	1		
NR9	2/14/2008	1122	1.0	1.0	14.0	225	150	108	2.02	1	Duplicate	130
NR6	2/14/2008	1103	7.0	1.0	14.1	201	124	112	2.02	1	Replicate	116
NR4	2/14/2008	1050	6.0	1.1	14.0	206	112	112	2.02	1	Field Blank	0
SM3	2/14/2008	1038	3.0	2.1	13.9	205	160	120	2.02	1		
NR1	2/14/2008	1020	2.0	1.5	14.2	206	192	168	2.02	1		
NR23	3/6/2008	1035	5.0	4.8	14.3	712	144	144	0.56	1		
NR22	3/6/2008	1045	6.0	8.2	10.7	678	5600	5100	0.56	1	Field Blank	0
NR21	3/6/2008	1052	6.5	1.3	11.9	284	44	44	0.56	1		
NR20	3/6/2008	1056	6.5	2.4	12.2	409	920	900	0.56	1		
NR15	3/6/2008	1110	6.5	2.4	14.8	405	116	96	0.56	1	Duplicate	104
NR13	3/6/2008	1125	6.5	3.7	15.0	340	40	40	0.56	1	Replicate	36
NR9.5	3/6/2008	1148	12.0	4.0	12.8	312	260	120	0.56	1	Duplicate	300
NR9	3/6/2008	1128	12.0	4.5	13.0	294	122	60	0.56	1	Replicate	108
NR6	3/6/2008	1112	12.0	4.2	13.1	260	44	44	0.56	1		
NR4	3/6/2008	1057	10.0	4.3	12.8	267	12	12	0.56	1		
SM3	3/6/2008	1043	8.0	4.0	12.7	215	56	56	0.56	1		
NR1	3/6/2008	1027	5.0	4.1	13.4	249	84	84	0.56	1	Field Blank	0
NR23	4/3/2008	1043	9.0	5.9	12.3	796	32	32	0.74	2	Replicate	20
NR22	4/3/2008	1056	11.0	9.8	7.9	740	TNTC	n/a	0.74	2		
NR21	4/3/2008	1105	12.0	5.4	10.0	588	276	224	0.74	2	Field Blank	0
NR20	4/3/2008	1110	10.0	5.6	12.7	603	880	740	0.74	2		
NR15	4/3/2008	1120	10.0	6.9	12.7	551	36	32	0.74	2		
NR13	4/3/2008	1135	9.5	7.1	14.0	402	22	22	0.74	2	Duplicate	20
NR9.5	4/3/2008	1150	7.0	8.4	13.2	358	18	8	0.74	2	Replicate	14
NR9	4/3/2008	1138	6.0	7.3	12.5	326	10	6	0.74	2		
NR6	4/3/2008	1124	7.5	6.6	13.9	299	20	20	0.74	2		
NR4	4/3/2008	1105	8.0	6.6	14.0	299	24	16	0.74	2	Field Blank	0
SM3	4/3/2008	1053	5.0	6.3	13.0	232	42	18	0.74	2		
NR1	4/3/2008	1036	9.0	7.5	13.3	282	52	40	0.74	2	Duplicate	32

Table B2 Results of fecal coliform bacteria counts (colonies/100 mLs) inter-laboratory services with the Norwalk Public Health Laboratory (NPHL)

Date	Site	Fecal coliform bacteria counts (NPHL)	Fecal coliform bacteria counts HW/RW Lab
5/3/2007	NR20	n/a	36/30
5/3/2007	SM3	n/a	104/80
5/9/2007	NR15	n/a	48/52
5/9/2007	NR4	n/a	198/2006
5/17/2007	NR20	n/a	700/600
5/17/2007	NR6	n/a	500/440
5/24/2007	NR23	0	70/ng
5/24/2007	NR9	164	134/144
6/7/2007	NR23	120	64/70
6/7/2007	NR9	190	128/92
6/13/2007	NR15	420	480/520
6/13/2007	NR9	400	288/ng
6/21/2007	NR13	n/a	390/340
6/21/2007	NR9.5	n/a	108/82
6/27/2007	NR23	140	136/148
6/27/2007	NR1	n/a	500/460
7/5/2007	NR20	960	1000/940
7/5/2007	NR9.5	520	250/200
7/11/2007	NR13	224	192/246
7/11/2007	NR1	620/960	800/800
7/19/2007	NR20	244	380/240
7/19/2007	NR9	284	296/204
7/25/2007	NR13	380	304/300
7/25/2007	NR6	216	180/204
8/1/2007	NR20	144	208/140
8/1/2007	NR9	300	240/240
8/8/2007	NR13	19,600	20,400
8/8/2007	NR9.5	14,500	9,200
8/16/2007	NR15	396	380
8/16/2007	NR9.5	108	120/120
8/22/2007	NR13	620	1000/920
8/22/2007	NR1	1300	1800/1500
9/5/2007	NR23	n/a	144/140
9/5/2007	SM3	n/a	92/72
9/12/2007	NR21	640	580/500
9/12/2007	NR4	2100	2000/2000
9/20/2007	NR15	n/a	136/180
9/20/2007	NR6	n/a	216/256
9/26/2007	NR21	n/a	84/80
9/26/2007	SM3	n/a	60/48

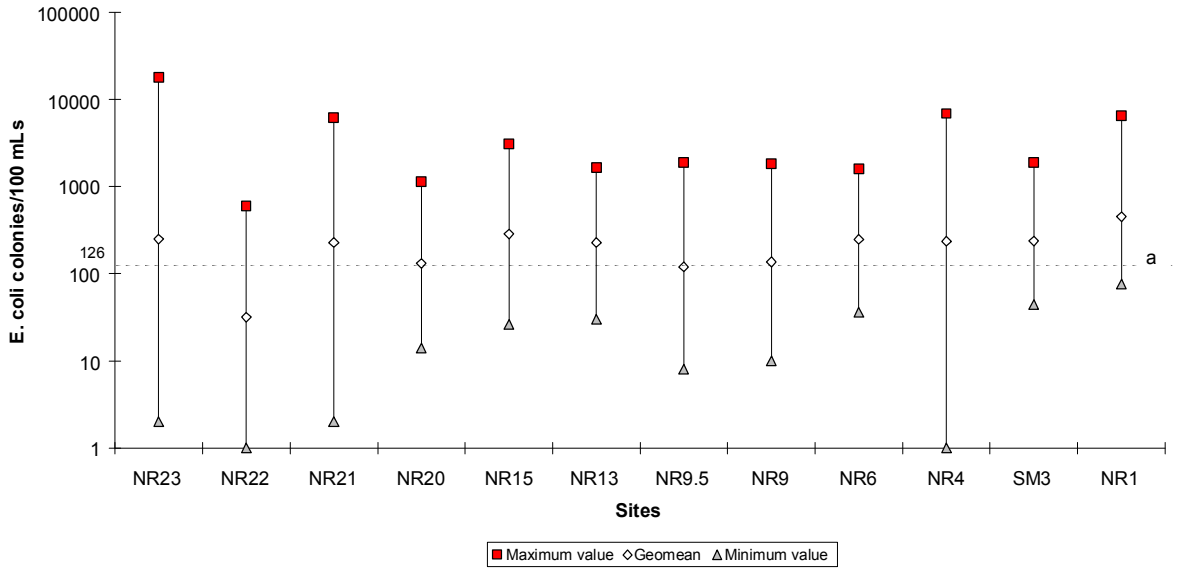
Appendix C

How to read the graphs in this report

Monitoring data are presented in this report with graphs and tables. Selected Figures and Tables are used to highlight critical parameters of the Norwalk River's water quality on either a monthly or total project basis. The following are some examples of the types of graphs and how to read them.

Graphs of Physical and Bacteria Data
Physical and bacteria data are graphed in the following way:
During a sampling period (usually a three month period) the *E. coli* colony concentration, the dissolved oxygen level and the conductivity are graphed by displaying the maximum value, the minimum value, and the mean or geomean value for each sampling site. The graph below is an example of a graph displaying *E. coli* counts

An example of a graph for maximum, geometric means, and minimum values of *E. coli* bacteria concentrations at 12 monitoring sites in the Norwalk River Watershed when the two Ridgefield and one Georgetown wastewater treatment facilities are required by NPDES permits to disinfect sewage effluent

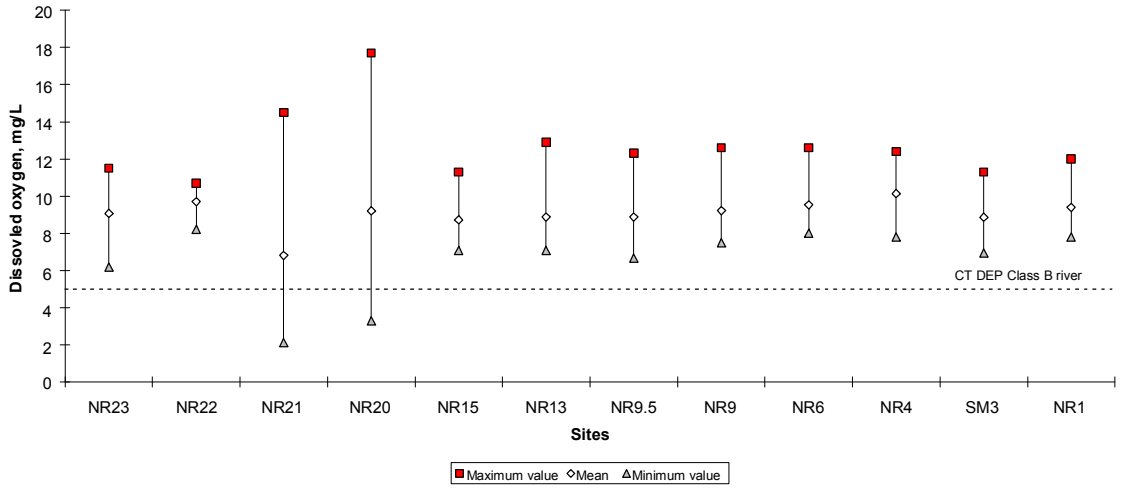


Upstream to Downstream

[a]CT DEP water quality geometric mean limit for *E. coli* bacteria level for Class B rivers

The previous graph shows the results for E. coli bacteria for the Norwalk River watershed. The sample sites are arranged along the bottom (X-axis), upstream to downstream, left to right. The concentration of *E. coli* bacteria forming units (CFUs) per 100 mL is arranged on the logarithmic scale along the left (Y-axis). The dashed horizontal line at 126 colonies/100 mL (left Yaxis) indicates the geomean *E. coli* criterion in the Connecticut Department of Environmental Protection (CT DEP) Water Quality Standards (WQS) that are set for Class B surface waters. The geometric mean presents results of all sample runs in a way that minimizes the impact on the entire data set by very high or very low individual results An *E. coli* geometric mean marker extending above this line exceeds the criterion. For example, every site except NR22 exceeded the geomean criterion

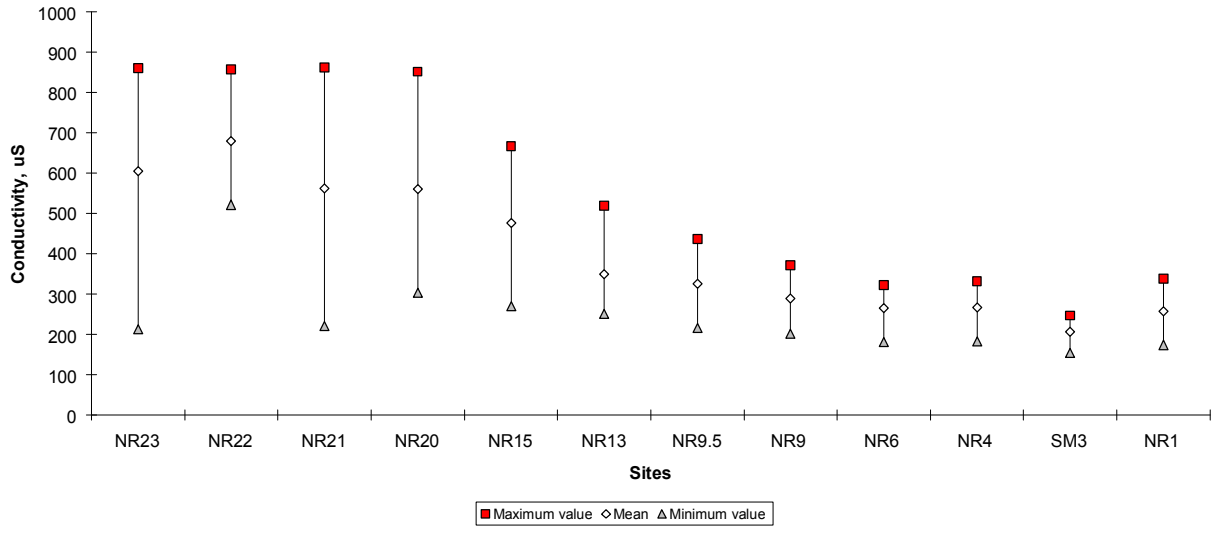
The graph below is an example of a graph showing maximum, mean and minimum values for dissolved oxygen at 12 sampling sites on the Norwalk River Watershed



5 mg/L dissolved oxygen = The CT DEP water quality standard for a Class B rivers

The graph above is read in the same way as the previous one. However, it displays the maximum, minimum values and the mean for dissolved oxygen levels for each sampling site during the sampling period. The dashed horizontal line shows the CT DEP water quality standard for dissolved oxygen for a Class B river. In the example above all mean values for dissolved oxygen meet the CT DEP Class B criterion for dissolved oxygen. However, Sites NR21 and NR20 had minimum readings below the CT DEP criterion.

An example of a Conductivity graph is below.



The line graph above again displays the conductivity range (maximum value to minimum value) with the mean for that range. The conductivity is recorded in micro-Siemens (*u*S)

Appendix D

Glossary

Dissolved oxygen: The oxygen dissolved in water and readily available to aquatic organisms expressed in milligrams per liter (mg/L) or parts per million (ppm). Connecticut's Water Quality Standards requires that the dissolved oxygen of a Class B stream shall not be less than 5 mg/L at any time.

Conductivity: Conductivity is a measure of the ability of water to pass an electrical current. Conductivity of water is positively affected by the presence of inorganic dissolved solids such as chloride, nitrate, sulfate, and phosphate (ions that carry a negative charge) as well as sodium, magnesium, calcium, iron and aluminum (ions that carry a positive charge). Conductivity is useful as a general measure of stream water quality. Each stream tends to have a relatively constant range of conductivity measurements. Significant changes in conductivity can be used as an indicator of pollution entering a stream. For example, the presence of metal trash in water and/or the use of iron pipes can increase conductivity. An elevated conductivity level can also occur from natural sources such as the presence of limestone in streambeds. Conductivity is measured in micromhos per cm, (µmhos/cm) a measure of conductance equal to one millionth of a mho/cm. While there is no CT DEP criterion for conductivity, the rivers in the United States generally range from 50 to 1500 µmhos/cm. Studies of inland fresh waters indicate that streams supporting good mixed fisheries have a range between 150 and 500 µmhos. Conductivity values outside this range could indicate that the water is not suitable for certain species of fish or macro invertebrates.

Fecal coliform bacteria: Fecal coliform bacteria are that portion of the coliform group that originates in the intestinal tract of man and other warm-blooded animals. Fecal bacteria are used as indicator organisms, which are not usually harmful to man. Their presence indicates that pathogens (such as cholera, salmonella, etc.) may be present in surface waters. The higher the count in colonies per 100 milliliters indicates a higher probability that pathogens are being discharged to surface waters. Fecal bacteria are used because they are more universal and survive for longer periods than pathogens in water. The Connecticut Water Quality Standards for a Class B stream are as follows: As an indicator of general sanitary quality Fecal coliform bacteria shall not exceed a geometric mean of 200 organisms/100 mL in any group of samples nor shall 10% of the samples exceed 400 organisms/100 mL.

***E. coli* bacteria:** *Escherichia coli* (*E. coli*) bacteria are one of two organisms that comprise fecal coliform bacteria. Studies have indicated that *E. coli* alone may be a more specific indicator organism of gut level contaminants to fresh surface waters from either man or animal. The other organism comprising coliform bacteria is *Klebsiella*, which sometimes occurs in soil or leaves. The EPA recommends *E. coli* as the best indicator of health risk from water contact in recreational waters.

Quality Assurance/Quality Control (QA/QC): Analytical measures taken to assure that field and laboratory work meets the highest standards of precision and accuracy. QA is an integrated management system designed to ensure that a product or service meets defined standards of quality with a stated level of confidence. QA activities involve planning quality control, quality assessment, data management and quality improvement. QC is the overall system of technical activities designed to measure quality and limit error in a product or service. A QC program
manages quality so that data meets the needs of the user as expressed in a quality assurance project plan. All scientific analysis of the Norwalk River is accomplished in accord with an EPA approved QA/QC which was re-approved on April 25, 2001 and covers the monitoring period from April 2001 through September 2001.

Water temperature: Water temperature is measured in degrees centigrade (^{o}C). Connecticut's Water Quality Standards state that no temperature increase is allowable except when the increase will not exceed the recommended limit on the most sensitive receiving water use. In no case shall the temperature exceed 85 ^{o}F (29.4 ^{o}C), or in any case raise the normal temperature of the receiving water more than 4 ^{o}F (2.2 ^{o}C).

Rainfall: Rainfall measurements used in this report follows criteria used by the CT State Health Services. The day of sampling is referred to as day zero. Days are numbered backwards from the testing date to the first rainfall in inches prior to the testing date. For example, if a test was conducted on Monday 5/25 and the previous rain of 0.2 inches occurred on 5/18, the records would indicate 0.2 inches for the amount of rain occurring seven days before the sampling date. If the rain were continuous over the time period, for example, if 0.3 inches fell on 5/17 and 0.2 more inches fell on 5/18, rainfall would be shown as 0.5 inches occurring seven days before the sampling. Rainfall is recorded at rainfall monitoring station located at the Town Hall in Norwalk.

Storm events: Storm events are classified as rainfall exceeding one inch in 24 hours. This much rain will increase surface runoff (input) and flow through the storm drain networks. Stormwater runoff carries many pollutants to the river, especially during the first hour.

Observations: Observations are noteworthy occurrences in the river ecology such as the appearance of stranding blue-green algae, a flock of geese or fish kills. These observations can be incorporated into the data record sheets. These help provide a seasonal definition for water related problems which are not recorded elsewhere.

Seasonal Disinfection: Seasonal disinfection is action taken by a wastewater treatment plant to eliminate bacteria from the effluent discharge. Connecticut's Water Quality Standards require disinfection for the period of May 1st through September 30th at all Wastewater Treatment Plants discharging effluent into streams north of Route I-95. The process is carried out by chlorination or exposing the effluent to ultra violet light just prior to discharge. The period of this disinfection presently takes place when the public is deemed more likely to be fishing or bathing in the water.