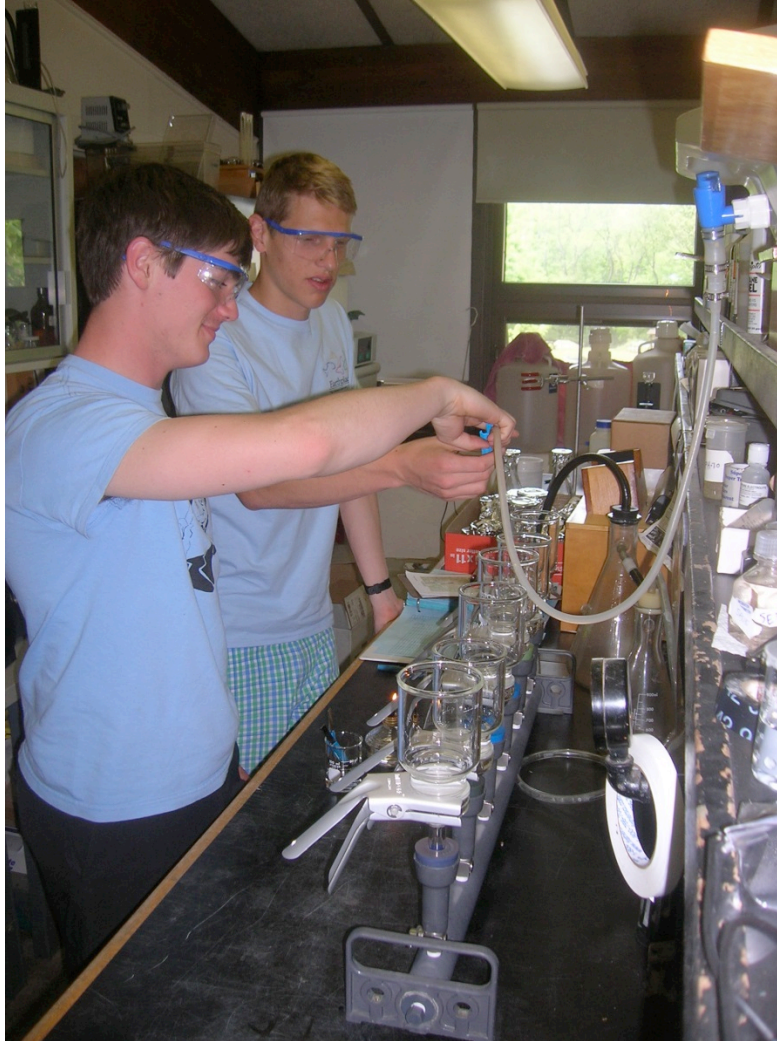


**Water Quality Data Report
For
Norwalk River Watershed
May through September 2014**



Senior Interns complete membrane filtration on Norwalk River samples

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Introduction:

Purpose of Study: The Earthplace Harbor Watch (HW) 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 initially collected and analyzed water samples for fecal coliform bacteria at 21 sites, eleven of them along the main stem of the Norwalk River and one on the Silvermine River (Figure 1, Figure 2).

Background: From June 1998 through May 1999, HW 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 determined that the water quality in the Norwalk River Watershed was moderately impaired.

The CT DEP and HW executed a contract for a second year funding in September 1999 (from September 1, 1999 through November 30, 2000). HW was authorized to begin testing for *E. coli* bacteria in November 1999. Sampling was then limited to 12 of the 21 most impacted 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 and all contributing organizations.

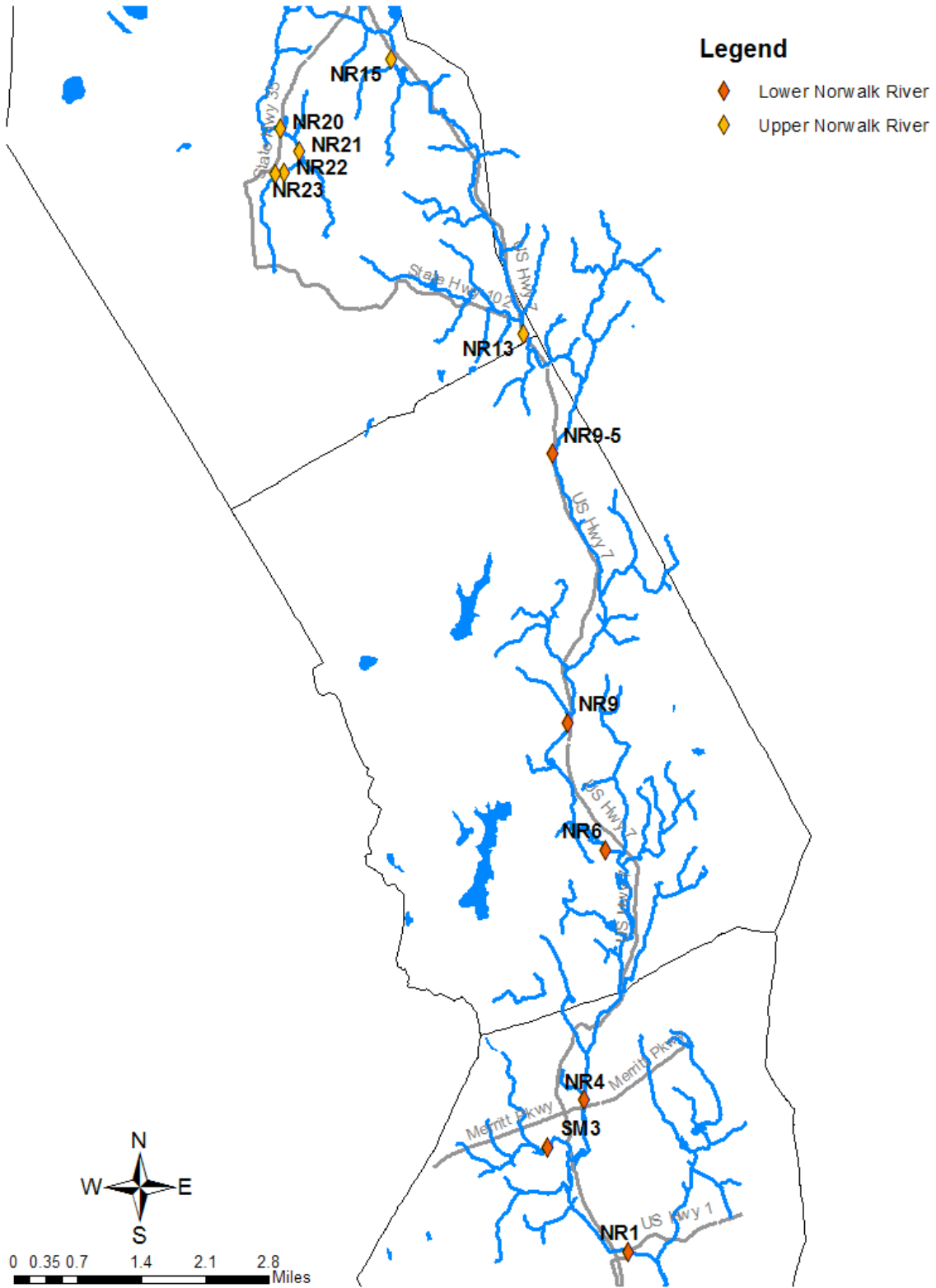
Funding was then made available by the CT DEP to continue testing on the Norwalk River for a third summer (April 1 to September 30, 2001) based on a continuing interest by Norwalk River Watershed Advisory Committees and the CT DEP. The same testing protocols, used in 2000 by HW, were again used under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

During 2002, the CT DEP switched to *E. coli* bacteria as the "preferred" indicator species for freshwater, as it is a more specific indicator of fecal material arising from humans and other warm-blooded animals. Presently the Norwalk River is monitored on a year round basis with weekly testing at 12 test sites from May 1st through September 30th and monthly testing from October through April.

Additional 319 funding was allocated to continue the HW 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. HW again renewed testing of the Norwalk River and its tributaries on May 1, 2005 thanks to the interest and generosity of the Town of Wilton, The Norwalk Mayor's Water Quality Committee, The Wilton Inland Wetlands Commission, King Industries, Norwalk River Watershed Association, Inc., NRG-Manresa, Town of Ridgefield, Norm Bloom, Leslie Bloom-Miklovich, and Trout Unlimited (both the Mianus and Nutmeg chapters) have collectively continued to provide additional funds to support the 2011/2012 monitoring season.

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

Figure 1 Location of 12 monitoring sites in the Norwalk River Watershed



Methods and Procedures: Water monitoring is carried out under Quality Assurance Project Plan (QAPP) RFA#10160 approved by CT DEEP and EPA on 9/10/10 for five years. Monitoring teams leave Earthplace in Westport at 9:30am and return at 11:00am. The team is comprised of a fully trained Harbor Watch employee and three volunteers. Water samples are collected at 12 (Figure 1) monitoring sites along the length of the river. These sites, which represent the more impacted sites and developed areas, were selected in concert with the CT DEEP, because results from the first year’s study consistently demonstrated elevated fecal coliform bacteria counts at these locations.

The following tests are run *in situ*: dissolved oxygen (QAPP Appendix A3.2) and conductivity (QAPP Appendix A3.3). 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 data sheet.

Upon return to the lab, fecal coliform bacteria membrane filtration tests (QAPP Appendix A3.5) are performed and *E. coli* testing is carried out according to Standard Methods, 22nd edition (9222D & 9222G) and recorded (QAPP Appendix 5) on the HW bacteria log. During the monitoring period, 5/1 through 9/25/14, sites were monitored weekly.

E. coli bacteria will be evaluated against the criteria published in the CT DEEP Surface Water Quality Standards, 2/25/11. The CT DEEP *E. coli* criterion for Class AA, A, and B water is established at three levels (Table 1).

The Norwalk River is classified for “all other recreational uses” because people do not bathe in or drink the river water and it is too shallow for swimming. The report will focus on *E. coli* bacteria levels, because it is the indicator bacteria of choice by the CT DEEP.

Table 1 CT DEEP criterion for *E. coli* bacteria levels as applied to recreational use, effective 2/25/11

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

CFU stands for Colony Forming Units. A colony is raised from a single bacterium to a visible colony for counting by providing the preferred heat range and media for 24 hours.

Nutrient data sample collection is carried out by HW using preserved bottles and transported on ice to York Analytical Laboratories in Stratford, CT for analysis of total nitrogen (TN) and total phosphorous (TP).

Preliminary HW nutrient assessment was carried out at 6 sites in the upper Norwalk River during 7/17, 7/30 and 8/7 in preparation for possible routine assessment of TN and TP for the 2015 summer season. After acquiring a new Hach spectrophotometer, model DR3900 and a new digester model DRB200, HW

has begun trials to make sure the acquired technology will reliably meet stated MDLs, precision, and accuracy. To that end side by side sampling trials for TP and TN were run on three dates during the 2014 summer season with the inter-labing done by York Analytical Laboratories Inc. in Stratford, CT.

Initial results have proven that the new spectrophotometer and digester will meet the EPA criteria for nutrient monitoring. More tests need to be initiated and completed by HW to use the technology to its best advantage and efficiency. A QAPP section for all EPA approved HW QAPPs and HW environmental laboratory protocols needs to be written and approved by the EPA and the CT Dept. of Public Health (CT DPH) for the new equipment prior to full utilization for summer 2015. Results of TN and TP testing in the upper Norwalk River 7/17, 7/31 and 8/7 done at five sites were revealing and of interest (Table 7, Table 8). Monitoring results from York Lab only are used in this report as their lab is certified by CT DPH.

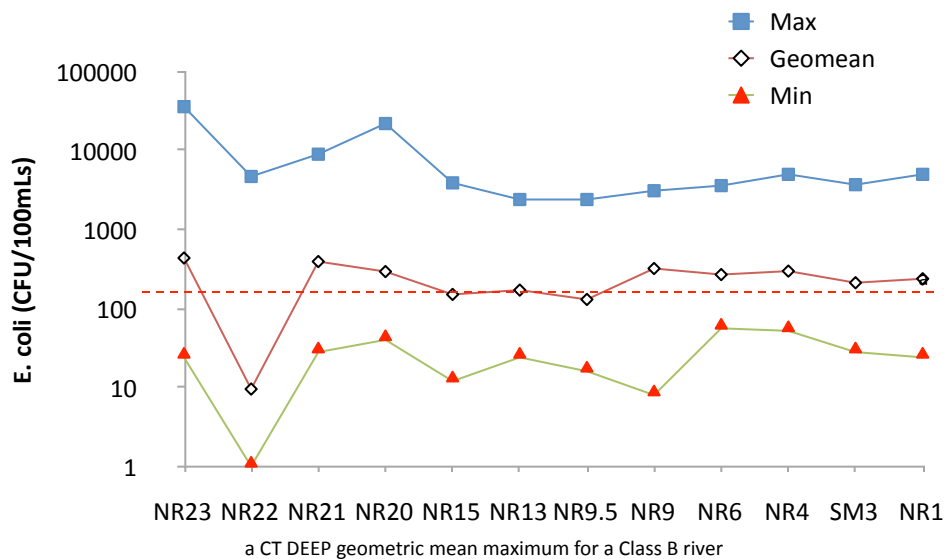
Results: Observed *E. coli* geometric means exceeded the CT DEEP *E. coli* criterion for a class B river of <126CFUs/100mLs at all sites except for NR22 (Figure 2, Table 2). All twelve sites exceeded the CT DEEP single sample maximum (SSM) of <10% over 576 CFU/100mL of all samples taken at a single site for a Class B river (Table 2).

All twelve sites passed the CT DEEP mean minimum of 5mg/L for dissolved oxygen (Figure 3). There were two individual sites, NR21 and NR20, which fell below 5mg/L on multiple days. The lowest reading was observed at site NR20 on 8/14 of 4.1mg/L (Figure 3, Table 3).

Conductivity means ranged from a maximum of 860µS at NR23 to a minimum of 286µS at SM3. The widest conductivity range was observed at NR23 with a range of 1149µS and narrowest at SM3 with a range of 307µS (Figure 5).

Six sites were also monitored for total nitrogen (TN) and total phosphorous (TP) in the Upper Norwalk River, NR23, NR22, NR21, NR20, NR15, and NR13, exceed CT DEEP Water Quality Standards for oligotrophic levels in lakes¹ (Figure 7, Figure 8).

Figure 2 Maximum, geometric means, and minimum *E. coli* values for twelve sites in the Norwalk River watershed from May through September 2014



¹ There are currently no standards for rivers set by the CT DEEP for nutrients values in moving water, so the trophic level of lakes as set forth by CT DEEP is used here as a guide for TN and TP concentrations.

Figure 3 Maximum, average, and minimum dissolved oxygen values for twelve sites in the Norwalk River watershed from May through September 2014

a CT DEEP minimum criterion for dissolved oxygen for Class B river

Figure 4 Maximum, average, and minimum conductivity values for twelve sites in the Norwalk River watershed from May through September 2014

Figure 5 Rainfall for the monitoring period May through September 2014

Figure 6 Maximum, average, and minimum water temperature values for twelve sites in the Norwalk River watershed from May through September 2014

Table 2 Observed *E. coli* counts on each sampling date, geometric means and % frequency exceeding 576 CFUs/100mLs for each site in the Norwalk River watershed during the May through September 2014 monitoring period

	5/1/2014	5/8/2014	5/15/2014	5/22/2014	6/5/2014	6/12/2014	6/19/2014	6/26/2014	7/10/2014	7/17/2014	7/24/2014							
NR23	400	960	96	500	>100,000	52	20000	500	840	92	36000							
NR22	9	1*	1*	1*	>100,000	>100,000	1*	1*	1200	400	4700							
NR21	540	84	28	284	4100	220	9000	640	300	170	660							
NR20	560	64	40	720	1900	260	22000	2000	136	72	280							
NR15	Bottle Lost	12	24	92	2100	580	3900	540	156	116	480							
NR13	580	28	36	332	800	76	2400	330	228	84	380							
NR9.5	500	52	16	60	2300	48	2400	80	280	52	140							
NR9	480	8	56	112	1300	156	3100	380	560	208	500							
NR6	560	60	60	660	2800	132	3600	330	900	180	300							
NR4	540	152	120	820	5000	1280	3100	270	620	248	220							
SM3	460	104	68	300	3700	200	1500	230	192	232	164							
NR1	680	88	160	700	4500	204	5000	150	280	163	160							
Rain (in)	5.43	1.73	0.76	1.16	0.89	1.29	0.99	1.88	1.75	1.47	0.27	0.45	1.85	1.34	1.48	2.63	0.38	0.08
Days Prior	0	0	6	0	0	0	0	3	0	0	7	7	1	2	2	2	1	1

	7/31/2014	8/7/2014	8/14/2014	8/21/2014	8/28/2014	9/4/2014	9/11/2014	9/18/2014	9/25/2014	Geomean	% Freq over 576 CFU/100 mLs			
NR23	24	2600	960	1100	5300	70	32	104	64	436	45%			
NR22	31	2200	100	1*	1	1	3	1	1*	40	25%			
NR21	340	1700	420	212	980	460	148	192	184	393	30%			
NR20	140	1380	580	88	620	92	56	84	136	293	35%			
NR15	56	1000	460	60	212	64	24	20	40	151	20%			
NR13	320	192	380	52	144	180	56	24	156	171	15%			
NR9.5	40	160	440	72	260	44	92	40	208	130	10%			
NR9	320	480	480	320	420	500	380	420	500	321	10%			
NR6	172	1060	480	56	128	116	120	72	216	269	25%			
NR4	52	1700	600	68	144	80	64	60	124	297	35%			
SM3	140	3200	240	28	96	92	84	112	72	212	15%			
NR1	140	1160	300	60	116	100	68	24	180	238	25%			
Rain (in)	0.2	0.2	0.3	0.48	1.60	1.42	0.10	0.02	0.40	0.08	0.32	1.38	0.42	0.84
Days Prior	4	3	5	5	1	1	0	0	1	1	4	5	5	0

*Actual observed count is zero, but geomean cannot be calculated with zeros so they were changed to one.

Italic rainfall data are from the Ridgefield Wastewater treatment plant which indicates slight difference in precipitation farther north. All other rain data is acquired from the City of Norwalk.

Table 3 Observed dissolved oxygen readings that fell below 5mg/L during the 2014 May through September monitoring period

Site	Date	DO Value
NR21	8/14/2014	4.8
NR20	8/14/2014	4.1
	9/11/2014	4.7

Figure 7 Total Nitrogen values at the Upper Norwalk River sites over three separate monitoring days

*CT DEEP Water Quality Standards for TN in of CT lakes, line indicates oligotrophic levels

Figure 8 Total Phosphorus vlaues at the Upper Norwalk River sites over three separte monitoring days

*CT DEEP Water Quality Standards for TP in CT lakes, line indicates oligotrophic levels

Discussion: Monthly rainfall averaged at 3.46in/month which is an inch below the normal average of 4.5in/month (Figure 5). It should be noted that the 5.43in of rain recorded on 5/1 is a culmination of 1.29in that fell on 5/1 and an additional 4.14in that fell on the previous 7 days at the end of April. There were several monitoring dates in June, 6/5 and 6/19, that received over 1in of rainfall during sampling which led to observed *E. coli* bacteria counts in the thousands (Table 2).

Eleven monitoring sites exceeded both the CT DEEP geometric mean criterion for a class B river of <126CFUs/100mLs and the SSM value of 760CFU/100mLs (Table 2). Past research indicates that this is an abnormally high number of sites not meeting the CT DEEP criteria. Unfortunately there were no signs identified during sampling, such as grey water or random discharges, which indicated pollution sources. Monitoring will continue during the winter period of October through April once a month.

Rainfall initially appeared to have had a large impact on results observed at the discharge site NR22 on 6/5 and 6/12 for the Ridgefield Wastewater Treatment Plant (RWTP), despite the fact that the plant keeps its UV lights on during the monitoring period to sanitize the effluent (Table 2). During the 2014 summer monitoring period only seven out of the twenty monitoring days attained bacteria counts of 0 CFU/100mls (Table 2). It is important to note that the geometric mean for *E. coli* bacteria from the plant's effluent, site NR22, is at 40 CFU/100mLs which meets the CT DEEP geometric criterion (Table 2, Figure 2). Nevertheless, on 6/5 and 6/12 the incubated samples were too numerous to count based on 1mgL effluent samples. Both monitoring days for site NR22 could not be included in the geometric calculations. In addition, the corresponding SSM value is at 25%, which exceeds the CT DEEP *E. coli* SSM criterion (Table 1, Table 2, Figure 2).

Based on past history, HW records show the majority of all seasonal (April through October) bacteria counts at zero as observed at the plant discharge pointing to efficient use and maintenance of UV lights during effluent disinfection. To gain a better understanding of the elevated bacteria counts in the Ridgefield WTP discharge as observed by HW, two possible problems that could negatively impact effluent quality were discussed with the plant manager. The first of these events would be very heavy rains causing the plant to exceed design capacity of 0.7mgd which would have the effect of shortening residence time and reducing plant efficiency (Table 2). The second would be an upset in plant operations that would show up in reduced water quality of the discharge. After a review of the plant's environmental records it was clear that neither of these events occurred, i.e., rainfall was not excessive at the Ridgefield WTP prior to the five monitoring dates (Table 2), plant thruput was below or slightly exceeded nameplate capacity and there was no plant record of operational upsets (Table 4).

Table 4 Harbor Watch monitoring dates for the Norwalk River and Ridgefield Waste Water Treatment Plant effluent volumes on those dates

Monitoring dates	6/8	6/12	7/10	7/24	8/7
Plant throughput mgd.	0.77	0.69	0.63	0.58	0.56

A review of HW monitoring records for site NR 22 also showed no irregularities for the monitoring dates in question. Norwalk interns confirmed that samples were taken at the discharge (site NR22) as directed. There is no apparent reason for these discrepancies and after 8/14 HW was again able to confirm that the RWTP effluent was at 0 CFUs/100mLs (Table 2).

Observed DO means met the CT DEEP criteria with the exception of individual readings at two sites, NR21 and NR20 (Table 3) The reason for these low DO values can be attributed to the large expanse of The Great Swamp at Ridgefield where the quality of slow moving water quality is exposed to direct sunlight and heat prior to being routed downstream to the faster moving currents of the river.

Conductivity ranges are wide in the upper sites of the main river. This is expected because the headwaters are affected by the presence of limestone beds on the river banks in Ridgefield. As the river flows to the estuary, the conductivity is sequentially diluted by the lower conductivity values of the incoming tributaries such as Cooper Brook, Branchville Brook and Comstock Brook that begin entering the river just above site NR13. The lower Norwalk River monitoring sites from NR9.5 down show better stability during the dry period of the summer (Figure 4). Conductivity mean values in the upper river (sites NR23, NR 20 and NR15) are elevated and are subject to wider ranges due to the impact of storm water runoff on exposed limestone beds in the Ridgefield area (Figure 4).

Nutrient samples, total nitrogen (TN) and total phosphorus (TP), were collected on three monitoring days between July and August (Figure 7, Figure 8). All observed nutrient concentrations exceed the CT DEEP oligotrophic water quality standards for lake water or impoundments, i.e., .010mg/L for TP and .20mg/L for TN (CT Water Quality Standards, 2/25/2011). The highest levels of total nitrogen recorded were observed on 7/31 at site NR21, followed closely by elevated values at sites NR20 and NR22 (Figure 7). Currently, the wastewater treatment plant in Ridgefield (throughput of approximately 0.7mgd) has no permit regulations for nitrogen removal in their effluent stream although pending design improvements to the existing system will modernize the plant for controlled nitrogen removal in the future (Figure 7). Site NR21 at Farmingville Road had the highest observed TN levels on 7/31 (Figure 7) and the highest levels of TP on 8/7 (Figure 8) although these concentrations do not appear to totally be the result of the RWTP discharge less than ½ mile away. The plant's TP discharge on the three dates is less than 0.1mg/L (Figure 8) which meets the latest NPDES maximum permit levels for plants designed to treat effluent for phosphorous. Although the plant's nitrogen discharge is elevated on 7/31, it still does not exceed the rate of 3.8mg/L for TN (Figure 7) shown on the same date for site NR21. It is possible that by comingling waters of the adjoining Great Swamp with the previously discharged effluent just downstream from site NR22, TP and TN levels could be higher at site NR21 (Figure 7) due to the release of nutrients caused by naturally occurring biological decomposition (regeneration) in the swamp. Further downstream, site NR15 had observed elevated TP levels exceeding 0.2mg/L for all three monitoring days (Figure 8). It is speculated that these elevated counts are possibly a result of the effluent from a small, secondary WTP (throughput estimated at .05mgd) located in Ridgefield off Route 7 plus the addition of TP in fertilizer runoff from a golf driving range (located approximately ¼ miles upstream) entering Ridgefield Brook (Figure 8). The Route 7 plant is presently not required by NPDES permit to remove nutrients. Pending the allocation

of funding, ultimately this plant will also be required to meet NPDES permit removal requirements for TN and TP in the future.

Downstream at sites NR15 and NR13, TN levels decline to less than 1mgL due to dilution and uptake by macro algae at several small ponds, the largest of which is Factory Pond in Georgetown (Figure 1). Elevated TP levels (the limiting nutrient) also decline below .2mgL for the same reasons although enough TP remains downstream of Georgetown to cause nuisance algae proliferation in other Norwalk River impoundments downstream (Figure 7, Figure 8).

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
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"
NR21	Farmingville Road at the Great Swamp outlet	Ridgefield	Latitude: N 41° 17' 40.2" Longitude: W 73° 29' 18.5"
NR20	Danbury Road north of Farmingville Road intersection	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"