Analysis of the Effects of the 2003 and 2004 Home Heating Oil Spills on the Macroinvertebrate and Trout Populations of Deep Brook and the Pootatuck River

(Phase I, Background and October, 2005 Sampling)

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In conjunction with
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Table of Contents

I. Introduction:

Background

The purpose of this report is to document the first phase and background information of the controlled, two-year study on stream health of Deep Brook and Pootatuck River, which is being conducted by the Candlewood Valley Chapter of Trout Unlimited. After two oil spills in two successive years, the Newtown community and Trout Unlimited had expressed significant concern on how the two streams were affected. After the second spill from the Reed Intermediate School, the Environmental Protection Agency expressed intent to fine the Town of Newtown. Trout Unlimited suggested that this fine should be used in part to conduct a supplemental environmental project (SEP) by conducting studies on the stream health. One of these studies, the effect of the oil contamination on the macroinvertebrate population and sequentially the native brook and brown trout populations, will be discussed in this report. Deep Brook is of special concern, in that it is one of only eight Class 1 Trout Streams in the State. Deep Brook runs into the Pootatuck River, which is known for being a productive trout habitat. Both streams together are Wild Trout Management Areas.

On December 13, 2003, 4550 gallons of #2 heating oil spilled into an unnamed tributary of Deep Brook, referred to in this report as "Oil Creek". The spill occurred when a boiler feeder line broke on the Fairfield Hills Campus. The oil reached a storm water sewer in Fairfield Hills and was emulsified with the storm water when it reached Deep Brook. Approximately 100 gallons of oil were estimated to reach Deep Brook. The State Department of Public Works, who were in charge of Fairfield Hills at the time, took responsibility for the cleanup. The cleanup consisted mostly of the removal of large amounts of contaminated soils from the Fairfield Hills Campus and installation of booms and other oil control measures on Deep Brook. A heavy rain and resulting increased flow rates directly after the spill helped remove and dilute some of the oil, and therefore decreased immediate effects. The Department of Environmental Protection examined the site and concluded that a fish kill had occurred in Deep Brook.

On December 8, 2004, a second spill occurred in the area. Approximately 4,000 gallons of #2 heating oil were spilled at Reed Intermediate School on Wasserman Way in Newtown. The spill traveled into the gravel bedding around a sanitary sewer line, which ran underneath Deep Brook. The oil then contacted the groundwater near Deep Brook, and began to bubble to the surface of the stream. Approximately 100 gallons of heating oil were estimated to reach Deep Brook, only 100 feet from the 2003 spill site. The second spill was not emulsified with water. The spill was noticed quickly, and a system of in-stream booms was put in place to control the spill. The EPA and DEP stated that no known fish kill had occurred. A pump system which removes groundwater and separates the oil from was installed and continues in place at this time. The locations of the oil spills and the general study area are shown in Figure 1.

In April of 2005, EPA expressed intent to fine the Town of Newtown, and use the awarded money for a SEP to conduct environmental studies focusing on overall health of Deep Brook, and the Pootatuck River. The Candlewood Valley Chapter of Trout Unlimited agreed to conduct the study.

Study Objectives

The objective of this study is to collect macroinvertebrate population data, and use this data to determine stream health, water quality, water quality changes, and identify potential threats to the Deep Brook/ Pootatuck River area. Six different samples sites were selected in cooperation with the State of Connecticut Department of Environmental personnel (DEP). The sites were, one as a control of Deep Brook, one as a control of the Pootatuck River, two sites on Deep Brook below the spills, and two on the Pootatuck River after its convergence with Deep Brook (see Figure 1 for sampling locations). Spring and fall sampling of macroinvertebrate species density, over a period of two years, will be analyzed. In addition, a sampling of the populations of native brook and brown trout will be conducted by the DEP. The DEP has a variety of historical macroinvertebrate data collected periodically over the past 20 years which will be compared to data from this study. A consensus on impacts to the stream and stream health will be determined after completion of the studies. From this information, it will be decided what, if any, restoration measures are necessary for the streams and their ecosystems.

II. Study Plan:

The following is the original study plan created by the Candlewood Chapter of Trout Unlimited:

Background – The Town of Newtown has entered into a Compliance Order on Consent with the US Environmental Protection Agency as the result of an oil spill at the Reed Intermediate School. As a part of this Order, the Candlewood Valley Chapter of Trout Unlimited (CVTU) agreed to conduct a Supplemental Environmental Project (SEP) to study macroinvertebrate life in the area of the spill. Macroinvertebrate populations are continually exposed to stream conditions and are important indicators of ongoing stream health and water quality.

Study Objectives: Collect macroinvertebrate population data and use this data to assess existing stream health, water quality, water quality changes, and identify potential threats in the Deep Brook/ Pootatuck Wild Trout Management area (WTMA). As necessary, use the data to aid in the development of remediation strategies and goals. Provide educational opportunities on water quality through involvement of citizens and students in these studies.

Sampling Technique: Based on the discussion of study goals/objectives and the anticipated available resources, Connecticut Department of Environmental Protection (DEP) personnel recommend that the Rapid Bioassessment in wadeable streams & rivers by volunteer monitors protocol (RBV) be used for invertebrate sampling. There are several advantages to the RBV program, it is currently used statewide, it is managed by the CT DEP, it is relatively simple, quick, does not require extensive resources, and works very well to screen for very high or very low water quality. Samples can be collected by Candlewood Valley Trout Unlimited members or others who are trained in the protocol. CT DEP (Mike Beauchene) will verify identification of samples.

Sample Locations: After an onsite review with CT DEP personnel, the following sampling locations are suggested. Each of the proposed sample sites has some historical data collected by CT DEP between 1980 and 1997.

Sample Locations	GPS Reading	Description
1) Deep Brook near the Cow Tunnel Railroad Bridge;	N 41 24' 18.9" W073 17' 22.3"	First riffle downstream of Cow Tunnel railroad bridge at path
2) Deep Brook near the Old Farm Road bridge.	N41 24' 36.4" W072 17' 07.1"	Riffle ~100' below bridge on Old Farm Road
3) Deep Brook near the mouth;	N41 24' 46.3" W072 17' 00.2"	At path upstream of farm road turn at end of pumpkin fields
4) Pootatuck River upstream of Deep Brook near Wasserman Way;	N41 24' 24.1" W073 16' 21.1"	First riffle downstream of Wasserman Way bridge. Note – on private Pootatuck club property, permission must be obtained before each sampling.
5) Riffle between the mouth of Deep Brook and the effluent from the Newtown wastewater treatment facility.	N 41 24' 49.8" W 073 16' 56.0"	First riffle upstream of wastewater treatment plant discharge
6) Pootatuck River near I-84.	N41 24' 53.2" W073 16' 57.6"	Riffle immediately upstream of Tom Brook. Note-samples must be collected from river left looking upstream to avoid sampling area that is dry during summer months

Sites 1-3 on Deep Brook are most critical to the SEP. Sites on the Pootatuck provide additional data on the WTMA and additional background on a high quality stream in the immediate area. The number of sites sampled will be dependent of the number of people available to collect samples. 1 1/2 to 2 hours per sample locations for 3 people are required to collect a set of samples. Each of these sample locations is in a shallow riffle with a cobble/gravel/boulder bottom.

Sample Timing: An advantage to using the macroinvertebrate community to assess water quality is that the resident organisms reflect water quality conditions for the recent past. The community structure (abundance and types of species present) varies with the time of year. In general the low-flow summer months are the most stressful time for many aquatic organisms due to reduced flows, higher temperatures, increased in-stream concentration of stressors (if present). Therefore the CT DEP samples the macroinvertebrate community during a fall index period (October and November). Macroinvertebrate community samples collected in this window tend to reflect the "worst case" condition.

Other Data:

Photographic Records – A digital photo of each sample site at the time of each sampling event will be collected.

Prior macroinvetebrate sampling data – There are a variety of macroinvertebrate data collected in various points along Deep Brook and the Pootatuck from 1980 to the present. DEP has provided a map and spreadsheet containing the data. An analysis of the prior sampling data will be completed to provide baseline information for this study.

Water temperature data – Summer temperatures are critical to a cold water fishery. Some historical data have been collected. An ongoing sampling program is recommended. CT DEP currently uses the HOBO WATER TEMP PRO model for data collection. CVTU will determine if resources are available to purchase monitors for use in this study.

Water Chemistry – stream chemistry data can be of limited value in that they indicate the conditions only at the time of the sample. In addition, high quality chemistry data are relative expensive. However, there are some specific data related to stream threats that

could be useful such as hydrocarbons (oil spills) and salinity (salt shed discharge). Some additional data may be available on pesticides originating from "Oil Creek". CVTU recently purchased a hydrocarbon monitoring system for Newtown High School and will work with the Science department to obtain data on hydrocarbons and salinity as well as other important chemistry information.

Fish sampling data – CT DEP Department of Fisheries periodically collect electro shocking data on Deep Brook and the Pootatuck

Consultants/Additional Resources: CVTU plans to hire a Coordinator for each sampling event to organize and help in sample collection and delivery to DEP. The Coordinator would be paid on a task dependent basis. Some additional tasks for the Coordinator could be to assist in baseline and ongoing data analysis and presentation to interested parties. Tentative plans are to hire a student from the University of Connecticut Fisheries program to act as the sampling Coordinator.

CT DEP personnel will assist in training and data analysis and consult for 2-3 years. A training date of October 22 has been set.

Newtown High School faculty and students can assist in sample collection and collection of water chemistry data, in particular hydrocarbon data.

Tentative Study Budget –

Item	Estimated Cost
Sampling equipment based on CT DEP suggested equipment list – 2 sets	~$1000
Water temperature samplers (4) and software	~$700
Sampling coordinator to provide baseline assessment	TBD
Sampling coordinator to assist in sample collection	~$800
Expenses for training	~$100
Analytical	TBD
Other equipment	~$1000
SEP Budget	$4300

III. Site Descriptions/Historical Data:

The following is an analysis of each site, its location, and a short historical sampling background. Sample locations are shown on Figure 1 while historical information on macroinvertebrate sampling is contained in Appendix I.

Site1: Located in Deep Brook, this site is directly downstream of the Cow Path Railroad Bridge. It coordinates are N 41° 24' 18.9" and W 73° 17' 22.3". Samples were taken from the first riffle, almost directly downstream from the bridge where the railroad crosses Deep Brook. Site 1 acts as a control for the rest of the sites on Deep Brook, being that it is above both spill sites and not affected by the wastewater treatment plant.

The past samples that can relate to site 1 are a 1980 sample done by the DEP and also one done in 1994 designated as "Fisheries 3009". Both of the sites were either in the same riffle or above it. One other significant sample was completed in 2004 by a Newtown High School student as part an independent study program (1). This sample was obtained in Deep Brook immediately upstream of the confluence of "Oil Creek" and Deep Brook. The macroinvertebrate population was analyzed using SEARCH protocols.

The sample has a significant meaning in comparison, because it can provide information on how much the oil spill has affected the area.

Site 2: Also located in Deep Brook, this site is only a short distance downstream from the two spill sites. Its coordinates are N 41° 24' 3.64" and W 73° 17' 22.3". It is the riffle approximately100 feet below the Old Farm Road Bridge. Macroinvertebrates at this site could be affected by both spills, and is the site most likely to show continuous detrimental effects from the spills. Also located about 35 feet above the site, is the drainage pipe from the old Fairfield Hills wastewater treatment plant. Although this facility has been removed from service and dismantled, it must also be considered as a pollutant source. While the effluent pipe is blocked off with cement, during recent studies of the area, it has been seen leaking small amounts of water into the stream.

The past sample that relates to this site was conducted upstream of the old sewage treatment plant, by the DEP in 1980. Other samples that may relate were collected below the oil spills but well upstream of the Old Farm Road bridge in 2004 (labeled Search 2) and 2005 (labeled as 5/15/2005 and collected by TU members). These samples were collected in response to the oil spill contamination from the Fairfield Hills incident. The sample labeled as Search 2 may have been collected in "Oil Creek" and not be representative of conditions on Deep Brook.

Site 3: This site is near the mouth of Deep Brook, only a short distance before it enters the Pootatuck. It is another riffle, and can be located best by walking down a path at the end of a group of pumpkin fields on the south side of Deep Brook. The site coordinates are N 41° 24' 46.3" and W 72° 17' 00.2". Its significance is that both spill sites and also the closed Fairfield Hills wastewater treatment plant may affect it. However, it is farther away from them than site 2, so it can help determine potential close range to far range damage of the spill on Deep Brook.

There is one historical sample that must be considered when looking at this site. This is a sample collected at the mouth of Deep Brook in 1997 with data provided by DEP as DB6. Comparing this to the data that is collected from Trout Unlimited studies will help determine if the entire stream was impacted by the spills.

Site 4: This site acts as the control for all samples done on the Pootatuck River. It is located on the Pootatuck well upstream of the confluence with Deep Brook. It is the first riffle after Wasserman Way (also known as Mile Hill Road) bridge and located on Pootatuck Club Property. Their permission was obtained before sampling at this site. The coordinates of the site are N 41° 24' 24.1" and W 73° 16' 21.1". This is an example of what the streambed ecosystem should be in the rest of the stream.

There are two samples that can be relevant to this site, and both were taken at Wasserman Way (Mile Hill Road) on the Pootatuck River. The first was done in 1995, and the second done in 1998, both sites are designated as PT1.

Site 5: This site is the first on the Pootatuck River after the confluence with Deep Brook. It is the first riffle downstream of the mouth of Deep Brook and immediately upstream of the effluent of the current Newtown Wastewater Treatment Plant. Its coordinates are N 41° 24' 53.2" and W 73° 16' 57.6". It provides information on the state of the macroinvertebrate community once the Pootatuck has had the influence of the spills from Deep Brook. However, it is not affected by the effluent from the Wastewater Treatment Plant.

There are 4 historical samples that are located at or around this site. All four were designated as PT2. All were completed within the general area of this first riffle or ones immediately following it, upstream of the Wastewater Treatment Plant, in the years 1995,1997 (two samples), and 1998. All of these samples were similar in numbers, therefore giving us a reasonable idea of how the area was populated before the oil spills.

Site 6: This is the final site in the Trout Unlimited sample, and is located below the effluent of the Wastewater Treatment Plant. It is the first riffle upstream from Tom Brook, a tributary to the Pootatuck. Its coordinate are N 41° 24' 53.2" and W 73° 16' 57.6". Its importance compared to site 5, which is relatively close by, is that it is below the effluent of the Wastewater Treatment Plant, a possible influence on the ecosystem.

There are six historical samplings that are within a short proximity of this site, the first four identified by DEP as PT3 and the final two identified as PT4. The first four were conducted in the years 1995, 1997 (two samples), and 1998. They were collected directly downstream of the Newtown Wastewater Treatment Plant. The final two were conducted in the years 1997 and 1998, slightly downstream from site 6, at the Route 84 bridge.

IV. October 2005 Study Data

The first sampling of the Trout Unlimited study was conducted October 22, 2005 (10/22/05 sample). It should be noted that water flow conditions before the sampling could have significant impact on the macroinvertebrate populations. During the weeks proceeding the sampling stream flows were very low, resulting in potential impacts of warm water and portions of the stream bed being dry. Immediately before the sampling, very heavy rains fell, causing flood conditions and potentially disturbing the stream bed. For these reasons, data from the October 22 sampling may not be fully representative of stream conditions. No firm conclusions should be drawn before all sampling is completed.

All data collected during the October 22 sampling are included in Appendix II. A summary of the data available to date as categorized by the RBV groups is included below.

The RBV program characterizes riffle dwelling, benthic, macroinvertebrate organisms into three categories,

- **Most Wanted**. In general these organisms require a narrow range of environmental conditions. When found in abundance one can infer non-impaired stream condition.
- **Moderately Wanted**. These organisms can be found in a variety of water quality conditions. When found in abundance further information about the upstream watershed may be necessary to infer water quality.
- **Least Wanted**. These organisms tend to be very tolerant of a wide range of environmental conditions. As a result when these organisms comprise the majority of a sample, one can infer some level of water quality impairment

The presence of an organism is the important factor rather than the number of a particular organism present. A full discussion of the RBV program can be found at http://www.dep.state.ct.us/wtr/volunmon/rbv.htm.

At Site 1 (Table 1), the 10/22/05 sample contained two most wanted, five moderately wanted, and one least wanted macroinvertebrate. This is the lowest number of most wanted organisms seen in comparison to the other three samples from this site prior to the spills. There are a relatively large number of moderate (5) and only one least wanted organism, while the other three samples contained two.

At Site 2 (Table 2), there was one most wanted, six moderately wanted, and one least wanted organisms. This is a decrease from the May 2005 sample, which had three most wanted. However, the previous two samples in 1980 (prior to the closure of the Fairfield Hill treatment plant) and 2004 (after the first oil spill) had one and zero most wanted, respectively.

At Site 3 (Table 3), the sample contained one most wanted, four moderately wanted and zero least wanted macroinvertebrates. This is less than the four most wanted collected in the 1997 sample, however in 2004, after the first spill and before the second, there were zero most wanted. There was only one moderately wanted in the 2004 sample, and four in the 1997 sample. The greatest number of least wanted occurred in the 2004 sample, with three, while each of the other samples only have one.

At Site 4 (Table 4), four most wanted, five moderately wanted, and one least wanted organisms were found. These numbers are similar to the previous samples taken with slightly less most wanted, and the same amount of moderately wanted macroinvertebrates.

At Site 5 (Table 5), there were two most wanted, three moderately wanted, and one least wanted macroinvertebrates. This is dramatically lower than the samples collected in 1995, 1997 (2), and 1998 in every level of macroinvertebrates. The most drastic decrease occurred in the most wanted macroinvertebrates, dropping from seven in the 1998 sample, and five in the samples previous.

At Site 6 (Table 6), the sample contained one most wanted, four moderately wanted, and one least wanted. These numbers are down in the most wanted macroinvertebrate category, dropping from six to one. The numbers of the most wanted were relatively constant over the pervious six samples, ranging from four to six types. The moderately wanted invertebrates maintained themselves at four types, as well as the least wanted. Note that Site 6 was one of the sites most likely impacted be the low water conditions during the summer of 2005.

In Figure 2, we see a comparison of the six sites, showing the amount of macroinvertebrate types in each class observed during the 10/22/05 sampling. Overall, site 4 had the greatest number of Most Wanted macroinvertebrates at five, while sites 2, 3, and 6 had the least, at one.

As mentioned above, it is important to note that all the 10/22/05 samples were collected following a period of very low flows followed by extreme turbidity and flood levels.

V. Historical Fisheries Information:

Tables 7 and 8 show the Trout Population Samples conducted by the Department of Environmental Protection over the past years. Full data supplied by DEP fisheries is contained in Appendix III. The Tables are divided into Brown and Brook Trout, each separated into length/age classes. Total Amount of Wild Trout estimates for each Stream in each year are shown on the far right. Sampling factors are listed below each table. In the Pootatuck River (Table 7), there were samples conducted upstream from the foot Bridge above Route 6 (actually downstream of all macroinvertebrate sampling stations). The sampling dates run from 2000 to 2005. The lowest population estimate occurred in the year 2001 with a total of 127. The greatest occurred in the year 2004, with a total of 264.

In Deep Brook (Table 8) sample numbers were obtained from the years 1998 to 2005. The area ranged from the bridge located near the old Fairfield Hills wastewater treatment plant (sample point 2) upstream to the steel I-beam (immediately upstream of "Oil Creek"). This area was directly affected by each oil spill, and the amount of area it covered was 400 meters. The population estimates ranged from the lowest in 1998 (198) to the highest in 2001 (630). It is noticeable in the years following the oil spills that population numbers declined significantly. In 2003 before the spill, the population was estimated to be 568 trout. In 2004, following the first spill, the population was estimated at 393. In 2005, the population dropped significantly again, to 268 trout. However, it is important to note that fish populations could also be impacted be the warm, low water conditions present during the summer of 2005.

VI. Discussion:

It can be speculated that the two oil spills have caused some damage to the ecosystem of Deep Brook and the Pootatuck River. The data from the 10/22/05 sampling, however, cannot be seen as conclusive evidence that significant damage has occurred. The reason being that prior to the sampling event, a period of very low flow and high temperatures occurred. A flood had occurred just one week prior that had probably altered the areas ecosystem significantly. Data that was collected were expected to be impacted by these events. However, it can still be seen that in most sites sampled, there was a drop-off in the quantity and quality of macroinvertebrates. Some insight may be gained from Site 4 which was not affected by the oil spill and maintained relatively large numbers of most wanted macroinvertebrate types before and after the 2005 flow stresses (5 and 4, respectively). In comparison, the sites below the Deep Brook mouth, sites 5 and 6, both had a dramatic decrease in the numbers of most wanted macroinvertebrates. Since both spills occurred in times of high flow, it could be speculated that the oil may have settled in or near this area, causing a decrease in macroinvertebrate quality.

It can also be noted that initial samples from Deep Brook itself (Sites 1, 2 and 3) have decreased most wanted and moderate macroinvertebrates. The most notable would be Site 3, located just above the Deep Brook mouth, which had 4 types of most wanted macroinvertebrates in the 1997 sample and only 1 most wanted macroinvertebrate group present in the 10/22/05 sample by Trout Unlimited.

In the next two years of study, if these numbers continue, it will be relatively certain that some change has occurred.

In regards to the trout population studies, varying results and patterns from each stream can lead to an idea that Deep Brook has had some damage to its trout populations, while the Pootatuck had relatively little. In Deep Brook, after the two oil spills, the population noticeably dropped by over 300 trout. It is now estimated at its lowest since 1998, the first year of the samples. Further study in the following years can determine if this is simply an affect of population cycling, or the result of the oil spills. In the Pootatuck River, the populations actually increased in the two population estimates after the oil spills. It should be noted, however, that in these two years the sampling was conducted in two combs adding up to 742 meters, as opposed to the one comb that was used for all 742 meters in the previous years. Although this may not account for an increase in estimate, it could be the result of greater efficiency in sampling due to the smaller area.

VII. Tables

Table 1: Historical Data Surrounding Site 1 and Current Macroinvertebrate Study Data

	Deep Brook by Railroad Track:	Deep Brook by Railroad Track:	Deep Brook Upstream of Spill Entrance:	1st RBV by Trout Unlimited	2nd RBV by Trout Unlimited	3rd RBV by Trout Unlimited	4th RBV by Trout Unlimited
	7/3/1980	5/XX/1994	11/XX/2004	10/22/2005			
Most	3	4	3	2			
Moderate	2	6	3	5			
Least	2	2	2	1			

Table 2: Historical Data Surrounding Site 2 and Current Macroinvertebrate Study Data

	Deep Brook Upstream of Old STP	Deep Brook At Old STP	Downstream, at Plugged Pipe	1st RBV by Trout Unlimited	2nd RBV by Trout Unlimited	3rd RBV by Trout Unlimited	4th RBV by Trout Unlimited
	7/3/1980	11/XX/2004	5/15/2005	10/22/2005			
Category							
Most	1	0	3	1			
Moderate	4	1	2	6			
Least	1	3	2	1			

Table 3: Historical Data Surrounding Site 3 and Current Macroinvertebrate Study Data

	Deep Brook Mouth	1st RBV by Trout Unlimited	2nd RBV by Trout Unlimited	3rd RBV by Trout Unlimited	4th RBV by Trout Unlimited
	10/8/1997	10/22/2005			
Category					
Most	4	1			
Moderate	4	4			
Least	2	0			

Table 4: Historical Data Surrounding Site 4 and Current Macroinvertebrate Study Data

	Pootatuck River Mile Hill	Pootatuck River Mill Hill	1st RBV by Trout Unlimited	2nd RBV by Trout Unlimited	3rd RBV by Trout Unlimited	4th RBV by Trout Unlimited
	11/28/1995	11/4/1998	10/22/2005			
Category						
Most	5	6	4			
Moderate	5	5	5			
Least	2	1	1			

Table 5: Historical Data Surrounding Site 5 and Current Macroinvertebrate Study Data

	Pootatuck River Upstream of New STP	Pootatuck River Upstream of New STP	Pootatuck River Upstream of New STP Outfall	Pootatuck River Upstream of New STP Outfall	1st RBV by Trout Unlimited	2nd RBV by Trout Unlimited	3rd RBV by Trout Unlimited	4th RBV by Trout Unlimited
	11/28/1995	5/5/1997	10/8/1997	11/4/1998	10/22/2005			
Category								
Most	5	5	5	7	2			
Moderate	4	4	4	5	3			
Least	3	3	3	2	1			

Table 6: Historical Data Surrounding Site 6 and Current Macroinvertebrate Study Data

	Pootatuck River Downstream of New STP Outfall	Pootatuck River Downstream of New STP Outfall	Pootatuck River Downstream of New STP Outfall	Pootatuck River Downstream of New STP Outfall	Pootatuck River Route 84	Pootatuck River Route 84	1st RBV by Trout Un-limited	2nd RBV by Trout Un-limited	3rd RBV by Trout Un-limited	4th RBV by Trout Unlimited
	11/28/1995	5/5/1997	10/8/1997	11/4/1998	10/8/1997	11/4/1998	10/22/2005			
Category										
Most	5	6	6	4	5	6	1			
Moderate	4	5	4	5	4	4	4			
Least	1	3	2	2	2	3	1			

Table 7: Wild Trout Population Estimates of the Pootatuck River, Upstream form Foot Bridge above Route 6 in Sandy Hook

Year		Brown Trout			Brook Trout		Stocked Trout	Total Wild	Meters	Trout Estimate
	Age 0	Age 1	Age 2+	Age 0	Age 1	Age 2+				
	<11 cm	11-23 cm	>23 cm	<11 cm	11-18 cm	>18 cm				
2000	71	27	23	4	3	0	29	128	742	173
2001	40	33	9	10	2	0	18	94	742	127
2002	30	50	12	5	7	0	30	104	742	140
2003	20	53	5	13	5	0	40	96	742	129
2004	100	53	9	25	6	0	23	196	742	264
2005	48	83	4	6	13	0	24	159	742	214

Table 8: Wild Trout Population Estimates of Deep Brook, From Old STP up to Steel I-Beam Bridge

Year		Brown Trout			Brook Trout		Stocked Trout	Total Wild	Meters	Trout Estimate
	Age 0	Age 1	Age 2+	Age 0	Age 1	Age 2+				
	<11 cm	11-23 cm	>23 cm	<11 cm	11-18 cm	>18 cm				
1998	10	29	8	0	29	2	0	79	400	198
2000	29	50	7	19	12	1	0	118	400	295
2001	105	46	4	29	67	1	0	252	400	630
2002	26	66	9	15	33	3	0	152	400	380
2003	129	41	12	8	37	0	0	227	400	568
2004	57	70	13	9	7	1	1	157	400	393
2005	35	43	7	3	17	1	0	107	400	268

Figure 1. Macroinvertebrate Study Sampling Sites

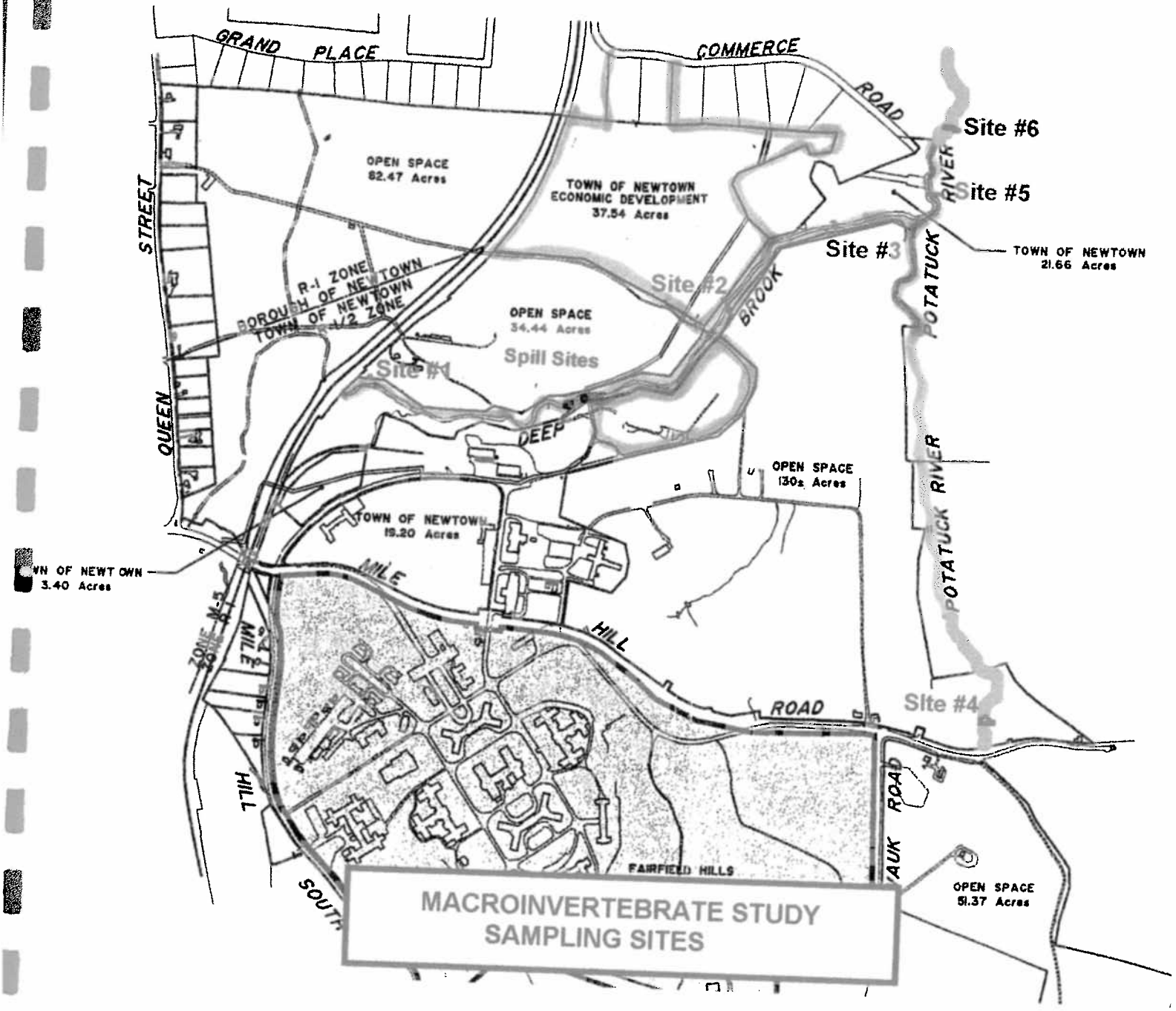
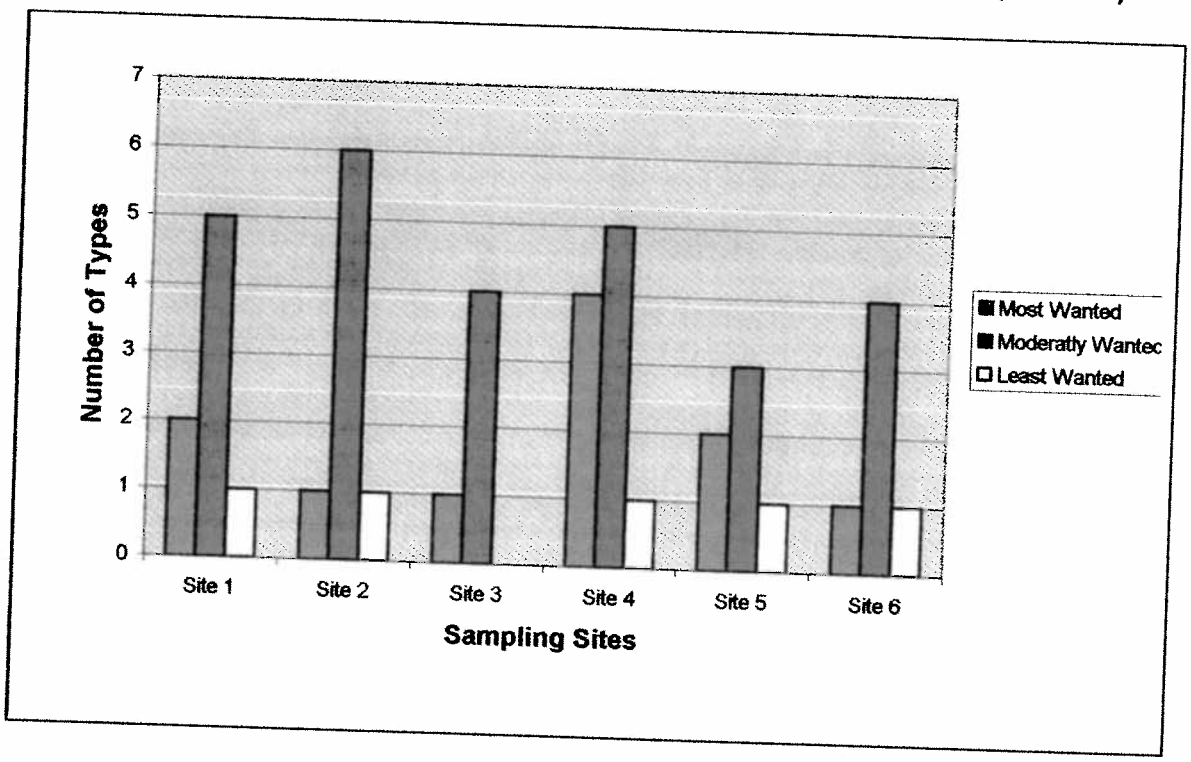


Figure 2: Trout Unlimited Macroinvertebrate Type Totals For Each Site (Fall 2005)



Appendix I - Historical Deep Brook/Pootatuck Macroinvertebrate Data

	A	A	B	C	C	D	E	E	F	
	DEEP BROOK	DEEP BROOK	DEEP BROOK	DEEP BROOK	DEEP BROOK	Deep Brook	Pootatuck River	Pootatuck River	Pootatuck River	
	RR Tracks	RR Tracks	US SPILL ENTRANCE	US OLD STP	AT OLD STP	Mouth	Mile Hill	Mile Hill	US New STP outfall	
	DEP I-1	FISHERIES 3009	SEARCH-1	DEP 2	SEARCH-2	DB6	PT1	PT1	PT2	
Family	7/3/80	5/XX/94	11/XX/04	7/3/80	11/XX/04	10/8/1997	11/28/95	11/4/98	11/28/95	
MOST	**3**	**4**	**3**	**1**	**0**	**4**	**5**	**6**	**5**	
MOD	2	6	3	4	1	4	5	5	4	
LEAST	2	2	2	1	3	2	2	1	3	
Acari										
Acariformes										
Ancylidae										
Asellidae										
Athericidae								2		
Baetidae		OTHER					1			
Brachycentridae			MOST			OTHER				
Cambaridae			OTHER							
Capniidae										
Chironomidae	Least	LEAST	LEAST	LEAST	LEAST	LEAST	14		16	
Corydalidae		MOD				MOD	LEAST	LEAST	LEAST	
Dolichopodidae							MOD	MOD	MOD	
Dryopidae							1			
Elmidae	OTHER	OTHER					1			
Empididae				OTHER		OTHER	12	13.5	20	
Ephemerellidae	OTHER	OTHER						4		
Gammaridae	LEAST			OTHER			30	20.5	10	
Glossosomatidae			MOST	MOST			1			
Gomphidae		MOD				MOST	MOST	MOST		
Heptageniidae	MOD	MOD	MOD	MOD			MOD		MOD	
Hydrophilidae						MOD	MOD	MOD		
Hydropsychidae	MOD	MOD		MOD	MOD	MOD	15	108.5	41	
Isonychidae		MOST				MOST	MOST	MOST	MOST	
Isotomidae										
Lepidoptera										
Lepidostomatidae										
Leptoceridae										
Leuctridae			MOST							
Limnephilidae				OTHER		OTHER	1			
Lumbriculidae							5	1	4	
Nematoda										
Nemouridae				MOD						
Odonata								MOD		
Peltoperlidae										
Perlidae		MOST					MOST			

Appendix I - Historical Deep Brook/Pootatuck Macroinvertebrate Data

	A	A	B	C	C	D	E	E	F	
	DEEP BROOK	DEEP BROOK	DEEP BROOK	DEEP BROOK	DEEP BROOK	Deep Brook	Pootatuck River	Pootatuck River	Pootatuck River	
	RR Tracks	RR Tracks	US SPILL ENTRANCE	US OLD STP	AT OLD STP	Mouth	Mile Hill	Mile Hill	US New STP outfall	
	DEP I-1	FISHERIES 3009	SEARCH-1	DEP 2	SEARCH-2	DB6	PT1	PT1	PT2	
Family	7/3/80	5/XX/94	11/XX/04	7/3/80	11/XX/04	10/8/1997	11/28/95	11/4/98	11/28/95	
Philopotamidae		MOD	MOD			MOD	MOD	MOD	MOD	
Physidae										
Planorbidae										
Polycentropodidae										
Psephenidae	MOD	MOD	MOD	MOD			MOD	MOD	MOD	
Psychomylidae								1		
Pteronarcyidae										
Rhyacophilidae						LEAST	LEAST		LEAST	
Simuliidae		LEAST								
Taeniopterygidae							1	2	8	
Tetrastemmatidae							1	1	4	
Tipulidae	OTHER	OTHER		OTHER					LEAST	
Tubificidae			LEAST		LEAST		OTHER	OTHER	OTHER	
Uenoidae										
Veliidae										
LEECH					LEAST					

	F	F	F	G	G	G	G	H	H
	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River
	US New STP outfall	US New STP outfall	US New STP outfall	DS new STP outfall	DS new STP outfall	DS new STP outfall	DS new STP outfall	RTE 84	RTE 84
	PT2	PT2	PT2	PT3	PT3	PT3	PT3	PT4	PT4
Family	5/5/97	10/8/97	11/4/98	11/28/95	5/5/97	10/8/97	11/4/98	10/8/97	11/4/98
MOST	**5**	**5**	**7**	**5**	**6**	**6**	**4**	**5**	**6**
MOD	4	4	5	4	5	4	5	4	4
LEAST	3	3	2	1	3	2	2	2	3
Acari									
Acariformes								1	
Ancylidae			0.5			1			
Asellidae									
Athericidae						1			
Baetidae	14	14							
Brachycentridae					13.5	2		4	
Cambaridae									
Capniidae					OTHER	OTHER		OTHER	
Chironomidae	LEAST	LEAST	1	9			1	2	5
Corydalidae	MOD	MOD	LEAST		LEAST	LEAST	LEAST	LEAST	LEAST
Dolichopodidae			MOD		MOD	MOD	MOD	MOD	MOD
Dryopidae									
Elmidae	6	17	16.5	27	6	10	14	17	27.5
Empididae	2			1	9		1		1
Ephemerellidae		5.5	10.5	8		4	11.5	9.5	38.5
Gammaridae		1				7	2		
Glossosomatidae									
Gomphidae	MOD		MOD	MOD	MOD		MOD		
Heptageniidae	MOD	MOD	MOD	MOD	MOD	MOD	MOD	MOD	MOD
Hydrophilidae						2			
Hydropsychidae	13	94.5	59.5	27	7	47.5	29.5	118.5	11.5
Isonychiidae									
Isotomidae						1			
Lepidoptera	1								
Lepidostomatidae									
Leptoceridae				1					
Leuctridae	1								
Limnephilidae			2	3	1	10	18	1	
Lumbriculidae	9	1	1		1				2
Nematoda					1				
Nemouridae	3				1				
Odonata		MOD	0.5		0.5				
Peltoperlidae									
Petitidae									

Appendix I - Historical Deep Brook/Pootatuck Macroinvertebrate Data

	F	F	F	G	G	G	G	H	H
	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River	Pootatuck River
	US New STP outfall	US New STP outfall	US New STP outfall	DS new STP outfall	DS new STP outfall	DS new STP outfall	DS new STP outfall	RTE 84	RTE 84
	PT2	PT2	PT2	PT3	PT3	PT3	PT3	PT4	PT4
Family	5/5/97	10/8/97	11/4/98	11/28/95	5/5/97	10/8/97	11/4/98	10/8/97	11/4/98
Philopotamidae		MOD	MOD	MOD	MOD	MOD	MOD	MOD	MOD
Physidae		1		1					1
Planorbidae				1					
Polycentropodidae							1		
Psephenidae	MOD	MOD	MOD	MOD	MOD	MOD	MOD	MOD	MOD
Psychomyiidae	1		1			2	6	3	
Pteronarcyidae									
Rhyacophilidae									
Simuliidae	LEAST	LEAST			LEAST			LEAST	LEAST
Taeniopterygidae						MOST	MOST		
Tetrastemmatidae		1		3			1		2
Tipulidae	7		4.5	9	10	4	11	2	2.5
Tubificidae	LEAST	LEAST	LEAST	LEAST	LEAST	LEAST	LEAST		LEAST
Uenoidae			OTHER	OTHER					
Veliidae						1			
LEECH									

Appendix II - Study Raw Data

		Site number	50-001	50-002	50-003	50-004	50-005	50-006
		Stream Name	Deep Brook	Deep Brook	Deep Brook	Pootatuck River	Pootatuck River	Pootatuck River
		Landmark	DS RR crossing	DS bridge near old STP	Near Mouth	Wasserman Way on Game Club Property (Mile Hill Rd)	above STP outfall	Adjacent to Tom's Bk (DS STP outfall)
category	RBC panel numbe	Organism						
most wanted	2	Isonychia						
most wanted	5A	Perlidae	1		1	1		
most wanted	5B	Pteronarycs		1		1	1	1
most wanted	6A	Glossosoma				1		
most wanted	7	Rhyacophila	1			1		
moderately wanted	10	Chimarra					1	
moderately wanted	11	Stenonema	1	1	1	1	1	1
moderately wanted	12	Psephenus	1	1	1			
moderately wanted	13B	Nigronia	1	1	1	1		1
moderately wanted	14	Odonata	1	1		1	1	1
moderately wanted	9	Hydropsychidae	1	1	1	1	1	1
least wanted	15G	Worm	1	1		1		1
		Total Most types	2	1	1	4	2	1
		Total Moderate types	5	6	4	5	3	4
		Total Least types	1	1	0	1	1	1
		Total all types	8	8	5	10	6	6

Pootatuck River

Table 8.- Number of trout caught during single pass trout population sampling at areas sampled in the Pootatuck River WTMA, 1997-2004. Sites are arranged in order from upstream to downstream.

Year Trout/ Sampled	Brown Trout			Brook Trout			Stocked Trout	Total Wild Trout	meters sampled	W km
	Age 0 <11cm	Age 1 11-23cm	Age2+ >23cm	Age 0 <11cm	Age 1 11-18cm	Age2+ >18cm				
Upstream from 100 m above Newtown STP outfall.										
1997	7	4	0	6	2	4	0	23	600	38
Upstream from approximately 200 m below I-84.										
1997 [1]	69	6	7	26	2	4	8	114	550	207
Upstream from foot bridge above Rte 6 in Sandy Hook.										
2000 [1]	71	27	23	4	3	0	29	128	742	173
2001	40	33	9	10	2	0	18	94	742	127
2002	30	50	12	5	7	0	30	104	742	140
2003 [1]	20	53	5	13	5	0	40	96	742	129
2004 (lower)	59	28	5	9	3	0	13	105 [2]	352	298
2004 (upper)	41	25	4	16	3	0	10	91 [3]	390	233
2004 (comb)	100	53	9	25	6	0	23	196 [4]	742	264

[1] Turbidity due to recent rain reduced sampling efficiency.
[2] Includes one wild rainbow trout (10 cm).
[3] Includes one wild rainbow trout (12 cm) and one wild tiger trout (18 cm).
[4] Includes two wild rainbow trout (10 cm, 12 cm) and one wild tiger trout (18 cm).

2004 Wild Trout Source Document; Historic and Current Sampling Data for Each Stream

Natural Catch-and-Release WTMAs (Class 1 regulations: Catch–and-Release, single-hook artificials, open year-round)

Deep Brook WTMA

Table 8- Number of trout caught during single pass trout population sampling at areas sampled in the Deep Brook WTMA, 1991-2004. Sites are arranged in order from upstream to downstream.

Year Trout/ Sampled	Brown Trout			Brook Trout			Stocked	Total	meters	W
	Age 0 <12cm	Age 1 12-21cm	Age2+ >21cm	Age 0 <12cm	Age 1 12-21cm	Age2+ >21cm	Trout	Wild Trout	sampled	km
Upper areas (above train trestle/below Wasserman Way)										
1991	47	9	0	5	5	0	0	66	100	660
2000	0	3	6	0	10	3	0	22	210	105
Middle area (old STP bridge up to steel I-beam)										
1998	10	29	8	0	29	2	0	79 [1]	400	198
2000	29	50	7	19	12	1	0	118	400	295
2001	105	46	4	29	67	1	0	252	400	630
2002	26	66	9	15	33	3	0	152	400	380
2003	129	41	12	8	37	0	0	227	400	568
2004	57	70	13	9	7	1	1	157	400	393
Lower area (upstream from mouth)										
1998	23	21	4	13	36	2	3	99	598	166
2003	158 [2]	24	5	83 [2]	36	1	1	307	598	513

[1] Includes one 20 cm tiger trout.
[2] Age 0 numbers were expanded up from a 344-m subsample.

X. References

1. Boushell, Maggie - The Effects of a Home Heating Oil Spill on the Local Environment