ECOLOGICAL STUDIES OF THE CONNECTICUT RIVER VERNON, VERMONT REPORT 34

JANUARY – DECEMBER 2004

MAY 2005

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Vermont Yankee Nuclear Power Station
Brattleboro, Vermont

Prepared for
ENTERGY NUCLEAR VERMONT YANKEE
P.O. Box 157, Governor Hunt Road
Vernon, Vermont 05354

Prepared by
NORMANDEAU ASSOCIATES, INC.
25 Nashua Road
Bedford, NH 03110

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1.0 INTRODUCTION

This Annual Report 34 is submitted on behalf of Entergy Nuclear Vermont Yankee, LLC (Vermont Yankee) and fulfills requirements of Part IV, of their Final Amended Discharge Permit #3-1199, dated 28 September 2004 (NPDES number VT0000264). This is the fourth annual report submitted under the five-year discharge permit issued in August 2001, and is the first presented under the final amended discharge permit issued on 28 September 2004. Annual Report 34 presents the methods and results of monthly NPDES thermal compliance and water quality monitoring in Sections 2 and 3, respectively, and the methods and results of macroinvertebrate, fish, and mollusk monitoring, in Sections 4, 5, and 6 respectively. The NPDES permit environmental sampling stations referred to in this report are described by number, name, and type of sampling conducted, in Table 1-1, and are geographically identified in Figure 1-1.

At the request of the Vermont Agency of Natural Resources (VANR) no adult American shad were processed during the spring of 2004. Low passage numbers at Vernon Dam during the 2004 spawning season prompted these actions. Adult American shad will be processed during the 2005 migration season if numbers are considered sufficient and approval is obtained from the VANR. Juvenile American shad studies were conducted during 2004. The final report outlining this study will be submitted under separate cover to the Environmental Advisory Committee (EAC) in spring 2005 as Analytical Bulletin No. 82 (Normandeau 2005).

Annual Report 34 for 2004 was produced as a collaborative effort between Vermont Yankee and Normandeau Associates, Inc.

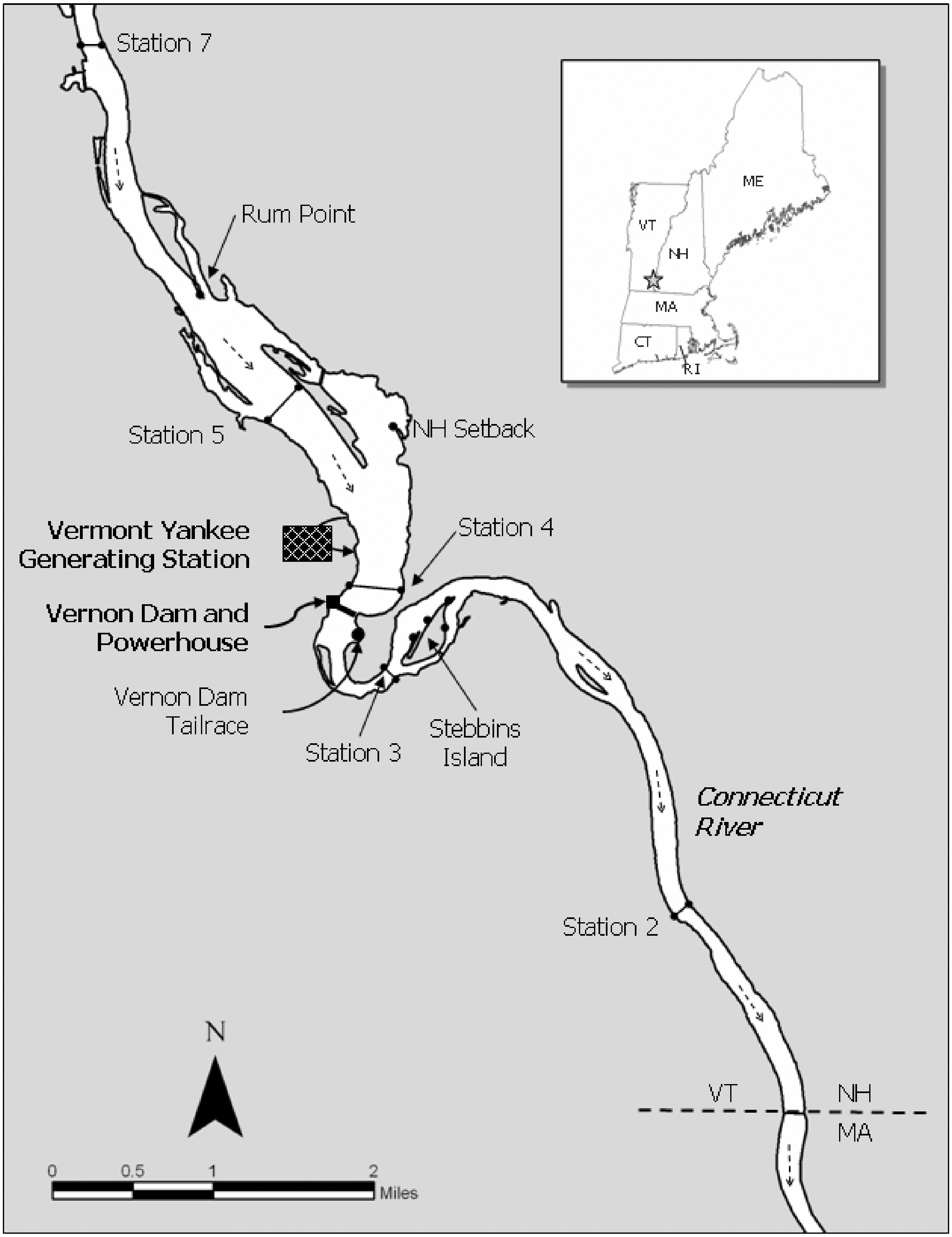

Figure 1-1. Connecticut River in the Vicinity of Vernon Pool.

Table 1-1. Sampling Station Numbers, Names, and Descriptions of Sampling Conducted for the Vermont Yankee NPDES Program in the Connecticut River in the Vicinity of Vernon, Vermont.

Station Number	Station Name	Sample Type(s)
	Downstream Stations	
217	Station 2 NH South	General electrofishing
227	Station 2 VT South	Macroinvertebrates
031	Station 3 NH	Macroinvertebrates, anadromous electrofishing
032	Station 3 VT	Water quality, general electrofishing
624	Stebbins Island VT Lower	Anadromous electrofishing
614	Stebbins Island NH Lower	Anadromous electrofishing, general efishing
613	Stebbins Island NH Mid	Anadromous electrofishing
615	Stebbins Island NH Upper	Anadromous electrofishing
724	0.1 Mi. South of Vernon Dam (Lower)	General electrofishing
725	0.1 Mi. South of Vernon Dam (Upper)	Anadromous electrofishing
020	Vernon Dam Fish Ladder	Water quality, adult shad
	Upstream Stations	
051	Station 5 NH	Zebra mussel, corbicula, general electrofishing
053	Station 5 Mid-River	Zebra mussel, corbicula
052	Station 5 VT	Zebra mussel, corbicula, general electrofishing
072	Station 7 VT	Water quality
091	NH Setback	General electrofishing
102	Rum Point	General electrofishing
300	VY Discharge	Water quality
416	Station 4 NH North	Zebra mussel, corbicula, general electrofishing
436	Station 4 Mid-River North	Zebra mussel, corbicula
426	Station 4 VT North	Zebra mussel, corbicula, general electrofishing
800	VY Intakes	Larval fish, impingement

2.0 COMPLIANCE WITH THERMAL STANDARDS

2.1 THERMAL STANDARDS

The operational mode of Vermont Yankee's cooling water system is related to calendar dates and ambient Connecticut River water temperatures as specified in Vermont Yankee's discharge permit (Permit No. 3-1199, NPDES Number VT0000264) effective 28 September 2004 and expiring on 31 March 2006. During the “summer” period of 16 May through 14 October of each year, Vermont Yankee is permitted to discharge heat to the river within the following thermal standards (A.6.b of the NPDES permit):

Connecticut River Temperature at Station 7 (T7)	Calculated Increase in River Temperature above Ambient
T7>63°F	2°F
63°F〈T7>59°F	3°F
59°F〈T7>55°F	4°F
55°F〈T7	5°F

During the “winter” period of 15 October through 15 May of each year, Vermont Yankee is permitted to discharge heat to the Connecticut River within the following thermal standards (Section A.6.a of the NPDES permit):

- The temperature at Station 3 during open cycle operation shall not exceed 65°F;
- The rate of change of temperature at Station 3 shall not exceed 5°F per hour; and,
- The increase in temperature above ambient at Station 3 shall not exceed 13.4°F.

The river discharge near Vernon is regulated by Vernon Dam Hydroelectric Station to remain at or above 1250 cubic feet per second (cfs) or inflow if less than 1250 cfs. Since the theoretical maximum increase in temperature at full power due to Vermont Yankee's thermal discharge at a river flow of 1250 cfs is 12.9°F, these standards, in effect, permit open cycle condenser cooling without cooling tower operation when ambient river temperatures are less than 52.1°F during 15 October through 15 May. If ambient river temperatures are equal to or greater than 52.1°F, the amount of heat discharged to the river can be reduced by using the cooling towers if the river flow is low.

2.2 METHODS OF DEMONSTRATING COMPLIANCE

Compliance with the criterion that limits open cycle operation to times when the downstream temperature is less than 65°F (i.e. winter period) was demonstrated by examination of the hourly average Connecticut River temperature measured at Station 3 and hourly average plant operating data. The rate of change of temperature is defined in the NPDES permit as the difference between consecutive hourly average temperatures measured at Station 3. Measurements recorded in the Connecticut River below the Vernon Dam (Station 3) were used to calculate these differences.

Increase in temperature above ambient is defined in the NPDES permit as a plant-induced temperature increase as calculated by Equation 1-1 from the executive summary of the 1978 316 Demonstration (Binkerd et al. 1978). This equation is based on the principle of conservation of energy, a principle integral to the computer simulation of the Vermont Yankee/Connecticut River system. Using measured upstream (Station 7) river water temperature, plant operating data, and core thermal power, the amount of heat discharged to the river was calculated. Then, using thermodynamic and hydrodynamic principles and river discharge information, the mixed river temperature increase was calculated and compared with thermal standards.

Equation 1-1, rearranged for ease of computer computation using input from the plant environmental thermal sensor network, is as follows:

Equation 1a $H\_RECIRC_t = (TCI_{t-1} – TCI_t) * 472640.5 / 3600$

Equation 1b IF $(TCIT_{t-1} – TCIT_t) < |0.1|$ THEN $H\_RECIRC_t = 0$

Equations 1c IF $CWP_t = 1$ AND $CWBP_t = 0$ THEN $PUMP\_CAP_t = 267.38$
IF $CWP_t = 2$ AND $CWBP_t = 0$ THEN $PUMP\_CAP_t = 304.14$
IF $CWP_t = 2$ AND $CWBP_t > 0$ THEN $PUMP\_CAP_t = 267.38$
IF $CWP_t = 3$ AND $CWBP_t = 0$ THEN $PUMP\_CAP_t = 259.58$
IF $CWP_t = 3$ AND $CWBP_t > 0$ THEN $PUMP\_CAP_t = 254.01$

Equation 1b $H\_RIV_t = (PUMP\_CAP_t * CWP_t) * ((TCO_t – TCI_t) – (CWBP_t / CWP_t) * TCO_t – (TETO_t + TWTO_t) / 2)))$

Equation 1: $DELTA\_T_t = (H\_RIV_t + H\_RECIRC_t) / Q_t$

where,

H_RECIRC_t = heat content of the circulating water system and cooling towers in cfs ^oF at time interval t

TCI_{t-1} = condenser inlet temperature in ^oF at time interval t-1

TCI_t = condenser inlet temperature in ^oF at time interval t

CWP_t = number of circulating water intake pumps operating in time interval t

$CWBP_t$ = number of cooling tower booster pumps operating in time interval t

$PUMP\_CAP_t$ = pump capacity of the circulating water intake pumps in cfs

H_RIV_t = heat content of the cooling water discharge in cfs ^oF in time interval t

TCO_t = condenser outlet temperature in ^oF at time interval t

$TETO_t$ = east cooling tower outlet temperature in ^oF at time interval t

$TWTO_t$ = west cooling tower outlet temperature in ^oF at time interval t

$DELTA\_T_t$ = average simulated Connecticut River temperature increase at Station 3 in ^oF in time interval t

Q_t = average Connecticut River discharge observed at Vernon Dam in cfs in time interval t

Vermont Yankee‘s Azonix® thermistor temperature monitoring systems at Stations 3 and 7 are linked to the Station’s process computer. This allows Vermont Yankee operators to utilize real time, accurate temperature data for thermal compliance. It also allows Vermont Yankee’s Environmental personnel an opportunity to generate thermal compliance reporting. The WaDaR® units remain in the river at Stations 3 and 7 as the back-up temperature recorders to the Azonics®. Both the Azonix® thermistors and the WaDaR® temperature monitoring systems record ambient river water temperature to the nearest 0.1°F. The simulation is based on electronically acquired five-minute river discharge data from the Vernon Dam and Vermont Yankee's five minute observations of thermal temperatures at Stations 3 and 7 and thermal heat discharge to the river.

2.3 THERMAL IMPACT

Figures in this section illustrate the principle of conservation of energy as applied to the Vermont Yankee/Connecticut River system. Figure 2-1 depicts core thermal power produced and plant discharge flow by Vermont Yankee in 2004. This data was obtained from five minute records supplied by Vermont Yankee. The licensed maximum reactor core thermal power is limited to 1593 megawatts. About one-third of this power was converted to electrical power, while the remainder was transferred as heat to the atmosphere via the cooling towers, or discharged to the river (Figure 2-2, Table 2-1). Vermont Yankee experienced a planned refueling outage from 2349 on 3 April 2004 through 2307 on 4 May 2004. An additional forced outage occurred from 16 June through 5 July 2004 as a result of an electrical fault which caused a transformer fire. Otherwise the plant remained at full power throughout 2004, with occasional brief periods of power derating.

Figure 2-3 is a plot of hourly Connecticut River discharge for the Vernon Hydroelectric Station in Vernon, Vermont during 2004. The hourly average Connecticut River discharge was computed using observations obtained every five minutes by Vermont Yankee through their computer system from sensors installed at the Vernon Dam. When the river flows were above 32,000 cfs at Vernon Dam, electronic hourly river flow data was obtained from US Generation New England (formally, PG&E New England Generation). Table 2-2 presents the average daily and monthly Connecticut River discharge computed from the hourly observations obtained for 2004 as described above. For discharge greater than 12,000 cfs, a rating curve was used by Vernon Station to convert stage height to discharge. The rating curve was the same one used by the USGS prior to abandoning the Vernon gauging station (Aquatec 1995). This curve is believed to be sufficiently accurate because backwater from the Northfield Mountain Pump Storage Facility and the modification at Turners Falls Dam have had little impact on stage height near Vernon Dam during times of high discharge (Aquatec 1995). Below 12,000 cfs, discharge data were obtained from turbine rating curves at Vernon Station.

The peak daily Connecticut River average flow for 2004 was 50,618 cfs, which occurred on 2 April 2004 (Table 2-2) compared to 62,765 cfs on 30 October 2003 (Vermont Yankee and Normandeau 2004). The hourly average flows are represented in Figure 2-3. The peak hourly average Connecticut River flow of 56,250 cfs was observed on 1 April 2004 at 2200 DST. The lowest daily Connecticut River flow at Vernon Dam was 1707 cfs on 8 August 2004. The lowest hourly Connecticut River flow at Vernon Dam was 1277 cfs observed on 29 August 2004 at 0900 DST.

The calculated increases in Connecticut River temperature at Station 3, due to Vermont Yankee's operation are plotted for each hour of operation and compared to the NPDES permit limit delta T in Figure 2-4. Vermont Yankee's discharged heat remains dependant upon reactor power and plant operational mode. During normal full power operations these values range from 1035 to 1120 MWT. Connecticut River discharge (Figure 2-3), Vermont Yankee daily average discharge flow (Figure 2-2) and river temperature increase (Figure 2-4) illustrates that for a constant heat rejection rate to the river, the temperature increase is inversely proportional to the river discharge.

Vermont Yankee's operation remained at or below the permit limits for all of 2004 except for one hour on 6 July 2004 between 2000 and 2001 when the calculated hourly average temperature increase was 2.06˚F, which rounded to 2.1˚F, compared to a NPDES permit limit of 2.0˚F. The calculated increase in temperature was slightly above 2.0˚F for 45 minutes (2005 through 2050) on 6 July 2004 when the plant was brought back on-line after the outage caused by the transformer fire.

During the cold water (winter) period from 15 October through 15 May when the permit limit was 13.4˚F, the maximum calculated river water temperature increase observed was 12.9°F on 2 February 2004 when the river flow was 1331 cfs. The rate of change of temperature at Station 3 did not exceed ±5ºF permitted change per hour.

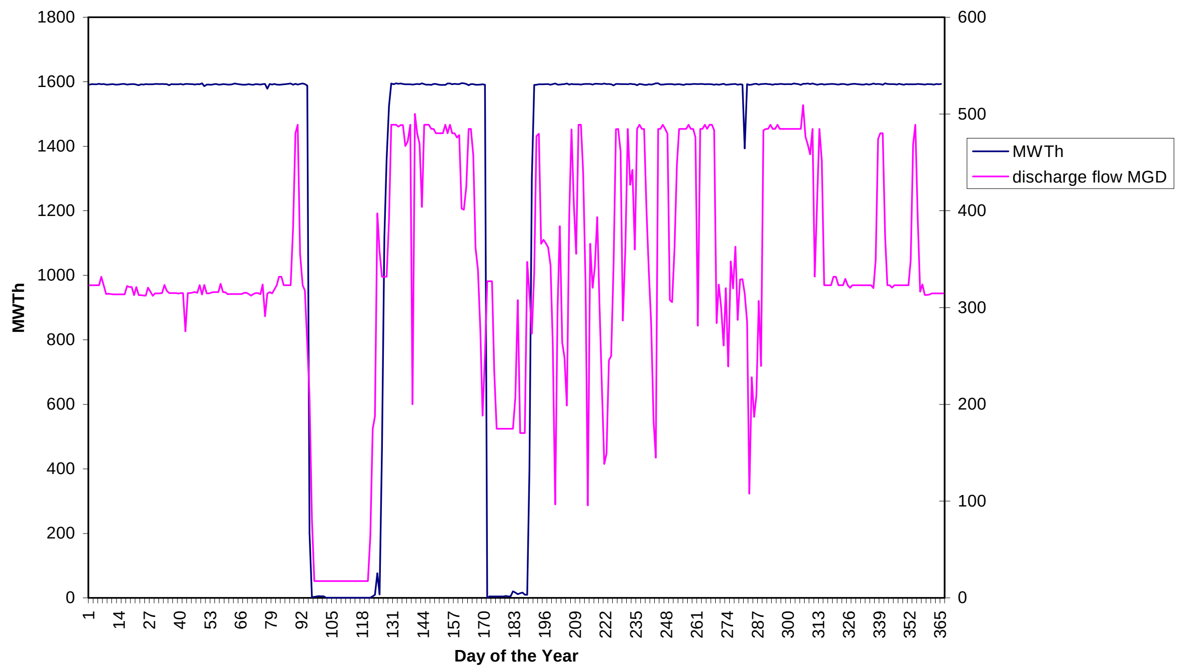

Figure 2-1. Vermont Yankee Core Thermal Power and Plant Discharge Flow 2004.

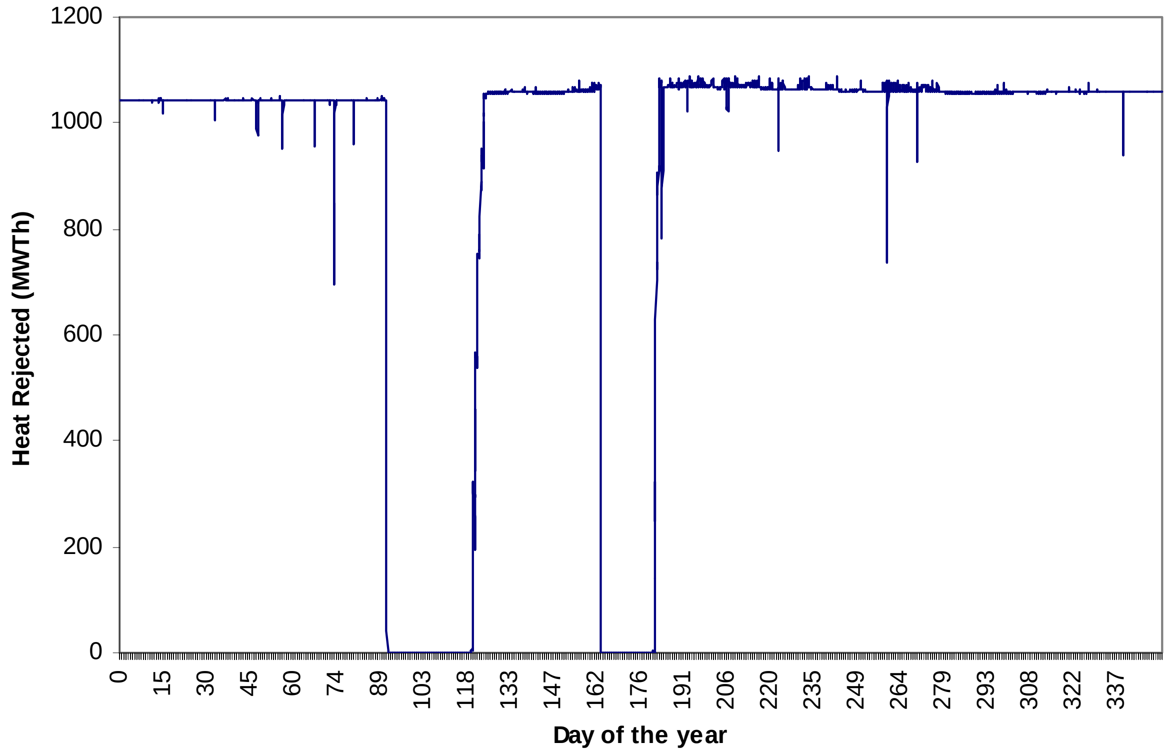

Figure 2-2. Hourly Average Heat Rejected by Vermont Yankee's Condenser during 2004.

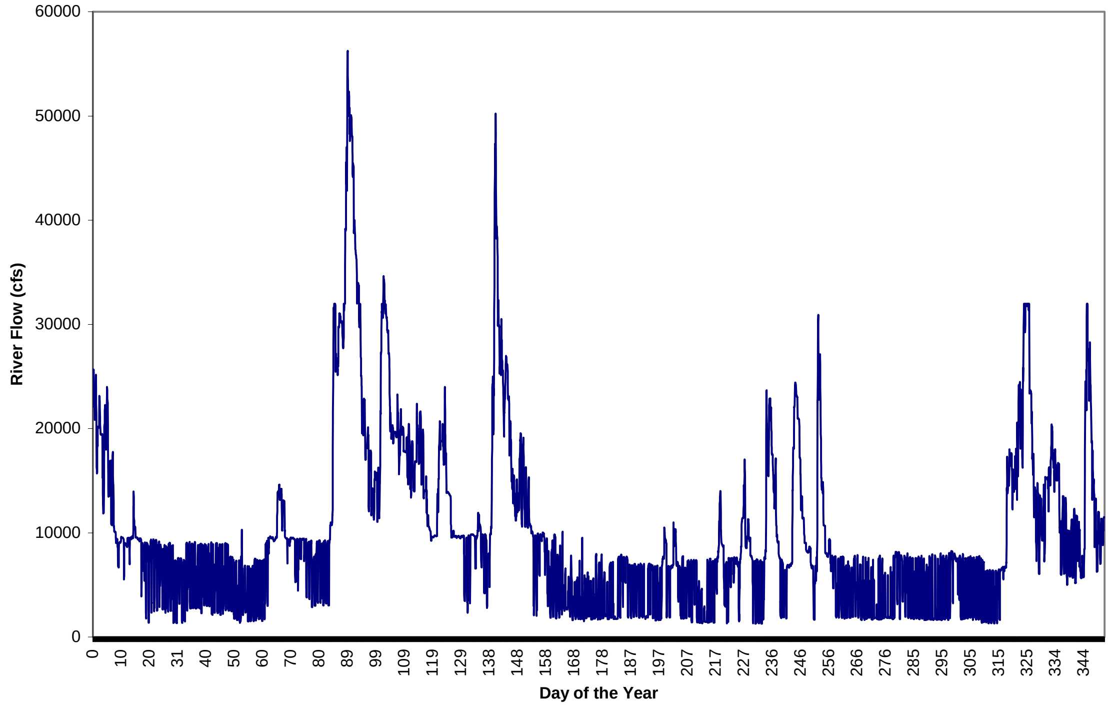

Figure 2-3. Hourly Average Connecticut River Flow at Vernon Dam During 2004.

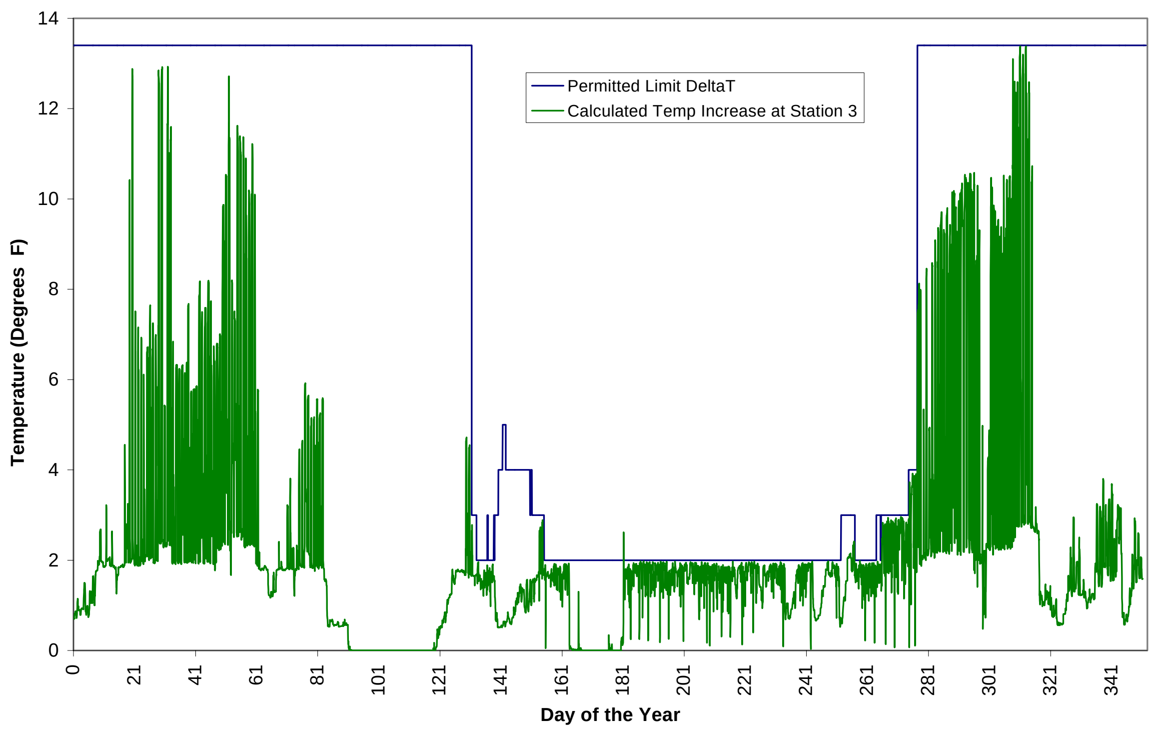

Figure 2-4. Simulated Hourly Connecticut River Temperature Increase at Downstream Station 3 During 2004.

Table 2-1. Average Heat Rejected by the Condenser (MWth) for the Year 2004.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day												
1	1043	1043	1043	1044	0	1057	0	1065	1064	1064	1057	1059
2	1042	1043	1043	1045	0	1058	0	1074	1064	1064	1057	1059
3	1043	1041	1043	949	1	1058	0	1074	1063	1062	1058	1058
4	1044	1044	1043	13	236	1058	0	1074	1063	1064	1058	1058
5	1044	1043	1043	0	538	1058	0	1072	1067	1062	1057	1058
6	1043	1044	1043	0	786	1058	53	1070	1067	1049	1064	1060
7	1042	1044	1043	0	956	1059	687	1071	1066	1045	1059	1058
8	1043	1043	1043	0	1047	1061	1008	1072	1065	1064	1057	1058
9	1043	1043	1031	0	1057	1061	984	1073	1062	1070	1058	1059
10	1043	1044	1043	0	1057	1061	1067	1072	1061	1066	1058	1059
11	1043	1043	1043	0	1057	1060	1067	1074	1061	1065	1058	1059
12	1042	1043	1043	0	1058	1061	1070	1072	1061	1065	1058	1059
13	1043	1044	1043	0	1058	1062	1069	1066	1061	1061	1058	1059
14	1043	1043	1043	0	1058	1064	1068	1064	1061	1063	1058	1059
15	1045	1043	1043	0	1059	1066	1070	1066	1061	1059	1058	1059
16	1043	1044	964	0	1059	1068	1069	1071	1062	1058	1058	1059
17	1043	1044	1042	0	1059	1070	1073	1068	1069	1058	1058	1059
18	1043	1035	1043	0	1059	312	1067	1063	1061	1057	1058	1026
19	1044	1043	1044	0	1059	0	1074	1060	1059	1057	1058	1058
20	1043	1043	1044	0	1059	0	1070	1065	1059	1057	1058	1058
21	1043	1043	1043	0	1060	0	1074	1068	1059	1057	1058	1058
22	1043	1044	1044	0	1060	0	1077	1063	1059	1057	1058	1059
23	1043	1044	1031	0	1059	0	1080	1062	1060	1057	1058	1059
24	1043	1043	1043	0	1059	0	1072	1063	1060	1057	1058	1059
25	1043	1043	1043	0	1057	0	1069	1063	1067	1057	1058	1059
26	1043	1044	1043	0	1057	0	1071	1065	984	1057	1059	1059
27	1043	1033	1044	0	1057	0	1072	1068	1067	1057	1058	1059
28	1043	1043	1044	0	1057	0	1067	1073	1068	1057	1058	1059
29	1043	1042	1043	0	1057	0	1065	1077	1066	1057	1059	1059
30	1043		1043	0	1057	0	1068	1069	1066	1057	1059	1059
31	1043		1044		1057		1073	1065		1057		1059
Monthly Avg	**1043**	**1043**	**1040**	**102**	**900**	**612**	**848**	**1068**	**1060**	**1059**	**1058**	**1058**

Table 2-2. Average Daily Connecticut River Discharge (cfs) at Vernon Dam during 2004.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day												
1	23072	6166	3461	44630	10545	12685	3243	3109	21345	5391	3931	23889
2	19803	4433	4655	50618	9501	13193	3623	5510	15657	4556	4186	31625
3	20743	5207	6897	48032	9683	15603	3170	5068	12493	4561	4541	30478
4	15849	6215	8194	40165	12714	15143	2770	5211	8327	3777	4446	21909
5	19654	5282	9537	34445	18975	12388	4254	5572	5032	3683	6041	14737
6	18230	6046	9310	29605	18354	11684	3483	2600	4293	3937	7271	12222
7	13928	4514	11524	21510	17278	10039	1757	2165	5376	3989	7469	10579
8	12689	6172	13779	19287	13771	7262	4493	1707	6825	3759	6021	10629
9	9405	5247	12565	17163	10772	7726	5449	2550	13323	1890	4126	12894
10	8245	4776	10351	15508	9788	8690	6520	3835	23383	3822	4367	14848
11	9466	4296	9245	13687	9628	9728	6778	4654	21216	2769	4214	17070
12	8612	5561	9361	14107	9567	8211	5407	5458	14328	3095	5028	16975
13	9193	4817	9435	15795	9611	5742	5348	7615	10521	2392	4541	15960
14	9138	5468	7964	30639	6612	6205	5366	11476	8442	2682	3504	13890
15	10690	4701	8337	32489	6578	6898	5333	7041	8386	3267	3578	9526
16	9839	4211	8905	29115	8274	4931	5118	4769	6551	6195	3960	9482
17	9376	4949	8504	21414	9741	3633	4102	5652	4137	7374	3859	8693
18	8574	5688	7581	19586	8717	4463	1908	6661	18502	6072	3852	8212
19	7848	4628	7352	19455	10842	3510	4725	6839	22114	5571	3806	8332
20	7061	4122	4933	18728	8973	3850	5572	7102	12693	5275	4457	8899
21	6891	3427	6555	20258	8101	4832	3823	5698	8419	4239	3446	9276
22	7339	3822	7506	18235	6916	3157	3897	11880	8527	4351	4594	6398
23	7287	5367	5963	17191	9117	3612	2992	11214	7178	3352	5265	9294
24	6556	4325	6248	17075	24632	3185	5954	9938	6668	4155	6420	26994
25	7285	3677	5973	16398	43004	3491	9175	8119	4662	4478	9737	25372
26	4985	4011	7983	16433	30053	3620	5442	5984	4929	3054	15585	17159
27	5530	5161	17357	18884	26708	2776	5158	5224	5349	2558	15790	11694
28	7020	4910	29393	18094	22818	2946	8388	4594	4474	3167	14990	9397
29	6024	4395	27754	15692	25388	2723	8413	3185	4790	3502	17915	9381
30	5146		30551	12850	20225	3626	5801	8262	3837	3449	23058	10456
31	5544		29952		14656		5190	18051		2606		11143
Monthly Avg	*10356*	*4883*	*11198*	*23570*	*14566*	*6852*	*4924*	*6347*	*10059*	*3967*	*7000*	*14433*

3.0 WATER QUALITY

3.1 COPPER, IRON AND ZINC CONCENTRATIONS

Beginning in April 1996, and continuing through 2004, monthly grab samples of Connecticut River water from Stations 3, 7, and the plant discharge (Figure 3-1) were analyzed for total copper, iron, and zinc, as required by Vermont Yankee's NPDES permit #3-1199. Results of the analysis are presented in Table 3-1 and Figures 3-2, 3-3 and 3-4.

Total copper concentrations in Connecticut River water from the upstream Station 7, Vermont Yankee's discharge, and downstream Station 3 ranged from <0.002 to 0.135 mg/l, 0.003 to 0.011 mg/l, and 0.001 to 0.0123 mg/l, respectively, in 2004 (Table 3-1, Figure 3-2). The highest total concentration of copper observed at Station 7 was 0.135 mg/l on 16 March 2004. The highest total concentration of copper observed in the Vermont Yankee Station discharge was 0.011 mg/l on 16 August 2004. The highest total copper concentration of 0.123 mg/l at Station 3 was observed on 19 October 2004.

On twelve occassions, the total iron concentration in the Connecticut River water samples at all three monitoring locations was greater than 0.5mg/l during 2004 (Table 3-1, Figure 3-3). The highest total iron concentration of 117 mg/l was measured at the upstream Station 7 on 16 March 2004, and was likely caused by the inadvertent contamination of the sample with suspended river sediments. The highest total iron concentration measured in the Vermont Yankee Discharge water was 0.569 mg/l on 17 January 2004. The highest total iron concentration measured at Station 3 was 2.42 mg/l observed on 19 October 2004.

Total zinc concentrations in Connecticut River water samples were generally less than 0.05 mg/l during 2004 (Table 3-1, Figure 3-4). The highest total zinc concentration at upstream Station 7 was 0.425 mg/l observed on 16 March 2004. Three other grab samples from Station 7 had total zinc concentrations above 0.5 mg/l; 0.105 mg/liter on 15 July, 0.112 on 4 September, and 0.052 mg/l on 19 October 2004. Total zinc concentrations in the Vermont Yankee discharge water (Station 4) were low compared to the two river stations, with the highest total zinc concentration of 0.041 mg/l observed in the sample from 16 August 2004. The two highest total zinc concentrations observed at Station 3 were 0.159 mg/l on 4 September and 0.143 mg/l on 19 October 2004.

High concentrations of total copper, iron, and zinc tend to be observed at upstream Station 7 at irregular times throughout the year. Station 7 is relatively shallow (water depth <1 foot) with a mud substrate that is easily disturbed by wave action. Each monthly water quality sample from Station 7 is collected as a surface grab from the shallow, near-shore area and may include some suspended sediments if the wind and water conditions at the time of collection facilitate sediment re-suspension. For example, total copper, iron and zinc were all highest in the grab sample collected from Station 7 on 16 March 2004, suggesting that some re-suspended bottom sediments were included in the grab. Prior to 1996, water quality samples were removed from a continuous stream of pumped water withdrawn from an off-shore mid-depth intake at Station 7. The discharge (Station 4) grab samples are taken from the water surface in the concrete discharge structure of the Station and therefore is not likely contaminated by sediments. The Station 3 grab sample is collected from a continuous stream of pumped water withdrawn from an off-shore mid-depth intake in the Vernon Dam tailrace. Therefore, some of the observed monthly and location differences in total copper, iron and zinc concentrations, particularly at Station 7, are likely due to differences in the physical nature of the stations and events during sampling that result in sediments being inadvertently collected in the sample container. In previous years, the concentrations of copper, iron, and zinc were determined in both the dissolved and particulate fractions for some sampling events, although not required by the NPDES permit (Vermont Yankee and Normandeau 2004). These previous results confirmed that most of the metals were found in suspended sediments and not in the dissolved fraction.

3.2 WATER TEMPERATURE

Water temperature was measured continuously in the Connecticut River at Station 7 and Station 3 during 2004 and at the Vernon Dam fishway during its operation. Daily and monthly average temperature data for Station 7 and Station 3 are summarized in Tables 3-2 and 3-3; the hourly average temperature data for both stations are plotted on Figure 3-5. Station 7 is well upstream of the plant, where water temperatures are unaffected by the plant's thermal discharge, and reflect the natural seasonal changes associated with atmospheric heating and cooling experienced in the northern New England climate. Heat discharged from the plant was well mixed at Station 3, due to passage through the Vernon Dam. Temperatures measured at Station 3 reflected both the natural and plant-induced changes in temperature between the upstream and downstream locations, and never exceeded the 65˚F limit during the winter permit period from 15 October through 15 May (Figure 3-5).

Hourly and daily average temperature data from the Vernon Dam fishway are presented in Table 3-4 and Figure 3-6. The fishway operated daily from 19 May 2004 at 1030 to 7 July 2004 at 0930. During the 2004 period of fishway operation, the hourly water temperature observed in the fishway ranged from a low of 54.8°F at 0730 on 27 May 2004 to a high of 76.1°F at 1644 on 3 July 2004

On three occasions, the downstream Station 3 modem failed and the primary temperature data was not available from the Azonix® temperature probe system. For each of those occasions backup temperature data from the WaDaR® data logger was used. The three time periods for which the backup data was used in 2004 were from 15 May at 1900 to 17 May at 1700, 24 May at 0400 to 0800, and 20 August at 2000 to 23 August at 2000.

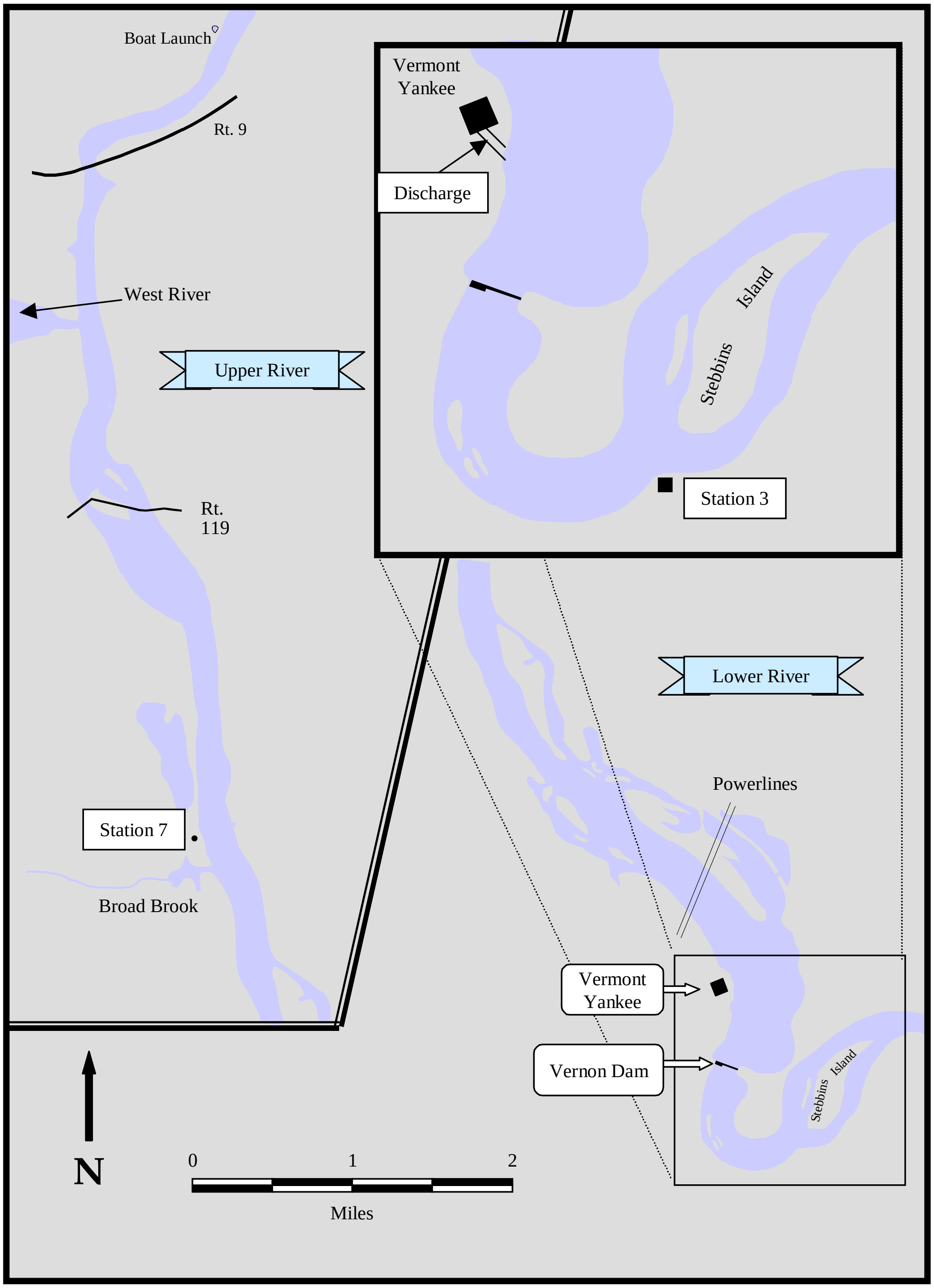

Figure 3-1. NPDES Copper, Iron and Zinc Sampling Stations.

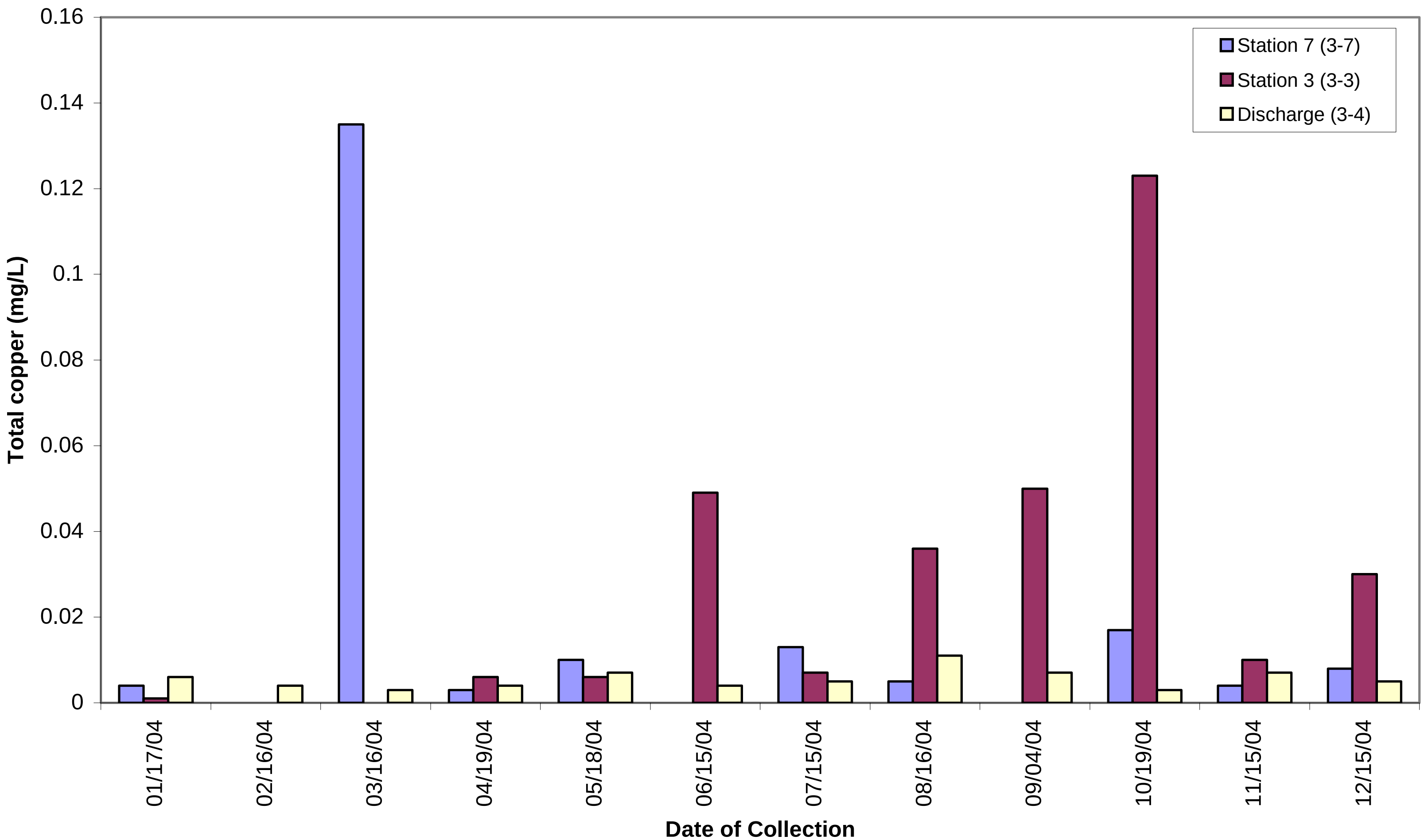

Figure 3-2. Monthly Total Copper Concentrations Observed at NPDES Permit Required Monitoring Stations During 2004. At Station 7 on 3/16/05 the concentration was 0.135 mg/l, likely due to sediment contamination during sample collection. Samples where concentration values were equal to 0 mg/l fell below detection limits.

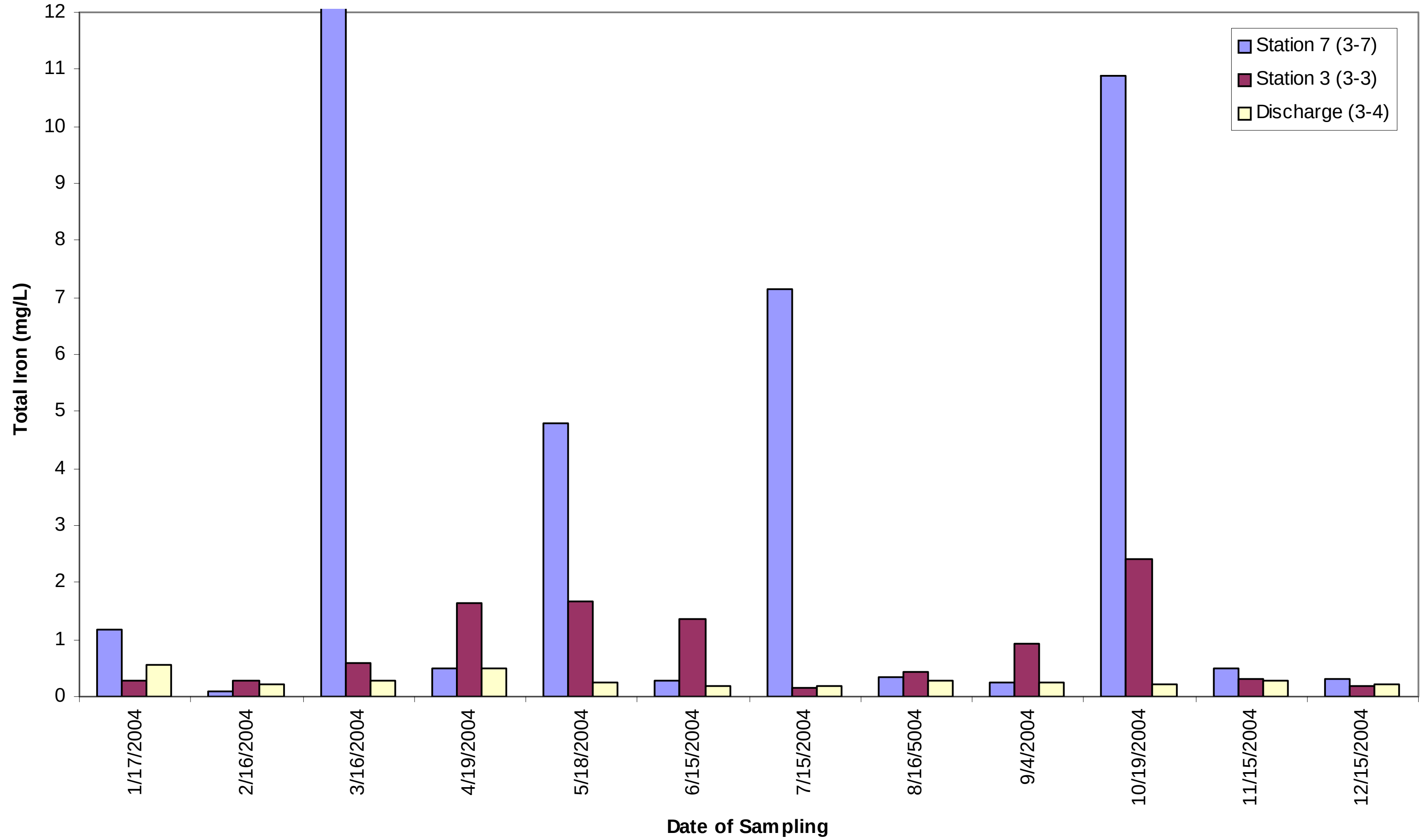

Figure 3-3. Monthly Total Iron Concentrations Observed from NPDES Permit Required Monitoring Stations During 2004. At Station 7 on 3/16/05 the concentration was 117 mg/l, likely due to sediment contamination during sample collection.

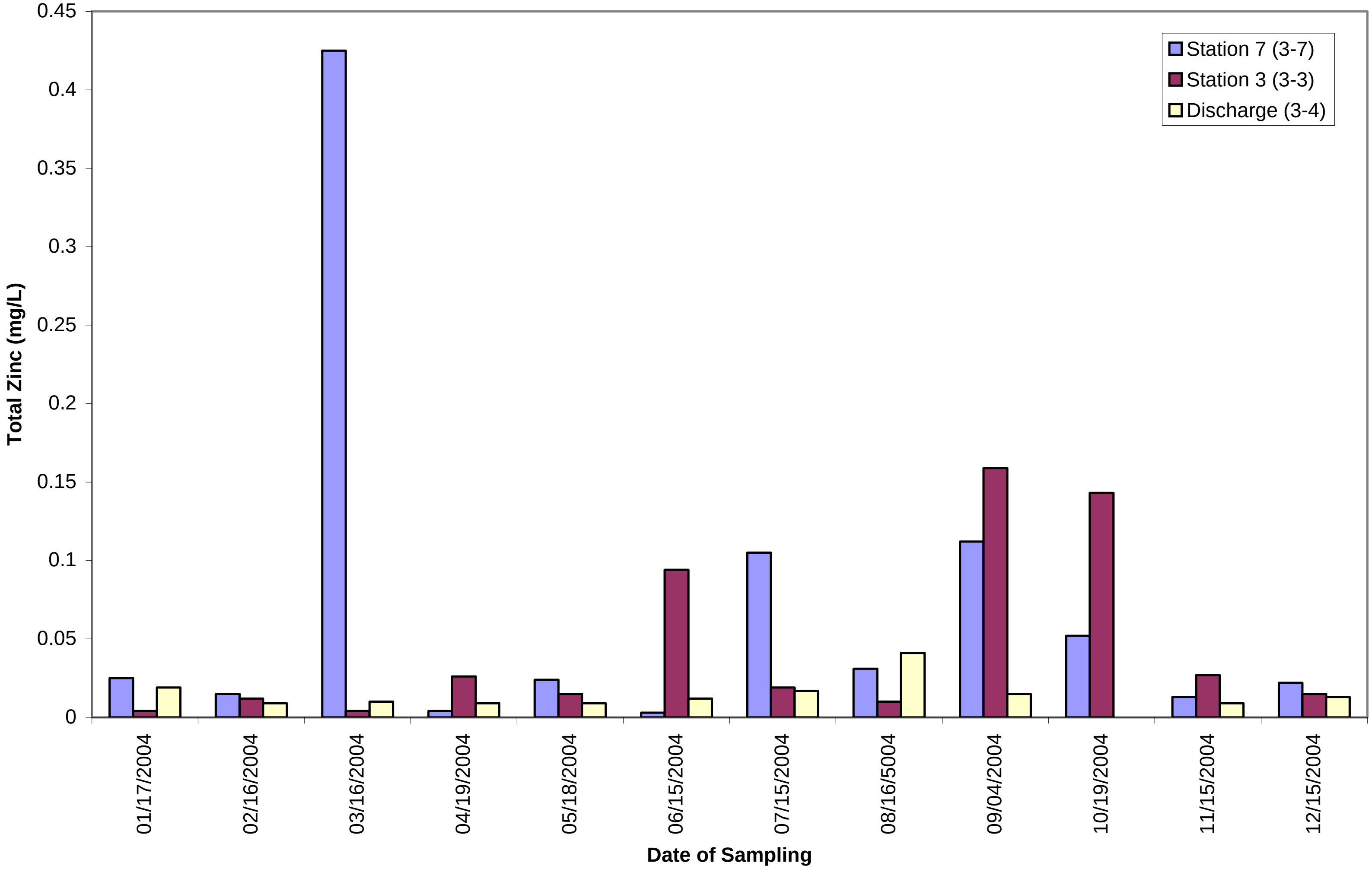

Figure 3-4. Monthly Total Zinc Concentrations Observed from the NPDES Permit Required Monitoring Stations during 2004. At Station 7 on 3/16/05 the concentration was 0.425 mg/l, likely due to sediment contamination during sample collection.

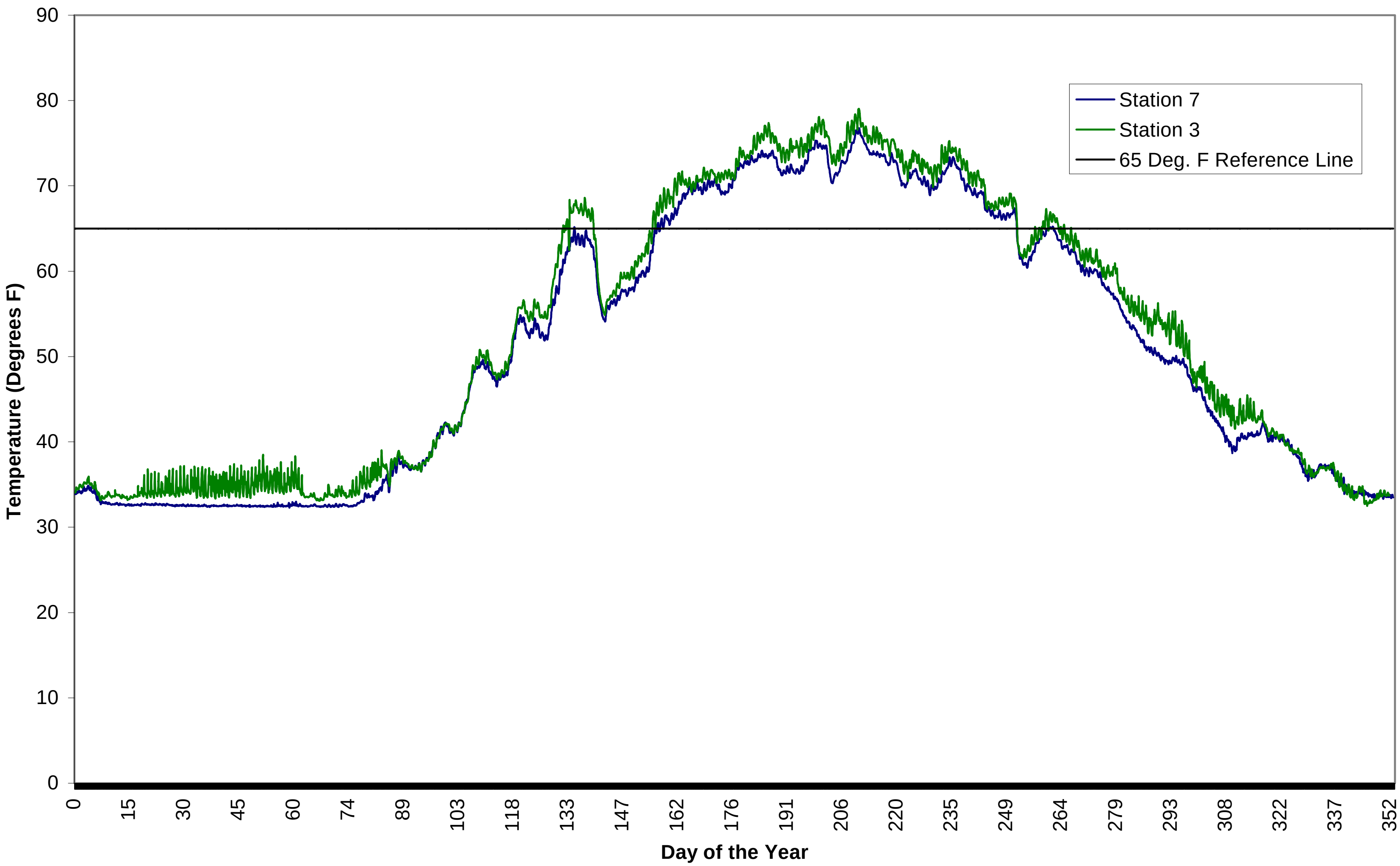

Figure 3-5. Measured Hourly Average Connecticut River Temperatures at Monitoring Stations 3 and 7 During 2004.

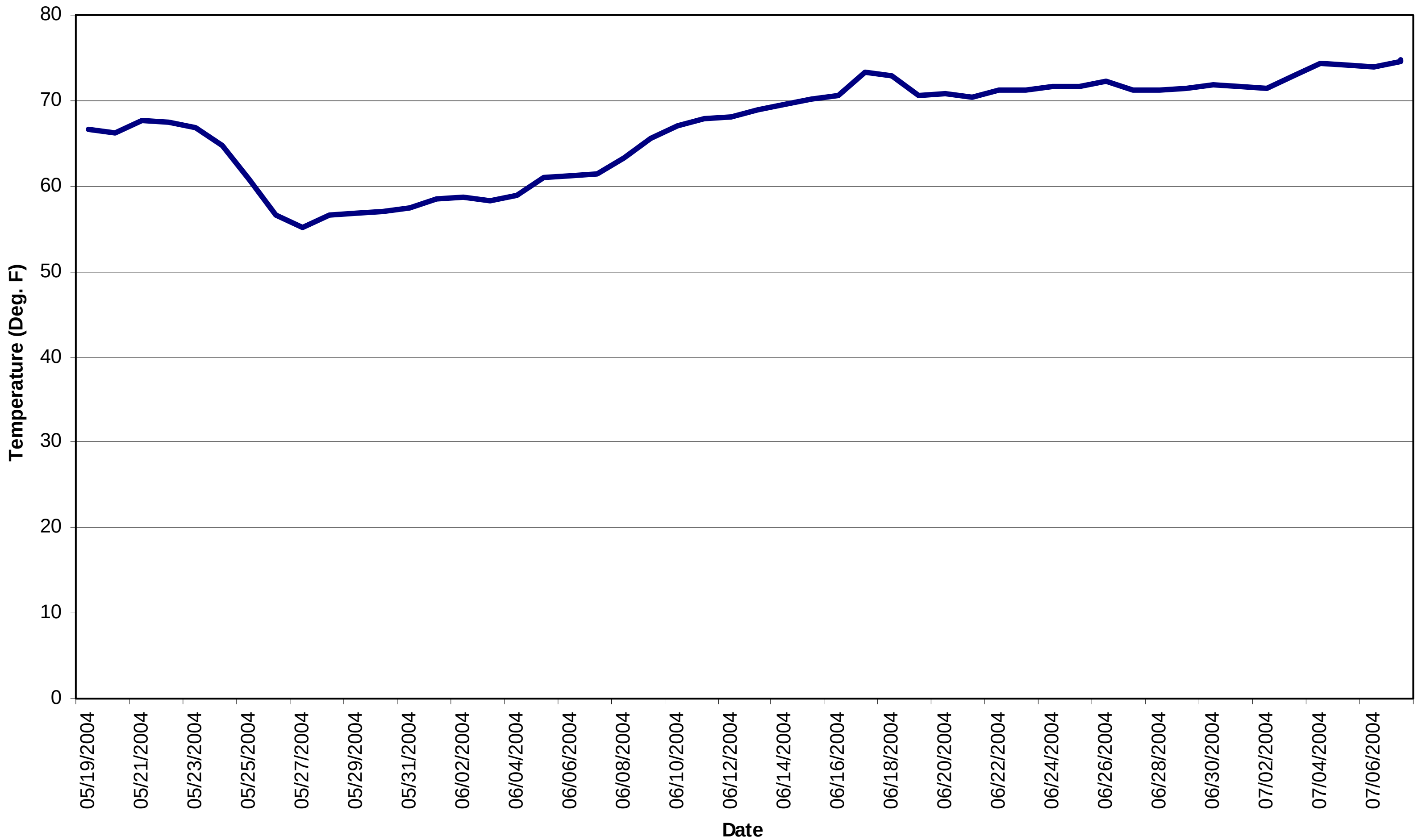

Figure 3-6. Hourly Average Vernon Dam Fishway Water Temperatures Measured from 22 May through 30 June 2004.

Table 3-1. Metal Concentrations in Connecticut River Water Samples Collected at NPDES Stations 7, 3, and Vermont Yankee Discharge during 2004.

	Station 7 (3-7) mg/L			Station 3 (3-3) mg/L			Discharge (3-4) mg/L		
Date	Copper	Iron	Zinc	Copper	Iron	Zinc	Copper	Iron	Zinc
01/17/2004	0.004	1.18	0.025	0.001	0.287	0.004	0.006	0.569	0.019
02/16/2004	<0.002	0.100	0.015	<0.002	0.290	0.012	0.004	0.225	0.009
03/16/2004	0.135	117	0.425	<0.002	0.580	0.004	0.003	0.290	0.010
04/19/2004	0.003	0.491	0.004	0.006	1.640	0.026	0.004	0.498	0.009
05/18/2004	0.01	4.8	0.024	0.006	1.660	0.015	0.007	0.249	0.009
06/15/2004	<0.002	0.271	0.003	0.049	1.360	0.094	0.004	0.201	0.012
07/15/2004	0.013	7.13	0.105	0.007	0.147	0.019	0.005	0.178	0.017
08/16/5004	0.005	0.352	0.031	0.036	0.447	0.010	0.011	0.278	0.041
09/04/2004	<0.003	0.233	0.112	0.050	0.918	0.159	0.007	0.247	0.015
10/19/2004	0.017	10.9	0.052	0.123	2.42	0.143	0.003	0.216	<0.003
11/15/2004	0.004	0.498	0.013	0.010	0.294	0.027	0.007	0.272	0.009
12/15/2004	0.008	0.317	0.022	0.030	0.196	0.015	0.005	0.214	0.013

Table 3-2. Average Daily Connecticut River Temperature (^oF) at Station 7 for the Year 2004.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day												
1	34.00	32.54	32.64	37.26	50.27	57.72	70.15	72.79	72.71	62.82	49.73	40.29
2	34.15	32.54	32.70	37.06	52.88	57.46	71.20	73.25	72.01	62.80	49.38	40.01
3	34.31	32.53	32.56	36.84	54.33	57.94	72.21	74.34	70.85	62.25	49.42	39.39
4	34.52	32.49	32.46	36.98	54.35	58.26	72.36	75.52	69.87	62.22	48.77	38.73
5	34.39	32.51	32.47	37.10	53.25	59.15	72.76	76.39	69.82	61.12	47.57	38.28
6	34.11	32.50	32.50	37.12	52.70	59.76	72.91	75.88	69.21	60.45	46.41	37.38
7	33.36	32.46	32.58	37.66	53.39	59.76	73.02	74.96	68.98	59.98	46.20	36.47
8	32.93	32.53	32.46	38.16	53.65	60.60	73.19	74.09	69.23	59.94	46.16	36.03
9	32.87	32.48	32.43	39.21	52.58	62.79	73.65	73.77	68.31	59.94	45.04	36.11
10	32.77	32.50	32.51	40.00	52.26	64.82	73.64	73.77	67.24	60.12	43.94	36.22
11	32.67	32.55	32.51	41.06	52.67	65.27	73.50	73.65	66.91	59.54	43.36	37.06
12	32.74	32.51	32.45	41.57	55.09	65.62	73.83	73.56	66.44	58.52	42.69	37.14
13	32.68	32.49	32.55	41.99	57.01	66.29	73.36	72.87	66.64	57.95	42.12	37.06
14	32.66	32.53	32.51	41.25	58.28	66.00	72.13	73.06	66.40	57.57	41.50	36.96
15	32.60	32.55	32.59	41.30	60.42	66.72	71.48	73.02	66.37	57.05	40.47	36.28
16	32.61	32.51	32.56	41.68	61.82	67.25	71.77	72.21	66.57	56.56	39.91	35.70
17	32.58	32.48	32.46	42.49	62.92	68.25	71.92	70.55	66.94	55.57	44.88	35.12
18	32.62	32.48	32.51	43.99	64.11	68.91	71.87	70.08	65.34	54.67	39.54	34.75
19	32.64	32.46	32.70	45.52	63.88	69.47	71.75	70.75	61.88	53.98	40.45	34.31
20	32.70	32.48	32.97	47.49	63.67	69.52	71.75	71.33	60.96	53.45	40.61	34.07
21	32.67	32.47	33.41	48.58	63.62	69.89	72.22	71.74	60.82	53.14	40.59	33.97
22	32.64	32.45	33.64	48.89	63.97	69.79	73.14	70.87	61.67	52.25	40.90	34.05
23	32.69	32.47	33.61	49.24	63.15	69.57	74.28	70.53	62.60	51.72	40.73	33.91
24	32.67	32.46	33.66	48.86	61.39	69.91	74.72	70.33	63.45	50.97	40.93	33.98
25	32.66	32.47	34.28	48.22	57.46	70.35	74.83	69.53	64.17	50.91	41.65	33.78
26	32.65	32.56	34.91	47.48	55.11	70.47	74.62	69.78	64.43	50.55	41.46	33.65
27	32.60	32.52	35.69	47.11	54.83	70.12	74.52	70.09	65.00	50.32	40.32	33.68
28	32.53	32.47	35.46	47.59	55.91	69.38	72.20	70.82	65.01	49.92	40.46	33.78
29	32.54	32.54	36.90	47.89	56.44	69.17	70.57	71.55	64.34	49.53	40.65	33.62
30	32.55		37.35	48.62	56.48	69.59	71.38	72.43	63.60	49.39	40.42	33.62
31	32.55		37.66		57.16		72.02	72.89		49.49		33.65
Monthly Avg	**32.99**	**32.50**	**33.47**	**42.94**	**57.26**	**65.66**	**72.67**	**72.46**	**66.26**	**55.96**	**43.21**	**35.78**

Table 3-3. Average Daily Connecticut River Temperature (°F) at Station 3 for the Year 2004.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Day												
1	34.38	34.53	35.63	37.78	51.09	59.34	71.22	74.28	74.11	64.57	53.19	40.50
2	34.77	34.92	35.71	37.41	53.51	59.44	71.82	76.00	73.46	64.00	52.15	39.70
3	34.98	34.74	34.86	37.09	55.59	59.72	73.29	76.43	72.72	63.98	52.06	39.16
4	35.40	34.79	34.06	36.96	56.06	60.23	73.80	77.28	72.39	63.45	51.11	38.90
5	35.07	34.90	33.53	37.02	55.28	61.18	73.35	78.08	71.10	63.20	49.74	38.88
6	34.82	34.54	33.68	37.11	54.67	61.71	73.64	77.41	70.93	61.84	47.68	38.27
7	33.99	35.16	33.66	37.65	55.41	62.41	74.70	76.44	71.05	61.82	47.40	37.22
8	33.40	34.79	33.24	38.21	55.94	63.51	75.08	75.58	70.68	61.87	47.87	36.68
9	33.52	34.52	33.23	39.10	54.87	65.19	75.62	75.76	70.01	61.32	47.65	36.23
10	33.86	34.56	33.58	39.86	54.79	66.73	76.22	75.97	67.78	61.71	46.19	36.29
11	33.60	35.01	34.04	40.97	55.16	67.63	76.50	75.68	67.70	60.91	46.18	36.78
12	33.81	34.70	33.74	41.71	57.04	68.24	75.92	75.10	67.61	59.93	44.64	36.99
13	33.66	34.81	33.83	42.10	59.93	68.50	75.51	75.20	67.86	59.78	44.32	36.87
14	33.58	34.97	34.18	41.61	62.06	68.61	74.62	74.53	68.18	59.83	44.26	37.13
15	33.40	34.91	34.13	41.41	63.93	69.42	73.86	75.14	68.00	60.24	44.16	36.89
16	33.47	35.13	33.71	41.74	65.31	70.31	73.65	73.96	68.44	59.11	43.42	35.91
17	33.61	35.01	33.92	42.49	65.60	70.77	74.23	73.49	68.20	57.55	42.91	35.20
18	33.79	34.51	34.24	44.03	67.25	70.48	74.46	72.20	66.38	56.88	46.17	34.60
19	34.04	35.07	34.34	45.68	67.64	70.31	74.68	72.08	62.22	56.23	43.52	34.39
20	34.13	35.30	35.37	47.88	67.29	69.95	74.55	73.10	62.01	55.85	42.79	33.89
21	34.28	35.74	35.51	49.10	67.44	70.38	74.36	73.51	62.34	55.47	43.76	33.59
22	34.12	36.08	35.34	49.89	66.95	70.66	75.02	72.70	63.19	55.26	43.37	34.32
23	34.19	35.39	35.91	50.05	66.59	71.19	75.46	72.49	64.05	55.06	43.09	34.25
24	34.27	35.36	36.33	50.03	63.98	71.32	76.47	72.39	64.28	54.50	42.62	32.80
25	34.37	35.47	36.47	49.26	58.86	71.38	77.12	71.76	64.90	53.64	43.02	32.92
26	34.64	35.18	37.29	48.10	55.94	71.46	77.05	71.40	66.10	53.85	41.99	33.09
27	34.63	34.97	37.03	47.78	55.61	70.95	76.41	71.90	65.99	54.89	40.95	33.46
28	34.52	34.66	35.80	48.02	56.83	71.02	75.23	72.87	66.26	54.06	41.32	33.83
29	34.38	35.32	37.52	48.59	57.35	71.30	73.20	73.42	65.98	53.44	40.89	33.93
30	34.69		38.02	49.20	57.86	71.41	73.17	74.12	64.86	53.66	40.55	33.82
31	34.68		38.37		58.82		73.94	74.17		53.27		33.77
Monthly Avg	**34.19**	**35.00**	**35.04**	**43.26**	**59.51**	**67.49**	**74.65**	**74.34**	**67.63**	**58.42**	**45.30**	**35.81**

Table 3-4. Hourly and Daily Average Temperature at the Vernon Dam Fishway During 2004.

Day	19-May	20-May	21-May	22-May	23-May	24-May	25-May	26-May	27-May	28-May	29-May	30-May
Hour												
0		66.31	67.60	67.46	66.59	64.60	60.69	56.64	55.06	56.49	56.82	57.01
1		66.95	67.44	67.31	66.38	64.34	60.26	56.47	54.99	56.46	56.78	56.96
2		67.01	66.68	67.23	66.13	64.09	59.89	56.33	54.93	56.44	56.74	56.95
3		67.00	66.64	66.98	66.09	63.81	59.65	56.31	54.88	56.43	56.75	56.95
4		67.01	66.66	67.04	66.06	63.68	59.50	56.26	54.84	56.43	56.69	56.83
5		67.05	66.63	66.87	66.07	63.73	59.34	56.17	54.83	56.43	56.69	56.74
6		67.02	66.66	66.76	66.03	63.67	59.18	56.10	54.80	56.40	56.72	56.75
7		67.28	67.09	66.69	66.58	63.43	58.94	56.02	54.81	56.34	56.83	56.84
8		67.56	67.21	66.85	67.10	63.26	58.74	55.98	54.85	56.37	56.96	57.09
9		67.86	68.16	66.50	67.23	63.10	58.51	55.90	55.12	56.37	57.04	57.39
10	66.60	68.13	68.72	66.76	66.67	62.99	58.29	55.81	55.31	56.38	57.17	57.61
11	67.14	68.44	68.79	67.17	66.86	62.83	58.13	55.70	55.49	56.35	57.30	57.86
12	66.92	68.34	68.64	67.74	67.33	62.73	58.01	55.64	55.64	56.35	57.35	58.01
13	66.92	68.62	68.01	67.69	67.69	62.81	57.88	55.61	55.68	56.36	57.37	58.11
14	66.95	68.53	68.14	67.79	68.06	63.00	57.85	55.54	55.83	56.46	57.40	58.13
15	67.35	68.42	68.73	67.84	68.04	63.09	57.71	55.50	55.95	56.63	57.40	58.09
16	67.61	68.19	68.82	67.90	67.72	62.89	57.58	55.39	56.08	56.70	57.33	57.96
17	67.45	68.02	68.68	67.91	67.39	62.63	57.45	55.30	56.11	56.67	57.18	57.84
18	67.39	67.86	68.76	67.84	67.44	62.38	57.33	55.29	56.13	56.68	57.03	57.76
19	67.85	67.92	68.62	67.61	67.39	62.15	57.21	55.25	56.17	56.67	57.00	57.70
20	67.78	67.94	68.41	67.51	67.16	61.91	57.06	55.17	56.25	56.71	57.00	57.64
21	67.77	67.72	68.32	67.31	65.77	61.65	56.95	55.16	56.29	56.75	57.04	57.61
22	67.63	67.76	68.07	67.27	65.63	61.38	56.84	55.14	56.42	56.81	57.06	57.55
23	67.27	67.74	67.73	67.10	65.28	61.07	56.75	55.09	56.50	56.81	57.03	57.52
Daily Average	*67.3*	*67.7*	*67.9*	*67.3*	*66.8*	*63.0*	*58.3*	*55.7*	*55.5*	*56.5*	*57.0*	*57.5*

(continued)

Table 3-4. (Continued)

Day	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun
Hour												
0	57.48	58.50	58.72	58.38	58.82	60.85	61.44	61.47	63.35	65.33	67.17	67.79
1	57.51	58.51	58.64	58.40	58.70	60.42	61.64	61.43	62.81	64.64	67.13	67.84
2	57.47	58.52	58.63	58.48	58.75	59.81	61.12	61.40	63.02	64.34	67.11	67.62
3	57.41	58.52	58.58	58.60	58.77	59.82	60.65	61.28	64.43	65.38	66.91	67.67
4	57.35	58.53	58.59	58.66	58.70	59.88	60.51	62.12	64.40	65.74	66.74	67.67
5	57.35	58.55	58.67	58.70	58.67	59.98	60.46	61.89	64.42	65.70	66.36	67.58
6	57.39	58.54	58.89	58.74	58.68	60.05	60.40	62.13	64.19	65.46	65.56	67.41
7	57.57	58.55	58.97	58.88	58.87	60.18	60.41	62.35	65.00	65.56	65.02	67.72
8	57.78	58.61	59.06	59.07	59.09	60.29	60.66	62.69	65.23	65.88	66.49	67.82
9	58.07	58.65	59.66	59.36	59.29	60.32	60.95	62.85	66.32	66.41	66.93	68.02
10	58.29	58.85	59.69	59.52	59.53	60.78	62.02	63.61	66.83	66.67	67.09	68.64
11	58.43	58.84	58.94	59.58	59.79	62.87	62.63	64.23	66.04	66.48	67.23	68.92
12	58.66	58.92	59.01	59.49	59.98	63.49	62.99	64.81	65.76	66.46	67.60	69.17
13	58.99	59.23	59.06	59.36	60.28	63.69	61.89	65.16	65.28	67.20	68.08	69.32
14	60.32	59.20	59.17	59.71	60.53	63.60	62.32	65.30	65.53	67.67	68.68	69.46
15	61.75	59.19	59.13	60.54	60.68	63.80	61.77	65.08	65.72	67.82	68.88	69.50
16	61.45	59.04	59.12	60.36	60.21	63.37	61.81	64.32	65.86	68.11	68.67	69.51
17	61.11	59.22	59.07	60.08	60.89	62.14	61.65	64.01	65.33	68.04	68.71	69.15
18	60.17	59.09	58.91	60.13	60.57	61.67	61.50	64.40	65.10	67.84	68.91	68.96
19	58.90	58.97	58.79	60.03	60.30	61.39	61.41	64.64	65.44	67.48	68.91	69.06
20	58.86	59.01	58.70	60.06	60.26	61.80	61.54	64.89	65.70	67.97	68.69	69.06
21	58.72	58.92	58.63	59.91	60.50	61.62	61.37	64.87	65.48	68.20	68.34	68.87
22	58.58	58.86	58.53	59.89	60.83	61.44	61.38	64.79	65.39	68.26	68.20	68.70
23	58.56	58.77	58.44	59.20	60.64	61.61	61.42	64.17	65.47	67.79	67.79	68.59
Daily Average	*58.7*	*58.8*	*58.9*	*59.4*	*59.7*	*61.5*	*61.4*	*63.5*	*65.1*	*66.7*	*67.5*	*68.5*

(continued)

Table 3-4. (Continued)

Day	12-Jun	13-Jun	14-Jun	15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun
Hour												
0	68.04	68.82	69.43	69.90	70.49	73.32	72.91	70.61	70.65	70.45	71.27	71.12
1	67.98	68.73	69.18	69.33	70.10	73.17	72.70	70.55	70.47	70.40	71.18	71.04
2	67.95	68.22	69.02	68.89	69.77	73.14	72.62	70.40	70.10	70.30	71.11	70.98
3	67.55	68.06	68.84	68.37	70.20	72.98	72.73	70.37	69.86	70.24	71.03	70.93
4	67.44	67.93	68.69	68.23	70.17	72.78	72.72	70.31	69.64	70.15	71.00	70.84
5	67.51	67.71	68.62	68.33	70.09	72.68	72.69	70.30	69.57	70.10	70.97	70.79
6	67.81	67.79	68.44	69.26	70.11	71.95	72.74	70.31	69.53	70.10	70.89	70.80
7	68.08	68.12	68.72	70.37	70.30	71.72	72.70	70.36	69.57	70.17	70.88	70.87
8	68.24	68.62	69.62	71.07	70.68	71.82	71.66	70.57	69.68	70.28	70.92	71.01
9	68.54	69.58	69.68	70.98	71.35	72.06	71.17	70.58	69.81	70.48	70.90	71.25
10	68.81	70.04	69.45	70.34	71.06	72.21	71.70	70.57	69.97	70.57	71.01	71.60
11	69.41	70.55	69.67	70.79	73.20	73.08	71.59	70.67	70.15	70.67	71.05	71.89
12	70.08	71.08	69.88	71.28	74.02	73.11	70.81	71.11	70.42	70.86	71.10	71.92
13	70.33	71.23	70.03	71.74	74.31	72.93	72.08	71.25	70.54	71.23	71.21	72.07
14	70.49	71.20	70.24	71.82	74.36	73.40	72.07	71.74	70.69	71.41	71.22	72.27
15	70.50	71.13	70.09	71.86	74.54	73.34	72.34	71.83	70.77	71.67	71.26	72.28
16	70.60	71.15	69.95	71.93	74.30	73.57	72.10	72.03	70.90	71.60	71.30	72.59
17	70.43	71.10	70.03	72.14	73.80	72.83	71.55	71.59	70.99	71.76	71.31	72.83
18	70.38	70.97	70.08	71.80	73.83	72.87	71.35	71.32	70.95	71.57	71.29	72.53
19	70.48	70.72	69.82	71.46	73.79	73.63	71.27	71.14	70.93	71.64	71.28	72.19
20	70.13	70.44	69.89	71.48	73.70	73.33	71.14	71.02	70.87	71.57	71.28	72.35
21	69.78	70.29	69.80	71.30	73.76	73.05	70.91	70.84	70.76	71.37	71.30	72.51
22	69.16	69.92	69.95	71.32	73.48	72.96	70.69	70.72	70.64	71.37	71.26	72.10
23	69.05	69.62	69.91	71.30	73.29	73.08	70.60	70.69	70.54	71.30	71.18	71.80
Daily Average	*69.12*	*69.71*	*69.54*	*70.64*	*72.28*	*72.87*	*71.87*	*70.87*	*70.33*	*70.89*	*71.13*	*71.69*

(continued)

Table 3-4. (Continued)

Day	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul
Hour												
0	71.64	71.67	72.29	71.14	71.19	71.38	71.88	71.58	71.40	72.97	74.35	74.07
1	71.46	71.58	72.20	71.05	71.08	71.32	71.68	71.45	71.34	72.96	74.19	73.90
2	71.38	71.37	72.14	70.98	70.97	71.28	71.50	71.35	71.28	72.93	74.06	73.80
3	71.26	71.25	72.10	70.89	70.88	71.22	71.36	71.24	71.19	72.90	73.93	73.71
4	71.13	71.24	72.03	70.79	70.82	71.17	71.26	71.19	71.16	72.76	73.76	73.65
5	71.09	71.23	71.99	70.70	70.81	71.11	71.17	71.14	71.16	72.69	73.63	73.63
6	71.10	71.23	71.94	70.75	70.84	71.12	71.16	71.14	71.20	72.68	73.58	73.62
7	71.15	71.35	71.84	70.84	70.95	71.18	71.20	71.19	71.29	72.72	73.63	73.61
8	71.39	71.51	71.77	71.10	71.18	71.31	71.42	71.45	71.54	73.01	73.77	73.56
9	71.91	71.83	71.72	71.32	71.51	71.62	71.61	71.74	72.14	73.27	74.11	73.63
10	72.10	72.16	71.60	71.75	71.62	71.78	71.75	72.27	72.24	73.30	74.66	73.68
11	72.62	72.44	71.57	71.56	71.59	72.11	72.08	72.79	72.07	73.75	75.42	73.70
12	72.47	72.50	71.55	71.57	71.85	72.25	72.48	73.25	72.52	74.16	75.64	73.78
13	72.89	72.77	71.55	71.95	72.02	72.58	72.67	73.00	73.50	74.79	75.45	73.91
14	73.25	72.82	71.53	72.15	72.07	72.73	72.72	72.88	74.09	74.96	75.74	74.06
15	73.31	72.84	71.56	72.26	72.15	72.90	72.70	72.82	74.06	75.41	75.68	74.22
16	73.11	72.77	71.57	72.33	71.91	72.90	72.57	72.65	74.03	76.05	75.61	74.31
17	72.83	72.77	71.56	72.43	71.99	72.69	72.50	72.36	74.22	75.84	74.86	74.38
18	72.65	72.72	71.46	72.25	71.80	72.83	72.39	72.17	73.81	75.97	75.00	74.37
19	72.42	72.66	71.46	72.04	71.75	72.95	72.78	72.05	73.57	75.74	75.16	74.32
20	72.15	72.66	71.46	71.82	71.68	72.76	72.42	72.09	73.64	75.47	75.05	74.09
21	72.02	72.53	71.34	71.59	71.58	72.54	72.06	71.92	73.26	75.08	74.93	73.90
22	71.96	72.37	71.28	71.43	71.53	72.36	71.83	71.62	73.12	74.85	74.70	73.84
23	71.79	72.31	71.22	71.32	71.44	72.06	71.73	71.48	73.03	74.59	74.42	73.91
Daily Average	*72.04*	*72.11*	*71.70*	*71.49*	*71.45*	*71.92*	*71.94*	*71.99*	*72.39*	*73.94*	*74.61*	*73.90*

(continued)

Table 3-4. (Continued)

Day	6-Jul	7-Jul
Hour		
0	73.87	74.58
1	73.83	74.56
2	73.77	74.49
3	73.73	74.40
4	73.67	74.35
5	73.63	74.42
6	73.62	74.57
7	73.61	74.71
8	73.69	74.73
9	73.76	
10	73.88	
11	74.02	
12	74.14	
13	74.19	
14	74.31	
15	74.36	
16	74.50	
17	74.57	
18	74.52	
19	74.46	
20	74.56	
21	74.73	
22	74.99	
23	74.78	
Daily Average	*74.13*	*74.53*

4.0 MACROINVERTEBRATE COLLECTIONS

4.1 METHODS OF COLLECTION AND PROCESSING

Macroinvertebrate sampling station locations have changed with modifications to the NPDES Permit. The upstream stations were eliminated in 2000 and Station 2 was relocated in 2001 (Normandeau Associates, 2001 and 2002). In 2004 three rock baskets were deployed at each of two stations, Station 2 (substation 227) and Station 3 (substation 031, Figure 4-1). Station 2, near the Vermont shore is the most downstream sampling station and is approximately 10-12 ft deep with a substrate of cobble, boulders, and mud. Station 3 is located near the New Hampshire shore, in an eddy bordered by a swift-water riffle area approximately 10 feet deep with a sandy substrate.

Rock baskets used in 2004 and in previous surveys were made of one-inch square, 14-gauge galvanized wire with a PVC coating. The cylindrical basket measured 6.5 inches in diameter and 11 inches in length. Each rock basket was filled with clean, cobble-sized rocks (2.5 in. to 4 in. diameter) from the Connecticut River prior to sampling, and deployed at the sampling Station. The deployed rock baskets were allowed to incubate in the river at each sampling station for a period of approximately four weeks to allow benthic invertebrates to colonize them. The benthic macroinvertebrates that colonized each sampler were then removed at the end of the incubation period to constitute the rock basket sample. Retrieval of the rock basket samples in the field was initiated when each sampler was placed into an individual 5-gallon bucket. The rocks were individually examined for attached organisms, which were removed and washed onto a number 30 sieve (600µm mesh openings). The contents of each sample were preserved in 70% ethanol in a sample container that was labeled with date, time, Station, and sample number, and taken to the laboratory for later processing.

The NPDES permit for Vermont Yankee requires rock baskets (cage samplers) to be deployed in June, August, and October of each year at Stations 2 and 3. Rock baskets were deployed at Stations 2 and 3 on 17 June, 23 July, 11 August and 7 October 2004, and retrieved on 22 July, 31 August, 16 September, and 11 November, respectively. An extra deployment of rock baskets on 23 July 2004 was performed because all three rock baskets at Station 2 were found to be missing when the field crew arrived on 22 July to retrieve the samplers that had been previously deployed at the start of the incubation period on 17 June 2004. A replacement set of three rock baskets was deployed at Station 2 for an incubation period from 23 July through 31 August 2004. To insure temporal comparability between Station 2 and Station 3, a set of rock baskets was also redeployed at Station 3 on 23 July and allowed to incubate through 31 August 2004. As a result of this redeployment on 23 July, a two-week temporal overlap of incubation periods occurred between the July and August sets of rock basket samples at Stations 2 and 3 (overlap was from 11 August to 31 August). The two remaining sampling periods were successfully collected at Stations 2 and 3, with the August 2004 rock basket deployment represented by an incubation period of 11 August to 16 September, and the October 2004 rock basket deployment represented by an incubation period of 7 October to 11 November. A total of 21 rock basket samples were collected in 2004. This included three replicate samples from each station collected in July, August, and October, and one set of three replicate samples from Station 3 collected in June 2004.

In the laboratory, the contents of each macroinvertebrate rock basket sample were examined in their entirety under low magnification (2x) to separate and sort the organisms from sediment and detritus.

Identification of organisms to the lowest possible taxonomic level, given their life stage and condition, was completed using dissecting (45x) and compound (1,000x) microscopes. Chironomids and oligochaetes were separated by subfamily, tribe, or recognizable type prior to identification to the genus/species level. All or representative subsamples from each grouping were prepared by clearing and mounting, and then identified with a compound microscope. Where subsampled, the number of specimens identified to genus/species was used to apportion the remaining individuals from each group into specific taxa. In instances where chironomid or oligochaete specimens could be identified to genus or species without the aid of a compound microscope, no preparation was necessary. Taxonomic keys used to identify all specimens in addition to chironomids and oligochaetes, were: Burks (1953), Hitchcock (1974), Burch (1975), McCafferty (1975), Brown (1976), Simpson and Bode (1980), Wiederholm (1983), Klemm (1985), Roback (1985), Brinkhurst (1986), Peckarsky (1990), Jokinen (1992), Merritt and Cummins (1996), Wiggins (1996).

Four rock basket samples were inadvertently misplaced and lost at Normandeau's laboratory between the time they were collected and prior to processing and examination of content. The missing four samples, identified as missing on 1 February 2005, were replicates 1, 2, and 3 from Station 2 and replicate 2 from Station 3 all collected on 11 November 2004 and representing the incubation period from 7 October through 11 November 2004.

4.2 RESULTS

A total of 1,595 macroinvertebrates were collected, identified and enumerated among the four sampling periods in 2004 (Table 4-1). A total of 555 benthic macroinvertebrates were collected from rock baskets deployed at Station 2, and 1040 benthic macroinvertebrates were collected from rock baskets deployed at Station 3 during 2004 (Table 4-1). A majority of the total consisted of true flies (Diptera, 33.5%), caddis flies (Trichoptera, 25.6%), and mayflies (Ephemeroptera, 23.1%, Table 4-1).

At Station 2, 394 macroinvertebrates were collected in July and 161 macroinvertebrates were collected in August (Table 4-2). No macroinvertebrates were captured at Station 2 for the 17 June to 22 July sampling period due to the samplers being lost. Similarly, no macroinvertebrates were identified from Station 2 for the 7 October to 11 November sample due to a laboratory error described above

At Station 3, 352 macroinvertebrates were collected in June, 531 in July, 109 in August, and 48 in October 2004 (Table 4-3). The majority of the collection consisted of the taxonomic groups Diptera (64.5%), Ephemeroptera (16.2%) and Oligochaeta (9.4%, Table 4-3).

The greatest number of benthic macroinvertebrates collected during a sampling period occurred in August 2004 (22 July to 31 August) at both stations. At Station 3, 531 macroinvertebrates were collected in August and consisted primary of Diptera (36.2%), Trichoptera (32.6%) and Ephemeroptera (17.0%, Table 4-3). Three hundred and ninety four macroinvertebrates were collected at Station 2 during the August sample, and included Ephemeroptera (32.7%), Trichoptera (27.9%) and Mollusca (21.1%, Table 4-2).

Between 11 August and 16 September, 161 and 109 macroinvertebrates were collected at Stations 2 and 3, respectively. Ephemeroptera (32.3%), Trichoptera (41.0%), and Mollusca (14.3%) constituted 87.6% of the organisms collected at Station 2 (Table 4-2). Ephemeropterans (33.9%), Trichopterans (27.5%) and Dipterans (26.6%) comprised 88.0% of the sample collected at Station 3 (Table 4-3).

The sampling period between 7 October and 11 November produced the lowest count of macroinvertebrates at Station 3 (N=48), with Dipterans representing 52.1% of the sample. However, only two replicate samples are included in this count, due to the loss of the third replicate at the laboratory. Macroinvertebrate data are not available from Station 2 for the October 2004 incubation period, due to the loss of samples in the laboratory.

4.3 CONCLUSION

The macroinvertebrate communities found at both Stations 2 and 3 during 2004 reflect what would be expected from their location in the mainstem of the Connecticut River watershed (Vanote 1980). This community was dominated by Dipterans and Trichopterans whose primary mode of foraging is the collection and filtering of particulate detritus. In addition, benthic periphyton consumers and an assemblage of dominant predatory taxa accompany these taxa. While differences in community composition exist between these two stations, a number of environmental dissimilarities exist such as substrate size and mobility, and the character of organic matter, which may affect community composition to some degree and help explain the observed differences.

The number and relative percent of macroinvertebrate taxonomic groups that have been collected in rock baskets deployed at Stations 2 and 3 in June, August, and October of each year since 1996 are presented in Table 4-4. Results from the 2004 macroinvertebrate monitoring program are similar to and fall within the range of variability demonstrated in Table 4-4 for each major taxonomic grouping. This trend is demonstrative and indicative of natural inter-annual and spatial variability of macroinvertebrate populations at the locations sampled in the Connecticut River.

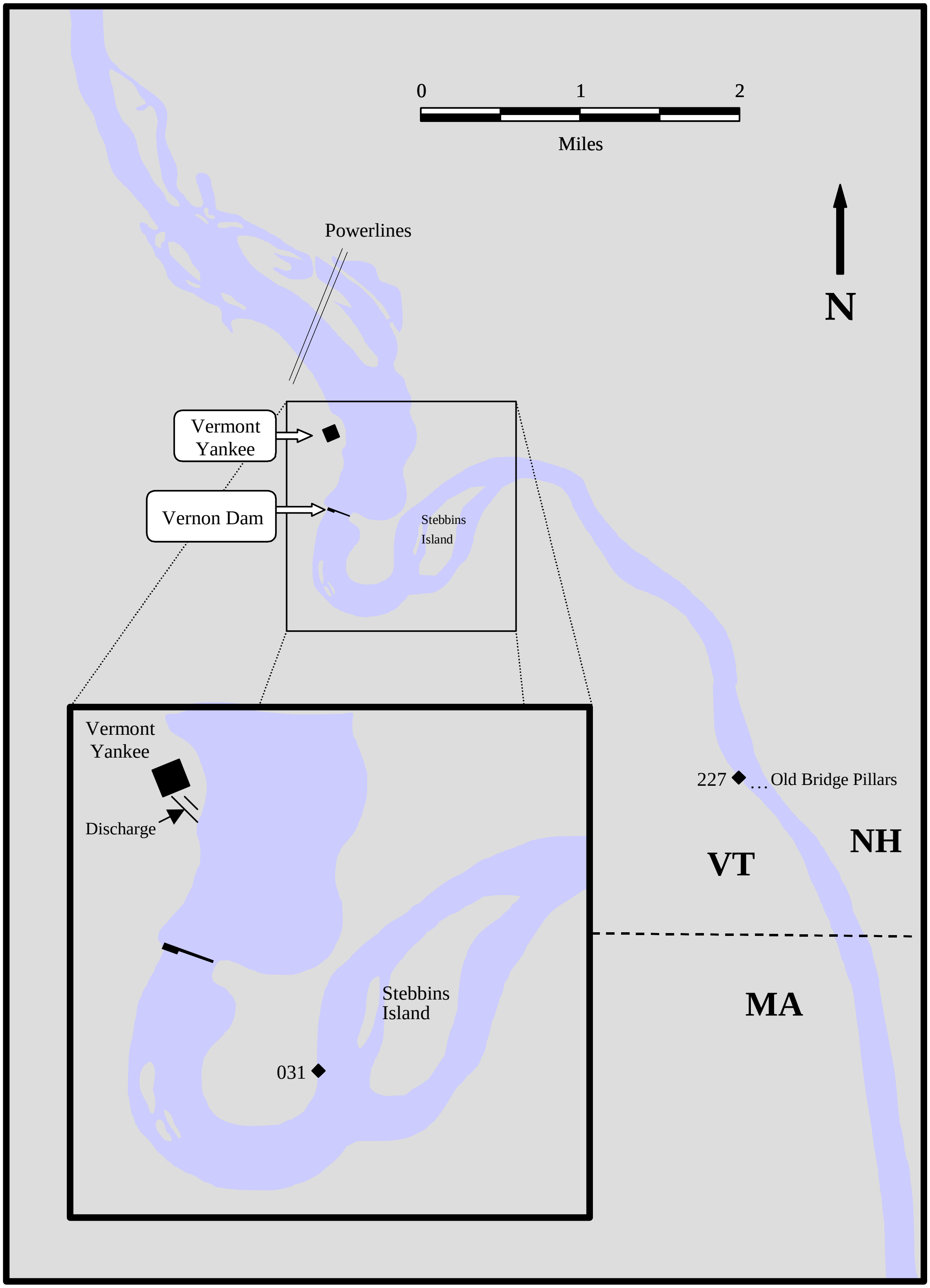

Figure 4-1. NPDES macroinvertebrate rock basket sampling at Stations 227 and 031.

Table 4-1. Total Number, Mean of Three Replicates, and Percentage of Total Macroinvertebrates Collected at Stations 3 and 2 during the combined sampling periods of June, July, August, and October 2004.

Taxon	Station 3 NH			Station 2 VT			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Turbellaria									
Dugesia tigrina	41	3.7	3.9	1	0.2	0.2	42	2.5	2.6
Subtotal	**41**	**3.7**	**3.9**	**1**	**0.2**	**0.2**	**42**	**2.5**	**2.6**
Hoplonemertea									
Prostoma graescense	3	0.3	0.3	0	0.0	0.0	3	0.2	0.2
Subtotal	**3**	**0.3**	**0.3**	**0**	**0.0**	**0.0**	**3**	**0.2**	**0.2**
Oligochaeta									
Dero sp.	3	0.3	0.3	1	0.2	0.2	4	0.2	0.3
Limnodrilus sp.	3	0.3	0.3	0	0.0	0.0	3	0.2	0.2
Naididae	14	1.3	1.4	0	0.0	0.0	14	0.8	0.9
Nais sp.	4	0.4	0.4	3	0.5	0.5	7	0.4	0.4
Ripistes parasita	12	1.1	1.2	0	0.0	0.0	12	0.7	0.8
Stylaria fossularis	5	0.5	0.5	0	0.0	0.0	5	0.3	0.3
Tubificidae imm. w/o cap. chaetae	2	0.2	0.2	0	0.0	0.0	2	0.1	0.1
Subtotal	**43**	**3.9**	**4.1**	**4**	**0.7**	**0.7**	**47**	**2.8**	**2.9**
Mollusca									
Amnicola limosa	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Ferrissia rivularis	14	1.3	1.4	92	15.3	16.6	106	6.2	6.6
Helisoma sp.	3	0.3	0.3	0	0.0	0.0	3	0.2	0.2
Physa sp.	1	0.1	0.1	13	2.2	2.3	14	0.8	0.9
Subtotal	**18**	**1.6**	**1.7**	**106**	**17.7**	**19.1**	**124**	**7.3**	**7.8**
Veneroida									
Pisidium sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Subtotal	**1**	**0.1**	**0.1**	**0**	**0.0**	**0.0**	**1**	**0.1**	**0.1**
Hydrachnidia									
Hydrachnida	8	0.7	0.8	3	0.5	0.5	11	0.6	0.7
Subtotal	**8**	**0.7**	**0.8**	**3**	**0.5**	**0.5**	**11**	**0.6**	**0.7**
Isopoda									
Caecidotea sp.	4	0.4	0.4	0	0.0	0.0	4	0.2	0.3
Subtotal	**4**	**0.4**	**0.4**	**0**	**0.0**	**0.0**	**4**	**0.2**	**0.3**
Amphipoda									
Hyalella azteca	2	0.2	0.2	8	1.3	1.4	10	0.6	0.6
Subtotal	**2**	**0.2**	**0.2**	**8**	**1.3**	**1.4**	**10**	**0.6**	**0.6**

Table 4-1. (Continued)

Taxon	Station 3 NH			Station 2 VT			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Decapoda									
Crangonyx sp.	4	0.4	0.4	0	0.0	0.0	4	0.2	0.3
Orconectes rusticus	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Subtotal	**5**	**0.5**	**0.5**	**0**	**0.0**	**0.0**	**5**	**0.3**	**0.3**
Ephemeroptera									
Caenis sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Heptagenia sp.	2	0.2	0.2	0	0.0	0.0	2	0.1	0.1
Leucrocuta sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Stenacron interpunctatum	41	3.7	3.9	104	17.3	18.7	145	8.5	9.1
Stenacron sp.	83	7.5	8.0	45	7.5	8.1	128	7.5	8.0
Stenonema mediopunctatum	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Stenonema sp.	44	4.0	4.2	30	5.0	5.4	74	4.4	4.6
Stenonema terminatum	3	0.3	0.3	1	0.2	0.2	4	0.2	0.3
Tricorythodes sp.	11	1.0	1.1	1	0.2	0.2	12	0.7	0.8
Subtotal	**187**	**17.0**	**18.0**	**181**	**30.2**	**32.6**	**368**	**21.6**	**23.1**
Odonata									
Argia sp.	0	0.0	0.0	2	0.3	0.4	2	0.1	0.1
Boyeria vinosa	0	0.0	0.0	5	0.8	0.9	5	0.3	0.3
Neurocordulia sp	2	0.2	0.2	5	0.8	0.9	7	0.4	0.4
Subtotal	**2**	**0.2**	**0.2**	**12**	**2.0**	**2.2**	**14**	**0.8**	**0.9**
Plecoptera									
Acroneuria lycorias	4	0.4	0.4	0	0.0	0.0	4	0.2	0.3
Acroneuria sp.	4	0.4	0.4	0	0.0	0.0	4	0.2	0.3
Allocapnia sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Isoperla bilineata	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Strophopteryx sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Subtotal	**11**	**1.0**	**1.1**	**0**	**0.0**	**0.0**	**11**	**0.6**	**0.7**

Table 4-1. (Continued)

Taxon	Station 3 NH			Station 2 VT			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Coleoptera									
Ancyronyx variegata	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Dubiraphia bivittata	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Macronychus glabratus	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Psephenus herricki	3	0.3	0.3	0	0.0	0.0	3	0.2	0.2
Subtotal	**3**	**0.3**	**0.3**	**3**	**0.5**	**0.5**	**6**	**0.4**	**0.4**
Trichoptera									
Ceraclea sp.	9	0.8	0.9	0	0.0	0.0	9	0.5	0.6
Cheumatopsyche sp.	91	8.3	8.8	6	1.0	1.1	97	5.7	6.1
Glossosoma sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Hydropsyche phalerata	8	0.7	0.8	2	0.3	0.4	10	0.6	0.6
Hydroptila sp.	3	0.3	0.3	0	0.0	0.0	3	0.2	0.2
Hydroptilidae	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Leucotrichia pictipes	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Limnephilidae	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Macrostemum sp.	4	0.4	0.4	0	0.0	0.0	4	0.2	0.3
Mystacides sepulchralis	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Mystacides sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Nectopsyche sp.	5	0.5	0.5	0	0.0	0.0	5	0.3	0.3
Neureclipsis sp.	31	2.8	3.0	122	20.3	22.0	153	9.0	9.6
Oecetis sp.	57	5.2	5.5	24	4.0	4.3	81	4.8	5.1
Orthotrichia sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Polycentropus sp.	21	1.9	2.0	17	2.8	3.1	38	2.2	2.4
Rhyacophila sp.	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Subtotal	**232**	**21.1**	**22.3**	**176**	**29.3**	**31.7**	**408**	**24.0**	**25.6**
Diptera									
Ablabesmyia mallochi	1	0.1	0.1	1	0.2	0.2	2	0.1	0.1
Ablabesmyia sp.	3	0.3	0.3	0	0.0	0.0	3	0.2	0.2
Chironomini	0	0.0	0.0	2	0.3	0.4	2	0.1	0.1
Clinocera sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Cricotopus bicinctus	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Cricotopus sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1

Table 4-1. (Continued)

Taxon	Station 3 NH			Station 2 VT			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Diptera (Continued)									
Dicrotendipes sp.	63	5.7	6.1	10	1.7	1.8	73	4.3	4.6
Microtendipes pedellus gp.	0	0.0	0.0	2	0.3	0.4	2	0.1	0.1
Microtendipes rydalensis gr.	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Microtendipes sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Nanocladius alternantherae	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Nanocladius sp.	2	0.2	0.2	0	0.0	0.0	2	0.1	0.1
Orthocladiinae	19	1.7	1.8	2	0.3	0.4	21	1.2	1.3
Orthocladius sp.	54	4.9	5.2	5	0.8	0.9	59	3.5	3.7
Paratanytarsus dissimilis	0	0.0	0.0	9	1.5	1.6	9	0.5	0.6
Paratanytarsus sp.	13	1.2	1.3	0	0.0	0.0	13	0.8	0.8
Paratendipes sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Polypedilum flavum	7	0.6	0.7	0	0.0	0.0	7	0.4	0.4
Polypedilum sp.	1	0.1	0.1	5	0.8	0.9	6	0.4	0.4
Polypedilum tritum	5	0.5	0.5	0	0.0	0.0	5	0.3	0.3
Psectrocladius sp.	9	0.8	0.9	1	0.2	0.2	10	0.6	0.6
Pseudochironomus sp.	0	0.0	0.0	1	0.2	0.2	1	0.1	0.1
Rheotanytarsus exiguus gr.	19	1.7	1.8	3	0.5	0.5	22	1.3	1.4
Rheotanytarsus sp.	201	18.3	19.3	5	0.8	0.9	206	12.1	12.9
Tanypodinae	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Tanytarsini	41	3.7	3.9	0	0.0	0.0	41	2.4	2.6
Tanytarsus sp.	14	1.3	1.4	12	2.0	2.2	26	1.5	1.6
Thienemanniella lobapodema	2	0.2	0.2	0	0.0	0.0	2	0.1	0.1
Thienemanniella sp.	5	0.5	0.5	0	0.0	0.0	5	0.3	0.3
Thienemannimyia gr.	6	0.5	0.6	0	0.0	0.0	6	0.4	0.4
Tribelos sp.	0	0.0	0.0	2	0.3	0.4	2	0.1	0.1
Xenochironomus sp.	1	0.1	0.1	0	0.0	0.0	1	0.1	0.1
Subtotal	**473**	**43.0**	**45.5**	**61**	**10.2**	**11.0**	**534**	**31.4**	**33.5**
Empidoidea									
Hemerodromia sp.	7	0.6	0.7	0	0.0	0.0	7	0.4	0.4
Subtotal	**7**	**0.6**	**0.7**	**0**	**0.0**	**0.0**	**7**	**0.4**	**0.4**
STATION TOTALS	**1040**	**94.5**	**100.0**	**555**	**92.5**	**100.0**	**1595**	**93.8**	**100.0**

Table 4-2. Macroinvertebrates Collected at Station 2 During July and August of 2004.

	23 July -31 Aug			11 Aug - 16 Sept			All		
Taxon	**Count**	**Mean**	**% of Total**	**Count**	**Mean**	**% of Total**	**Count**	**Mean**	**% of Total**
Turbellaria									
Dugesia tigrina	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Subtotal	**1**	**0.3**	**0.3**	**0**	**0.0**	**0.0**	**1**	**0.2**	**0.2**
Oligochaeta									
Dero sp.	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Nais sp.	3	1.0	0.8	0	0.0	0.0	3	0.5	0.5
Subtotal	**4**	**1.3**	**1.0**	**0**	**0.0**	**0.0**	**4**	**0.7**	**0.7**
Mollusca									
Amnicola limosa	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Ferrissia rivularis	70	23.3	17.8	22	7.3	13.7	92	15.3	16.6
Physa sp.	12	4.0	3.1	1	0.3	0.6	13	2.2	2.3
Subtotal	**83**	**27.7**	**21.1**	**23**	**7.7**	**14.3**	**106**	**17.7**	**19.1**
Hydrachnidia									
Hydrachnida	3	1.0	0.8	0	0.0	0.0	3	0.5	0.5
Subtotal	**3**	**1.0**	**0.8**	**0**	**0.0**	**0.0**	**3**	**0.5**	**0.5**
Amphipoda									
Hyalella azteca	2	0.7	0.5	6	2.0	3.7	8	1.3	1.4
Subtotal	**2**	**0.7**	**0.5**	**6**	**2.0**	**3.7**	**8**	**1.3**	**1.4**
Ephemeroptera									
Stenacron interpunctatum	76	25.3	19.3	28	9.3	17.4	104	17.3	18.7
Stenacron sp.	30	10.0	7.6	15	5.0	9.3	45	7.5	8.1
Stenonema sp.	21	7.0	5.3	9	3.0	5.6	30	5.0	5.4
Stenonema terminatum	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Tricorythodes sp.	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Subtotal	**129**	**43.0**	**32.7**	**52**	**17.3**	**32.3**	**181**	**30.2**	**32.6**
Odonata									
Argia sp.	1	0.3	0.3	1	0.3	0.6	2	0.3	0.4
Boyeria vinosa	5	1.7	1.3	0	0.0	0.0	5	0.8	0.9
Neurocordulia sp	2	0.7	0.5	3	1.0	1.9	5	0.8	0.9
Subtotal	**8**	**2.7**	**2.0**	**4**	**1.3**	**2.5**	**12**	**2.0**	**2.2**

Table 4-2. (Continued)

Taxon	23 July -31 Aug			11 Aug - 16 Sept			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Coleoptera									
Ancyronyx variegata	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Dubiraphia bivittata	0	0.0	0.0	1	0.3	0.6	1	0.2	0.2
Macronychus glabratus	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Subtotal	**2**	**0.7**	**0.5**	**1**	**0.3**	**0.6**	**3**	**0.5**	**0.5**
Trichoptera									
Cheumatopsyche sp.	2	0.7	0.5	4	1.3	2.5	6	1.0	1.1
Hydropsyche phalerata	0	0.0	0.0	2	0.7	1.2	2	0.3	0.4
Hydroptilidae	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Leucotrichia pictipes	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Limnephilidae	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Mystacides sepulchralis	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Neureclipsis sp.	73	24.3	18.5	49	16.3	30.4	122	20.3	22.0
Oecetis sp.	20	6.7	5.1	4	1.3	2.5	24	4.0	4.3
Polycentropus sp.	10	3.3	2.5	7	2.3	4.4	17	2.8	3.1
Rhyacophila sp.	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Subtotal	**110**	**36.7**	**27.9**	**66**	**22.0**	**41.0**	**176**	**29.3**	**31.7**

Table 4-2. (Continued)

Taxon	23 July -31 Aug			11 Aug - 16 Sept			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Diptera									
Ablabesmyia mallochi	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Chironomini	2	0.7	0.5	0	0.0	0.0	2	0.3	0.4
Dicrotendipes sp.	10	3.3	2.5	0	0.0	0.0	10	1.7	1.8
Microtendipes pedellus gp.	0	0.0	0.0	2	0.7	1.2	2	0.3	0.4
Microtendipes rydalensis gr.	0	0.0	0.0	1	0.3	0.6	1	0.2	0.2
Orthocladiinae	2	0.7	0.5	0	0.0	0.0	2	0.3	0.4
Orthocladius sp.	5	1.7	1.3	0	0.0	0.0	5	0.8	0.9
Paratanytarsus dissimilis	9	3.0	2.3	0	0.0	0.0	9	1.5	1.6
Polypedilum sp.	4	1.3	1.0	1	0.3	0.6	5	0.8	0.9
Psectrocladius sp.	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Pseudochironomus sp.	1	0.3	0.3	0	0.0	0.0	1	0.2	0.2
Rheotanytarsus exiguus gr.	3	1.0	0.8	0	0.0	0.0	3	0.5	0.5
Rheotanytarsus sp.	1	0.3	0.3	4	1.3	2.5	5	0.8	0.9
Tanytarsus sp.	11	3.7	2.8	1	0.3	0.6	12	2.0	2.2
Tribelos sp.	2	0.7	0.5	0	0.0	0.0	2	0.3	0.4
Subtotal	**52**	**17.3**	**13.2**	**9**	**3.0**	**5.6**	**61**	**10.2**	**11.0**
MONTH TOTALS	**394**	**131.3**	**100.0**	**161**	**53.7**	**100.0**	**555**	**92.5**	**100.0**

Table 4-3. Macroinvertebrates Collected at Station 3 During June, July, August, and October 2004.

Taxon	17 June - 22 July			23 July - 31 Aug			11 Aug - 16 Sept			7 Oct - 11 Nov			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Turbellaria															
Dugesia tigrina	0	0.0	0.0	38	12.7	7.2	3	1.0	2.8	0	0.0	0.0	41	3.7	3.9
Subtotal	**0**	**0.0**	**0.0**	**38**	**12.7**	**7.2**	**3**	**1.0**	**2.8**	**0**	**0.0**	**0.0**	**41**	**3.7**	**3.9**
Hoplonemertea															
Prostoma graescense	0	0.0	0.0	3	1.0	0.6	0	0.0	0.0	0	0.0	0.0	3	0.3	0.3
Subtotal	**0**	**0.0**	**0.0**	**3**	**1.0**	**0.6**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**	**3**	**0.3**	**0.3**
Oligochaeta															
Dero sp.	3	1.0	0.9	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	3	0.3	0.3
Limnodrilus sp.	0	0.0	0.0	0	0.0	0.0	1	0.3	0.9	2	1.0	4.2	3	0.3	0.3
Naididae	11	3.7	3.1	1	0.3	0.2	1	0.3	0.9	1	0.5	2.1	14	1.3	1.3
Nais sp.	4	1.3	1.1	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	4	0.4	0.4
Ripistes parasita	10	3.3	2.8	1	0.3	0.2	0	0.0	0.0	1	0.5	2.1	12	1.1	1.2
Stylaria fossularis	5	1.7	1.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	5	0.5	0.5
Tubificidae imm. w/o cap. chaetae	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	2	1.0	4.2	2	0.2	0.2
Subtotal	**33**	**11.0**	**9.4**	**2**	**0.7**	**0.4**	**2**	**0.7**	**1.8**	**6**	**3.0**	**12.5**	**43**	**3.9**	**4.1**
Mollusca															
Ferrissia rivularis	1	0.3	0.3	9	3.0	1.7	2	0.7	1.8	2	1.0	4.2	14	1.3	1.3
Helisoma sp.	0	0.0	0.0	2	0.7	0.4	1	0.3	0.9	0	0.0	0.0	3	0.3	0.3
Physa sp.	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Subtotal	**1**	**0.3**	**0.3**	**12**	**4.0**	**2.3**	**3**	**1.0**	**2.8**	**2**	**1.0**	**4.2**	**18**	**1.6**	**1.7**
Veneroida															
Pisidium sp.	0	0.0	0.0	0	0.0	0.0	1	0.3	0.9	0	0.0	0.0	1	0.1	0.1
Subtotal	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**	**1**	**0.3**	**0.9**	**0**	**0.0**	**0.0**	**1**	**0.1**	**0.1**
Hydrachnidia															
Hydrachnida	4	1.3	1.1	3	1.0	0.6	0	0.0	0.0	1	0.5	2.1	8	0.7	0.8
Subtotal	**4**	**1.3**	**1.1**	**3**	**1.0**	**0.6**	**0**	**0.0**	**0.0**	**1**	**0.5**	**2.1**	**8**	**0.7**	**0.8**
Isopoda															
Caecidotea sp.	0	0.0	0.0	3	1.0	0.6	0	0.0	0.0	1	0.5	2.1	4	0.4	0.4
Subtotal	**0**	**0.0**	**0.0**	**3**	**1.0**	**0.6**	**0**	**0.0**	**0.0**	**1**	**0.5**	**2.1**	**4**	**0.4**	**0.4**
Amphipoda															
Hyalella azteca	1	0.3	0.3	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	2	0.2	0.2
Subtotal	**1**	**0.3**	**0.3**	**1**	**0.3**	**0.2**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**	**2**	**0.2**	**0.2**
Decapoda															
Crangonyx sp.	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	3	1.5	6.3	4	0.4	0.4
Orconectes rusticus	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Subtotal	**0**	**0.0**	**0.0**	**2**	**0.7**	**0.4**	**0**	**0.0**	**0.0**	**3**	**1.5**	**6.3**	**5**	**0.5**	**0.5**

Table 4-3. (Continued)

Taxon	17 June - 22 July			23 July - 31 Aug			11 Aug - 16 Sept			7 Oct - 11 Nov			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Ephemeroptera															
Caenis sp.	1	0.3	0.3	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Heptagenia sp.	2	0.7	0.6	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	2	0.2	0.2
Leucrocuta sp.	1	0.3	0.3	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Stenacron interpunctatum	10	3.3	2.8	15	5.0	2.8	16	5.3	14.7	0	0.0	0.0	41	3.7	3.9
Stenacron sp.	26	8.7	7.4	45	15.0	8.5	12	4.0	11.0	0	0.0	0.0	83	7.5	8.0
Stenonema mediopunctatum	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Stenonema sp.	14	4.7	4.0	22	7.3	4.1	8	2.7	7.3	0	0.0	0.0	44	4.0	4.2
Stenonema terminatum	1	0.3	0.3	0	0.0	0.0	0	0.0	0.0	2	1.0	4.2	3	0.3	0.3
Tricorythodes sp.	2	0.7	0.6	8	2.7	1.5	1	0.3	0.9	0	0.0	0.0	11	1.0	1.1
Subtotal	**57**	**19.0**	**16.2**	**90**	**30.0**	**17.0**	**37**	**12.3**	**33.9**	**3**	**1.5**	**6.3**	**187**	**17.0**	**18.0**
Odonata															
Neurocordulia sp	0	0.0	0.0	0	0.0	0.0	2	0.7	1.8	0	0.0	0.0	2	0.2	0.2
Subtotal	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**	**2**	**0.7**	**1.8**	**0**	**0.0**	**0.0**	**2**	**0.2**	**0.2**
Plecoptera															
Acroneuria lycorias	0	0.0	0.0	4	1.3	0.8	0	0.0	0.0	0	0.0	0.0	4	0.4	0.4
Acroneuria sp.	3	1.0	0.9	0	0.0	0.0	1	0.3	0.9	0	0.0	0.0	4	0.4	0.4
Allocapnia sp.	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Isoperla bilineata	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Strophopteryx sp.	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Subtotal	**3**	**1.0**	**0.9**	**4**	**1.3**	**0.8**	**1**	**0.3**	**0.9**	**3**	**1.5**	**6.3**	**11**	**1.0**	**1.1**
Coleoptera															
Psephenus herricki	0	0.0	0.0	3	1.0	0.6	0	0.0	0.0	0	0.0	0.0	3	0.3	0.3
Subtotal	**0**	**0.0**	**0.0**	**3**	**1.0**	**0.6**	**0**	**0.0**	**0.0**	**0**	**0.0**	**0.0**	**3**	**0.3**	**0.3**
Trichoptera															
Ceraclea sp.	0	0.0	0.0	9	3.0	1.7	0	0.0	0.0	0	0.0	0.0	9	0.8	0.9
Cheumatopsyche sp.	14	4.7	4.0	67	22.3	12.6	8	2.7	7.3	2	1.0	4.2	91	8.3	8.8
Glossosoma sp.	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Hydropsyche phalerata	0	0.0	0.0	6	2.0	1.1	1	0.3	0.9	1	0.5	2.1	8	0.7	0.8
Hydroptila sp.	0	0.0	0.0	3	1.0	0.6	0	0.0	0.0	0	0.0	0.0	3	0.3	0.3
Macrostemum sp.	3	1.0	0.9	0	0.0	0.0	1	0.3	0.9	0	0.0	0.0	4	0.4	0.4
Mystacides sp.	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Nectopsyche sp.	0	0.0	0.0	2	0.7	0.4	3	1.0	2.8	0	0.0	0.0	5	0.5	0.5
Neureclipsis sp.	3	1.0	0.9	22	7.3	4.1	5	1.7	4.6	1	0.5	2.1	31	2.8	3.0
Oecetis sp.	2	0.7	0.6	48	16.0	9.0	7	2.3	6.4	0	0.0	0.0	57	5.2	5.5

Table 4-3. (Continued)

Taxon	17 June - 22 July			23 July - 31 Aug			11 Aug - 16 Sept			7 Oct - 11 Nov			All		
	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Trichoptera (Continued)															
Orthotrichia sp.	1	0.3	0.3	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Polycentropus sp.	2	0.7	0.6	14	4.7	2.6	5	1.7	4.6	0	0.0	0.0	21	1.9	2.0
Subtotal	**25**	**8.3**	**7.1**	**173**	**57.7**	**32.6**	**30**	**10.0**	**27.5**	**4**	**2.0**	**8.3**	**232**	**21.1**	**22.3**
Diptera															
Ablabesmyia mallochi	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Ablabesmyia sp.	0	0.0	0.0	3	1.0	0.6	0	0.0	0.0	0	0.0	0.0	3	0.3	0.3
Clinocera sp.	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Cricotopus bicinctus	0	0.0	0.0	0	0.0	0.0	1	0.3	0.9	0	0.0	0.0	1	0.1	0.1
Cricotopus sp.	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Dicrotendipes sp.	3	1.0	0.9	59	19.7	11.1	1	0.3	0.9	0	0.0	0.0	63	5.7	6.1
Microtendipes sp.	1	0.3	0.3	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Nanocladius alternantherae	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Nanocladius sp.	1	0.3	0.3	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	2	0.2	0.2
Orthocladiinae	19	6.3	5.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	19	1.7	1.8
Orthocladius sp.	9	3.0	2.6	41	13.7	7.7	1	0.3	0.9	3	1.5	6.3	54	4.9	5.2
Paratanytarsus sp.	0	0.0	0.0	2	0.7	0.4	0	0.0	0.0	11	5.5	22.9	13	1.2	1.3
Paratendipes sp.	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	1	0.1	0.1
Polypedilum flavum	7	2.3	2.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	7	0.6	0.7
Polypedilum sp.	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Polypedilum tritum	5	1.7	1.4	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	5	0.5	0.5
Psectrocladius sp.	0	0.0	0.0	9	3.0	1.7	0	0.0	0.0	0	0.0	0.0	9	0.8	0.9
Rheotanytarsus exiguus gr.	6	2.0	1.7	9	3.0	1.7	0	0.0	0.0	4	2.0	8.3	19	1.7	1.8
Rheotanytarsus sp.	128	42.7	36.4	48	16.0	9.0	25	8.3	22.9	0	0.0	0.0	201	18.3	19.3
Tanypodinae	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Tanytarsini	40	13.3	11.4	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	41	3.7	3.9
Tanytarsus sp.	0	0.0	0.0	14	4.7	2.6	0	0.0	0.0	0	0.0	0.0	14	1.3	1.3
Thienemanniella lobapodema	0	0.0	0.0	0	0.0	0.0	1	0.3	0.9	1	0.5	2.1	2	0.2	0.2
Thienemanniella sp.	3	1.0	0.9	2	0.7	0.4	0	0.0	0.0	0	0.0	0.0	5	0.5	0.5
Thienemannimyia gr.	5	1.7	1.4	0	0.0	0.0	0	0.0	0.0	1	0.5	2.1	6	0.5	0.6
Xenochironomus sp.	0	0.0	0.0	1	0.3	0.2	0	0.0	0.0	0	0.0	0.0	1	0.1	0.1
Subtotal	**227**	**75.7**	**64.5**	**192**	**64.0**	**36.2**	**29**	**9.7**	**26.6**	**25**	**12.5**	**52.1**	**473**	**43.0**	**45.5**
Empidoidea															
Hemerodromia sp.	1	0.3	0.3	5	1.7	0.9	1	0.3	0.9	0	0.0	0.0	7	0.6	0.7
Subtotal	**1**	**0.3**	**0.3**	**5**	**1.7**	**0.9**	**1**	**0.3**	**0.9**	**0**	**0.0**	**0.0**	**7**	**0.6**	**0.7**
MONTHLY TOTALS	**352**	**117.3**	**100.0**	**531**	**177.0**	**100.0**	**109**	**36.3**	**100.0**	**48**	**24.0**	**100.0**	**1040**	**94.5**	**100.0**

Table 4-4. Total Number and Percent of Macroinvertebrates Collected at Stations 2 and 3 from 1996 through 2004.

Station and Taxonomic Group	1991		1992		1993		1994		1995		1996	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Downstream Station 2												
Crustacea	20	4.8	28	5.1	107	10.7	38	3.4	58	9.0	20	14.9
Diptera	111	26.5	132	23.9	296	29.6	307	27.7	191	29.7	10	7.5
Ephemeroptera	24	5.7	67	12.1	69	6.9	207	18.7	67	10.4	50	37.3
Gastropoda	18	4.3	26	4.7	30	3.0	18	1.6	6	0.9	2	1.5
Oligochaeta	5	1.2	51	9.2	13	1.3	25	2.3	10	1.6	4	3.0
Other	43	10.3	29	5.3	20	2.0	74	6.7	52	8.1	14	10.4
Pelecypoda	7	1.7	142	25.7	5	0.5	1	0.1	1	0.2	2	1.5
Trichoptera	130	31.0	58	10.5	185	18.5	437	39.5	221	34.4	32	23.9
Turbellaria	61	14.6	19	3.4	274	27.4	0	0.0	37	5.8	0	0.0
Total	**419**	**100**	**552**	**100**	**999**	**100**	**1107**	**100**	**643**	**100**	**134**	**100**
Downstream Station 3												
Crustacea	1	1.0	94	10.9	41	11.0	30	4.4	19	4.4	136	13.6
Diptera	25	25.8	91	10.6	65	17.4	271	39.9	161	37.2	160	16.0
Ephemeroptera	9	9.3	59	6.8	69	18.5	25	3.7	59	13.6	18	1.8
Gastropoda	7	7.2	18	2.1	45	12.1	74	10.9	3	0.7	6	0.6
Oligochaeta	0	0.0	16	1.9	0	0.0	0	0.0	3	0.7	356	35.5
Other	11	11.3	412	47.8	90	24.1	170	25.0	147	33.9	54	5.4
Pelecypoda	0	0.0	0	0.0	0	0.0	4	0.6	0	0.0	0	0.0
Trichoptera	8	8.2	76	8.8	63	16.9	98	14.4	39	9.0	272	27.1
Turbellaria	36	37.1	96	11.1	0	0.0	8	1.2	2	0.5	0	0.0
Total	**97**	**100**	**862**	**100**	**373**	**100.0**	**680**	**100**	**433**	**100**	**1002**	**100**

Table 4-4. (Continued)

Station and Taxonomic Group	1997		1998		1999		2000		2001		2002	
	N	%	N	%	N	%	N	%	N	%	N	%
Downstream Station 2												
Crustacea	2	4.0	12	4.7	114	44.5	2	2.4	101	17.7	47	6.0
Diptera	6	12.0	80	31.5	10	3.9	56	66.7	137	24.0	144	18.4
Ephemeroptera	2	4.0	28	11.0	44	17.2	0	0.0	144	25.2	232	29.7
Gastropoda	26	52.0	22	8.7	40	15.6	0	0.0	57	10.0	112	14.3
Oligochaeta	0	0.0	14	5.5	4	1.6	10	11.9	11	1.9	7	0.9
Other	2	4.0	16	6.3	22	8.6	0	0.0	22	3.9	36	4.6
Pelecypoda	0	0.0	0	0.0	4	1.6	4	4.8	0	0.0	0	0.0
Trichoptera	12	24.0	82	32.3	18	7.0	12	14.3	93	16.3	197	25.2
Turbellaria	0	0.0	0	0.0	0	0.0	0	0.0	6	1.1	6	0.8
Total	**50**	**100**	**254**	**100**	**256**	**100**	**84**	**100**	**571**	**100**	**781**	**100**
Downstream Station 3												
Crustacea	0	0.0	6	2.5	24	27.3	84	80.8	47	0.5	11	0.3
Diptera	10	4.5	68	28.8	16	18.2	4	3.8	484	5.3	1050	30.7
Ephemeroptera	0	0.0	20	8.5	24	27.3	10	9.6	401	4.4	452	13.2
Gastropoda	10	4.5	4	1.7	4	4.5	6	5.8	72	0.8	13	0.4
Oligochaeta	2	0.9	4	1.7	0	0.0	0	0.0	19	0.2	2	0.1
Other	194	88.2	14	5.9	18	20.5	0	0.0	54	0.6	81	2.4
Pelecypoda	0	0.0	2	0.8	0	0.0	0	0.0	6	0.1	0	0.0
Trichoptera	4	1.8	118	50.0	2	2.3	0	0.0	7114	77.5	1722	50.4
Turbellaria	0	0.0	0	0.0	0	0.0	0	0.0	984	10.7	86	2.5
Total	**220**	**100**	**236**	**100**	**88**	**100**	**104**	**100**	**9181**	**100**	**3417**	**100**

Table 4-4. (Continued)

Station and Taxonomic Group	2003		2004		All	
	N	%	N	%	N	%
Downstream Station 2						
Crustacea	92	5.0	8	1.4	649	7.9
Diptera	540	29.6	61	11.0	2081	25.3
Ephemeroptera	311	17.1	181	32.6	1426	17.3
Gastropoda	172	9.4	106	19.1	635	7.7
Oligochaeta	13	0.7	4	0.7	171	2.1
Other	69	3.8	20	3.6	419	5.1
Pelecypoda	0	0.0	0	0.0	166	2.0
Trichoptera	621	34.1	174	31.4	2272	27.6
Turbellaria	5	0.3	1	0.2	409	5.0
Total	**1823**	**100**	**555**	**100**	**8228**	**100**
Downstream Station 3						
Crustacea	61	17.5	11	1.1	565	3.1
Diptera	72	20.7	473	45.5	2950	16.3
Ephemeroptera	40	11.5	187	18.0	1373	7.6
Gastropoda	2	0.6	18	1.7	282	1.6
Oligochaeta	8	2.3	43	4.1	453	2.5
Other	19	5.5	42	4.0	1306	7.2
Pelecypoda	3	0.9	1	0.1	16	0.1
Trichoptera	139	39.9	224	21.5	9879	54.6
Turbellaria	4	1.1	41	3.9	1257	7.0
Total	**348**	**100**	**1040**	**100**	**18081**	**100**

5.0 FISH COLLECTIONS

General fish collections were made monthly in May, June, September, and October, 2004 via electrofishing at the eight primary stations specified in the NPDES permit (Table 1-1 "general electrofishing," Figure 5-1). Larval fish were collected weekly from 6 May through 15 July 2004 in the vicinity of the Vermont Yankee circulating water intake structure. Fish impinged on the circulating water traveling screens were collected weekly from 29 March through 15 June and again from 27 July through 26 October 2004. An unscheduled plant outage due to a transformer fire occurred between 16 June and 5 July 2004 (Section 2.3), which prevented the collection of impingement samples during this period because the intake pumps were not operated. Anadromous fish collections were conducted twice a month from July through October 2004 at the three primary stations specified in the NPDES permit (Table 1-1 "anadromous electrofishing," Figure 5-1). All fish samples were successfully collected as specified in the NPDES permit.

5.1 METHODS OF COLLECTION AND PROCESSING

5.1.1 Electrofishing – General

General electrofishing was performed with a boat-mounted Coffelt Electronics Model VVP-15 electroshocker. All general electrofishing samples were collected in the evening beginning approximately 0.5 hour after sunset. General electrofishing was conducted monthly in May, June, September, and October 2004 at the following eight primary stations: Rum Point (substation 102), Station 5 (substations 051 and 052), Station 4 (substations 416 and 426), N.H. Setback (substation 091), 0.1 mile south of the Vernon Dam (substation 724), Station 3 (substation 032), Stebbin Island (substation 614) and Station 2 (substation 217) (Table 1-1, Figure 5-1). All fish collected by general electrofishing were identified to species, weighed to the nearest gram (wet weight), and measured to the nearest millimeter (total length).

5.1.2 Electrofishing - Anadromous Fish

Anadromous fish electrofishing was performed with a boat-mounted Coffelt Electronics Model VVP-15 electroshocker, the same boat and equipment used for general electrofishing (Section 5.1.1 above). All anadromous fish electrofishing samples were collected in the evening beginning approximately 0.5 hour after sunset. Fish other than clupeids were not processed if collected during the anadromous fish electrofishing runs. Anadromous fish electrofishing collections were conducted twice a month during July through October 2004 at the following three primary stations downstream of Vernon Dam: 0.1 mile south of Vernon Dam (substation 725), Station 3 (substation 031), and Stebbin Island (substations 615, 613, 614, and 624) (Table 1-1, Figure 5-1). Collected juvenile American shad were weighed to the nearest gram (wet weight), measured to the nearest millimeter (total length), and released alive after processing.

5.1.3 Impingement

Weekly and 24-hour spring and fall impingement samples were collected on Monday and Tuesday of each week from 29 March through 15 June and 27 July through 26 October 2004. Weekly samples (i.e., Monday collections) were produced from back-washing the traveling screens into the collection bin and represented the collection of fish impinged during the previous six days (i.e., Tuesday to

Monday). The debris from the collection bin was examined for Atlantic salmon and American shad only as specified in Vermont Yankee's NPDES Permit. The screens were again back-washed approximately 24 hours later (i.e., Tuesday collections) and all fish collected in this 24-hour sample were identified to species, weighed to the nearest gram (wet weight), and measured to total length (mm) as specified in Vermont Yankee's NPDES permit. The 2004 Atlantic salmon and American shad impingement limits were calculated as 252 and 1005, respectively, using the formula specified in Vermont Yankee's NPDES Permit.

5.1.4 Larval Fish

The NPDES Permit requires larval fish sampling to be conducted on a weekly basis from May to July 15, when Vermont Yankee is operating the cooling water system in an open or hybrid cycle. During 2004, larval fish samples were collected between 6 May and 15 July in the vicinity of the Vermont Yankee circulating water intake structure (Figure 5-1).

A 50-cm diameter, 363-µm nitex nylon plankton net was towed behind the boat, at surface (approximately 0.3 m), mid (approximately 1.8 m), and near bottom (approximately 3.7 m) depths. A flume-calibrated, General Oceanics Inc. Model 2030R mechanical flow meter was mounted in the net mouth and used to measure the volume of water filtered in each tow.

The contents of each ichthyoplankton sample were washed into a collection cup fastened to the distal end of the net. Each larval fish sample was rinsed from collection cup, labeled with sample number, date, time, and location, preserved in 5% formalin, and then taken to the laboratory for sorting and identification. In the laboratory, ichthyoplankton was separated from debris in each sample using an 8x to 80x variable magnification dissecting microscope. Larval fish and fish eggs were identified to the lowest practical taxonomic level using the following published larval fish keys: Fish (1930), Lippson and Moran (1974), Jones et al. (1978), and Auer (1982).

5.2 RESULTS

Twenty-one species of fish were collected during 2004, plus two unidentified fish (Table 5-1). The total number of species and species composition were similar to past years (Aquatec 1993, 1995, and Normandeau Associates 1997- 2003). All fish species collected were typical of the Connecticut River drainage, and no federally listed threatened or endangered species were collected during 2004.

5.2.1 Fish - General Electrofishing

During 2004, a total of 40 electrofishing collections representing 6.7 hours of sampling effort were completed among the eight general electrofishing Stations at ten substations (Figure 5-1, Table 5-2). The total number of fish collected by general electrofishing was 627 (Table 5-3). The overall catch per unit effort (CPUE) for the 40-electrofishing collections was 94.1 fish per hour (Table 5-2).

There were 463 fish weighing a total of 60,680 grams collected in the Connecticut River upstream from Vernon Dam and 164 fish weighing a total of 19,530 grams collected downstream from Vernon Dam during the 2004 general electrofishing survey (Table 5-3). Numerically, the most abundant fish species upstream from Vernon Dam were yellow perch (194 fish) and bluegill (123 fish, Table 5-3). Downstream from Vernon Dam, the numerically most abundant fish species were smallmouth bass (48 fish) and rock bass (30 fish, Table 5-3). Common carp (14,500 g), largemouth bass (12,542 g), and bluegill (12,300 g) accounted for the majority of the biomass of fishes collected by general electrofishing upstream from Vernon Dam (Table 5-3). Smallmouth bass (8,427 g), largemouth bass (3,423 g), and white sucker (3,406 g) accounted for the majority of the biomass of fishes collected by general electrofishing downstream from Vernon Dam (Table 5-3). No Atlantic salmon were collected by general electrofishing either upstream or downstream from Vernon Dam during 2004 (Table 5-3). No American shad were collected upstream from Vernon Dam, and 19 American shad were caught downstream of Vernon Dam during the 2004 general electrofishing collections (Table 5-3).

Based on catch per unit of effort (catch per hour), which standardizes for differences in the number of general electrofishing samples and effort between upstream and downstream locations, yellow perch (48.5 fish/hour), bluegill (30.8 fish/hour), and pumpkinseed (12.0 fish/hour) were numerically the most abundant fishes upstream from Vernon Dam (Table 5-4). Based on grams of fish caught per hour, common carp (3,625 grams/hour), largemouth bass (3,135 grams/hour), and bluegill (3,075 grams/hour) accounted for the majority of the biomass of fishes collected by general electrofishing upstream from Vernon Dam (Table 5-4). Downstream from Vernon Dam, smallmouth bass (18.0 fish/hour), rock bass (11.3 fish/hour), and spottail shiner (9.8 fish/hour) were numerically the most abundant fishes caught by general electrofishing, while smallmouth bass (3,160 grams/hour), largemouth bass (1,284 g/hour), and white sucker (1,277 g/hour) accounted for the majority of the biomass of fishes (Table 5-4).

5.2.2 Fish – Impingement

Seventy-three American shad were among the 236 fish comprising 18 taxa collected off of the circulating water traveling screens (CWTS) at the Vermont Yankee intake structure (Table 5-3). American shad (73 fish), bluegill (67 fish), rock bass (23 fish), and yellow perch (20 fish) were numerically the most abundant species in the impingement samples during the six months of sampling (Table 5-3). Bluegill (831 g), American shad (783 g), rock bass (643 g) and yellow perch (467 g) exhibited the highest total biomass among the total fish impinged during 2004 (Table 5-3).

No Atlantic salmon were impinged during 2004. Four American shad were impinged in August, 4 were impinged in September, and 66 were impinged in October 2004 (Table 5-5). The American shad and Atlantic salmon impingement limits of 252 Atlantic salmon and 1005 American shad were not exceeded during 2004. The month of October 2004 exhibited the highest total number of fish impinged, representing 104 total fish or 44% of the total number fish collected. The month of April exhibited the highest biomass of fish impinged, representing 986 g or 22% of the total biomass of fish impinged.

5.2.3 Anadromous Fish Electrofishing

In fulfillment of the NPDES permit requirements for anadromous fish sampling, electrofishing samples were collected at least twice in each month from July through October 2004 at Station 3 (substation 031), Stebbin Island (substations 615, 613, 614, 624) and 0.1 mile south of Vernon Dam (substation 725) (Table 1-1, Figure 5-1). Results reported in this section include American shad collected during anadromous fish sampling events only, not those American shad reported above in the general electrofishing Section 5.2.1.

A total of 92 juvenile American shad was collected in the anadromous electrofishing program performed between July and October 2004 (Table 5-6). August and September 2004 yielded the highest catch of American shad (36 and 37, respectively), representing 79% of the total catch.

American shad lengths recorded in August 2004 ranged from 56-88 mm total length and weight ranged from 3-6 g (Table 5-6). American shad lengths recorded in September 2004 ranged from 78-98 mm total length and weight ranged from 4-8 g (Table 5-6). The CPUE in August and September was highest (36.0 and 30.0 fish/hour, respectively) at Station 3. The bi-monthly collections during July and October resulted in the collection of 5 and 14 American shad, respectively. The American shad collected during July 2004 ranged in length from 46-74 mm. The CPUE in July 2004 was highest (3.0 fish/hour each) at Station 3 and 0.1 Miles south of Vernon Dam (Table 5-6). October American shad collections produced a catch ranging in length from 94-110 mm. The CPUE in October 2004 was highest at Station 3 (24.0 fish/hour) (Table 5-6).

5.2.4 Ichthyoplankton

Thirty-three ichthyoplankton samples were collected in close proximity to Vermont Yankee's circulating water intake structure between 6 May and 15 July 2004 (Table 5-7). A total of 1057 ichthyoplankters were identified and enumerated (Table 5-8). *Lepomis* sp. made up 68.7% of the total ichthyoplankton collected and exhibited the highest mean density per tow during the weeks of 24 June (29.67/100 m^3) and 2 July 2004 (194.80/100m^3, Table 5-9). Spottail shiner, white perch, white sucker, common carp, yellow perch, tessellated darter, and walleye eggs and larvae made up the remaining 31.3% of ichthyoplankton collected (Table 5-8). Spottail shiners were most abundant during the period from 17 June through 15 July 2004, with mean densities from 1.06/100 m^3 to 38.78/100 m^3.

5.2.5 Long-Term Fish Data

Relative abundances of each fish taxon collected during the general electrofishing efforts from 1991 to 2003 were compiled annually for comparison with the results from 2004 (Table 5-10). Upstream of Vernon Dam, yellow perch (4,413 fish) bluegill (2,418 fish), pumpkinseed (1,144 fish), and spottail shiner (1,071) were the most abundant species collected, representing 73% of the total catch among all 14 years (Table 5-10). These four fish taxa collectively represented 81% of the upstream general electrofishing collections from 2004 (276 fish/341 fish), and three of these species (yellow perch, bluegill and pumpkinseed) were also the most abundant species collected in 2004 (Table 5-3, Table 5-10). Below Vernon Dam, smallmouth bass (1,354 fish), spottail shiner (878 fish), American shad (541 fish) and rock bass (404 fish) were the most abundant species collected by general electrofishing over the past 14 years, representing 64% of the total collection among years (Table 5-11). These four fish taxa collectively represented 79% of the downstream general electrofishing collections from 2004 (84 fish/106 fish), and three of these species (smallmouth bass, spottail shiner and rock bass) were also the most abundant species collected in 2004 (Table 5-3, Table 5-11). These results indicate stability in species composition and relative abundance of the fish community in both lower Vernon Pool and in the Vernon Dam tailrace areas sampled by general electrofishing over the past 14 years.

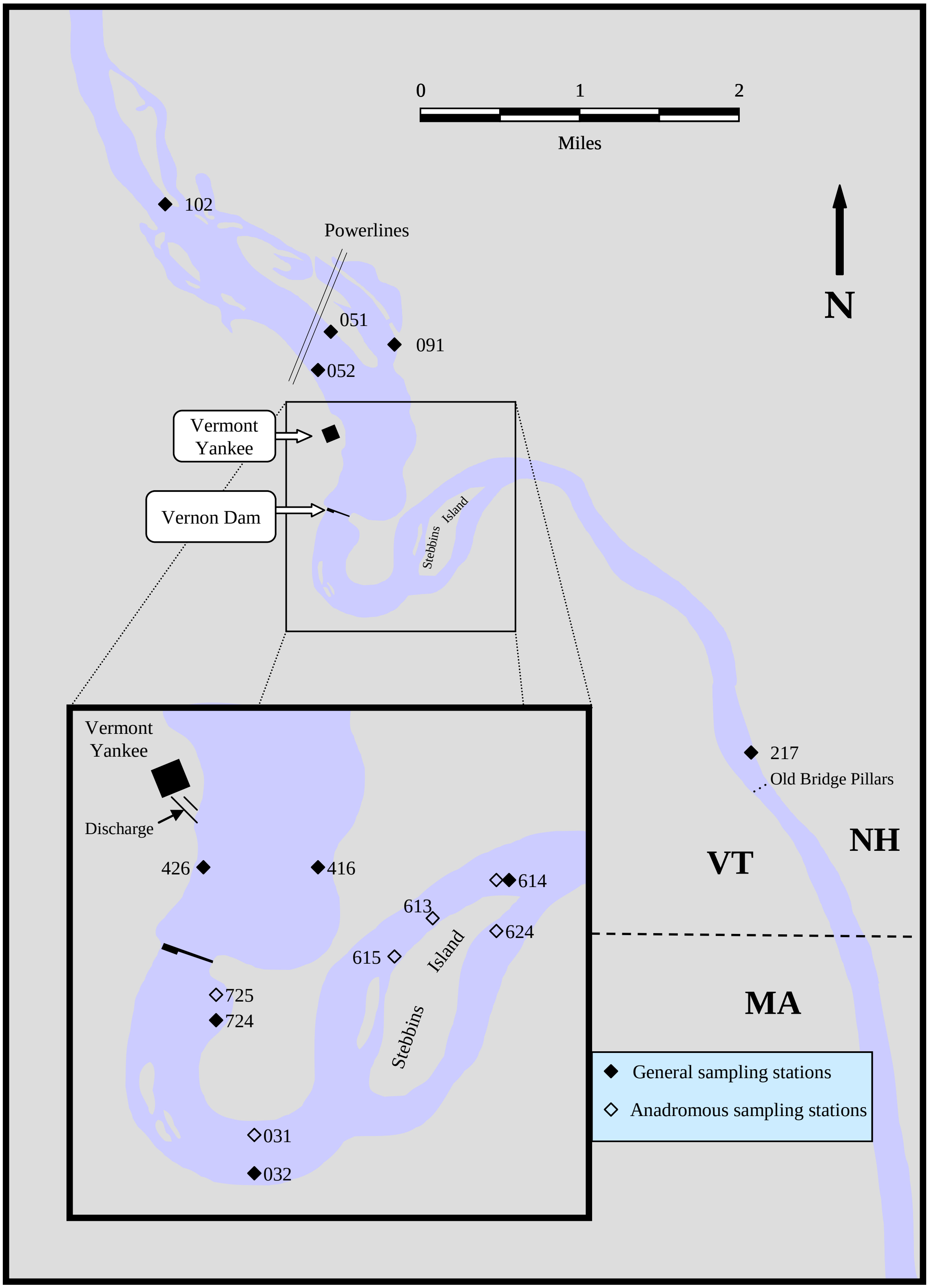

Figure 5-1. General and anadromous fish electrofishing sampling stations.

Table 5-1. Check List of Fishes (Nelson et al. 2004) Collected in the Connecticut River near Vernon, Vermont in each NPDES Sampling Program During 2004.

Scientific Name	Common Name	Program			
		Ichthyoplankton	Impingement	Anadromous Electrofishing	General Electrofishing
CHORDATA					
AGNATHA					
PETROMYZONTIFORMES					
Petromyzontidae					
Petromyzon marinus	Sea lamprey		X		X
Anguilla rostrata	American eel				X
OSTEICHTHYES					
CLUPEIFORMES					
Clupeidae					
Alosa sapidissima	American shad		X	X	X
CYPRINIFORMES					
Cyprinidae					
Cyprinus carpio	Common carp	X			X
Notemigonus crysoleucas	Golden shiner		X		X
Notropis hudsonius	Spottail shiner	X	X		X
Semotilus corporalis	Fallfish				X
Catostomidae					
Catostomus commersoni	White sucker	X	X		X
SILURIFORMES					
Ictaluridae					
Ameiurus catus	White catfish		X		
Ameiurus natalis	Yellow bullhead		X		X
Ameiurus nebulosus	Brown bullhead		X		X
SALMONIFORMES					
Esocidae					
Esox niger	Chain pickerel		X		X
PERCIFORMES					
Percichthyidae					
Morone americana	White perch	X			
Centrarchidae					
Ambloplites rupestris	Rock bass		X		X
Lepomis gibbosus	Pumpkinseed		X		X
Lepomis macrochirus	Bluegill		X		X
Lepomis sp.	Lepomis sp.	X			
Micropterus dolomieu	Smallmouth bass		X		X
Micropterus salmoides	Largemouth bass		X		X
Pomoxis nigromaculatus	Black crappie		X		X
Percidae					
Etheostoma olmstedi	Tessellated darter	X	X		X
Perca flavescens	Yellow perch	X	X		X
Sander vitreus	Walleye	X	X		

Table 5-2. Catch Per Unit of Effort (CPUE) for General Electrofishing Collections in the Connecticut River in the Vicinity of Vernon, Vermont during 2004.

Primary Station (Substation)	Number of Collections	Hours	Fish	CPUE[1]
Upstream				
Rum Point (102)	4	0.7	61	91.5
Station 5 - New Hampshire (051)	4	0.7	72	108.0
Station 5 - Vermont (052)	4	0.7	117	175.5
New Hampshire Setback (091)	4	0.7	65	97.5
Station 4 - New Hampshire (416)	4	0.7	82	123.0
Station 4 - Vermont (426)	4	0.7	66	99.0
Upstream Total	**24**	**3.9**	**463**	**116.0**
Downstream				
0.1 Miles south of Vernon Dam (724)	4	0.7	39	58.5
Station 3 - Vermont (032)	4	0.7	54	81.0
Stebbin Island - New Hampshire Side (614)	4	0.7	18	27.0
Station 2 - New Hampshire (217)	4	0.7	53	79.5
Downstream Total	**16**	**2.7**	**164**	**61.7**
OVERALL TOTAL	**40**	**6.7**	**627**	**94.1**

[1]CPUE = number of fish caught per hour

Table 5-3. Number, Weight, and Species of Fish Collected During Impingement and General Electrofishing Upstream and Downstream of Vernon Dam in 2004.

	Electrofishing				Impingement		Summary			
	Upstream		Downstream		CWTS					
Species	Number	Total Weight (g)	Number	Total Weight (g)	Number	Total Weight (g)	Total Number (No.)	Relative Number (%)	Total Weight (No.)	Relative Weight (%)
Sea lamprey										
American eel	1									
American shad										
Chain pickerel	2	210			2	328	4	0.5	538	0.6
Common carp	4	14500					4	0.5	14500	17.1
Golden shiner	27	1030			1	3	28	3.2	1033	1.2
Spottail shiner	6	77	26	80	5	23	37	4.3	180	0.2
Fallfish			8	409			8	0.9	409	0.5
White sucker	4	1339	5	3406	1	10	10	1.2	4755	5.6
White catfish					1	23	1	0.1	23	0.0
Yellow bullhead	4	705			1	16	5	0.6	721	0.9
Brown bullhead	1	700			3	398	4	0.5	1098	1.3
Rock bass	3	197	30	1445	23	643	56	6.5	2285	2.7
Pumpkinseed	48	4706	2	147	6	197	56	6.5	5050	6.0
Bluegill	123	12300	12	1410	67	831	202	23.4	14541	17.2
Smallmouth bass			48	8427	9	235	57	6.6	8662	10.2
Largemouth bass	33	12542	7	3423	3	10	43	5.0	15975	18.9
Black crappie	9	1307	1	175	10	91	20	2.3	1573	1.9
Tessellated	2	8			1	3	3	0.3	11	0.0
Yellow perch	194	10803	5	465	20	467	219	25.4	11735	13.9
Walleye					1	345	1	0.1	345	0.4
Unidentifiable	2	256					2	0.2	256	0.3
Total	**463**	**60680**	**164**	**19530**	236	4449	**863**	**100**	**84659**	**100**

Table 5-4. CPUE[1] and Relative (%) CPUE by Number and Weight of Fish Species Collected by General Electrofishing Upstream and Downstream of Vernon, Vermont in 2004.

	Upstream				Downstream				Total			
	By Number		By Weight		By Number		By Weight		By Number		By Weight	
Species	CPUE	%	CPUE	%	CPUE	%	CPUE	%	CPUE	%	CPUE	%
Sea lamprey					0.4	0.6	1.5	0.0	0.2	0.2	0.6	0.0
American eel	0.3	0.2	0.0	0.0					0.2	0.2	0.0	0.0
American shad					7.1	11.6	52.1	0.7	2.9	3.0	20.9	0.2
Chain pickerel	0.5	0.4	52.5	0.3					0.3	0.3	31.5	0.3
Common carp	1.0	0.9	3625.0	23.9					0.6	0.6	2175.0	18.1
Golden shiner	6.8	5.8	257.5	1.7					4.1	4.3	154.5	1.3
Spottail shiner	1.5	1.3	19.3	0.1	9.8	15.9	30.0	0.4	4.8	5.1	23.6	0.2
Fallfish					3.0	4.9	153.4	2.1	1.2	1.3	61.4	0.5
White sucker	1.0	0.9	334.8	2.2	1.9	3.0	1277.3	17.4	1.4	1.4	711.8	5.9
Yellow bullhead	1.0	0.9	176.3	1.2					0.6	0.6	105.8	0.9
Brown bullhead	0.3	0.2	175.0	1.2					0.2	0.2	105.0	0.9
Rock bass	0.8	0.6	49.3	0.3	11.3	18.3	541.9	7.4	5.0	5.3	246.3	2.0
Pumpkinseed	12.0	10.4	1176.5	7.8	0.8	1.2	55.1	0.8	7.5	8.0	728.0	6.1
Bluegill	30.8	26.6	3075.0	20.3	4.5	7.3	528.8	7.2	20.3	21.5	2056.5	17.1
Smallmouth bass					18.0	29.3	3160.1	43.1	7.2	7.7	1264.1	10.5
Largemouth bass	8.3	7.1	3135.5	20.7	2.6	4.3	1283.6	17.5	6.0	6.4	2394.8	19.9
Black crappie	2.3	1.9	326.8	2.2	0.4	0.6	65.6	0.9	1.5	1.6	222.3	1.8
Tessellated darter	0.5	0.4	2.0	0.0					0.3	0.3	1.2	0.0
Yellow perch	48.5	41.9	2700.8	17.8	1.9	3.0	174.4	2.4	29.9	31.7	1690.2	14.0
Unidentifiable	0.5	0.4	64.0	0.4					0.3	0.3	38.4	0.3
Totals	**115.8**	**100.0**	**15170.0**	**100.0**	**61.5**	**100.0**	**7323.8**	**100.0**	**94.1**	**100.0**	**12032.0**	**100.0**

[1]CPUE = number of fish caught per hour

Table 5-5. Monthly Impingement of Fish on Entergy Nuclear Vermont Yankee Circulating Water Traveling Screens in 2004.

Species	April		May		June		August		September		October	
	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)
American shad							4	13	3	30	66	740
Black crappie	1	36	7	20					1	29	1	6
Bluegill	5	200	3	6	1	5	5	510	19	50	34	60
Brown bullhead					2	380	1	18				
Chain pickerel	1	310	1	18								
Golden shiner											1	3
Largemouth bass							2	7	1	3		
Pumpkinseed			4	17	2	180						
Rock bass			10	23	2	189	6	298	3	61	2	72
Sea lamprey			9	43								
Smallmouth bass	1	3	1	3			2	117	5	112		
Spottail shiner	2	7					1	4	2	12		
Tesselated darter							1	3				
Walleye									1	345		
White catfish					1	23						
White sucker			1	10								
Yellow bullhead									1	16		
Yellow perch	10	430	3	10	1	7	3	10	3	10		
Total	**20**	**986**	**39**	**150**	**9**	**784**	**25**	**980**	**39**	**668**	**104**	**881**

Table 5-6. Summary of 2004 Anadromous Electrofishing Fish Collections of American shad at Stebbin Island, Station 3, and 0.1 Mile Below Vernon Dam.

Month and Station	No. of Fish	Hours	CPUE[1]	Minimum Length (mm)	Maximum Length (mm)	Minimum Weight (g)	Maximum Weight (g)
July							
Station 3 (031)	1	0.3	3.0	51	51	3	3
Stebbin Island (613,614,615,624)	3	1.3	2.3	46	51	3	3
0.1 Miles south of Vernon Dam (725)	1	0.3	3.0	74	74	4	4
August							
Station 3 (031)	12	0.3	36.0	56	79	3	4
Stebbin Island (613,614,615,624)	22	1.2	18.3	63	88	3	6
0.1 Miles south of Vernon Dam (725)	2	0.3	6.0	71	74	3	4
September							
Station 3 (031)	15	0.5	30.0	78	96	4	8
Stebbin Island (613,614,615,624)	21	2.0	10.8	81	98	4	8
0.1 Miles south of Vernon Dam (725)	1	0.5	2.0	95	95	8	8
October							
Station 3 (031)	8	0.3	24.0	99	105	8	10
Stebbin Island (613,614,615,624)	3	1.3	2.3	103	105	9	10
0.1 Miles south of Vernon Dam (725)	3	0.3	9.0	94	110	6	9

[1]CPUE = number of fish caught per hour

Table 5-7. Entergy Nuclear Vermont Yankee Ichthyoplankton Sampling Effort in the Connecticut River near the Vermont Yankee Intake Structure during 2004.

	Depth (m)						Mean	
	0.3		1.8		3.7			
Date	N	Volume	N	Volume	N	Volume	N	Volume
06-May-04	1	100.0	1	95.7	1	92.9	3	96.2
11-May-04	1	88.0	1	90.7	1	104.7	3	94.5
17-May-04	1	98.0	1	98.4	1	98.4	3	98.3
26-May-04	1	90.4	1	79.8	1	87.2	3	85.8
01-Jun-04	1	86.5	1	96.1	1	99.5	3	94.0
07-Jun-04	1	102.0	1	94.0	1	119.9	3	105.3
17-Jun-04	1	75.1	1	99.7	1	102.0	3	92.3
24-Jun-04	1	95.6	1	81.1	1	83.2	3	86.7
02-Jul-04	1	108.4	1	101.2	1	104.1	3	104.6
08-Jul-04	1	96.1	1	94.1	1	93.0	3	94.4
15-Jul-04	1	97.9	1	94.9	1	87.9	3	93.6
Total	11	1038.1	11	1025.6	11	1072.7	33	1045.5

Table 5-8. Earliest and Latest Collection Dates and Total Number of Ichthyoplankton Collected Near the Vermont Yankee Circulating Water Intake Structure in 2004.

Species	Earliest Capture	Latest Capture	Number	Percent
Common carp	17-Jun-04	24-Jun-04	5	0.5
Spottail shiner	17-Jun-04	15-Jul-04	269	25.4
White sucker	26-May-04	26-May-04	11	1.0
White perch	11-May-04	24-Jun-04	36	3.4
Lepomis sp.	17-May-04	15-Jul-04	726	68.7
Tessellated darter	26-May-04	26-May-04	3	0.3
Yellow perch	6-May-04	26-May-04	5	0.5
Walleye	17-May-04	26-May-04	2	0.2
Total			1057	100

Table 5-9. Density per 100 cubic meters of Ichthyoplankton Collected at Three Depths in the Vicinity of the Vermont Yankee Circulating Water Intake Structure during 2004.

Week	Species	Depth 0.3 m	Depth 1.8 m	Depth 3.7 m	Mean Density
6-May-04	Yellow perch	0.0	1.0	1.1	0.7
11-May-04	White perch	1.1	1.1	1.0	1.1
17-May-04	*Lepomis* sp.	0.0	1.0	0.0	0.3
	Walleye	1.0	0.0	0.0	0.3
	White perch	6.1	5.1	16.3	9.2
	Yellow perch	1.0	1.0	0.0	0.7
26-May-04	Tessellated darter	1.1	1.3	1.1	1.2
	Walleye	0.0	0.0	1.1	0.4
	White sucker	11.1	0.0	1.1	4.1
	Yellow perch	0.0	1.3	0.0	0.4
1-Jun-04	*Lepomis* sp.	2.3	2.1	1.0	1.8
	White perch	0.0	1.0	0.0	0.3
7-Jun-04	*Lepomis* sp.	0.0	1.1	0.8	0.6
17-Jun-04	Common carp	0.0	0.0	2.0	0.7
	Lepomis sp.	2.7	0.0	0.0	0.9
	Spottail shiner	20.0	2.0	3.9	8.6
	White perch	0.0	0.0	3.9	1.3
24-Jun-04	Common carp	3.1	0.0	0.0	1.0
	Lepomis sp.	12.5	29.6	46.9	29.7
	Spottail shiner	32.4	2.5	4.8	13.2
	White perch	0.0	0.0	1.2	0.4
2-Jul-04	*Lepomis* sp.	67.4	349.9	167.2	194.8
	Spottail shiner	6.5	87.0	1.0	31.5
8-Jul-04	*Lepomis* sp.	30.2	6.4	3.2	13.3
	Spottail shiner	1.0	1.1	1.1	1.1
15-Jul-04	*Lepomis* sp.	0.0	0.0	2.3	0.8
	Spottail shiner	84.8	17.9	13.7	38.8

Table 5-10. Summary of the Number and Percent of Fish Species Collected by General Electrofishing Upstream of Vernon Dam, from 1991 through 2004.

Species	1991		1992		1993		1994		1995		1996	
	N	%	N	%	N	%	N	%	N	%	N	%
American eel	7	0.5	2	0.2	8	0.8	4	0.4	2	0.2	0	0.0
American shad	19	1.3	29	3.3	5	0.5	2	0.2	24	2.4	3	0.3
Atlantic salmon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Banded killifish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Black crappie	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	5	0.4
Blueback herring	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bluegill	128	9.0	56	6.4	99	10.5	118	11.5	135	13.7	222	19.8
Brook trout	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Brown bullhead	19	1.3	19	2.2	29	3.1	8	0.8	20	2.0	1	0.1
Chain pickerel	17	1.2	29	3.3	5	0.5	4	0.4	5	0.5	12	1.1
Common carp	11	0.8	6	0.7	8	0.8	7	0.7	11	1.1	2	0.2
Common shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
E. silvery minnow	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Fallfish	1	0.1	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0
Gizzard shad	0	0.0	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0
Golden shiner	74	5.2	70	8.0	16	1.7	41	4.0	46	4.7	39	3.5
Goldfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Largemouth bass	151	10.6	83	9.5	99	10.5	58	5.7	69	7.0	44	3.9
Lepomis sp.	0	0.0	1	0.1	1	0.1	12	1.2	49	5.0	0	0.0
Mimic shiner	6	0.4	0	0.0	0	0.0	17	1.7	5	0.5	0	0.0
Northern pike	7	0.5	11	1.3	6	0.6	2	0.2	6	0.6	4	0.4
Notropis sp.	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0	0	0.0
Pumpkinseed	157	11.0	94	10.8	144	15.2	97	9.5	68	6.9	109	9.7
Redbreast sunfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rock bass	37	2.6	26	3.0	10	1.1	5	0.5	18	1.8	41	3.7
Sea lamprey	2	0.1	0	0.0	1	0.1	0	0.0	0	0.0	1	0.1
Smallmouth bass	15	1.1	10	1.1	18	1.9	11	1.1	22	2.2	12	1.1
Spotfin shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Spottail shiner	104	7.3	73	8.4	46	4.9	85	8.3	23	2.3	249	22.2
Tessellated darter	2	0.1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Walleye	15	1.1	1	0.1	12	1.3	12	1.2	13	1.3	6	0.5
White perch	19	1.3	11	1.3	7	0.7	34	3.3	18	1.8	0	0.0
White sucker	121	8.5	86	9.9	75	7.9	108	10.6	73	7.4	22	2.0
Yellow bullhead	5	0.4	4	0.5	5	0.5	4	0.4	7	0.7	2	0.2
Yellow perch	507	35.6	260	29.8	352	37.2	394	38.5	373	37.7	346	30.9
Total Number	**1424**	**100**	**872**	**100**	**946**	**100**	**1023**	**100**	**989**	**100**	**1120**	**100**
No. Collections	**24**		**24**		**24**		**24**		**24**		**20**	
Effort (Hrs)	**7.8**		**8.1**		**7.9**		**6.5**		**8.2**		**3.5**	
CPUE[1]	**183**		**108**		**120**		**157**		**121**		**320**	

(continued)

Table 5-10 (Continued)

Species	1997		1998		1999		2000		2001		2002	
	N	%	N	%	N	%	N	%	N	%	N	%
American eel	0	0.0	2	0.2	1	0.1	0	0.0	0	0.0	0	0.0
American shad	0	0.0	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0
Atlantic salmon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Banded killifish	0	0.0	0	0.0	0	0.0	1	0.1	4	0.3	0	0.0
Black crappie	3	0.5	7	0.8	10	1.2	12	1.5	9	0.7	4	0.7
Blueback herring	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bluegill	46	7.2	234	25.8	296	35.2	221	28.4	360	27.8	197	34.1
Brook trout	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Brown bullhead	2	0.3	2	0.2	0	0.0	3	0.4	2	0.2	0	0.0
Chain pickerel	14	2.2	20	2.2	9	1.1	12	1.5	11	0.8	5	0.9
Common carp	1	0.2	2	0.2	3	0.4	2	0.3	0	0.0	1	0.2
Common shiner	0	0.0	0	0.0	1	0.1	0	0.0	0	0.0	0	0.0
E. silvery minnow	0	0.0	0	0.0	9	1.1	5	0.6	0	0.0	2	0.3
Fallfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Gizzard shad	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Golden shiner	15	2.4	74	8.1	66	7.8	24	3.1	55	4.2	29	5.0
Goldfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Largemouth bass	30	4.7	31	3.4	43	5.1	47	6.0	91	7.0	31	5.4
Lepomis sp.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mimic shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Northern pike	0	0.0	0	0.0	0	0.0	4	0.5	1	0.1	1	0.2
Notropis sp.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Pumpkinseed	11	1.7	71	7.8	23	2.7	70	9.0	104	8.0	81	14.0
Redbreast sunfish	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rock bass	9	1.4	17	1.9	18	2.1	24	3.1	21	1.6	5	0.9
Sea lamprey	9	1.4	5	0.6	4	0.5	1	0.1	4	0.3	0	0.0
Smallmouth bass	7	1.1	26	2.9	21	2.5	10	1.3	2	0.2	6	1.0
Spotfin shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Spottail shiner	146	22.9	39	4.3	76	9.0	50	6.4	141	10.9	17	2.9
Tessellated darter	0	0.0	2	0.2	0	0.0	0	0.0	4	0.3	1	0.2
Walleye	7	1.1	6	0.7	3	0.4	2	0.3	7	0.5	2	0.3
White perch	1	0.2	0	0.0	1	0.1	0	0.0	0	0.0	3	0.5
White sucker	11	1.7	8	0.9	13	1.5	11	1.4	21	1.6	18	3.1
Yellow bullhead	0	0.0	2	0.2	4	0.5	7	0.9	5	0.4	0	0.0
Yellow perch	324	50.9	360	39.6	240	28.5	272	34.9	454	35.0	175	30.3
Total Number	**637**	**100**	**908**	**100**	**841**	**100**	**779**	**100**	**1296**	**100**	**578**	**100**
No. Collections	**24**		**24**		**24**		**24**		**24**		**24**	
Effort (Hrs)	**4.0**		**4.3**		**4.0**		**3.9**		**4.0**		**4.0**	
CPUE[1]	**159**		**211**		**210**		**200**		**324**		**145**	

(continued)

Table 5-10 (Continued)

Species	2003		2004		All Years		
	N	%	N	%	N	%	CPUE[1]
American eel	0	0.0	1	0.3	27	0.2	0.37
American shad	0	0.0	0	0.0	83	0.7	1.13
Atlantic salmon	0	0.0	0	0.0	0	0.0	0.00
Banded killifish	0	0.0	0	0.0	5	0.0	0.07
Black crappie	13	2.0	7	2.1	70	0.6	0.96
Blueback herring	0	0.0	0	0.0	0	0.0	0.00
Bluegill	202	31.8	104	30.5	2418	19.5	33.02
Brook trout	0	0.0	0	0.0	0	0.0	0.00
Brown bullhead	3	0.5	1	0.3	109	0.9	1.49
Chain pickerel	8	1.3	1	0.3	152	1.2	2.08
Common carp	0	0.0	2	0.6	56	0.5	0.76
Common shiner	1	0.2	0	0.0	2	0.0	0.03
E. silvery minnow	0	0.0	0	0.0	16	0.1	0.22
Fallfish	0	0.0	0	0.0	2	0.0	0.03
Gizzard shad	0	0.0	0	0.0	1	0.0	0.01
Golden shiner	19	3.0	24	7.0	592	4.8	8.09
Goldfish	0	0.0	0	0.0	0	0.0	0.00
Largemouth bass	27	4.2	21	6.2	825	6.7	11.27
Lepomis sp.	11	1.7	0	0.0	74	0.6	1.01
Mimic shiner	0	0.0	0	0.0	28	0.2	0.38
Northern pike	0	0.0	0	0.0	42	0.3	0.57
Notropis sp.	0	0.0	0	0.0	1	0.0	0.01
Pumpkinseed	75	11.8	40	11.7	1144	9.2	15.62
Redbreast sunfish	0	0.0	0	0.0	1	0.0	0.01
Rock bass	9	1.4	2	0.6	242	2.0	3.31
Sea lamprey	4	0.6	0	0.0	31	0.3	0.42
Smallmouth bass	5	0.8	0	0.0	165	1.3	2.25
Spotfin shiner	0	0.0	0	0.0	0	0.0	0.00
Spottail shiner	18	2.8	4	1.2	1071	8.6	14.63
Tessellated darter	0	0.0	2	0.6	11	0.1	0.15
Walleye	0	0.0	0	0.0	86	0.7	1.17
White perch	2	0.3	0	0.0	96	0.8	1.31
White sucker	8	1.3	2	0.6	577	4.7	7.88
Yellow bullhead	3	0.5	2	0.6	50	0.4	0.68
Yellow perch	228	35.8	128	37.5	4413	35.6	60.27
Total Number	**636**	**100**	**341**	**100**	**12390**	**100**	**169**
No. Collections	**24**		**18**		**326**		
Effort (Hrs)	**4.0**		**3.0**		**73.2**		
CPUE[1]	**158**		**114**		**169**		

[1] CPUE is catch per unit of effort expressed as fish per hour.

Table 5-11. **Summary of the Number and Percent of Fish Species Collected by General Electrofishing Downstream of Vernon Dam, from 1991 through 2004.**

Species	1991		1992		1993		1994		1995		1996	
	N	%	N	%	N	%	N	%	N	%	N	%
American eel	13	2.0	1	0.2	10	2.4	7	1.6	1	0.3	1	0.2
American shad	166	25.6	37	9.2	82	19.9	43	9.6	59	15.6	10	2.4
Atlantic salmon	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0
Banded killifish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Black crappie	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Blueback herring	0	0.0	2	0.5	0	0.0	0	0.0	0	0.0	0	0.0
Bluegill	8	1.2	12	3.0	15	3.6	28	6.3	25	6.6	37	8.8
Brook trout	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Brown bullhead	1	0.2	1	0.2	2	0.5	0	0.0	5	1.3	0	0.0
Chain pickerel	3	0.5	6	1.5	4	1.0	2	0.4	0	0.0	3	0.7
Common carp	3	0.5	1	0.2	3	0.7	4	0.9	7	1.8	4	1.0
Common shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
E. silvery minnow	0	0.0	0	0.0	0	0.0	0	0.0	6	1.6	0	0.0
Fallfish	49	7.6	22	5.5	11	2.7	27	6.1	9	2.4	6	1.4
Gizzard shad	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	2	0.5
Golden shiner	5	0.8	2	0.5	4	1.0	4	0.9	0	0.0	14	3.3
Goldfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.2
Largemouth bass	8	1.2	5	1.2	15	3.6	3	0.7	8	2.1	3	0.7
Lepomis sp.	6	0.9	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0
Mimic shiner	15	2.3	0	0.0	4	1.0	6	1.3	1	0.3	0	0.0
Northern pike	2	0.3	7	1.7	0	0.0	6	1.3	10	2.6	3	0.7
Notropis sp.	0	0.0	0	0.0	0	0.0	8	1.8	2	0.5	0	0.0
Pumpkinseed	11	1.7	3	0.7	3	0.7	4	0.9	4	1.1	5	1.2
Redbreast sunfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Rock bass	30	4.6	25	6.2	22	5.3	37	8.3	47	12.4	37	8.8
Sea lamprey	0	0.0	1	0.2	3	0.7	0	0.0	0	0.0	7	1.7
Smallmouth bass	101	15.6	85	21.2	99	24.0	109	24.4	118	31.1	73	17.3
Spotfin shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Spottail shiner	107	16.5	104	25.9	49	11.9	60	13.5	27	7.1	171	40.6
Tessellated darter	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Walleye	18	2.8	13	3.2	16	3.9	9	2.0	9	2.4	5	1.2
White perch	1	0.2	1	0.2	8	1.9	0	0.0	2	0.5	0	0.0
White sucker	73	11.3	62	15.5	40	9.7	71	15.9	30	7.9	18	4.3
Yellow bullhead	0	0.0	0	0.0	0	0.0	0	0.0	1	0.3	0	0.0
Yellow perch	28	4.3	11	2.7	21	5.1	18	4.0	6	1.6	21	5.0
Total Number	**648**	**100.1**	**401**	**99.5**	**412**	**99.8**	**446**	**99.9**	**379**	**100.1**	**421**	**100.0**
No. Collections	**20**		**20**		**20**		**20**		**20**		**16**	
Effort (Hrs)	**5.6**		**5.9**		**5.7**		**5.7**		**6.2**		**3.1**	
CPUE[1]	**116**		**68**		**72**		**78**		**61**		**136**	

(continued)

Table 5-11 (Continued)

Species	1997		1998		1999		2000		2001		2002	
	N	%	N	%	N	%	N	%	N	%	N	%
American eel	1	0.4	3	0.8	0	0.0	2	1.0	0	0.0	2	0.9
American shad	39	16.2	12	3.3	1	0.2	12	6.0	34	7.3	21	9.8
Atlantic salmon	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Banded killifish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.9
Black crappie	0	0.0	3	0.8	0	0.0	0	0.0	1	0.2	3	1.4
Blueback herring	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Bluegill	5	2.1	28	7.7	12	2.6	23	11.4	41	8.8	22	10.2
Brook trout	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Brown bullhead	0	0.0	0	0.0	2	0.4	0	0.0	0	0.0	0	0.0
Chain pickerel	3	1.2	0	0.0	0	0.0	1	0.5	1	0.2	0	0.0
Common carp	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Common shiner	0	0.0	0	0.0	21	4.6	1	0.5	1	0.2	0	0.0
E. silvery minnow	0	0.0	5	1.4	0	0.0	0	0.0	0	0.0	2	0.9
Fallfish	0	0.0	25	6.8	86	19.0	26	12.9	24	5.2	13	6.0
Gizzard shad	0	0.0	0	0.0	1	0.2	1	0.5	0	0.0	0	0.0
Golden shiner	4	1.7	4	1.1	10	2.2	3	1.5	1	0.2	1	0.5
Goldfish	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Largemouth bass	5	2.1	3	0.8	5	1.1	0	0.0	8	1.7	1	0.5
Lepomis sp.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Mimic shiner	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Northern pike	1	0.4	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0
Notropis sp.	0	0.0	0	0.0	0	0.0	2	1.0	9	1.9	0	0.0
Pumpkinseed	3	1.2	10	2.7	5	1.1	10	5.0	5	1.1	10	4.7
Redbreast sunfish	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Rock bass	6	2.5	43	11.8	38	8.4	13	6.5	60	12.9	13	6.0
Sea lamprey	0	0.0	6	1.6	3	0.7	0	0.0	3	0.6	2	0.9
Smallmouth bass	72	29.9	141	38.6	127	28.0	42	20.9	197	42.5	71	33.0
Spotfin shiner	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Spottail shiner	64	26.6	37	10.1	65	14.3	51	25.4	48	10.3	40	18.6
Tessellated darter	0	0.0	1	0.3	0	0.0	0	0.0	0	0.0	0	0.0
Walleye	2	0.8	5	1.4	12	2.6	6	3.0	3	0.6	4	1.9
White perch	1	0.4	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0
White sucker	7	2.9	17	4.7	20	4.4	6	3.0	11	2.4	6	2.8
Yellow bullhead	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Yellow perch	28	11.6	20	5.5	45	9.9	2	1.0	15	3.2	1	0.5
Total Number	**241**	**100.0**	**365**	**100.0**	**453**	**99.7**	**201**	**100.1**	**464**	**99.7**	**215**	**100.0**
No. Collections	**16**		**16**		**16**		**16**		**16**		**16**	
Effort (Hrs)	**2.7**		**2.7**		**2.7**		**2.6**		**2.7**		**2.7**	
CPUE[1]	**89**		**135**		**168**		**77**		**172**		**80**	

(continued)

Table 5-11 (Continued

Species	2003		2004		All Years		
	N	%	N	%	N	%	CPUE[1]
American eel	0	0.0	0	0.0	41	0.8	0.77
American shad	15	6.8	10	9.4	541	10.9	10.21
Atlantic salmon	0	0.0	0	0.0	1	0.0	0.02
Banded killifish	0	0.0	0	0.0	2	0.0	0.04
Black crappie	1	0.5	1	0.9	9	0.2	0.17
Blueback herring	0	0.0	0	0.0	2	0.0	0.04
Bluegill	42	18.9	7	6.6	305	6.1	5.76
Brook trout	0	0.0	0	0.0	1	0.0	0.02
Brown bullhead	0	0.0	0	0.0	11	0.2	0.21
Chain pickerel	2	0.9	0	0.0	25	0.5	0.47
Common carp	2	0.9	0	0.0	24	0.5	0.45
Common shiner	1	0.5	0	0.0	24	0.5	0.45
E. silvery minnow	0	0.0	0	0.0	13	0.3	0.25
Fallfish	6	2.7	3	2.8	307	6.2	5.80
Gizzard shad	0	0.0	0	0.0	5	0.1	0.09
Golden shiner	0	0.0	0	0.0	52	1.0	0.98
Goldfish	0	0.0	0	0.0	1	0.0	0.02
Largemouth bass	2	0.9	5	4.7	71	1.4	1.34
Lepomis sp.	0	0.0	0	0.0	7	0.1	0.13
Mimic shiner	0	0.0	0	0.0	26	0.5	0.49
Northern pike	0	0.0	0	0.0	30	0.6	0.57
Notropis sp.	0	0.0	0	0.0	21	0.4	0.40
Pumpkinseed	5	2.3	2	1.9	80	1.6	1.51
Redbreast sunfish	0	0.0	0	0.0	1	0.0	0.02
Rock bass	18	8.1	15	14.2	404	8.1	7.63
Sea lamprey	1	0.5	0	0.0	26	0.5	0.49
Smallmouth bass	84	37.8	35	33.0	1354	27.2	25.56
Spotfin shiner	0	0.0	0	0.0	1	0.0	0.02
Spottail shiner	31	14.0	24	22.6	878	17.7	16.58
Tessellated darter	1	0.5	0	0.0	2	0.0	0.04
Walleye	1	0.5	0	0.0	103	2.1	1.94
White perch	1	0.5	0	0.0	15	0.3	0.28
White sucker	7	3.2	3	2.8	371	7.5	7.00
Yellow bullhead	0	0.0	0	0.0	1	0.0	0.02
Yellow perch	2	0.9	1	0.9	219	4.4	4.13
Total Number	**222**	**100.4**	**106**	**99.8**	**4974**	**99.7**	**93.90**
No. Collections	**16**		**12**		**240**		
Effort (Hrs)	**2.7**		**2.0**		**53.0**		
CPUE[1]	**83**		**53**		**94**		

[1] CPUE is catch per unit of effort expressed as fish per hour.

6.0 2004 ZEBRA MUSSEL AND ASIATIC CLAM MONITORING

6.1 METHODS OF COLLECTION AND PROCESSING

Larval (veliger) mollusk sampling was conducted bi-weekly between 17 May and 8 October 2004. Collections were made at quarter point stations (at 25, 50 and 75% of the rivers width) at Stations 4 and 5. Station 4 is composed of sub-stations 416 on the New Hampshire shore, 436 at mid-river and 426 on the Vermont shore. Station 5 is composed of sub-stations 051 on the New Hampshire shore, 053 at mid-river and 052 on the Vermont shore (Figure 6-1). At each sample station, 1,000 liters of river water were pumped through a 64-micron plankton net at each quarter point for each collection. Six samples were collected during each bi-weekly sampling for a total of 66 pumped veliger samples in 2004. Samples were preserved in 70% ethanol, and later examined in the laboratory for the presence of the microscopic veligers.

Juvenile/adult (settling stage) zebra mussel (*Dreissena polymorpha*) sampling was conducted between 17 May and 8 October 2004 at Stations 4 and 5 (Figure 6-1). One settlement plate sampler was deployed at each station for a total of four samplers. Settlement plates were made of six, 6-inch by 6-inch, plates of 1/4 inch hardboard threaded laterally onto a rope with approximately 1.25 in between plates. The sampler was suspended in the water column at 1-2 m below the surface. Approximately every two weeks, the plate sampler at each station was lifted out of the water and one plate was randomly selected and cleaned into a 64-micron sieve. The sample was then preserved in 70% ethanol for examination in the laboratory. A total of 42 veliger plate samples were collected and processed during 2004.

One plate sampler deployed at Station 416 on 2 July 2004, could not be located when retrieval was attempted on 20 July 2004. A new plate sampler was deployed at that location on 30 July 2004. Therefore, one zebra mussel settling plate sample was not collected between 2 July and 30 July 2004. A second plate was found to be missing from Station 436 on 21 September 2004 that was deployed on 7 September 2004. A new plate was deployed on 21 September 2004.

Asiatic clam (*Corbicula fluminea*) samples were collected with a 9-inch Ponar dredge in July, August, and October 2004 at Station 4 (substations 416, 426, and 436) and Station 5 (substations 051, 052, and 053) (Figure 6-1). Dredge samples were collected at all six locations for a total of 18 dredges. At each station three dredges were combined into a single sample and sieved. All dredge samples were sieved through a 600-micron sieve in the field, prior to being preserved in 70% ethanol for laboratory examination.

6.1.1 Laboratory Identification Procedures

Each zebra mussel veliger sample was emptied into a petri dish and examined in entirety with cross-polarized light on a dissecting microscope with 40x magnification. The use of cross polarized light allows zebra mussel veligers to be distinguished from other planktonic organisms that are also collected in the samples, as the larval shells stand out as bright spots against a dark background (Johnson 1996).

In the laboratory, the 18 ponar dredge samples were examined in entirety under low magnification (2x) for the presence of *Corbicula fluminea*.

6.2 RESULTS

River water temperatures ranged from 12.0 to 25.5°C, dissolved oxygen ranged from 6.9 to 13.2 mg/l, and pH ranged from 6.0 to 8.0 during zebra mussel veliger and settlement plate sampling in the vicinity of the Vermont Yankee Plant (Stations 4 and 5).

No Asiatic clams or any life stage of zebra mussels were found in the samples collected during the 2004 Vermont Yankee monitoring program.

Normandeau presented information regarding Vermont Yankee’s zebra mussel monitoring program and results at the 2004 annual watershed conference at the New Hampshire Department of Environmental Services office in Concord, New Hampshire which was attended by over 200 people (Gonyaw and Pierce 2004). Normandeau also gave a similar presentation at the 30th Annual Atlantic International Chapter of the American Fisheries Society on 19 September 2004, attended by approximately 150 people (Comeau and Hanson 2004).

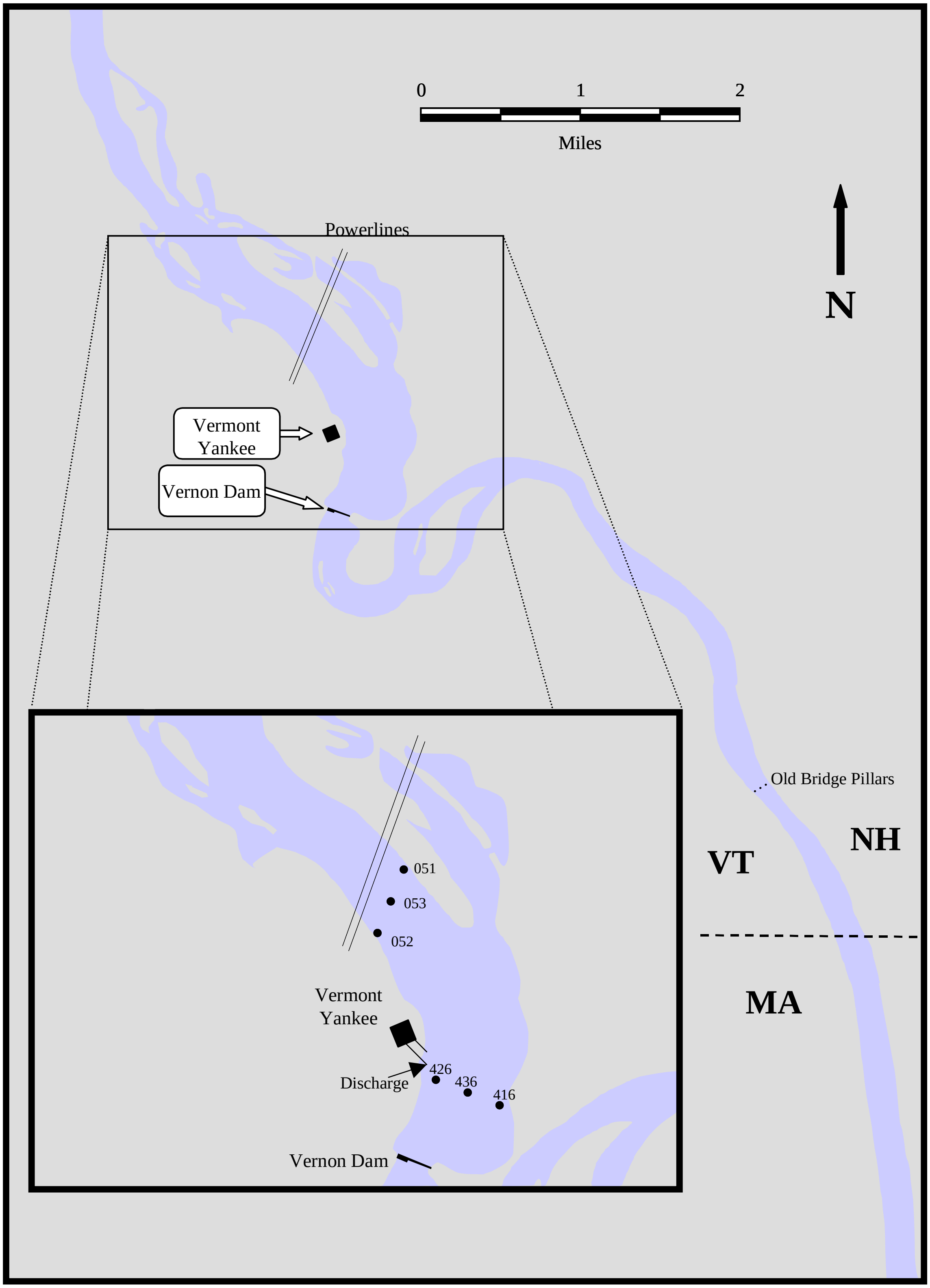

Figure 6-1. Zebra mussel and Asiatic clam monitoring stations. Zebra mussel veliger pump samples and Asiatic clam dredges at all stations. Zebra mussel plates at 051, 052, 426, and 416 only.

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