

A Summary of Biological Monitoring Results from the Kingdom Wind Project in Lowell, Vermont

Vermont Department of Environmental Conservation

Biomonitoring and Aquatic Studies Section

February 3, 2017

Introduction

Fish and macroinvertebrate communities were monitored annually in and around the Green Mountain Power (GMP) wind project in Lowell, Vermont in fulfillment of condition G included in the 401 Certification 33 USC 1341, dated August 19, 2011. This report presents biological data generated from the monitoring effort. Water chemistry, temperature, and physical habitat stream geomorphic data can be accessed in annual reports and is summarized in: *Kingdom Community Wind Project* prepared for Green Mountain Power Corporation by VHB consulting, South Burlington, Vermont and Bear Creek Environmental LLC, Montpelier, Vermont on May 6, 2016.

The permittee's representative assessed communities from eight test streams and a single adjacent off-site control stream before and during construction and operational phases of the project. Data from 2010 (for macroinvertebrates) and 2011 (for macroinvertebrates and fish) served as temporal controls. A spatial control site on Truland Brook (WQM 105) was selected to represent trends in the biological communities unrelated to project activities.

The fish community was monitored at six test sites on five streams that received runoff from project. Macroinvertebrate communities were sampled at 11 test sites from eight streams with eight of the sites being sampled in 2010 as well.

Comparison of Biological Results to Spatial and Temporal Controls

An unusually stressful hydrological year occurred in 2011, beginning with a rapid snowmelt exacerbated by intense precipitation on April 26 which caused high discharges and flooding. Later in August, Tropical Storm Irene again drove discharges up dramatically. These two events caused the scouring of biotic communities in the study streams as well as many streams across the state. The 2011 biological samples were collected only three to four weeks after TS Irene. Minimum annual fish density values over the five monitored years were observed in 2011 at four of the seven sites assessed. Young-of-the-year (YOY) Brook Trout numbers were the lowest in 2011 of all years monitored at all but one site. Because of this stressful water year, the fish communities of 2011 were less reflective of the true "average" condition at the study sites. Fewer stream sites showed depressed numbers of macroinvertebrates, however, as only four of the eleven sites registered their lowest density of the six years monitored. As a result, macroinvertebrate samples collected during 2011 represented a more acceptable temporal pre-construction control than it did for fish populations.

General Results and Conclusion

Data was collected and analyzed using established biological methods in accordance with the Vermont Water Quality Standards (WQS) Appendix G. All data was evaluated by DEC aquatic biologists and assessments of ecological health made that correspond to three levels of water classes: A1 (excellent), B1 (very good) and B2 (good). All waters included in the study are classified as B2.

Both macroinvertebrate and fish communities demonstrated annual variations in density - a common phenomenon in small higher gradient streams- which were likely related to the number and severity of annual high precipitation and snow melt driven discharge events. For most sites this variation resulted in shifting assessments through the period without respect to pre-post construction timing. The exception to this was the East Branch of the Missisquoi River site (WQM 103), which scored the same assessment level all five years for both fish and macroinvertebrate communities (Table 1).

All sites except McCleary Brook supported a combination of typical cold headwater fish species: Brook Trout, Blacknose Dace, and less frequently, Slimy Sculpin and Creek Chub (Table 2). The McCleary Brook site contained only Brook Trout, which is common for small, cold, headwater streams. Most sites supported low densities of fish throughout the period. The exception was the upper East Branch of the Missisquoi River (WQM103) which supported high numbers of Brook Trout throughout the five years. Cold water index of biotic integrity (CWIBI) scores generally exceeded Class B2 criteria (Table 3). Brook trout population estimates are presented in Table 4.

Population densities of macroinvertebrates in the study streams were relatively low and variable as would be expected in small, lightly-buffered, coldwater drainages. This was illustrated by a prevalence of high percent model affinity values, which depict the taxonomic similarity to the expected assemblage in unimpaired streams of this type.

In summary, the six years of biological evaluations for fish and macroinvertebrate populations in streams draining the project area failed to show any significant impacts that could be attributed to the project construction or operation.

Site Summaries for Fish and Macroinvertebrates

Truland Brook RM 0.7 (WQM105 -spatial control) - All five annual fish community assessments were *poor* due to very low Brook Trout densities as well as total densities (Tables 1-5). The highest densities, while still comparatively low, were observed in 2015 for total and Brook Trout first electrofishing pass numbers/100 meters² and YOY population estimates. If any 5-year trend was to be discerned in using Truland Brook as a reference, it was slightly upward through the five-year period with the fish CWIBI values ranging from 12 out of 45 (*poor*) in 2011 to 21 (*poor*) in 2015. Macroinvertebrate assessments barely achieved Class B2 criteria in 2011 and 2013, and ranged from *very good-good* to *excellent-very good* for 2012, 2014 and 2015 (Table 5).

McCleary Brook RM 2.0 (WQM15) - With the exception of 2011, this Brook Trout-only stream met Class B2 WQS annually by supporting modest densities comprised of three size classes: YOY, <6 inches and 6-10 inches. During the first three years of macroinvertebrate monitoring (including the two pre-construction years) this reach was found to be "*fair or good-fair*" due to very low density, low richness and EPT, and a slightly elevated sample proportion of Oligochaeta (worms). In the period of 2013-2015, the percent of Oligochaeta dropped into the reference range and assessments increased to *very good-good*, *excellent* and *very good -good* respectively (Table 6) .

Shalney Branch 1.3 (WQM17) - Slimy Sculpins (an intolerant species) accompanied Brook Trout in this community resulting in a perfect CWIBI score of 45 out of 45 (*excellent*) in 2013, 2014 and 2015 and a *very good* score in 2012. The 2011 fish community sample was rated *poor* due to very low density. The macroinvertebrate community showed *very good - good* to *Excellent* assessments throughout the period without regard for pre-post project construction (Table 7).

Rogers Branch 1.0 (WQM12) - Only macroinvertebrates were monitored at this location. Assessments ranged from “*very-good to excellent*” for all years except 2011 when low density dictated a rating of “*good*”. No trend in assessment ratings was observed (Table 8).

“Lower” East Branch Missisquoi River 1.7 (WQM16) - Fish were not monitored at this site. This is the lowest sampled reach on the East Branch, and the only reach that was evaluated for macroinvertebrates using the “Medium High Gradient” (MHG) model criteria. The assessments for the two pre-construction years were *good* in 2010 and *fair-good* in 2011 (low density). In 2012 the density returned to a *good* rating as did the overall assessment. Assessments were *very good to good* for 2013 and 2014 and *very good* for 2015 (Table 9).

“Middle” East Branch of the Missisquoi 3.0 (WQM9) - This site is located on the valley floor, winding through agricultural land where bank erosion and scant riparian vegetation may have contributed to consistently low fish CWIBI scores of between 27 and 30 (*fair to good*). High numbers of the tolerant Blacknose Dace were responsible for depressing the CWIBI at this site. Macroinvertebrate density was low during the 2010 and 2011 temporal controls and for 2012 and 2013. Community assessments however, were *good to very good* for those years. With density improving in 2014 and 2015, assessments were “*excellent-very good*” for both years (Table 10).

“Upper” East Branch Missisquoi River 5.4 (WQM103) - Biological integrity of both communities was remarkably consistent throughout the study period, exceeding Class B2 WQS for aquatic biota. Fish CWIBI scores were consistently in the *very good* range throughout the study with CWIBI values ranging from 36-38. Very high Brook Trout density was also recorded during the last four years. Macroinvertebrate community integrity consistently rated in the *very good-good* range for all five years sampled (Table 11).

Ace Brook Sites. Both Ace Brook RM 0.6 and RM 0.7 sites are located in a low gradient alluvial fan produced by an abrupt transition from a high gradient reach to a relatively flat area downstream on the valley floor. The channels in both Ace Brook sites were over-widened and over 50% of banks showed an unstable condition. The unforeseen result of this was a sporadically changing physical habitat that placed stress on the aquatic biota. Under this dynamic habitat condition aquatic communities are prevented from becoming fully established and exhibiting population metrics of a healthy community. Additional stresses may have been present on the community from an increased sediment transport load that could have originated from a large, intensively logged area upstream. This effect coupled with the impact from the shifting channel location combined to influence the biological integrity of the fish and macroinvertebrate populations and are unrelated to GMP project construction.

Ace Brook 0.7 (WQM 101) - Both Ace Brook sites contained a greater proportion of eurythermal and tolerant species (Blacknose Dace and Creek Chub) than would be expected in an unimpaired population from a stream of this size and elevation. Except for 2015, fish densities were low throughout the period. The CWIBI ranged from 18 - 30 meeting the Class B2 criterion only once, with a *good* assessment in 2013. Macroinvertebrates showed a steady decline over the five monitored years with a *very good- good* assessment in 2011 eventually falling to *fair* in 2014 and 2015 (Table 16). Very low community density and moderately low richness and EPT taxa accounted for the lower assessments (Table 12).

Ace Brook 0.6 (WQM1) - Density of the Brook Trout at these two sites was lower than expected, resulting in *poor* fish community assessments during 2011, 2012, 2013, and 2014. The 2015 assessment unexpectedly rose to *very good*. The presence of water quality sensitive

macroinvertebrate taxa indicated a lack of enrichment nutrient stress or sediment stress at this site. The observed low densities might have been due to a moderate level of embeddedness, a moderate silt index, and a temporally mobile channel. Annual assessments varied more at this site than any other in the study ranging from *fair* to *excellent* throughout the period (Table 13).

East Branch Missisquoi River, Tributary 8, 0.2 (WQM5) - Fish were not monitored at this site. Macroinvertebrate community evaluations were *excellent-very good* and *very good* in the two pre-construction years and *very good-good* to *excellent* thereafter. Although the post-construction years 2013 and 2014 recorded the lowest assessments (*very good* to *good*), the 2015 sample rose to *very good* (Table 14).

East Branch Missisquoi River, Tributary 10, 0.1 (WQM8) - Fish were not monitored at this site. With the exception of 2012, when the macroinvertebrate community was rated as *fair* due to very low density, macroinvertebrate assessments ranged from *very good-good* to *excellent-very good* before and after project construction. In 2015, 8 of the 10 dominant taxa were considered water quality sensitive and the assessment was *very good* (Table 15).

Table 1. Biological Assessments of macroinvertebrate and fish assemblages. Shaded areas represent study controls in the form of a temporal, 1-2 years of pre-construction samples and a spatial control -Truland Brook. "Fair" and "poor" assessments represent non-compliance with Class B2 Water Quality Standards for aquatic biota. Sites are identified by the project site prefix "WQM..." followed by the two-digit river mile from the mouth which is located after the stream name.

	Pre-Construction			Construction and Operation							
	2010	2011		2012		2013		2014		2015	
	Macro.	Macro.	Fish	Macro.	Fish	Macro.	Fish	Macro.	Fish	Macro.	Fish
WQM 105 Truland Brook 0.7 (Control)	-	Good-fair	Poor	Very good-good	Poor	Good-fair	Poor	Very good	Poor	Very good	Poor
WQM 17 McCleary Bk. 2.0	Fair	Good-fair	Did <u>not</u> meet B2	Good-fair	Met Class B2	Very good-good	Met Class B2	Excellent	Met Class B2	Excellent	Met Class B2
WQM 15 Shalney Branch 1.3 Black River	Excellent	Very good-good	Poor	Very good	Very good	Very good	Excellent	Excellent	Excellent	Excellent-very good	Excellent
WQM 12 Rogers Branch 1.0 Black River	Excellent	Good	-	Very good	-	Excellent-very good	-	Excellent	-	Excellent-very good	-
WQM 103 Upper East Br. Missisquoi R. 5.4	-	Very good-good	Very good	Very good-good	Very good	Very good-good	Very Good	Very good good	Very good	Very good	Very good
WQM 9 Lower East Br, Missisquoi R. 3.0	Very good	Good	Fair	Very good	Good	Good	Good	Excellent-very good	Fair	Excellent-very good	Good
WQM 16 Lowest East Br. Missisquoi R.1.7	Good	Good-fair	-	Good	-	Good	-	Good	-	Very good	-
WQM 5 East Br. Missisquoi Trib. 8 0.2	Excellent-very good	Very good	-	Excellent	-	Very good-good	-	Very good-Good	-	Very good	-
WQM 8 East Br. Missisquoi Trib.10 0.1	Excellent-very good	Very good-good	-	Fair	-	Very good	-	Very good-Good	-	Very good	-
WQM 1 Ace Brook 0.6	Very good	Excellent	Poor	Very good-good	Poor	Fair	Poor	Excellent-very good	Poor	Very good-good	Very good
WQM 101 Ace Brook 0.7	-	Very good-good	Poor	Good	Fair	Good-fair	Good	Fair	Poor	Fair	Fair

Table 2. Fish Cold Water Index of Biotic Integrity (CWIBI) scores and associated assessments. Shaded area represents pre-construction and control stream. IBI Scores range from 9 (poor) to 45 (excellent). Scores over 29 meet Class B2 WQS for aquatic biota. Assessments in red fail to meet Class B Water Quality Standards.

	2011	2012	2013	2014	2015
WQM105 Truland Brook RM 0.7 (Control)	12 Poor	18 Poor	18 Poor	18 Poor	21 Poor
WQM17 Mc Cleary Brook RM 2.0*	Poor -Did not meet B2 WQS	Meets Class B2 WQS	Meets Class B2 WQS	Meets Class B2 WQS	Meets Class B2 WQS
WQM15 Shalney Branch – Black River RM 1.3	21 Poor	45 Very Good	45 Excellent	45 Excellent	45 Excellent
WQM103 Upper East Branch Missisquoi River RM 5.4	38 Very Good	36 Very Good	36 Very Good	38 Very Good	38 Very Good
WQM9 Lower East Branch Missisquoi River RM 3.0	27 Fair	30 Good	30 Good	27 Fair	30 Good
WQM1 Ace Brook RM 0.6	24 Poor	24 Poor	24 Poor	21 Poor	36 Very Good
WQM101 Ace Brook RM 0.7	18 Poor	30 Fair	30 Good	21 Poor	27 Fair

* Only a single fish species collected-no IBI could be calculated

Table 3. One-pass density values for Brook Trout and all species total. Also listed is species collected other than Brook Trout. Shaded areas represent spatial and temporal controls.

	Total fish community density in numbers/100m ² from a single electroshocking run					
	Species	2011	2012	2013	2014	2015
WQM105 Truland Bk. RM 0.7 (Control)	Brook Trout	1.2	1.0	1.5	0.8	3.1
	Blacknose Dace	<u>0.9</u>	<u>2.9</u>	<u>0.4</u>	<u>0.4</u>	<u>1.3</u>
	Total	2.1	3.9	1.9	1.2	4.4
WQ17 McCleary Brook RM 2.0	Brook Trout	<u>0.4</u>	<u>8.5</u>	<u>4.2</u>	<u>8.1</u>	<u>9.8</u>
	Total	0.4	8.5	4.2	8.1	9.8
WQM15 Shalney Branch Black River RM 1.3	Brook Trout	0.9	4.9	7.6	7.4	24.1
	Slimy Scullin	<u>1.1</u>	<u>2.2</u>	<u>2.5</u>	<u>6.1</u>	<u>6.1</u>
	Total	2.0	7.1	10.1	13.5	30.2
WQM103 Upper East Branch Missisquoi R. RM 5.4	Brook Trout	7.5	28.6	17.2	20.8	52.2
	Blacknose Dace	<u>7.5</u>	<u>31.8</u>	<u>18.3</u>	<u>17.8</u>	<u>49.0</u>
	Total	15.1	60.7	35.7	38.6	101.2
WQM9 Lower East Branch Missisquoi RM 3.0	Brook Trout	1.9	4.7	5.8	2.8	7.8
	Blacknose Dace	32.7	124.6	49.9	100.5	133.0
	Creek Chub	<u>0.0</u>	<u>0.7</u>	<u>0.0</u>	<u>0.0</u>	<u>0.6</u>
	Total	34.6	130.0	55.7	103.3	141.4
WQM1 Ace Brook RM 0.6	Brook Trout	0.7	4.7	1.3	2.0	7.0
	Blacknose Dace	18.0	124.0	15.7	37.0	8.3
	Creek Chub	<u>0.0</u>	<u>34.6</u>	<u>0.7</u>	<u>4.8</u>	<u>0.0</u>
	Total	18.7	163.4	17.7	43.8	15.3
WQM 101 Ace Brook RM 0.7	Brook Trout	0.9	4.4	5.3	2.6	3.6
	Blacknose Dace	8.0	4.4	4.4	3.1	46.5
	Creek Chub	0.3	2.2	2.6	0.0	1.6
	White Sucker	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.0</u>	<u>0.6</u>
	Total	9.2	11.0	12.3	5.7	52.3

Table 4. Brook Trout population estimates in #s/mile (in bold) by size class. 95% confidence intervals appear below estimates. When no confidence interval appears, the interval is 0. YOY=young of the year. Shaded areas represent temporal and spatial study controls.

		2011	2012	2013	2014	2015
WQM105 Truland Brook RM 0.7 (Control)	Total	170	157	167	101	151
	YOY	0	24 24-33	90 90-120	23 23-46	128 128-135
	<6 inches	78 78-95	121 121-195	64	34 34-40	12
	6-10 inches	92 92-106	12	13	45 45-57	0
WQM17 Mc Cleary Brook RM 2.0	Total	42	248	216	451	263
	YOY	42 42-84	191	98 98-118	314 275-463	22 22-75
	<6 inches	0	57	20	98	215 215-230
	6-10 inches	0	0	98 98-144	39 39-77	27
WQM15 Shalney Branch- Black River RM 1.3	Total	117	354	766	613	1241
	YOY	78 78-113	92 92-116	578 465-807	143 143-161	941 840-1094
	<6 inches	39 39-72	223 197-317	163	404 365-505	176 176-183
	6-10 inches	0	39	25	65 65-78	12
WQM103- Upper East Branch Missisquoi R. RM 5.4	Total	1033	2,053	1,222	2,044	2,923
	YOY	441 243-639	1,414 1,299-1,544	754 720-823	1296 770-2216	2,496 2372-2621
	<6 inches	441 418-502	468 457-504	400 332-560	549 525-582	289 289-309
	6-10 inches	151 151-166	171 171-188	57	199 199-211	139 139-163
WQM9 Lower East Branch Missisquoi River RM 3.0	Total	733	559	<i>No second pass made</i>	<i>No second pass made</i>	533
	YOY	76 76-102	424 300-724			388 365-449
	<6 inches	609 304-1455	114 114-137			118 118-135
	6-10 inches	48 48-70	21			0

WQM1 Ace Brook RM 0.6	Total	165	322	140	199	179
	YOY	62 62- 91	262 242-363	40	60 60-88	124 124-139
	<6 inches	62 62-114	60 60-89	60 60-127	119 119-284	55
	6-10 inches	21 21-51	0	40 40-79	20	0
WQM101 Ace Brook RM 0.7	Total	33	310	298	169	316
	YOY	19	41 41-139	64	21	226 226-279
	<6 inches	14	228 228-256	213 213-244	84 84-109	68
	6-10 inches	0	41 41-81	21	63 63-94	23

Table 5. Macroinvertebrate community summary metrics for the Truland Brook control site. Shaded areas represent spatial and temporal study controls.

Location: WQM105 Truland Brook RM 0.7 (Spatial Control)				Bio Site ID: 429304000007			Town: Lowell		Type: SHG
Date	Density	Richness	EPT Richness	PMA- Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2011	282	31.0	23.0	80.6	1.48	1.38	0.96	0.44	Good-Fair
2012	357	28.0	23.0	61.5	2.44	0.33	0.50	0.58	V. good-Good
2013	363	27.0	22.5	62.6	1.95	0.17	0.99	0.35	Good-Fair
2014	905	39.0	27.5	65.6	1.53	2.26	0.96	0.46	Exc.-V. good
2015	458	31.5	23.5	73.2	2.09	0.00	0.97	0.52	Very good
<i>Class B2 WQS</i>	350	≥ 28	≥ 17	≥ 50	≤ 4.35	≤ 9.5	≥ 0.47	≥ 0.45	(Good)

Table 6. Macroinvertebrate community summary metrics for the McCleary Branch- Missisquoi River RM 2.0.

Location:WQM15 McCleary Branch Missisquoi R. RM 2.0					Bio Site ID: 392200000020		Town: Lowell		Type: SHG
Date	Density	Richness	EPT Richness	PMA- Order	Biotic Index	Oligo.	EPT/ EPT + chiro	PPCS- Function	Community Assessment
2010	132	27.5	17.5	72.9	1.47	6.39	0.95	0.65	Fair
2011	273	29.5	23.5	83.5	1.96	8.86	0.95	0.62	Good-Fair
2012	271	32.5	25.5	79.2	1.55	0.71	0.49	0.56	Good-Fair
2013	368	35.0	22.0	72.5	1.05	0.31	0.93	0.47	V. good-Good
2014	606	38.5	25.5	82.7	1.84	0.00	0.94	0.53	Excellent
2015	332	38.0	25.0	72.5	1.20	0.66	0.93	0.52	V. good-Good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	(Good)

Table 7. Macroinvertebrate community summary metrics for the Shalney Branch -Missisquoi River RM 1.3.

Location: WQM17 Shalney Branch Missisquoi River RM 1.3					Bio Site ID: 392300000013		Town: Albany		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	576	40.0	27.0	69.7	2.13	1.17	0.98	0.59	Excellent
2011	443	28.0	21.0	70.8	2.26	0.12	0.98	0.46	V. good-Good
2012	417	31.0	23.0	77.1	1.71	0.00	0.99	0.60	Very good
2013	592	32.5	23.5	80.7	1.44	0.16	0.98	0.58	Very good
2014	1268	37.5	24.5	76.9	1.77	0.00	0.95	0.65	Excellent
2015	686	39.5	29.0	71.2	1.62	0.00	0.96	0.49	Exc.-V. good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	<i>(Good)</i>

Table 8. Macroinvertebrate community summary metrics for Rogers Branch- Missisquoi River RM 1.0.

Location: WQM12 Rogers Branch -Missisquoi River RM 1.0					Bio Site ID: 392400000010		Town: Albany		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	461	36.5	25.5	68.8	2.12	0.32	0.96	0.58	Excellent
2011	324	31.5	23.0	65.0	3.02	1.87	0.97	0.45	Good
2012	433	33.5	25.5	71.1	2.12	0.44	0.97	0.59	Very good
2013	373	37.5	24.5	85.2	1.90	0.72	0.88	0.58	Exc.-V. good
2014	917	38.5	24.0	77.7	1.40	3.41	0.94	0.63	Very good
2015	586	35.5	23.0	68.6	1.67	0.16	0.83	0.43	Exc.-V. good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	<i>(Good)</i>

Table 9. Macroinvertebrate community summary metrics for the East Branch - Missisquoi River RM 1.7.

Location: WQM16 East Branch- Missisquoi River RM 1.7					Bio Site ID: 429300000017		Town: Lowell		Type: MHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	520	35.5	22.0	64.2	1.78	1.74	0.98	0.52	Very Good
2011	278	36.5	23.5	69.1	2.38	5.56	0.92	0.53	Good-Fair
2012	340	41.0	24.5	74.6	2.31	1.19	0.84	0.42	Good
2013	348	40.0	25.5	72.7	2.18	1.24	0.96	0.57	V. good-Good
2014	636	36.0	23.5	79.0	1.83	1.81	0.94	0.54	V. good-Good
2015	1070	39.5	28.0	71.3	2.82	0.14	0.97	0.69	Very Good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	<i>(Good)</i>

Table 10. Macroinvertebrate community summary metrics for the East Branch - Missisquoi River RM 3.0.

Location: WQM9 East Branch Missisquoi River RM 3.0					Bio Site ID: 429300000030		Town: Lowell		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	391	30.5	23.0	61.5	2.34	0.51	1.00	0.49	Very Good
2011	332	34.5	24.0	65.4	2.27	0.16	0.89	0.43	Good
2012	395	34.0	21.5	91.9	1.95	0.00	0.84	0.54	Very Good
2013	336	32.0	22.0	82.3	2.69	1.52	0.93	0.49	Good
2014	1234	33.0	22.0	80.0	2.09	0.32	0.93	0.52	Exc.-V. good
2015	688	31.5	22.0	82.3	2.14	0.60	0.97	0.54	Exc.-V. good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	<i>(Good)</i>

Table 11. Macroinvertebrate community summary metrics for the East Branch- Missisquoi River RM 5.4.

Location: WQM103 East Branch Missisquoi River RM 5.4					Bio Site ID: 429300000054		Town: Lowell		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2011	353	33.0	23.0	71.7	1.34	1.00	0.87	0.47	V. good-Good
2012	351	33.5	22.0	65.9	1.52	1.03	0.92	0.49	V. good-Good
2013	397	29.5	20.0	57.6	1.18	0.95	0.94	0.41	V. good-Good
2014	397	34.5	22.0	53.9	1.16	0.80	0.94	0.37	V. good-Good
2015	395	35.0	24.0	57.7	1.26	4.79	0.95	0.44	V. good-Good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	<i>(Good)</i>

Table 12. Macroinvertebrate community metrics for Ace Brook RM 0.7.

Location: WQM101 Ace Brook RM 0.7					Bio Site ID: 429306000007		Town: Lowell		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2011	364	29.0	20.0	72.5	1.29	0.28	0.87	0.46	V. good-Good
2012	324	29.5	20.5	62.3	1.02	0.83	0.92	0.39	Good
2013	277	26.5	18.0	70.4	1.70	0.72	0.94	0.59	Good-Fair
2014	223	28.5	16.0	68.4	1.67	0.00	0.90	0.43	Fair
2015	192	32.0	18.0	71.7	2.97	0.52	0.55	0.59	Fair
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	<i>(Good)</i>

Table 13. Macroinvertebrate community metrics for Ace Brook Rm 0.6.

Location: WQM1 Ace Brook RM 0.6					Bio Site ID: 429306000006		Town: Lowell		Type: MHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	338	32.5	22.5	75.6	1.10	0.30	0.93	0.66	V. good-Good
2011	888	39.0	30.0	70.5	1.55	1.69	0.96	0.56	Excellent
2012	391	31.5	22.5	75.5	1.24	0.17	0.90	0.52	V. good-Good
2013	235	30.0	19.5	73.8	1.77	0.37	0.87	0.61	Fair
2014	627	34.0	21.0	77.1	1.65	0.97	0.92	0.58	Exc.-V. good
2015	359	37.5	21.5	75.1	1.86	0.49	0.77	0.62	V. good-Good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	(Good)

Table 14. Macroinvertebrate community summary metrics for East Branch Missisquoi. River - Tributary 8 RM 0.2

Location: WQM5 East Branch- Missisquoi River, Trib. 8 RM 0.2					Bio Site ID: 429308000002		Town: Albany		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	459	35.5	23.0	74.1	1.57	3.55	0.87	0.65	Exc.-V. Good
2011	390	35.0	25.0	81.6	1.56	1.43	0.87	0.56	Very Good
2012	660	30.5	21.0	74.9	1.88	0.48	0.74	0.49	Excellent
2013	334	32.5	22.0	75.2	1.51	4.04	0.89	0.53	V. good-Good
2014	361	33.5	20.5	84.9	1.67	3.57	0.83	0.60	V. good-Good
2015	411	38.5	25.0	83.7	1.73	0.81	0.88	0.66	Very good
<i>Class B2 WQS</i>	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	(Good)

Table 15. Macroinvertebrate community summary metrics for the East Branch Missisquoi River- Tributary 10 RM 0.1.

Location: WQM8 East Branch Missisquoi River, Trib. 10 RM0.1					Bio Site ID: 429310000001		Town: Lowell		Type: SHG
Date	Density	Richness	EPT Richness	PMA-Order	Biotic Index	Oligo.	EPT/ EPT + Chiro	PPCS- Function	Community Assessment
2010	468	32.5	23.5	76.7	1.43	0.43	0.89	0.53	Exc-V. good
2011	358	33.0	24.0	74.2	1.62	0.96	0.96	0.52	V. good-Good
2012	182	28.5	20.5	89.7	1.59	0.81	0.91	0.62	Fair
2013	396	33.0	22.0	73.9	1.16	1.07	0.95	0.50	Very good
2014	315	34.0	24.0	67.1	1.50	0.00	0.92	0.52	V. good-Good
2015	372	35.0	24.0	71.3	1.40	0.82	0.89	0.56	Very good

Class B2 WQS	≥ 300	≥ 27	≥ 16	≥ 45	≤ 4.5	≤ 12	≥ 0.45	≥ 0.4	(Good)
-----------------	------------	-----------	-----------	-----------	------------	-----------	-------------	------------	--------