Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 5.8 — Ambient Biomonitoring Summary Report — Town: Essex

Site ID 480000000058 — WBID: VT05-09

age Area (km2): 22 — Latitude: 44.51361 — Longitude 73.12778 — Elevation (ft): 270

Description: Located below Suzie Wilson Rd bridge.

Sample Date	6/16/1988	8/8/1989	10/16/1992	9/30/1993	9/23/1994	10/13/1999	10/2/2003	10/6/2008	9/20/2011
Event ID	1988-02	1989-10	1992-44	1993-71	1994-37	1999-33	2003-59	2008-53	2011-12
IBI Metrics	Val (Score)	Val (Score)	Val (Score)	Val (Score)	Val (Score)	Val (Score)	Val (Score)	Val (Score)	Val (Score)
Species Richness	6 (3)	10 (5)	6 (3)	5 (3)	7 (3)	10 (5)	7 (3)	6 (3)	5 (3)
# Intol. Species	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
# Benth. Insectivores	2 (3)	2 (5)	1 (3)	1 (5)	1 (3)	2 (5)	1 (3)	2 (5)	2 (5)
% Ck. Chub+Wt. Sucker	11.4 (3)	20.9 (3)	24.4 (3)	16.9 (3)	25.2 (3)	9.0 (5)	8.2 (5)	6.1 (5)	31.8 (1)
% Generalist Feeders	11.7 (5)	27.7 (5)	25.4 (5)	17.9 (5)	26.9 (5)	16.6 (5)	9.2 (5)	8.4 (5)	31.8 (3)
% Insectivores	88.3 (1)	70.4 (5)	74.6 (1)	82.1 (1)	73.1 (1)	83.4 (1)	90.8 (1)	91.6 (1)	68.2 (1)
% Top Carnivores	(5)	1.9 (5)	(5)	(5)	(5)	(5)	(5)	(3)	(5)
% Anomolies	.6 (5)	.0 (3)	6.4 (1)	.6 (5)	1.3 (3)	.4 (5)	1.7 (3)	.0 (5)	.0 (5)
Density (#/100m2)	118.0 (5)	170.4 (5)	82.7 (5)	81.9 (5)	142.2 (5)	161.4 (5)	106.3 (5)	15.2 (1)	28.3 (5)
Mixed Water Index of Biotic Integrity (MWIBI)	(33)	(35)	(27)	(33)	(31)	(37)	(31)	(29)	(29)
Community Assessment	Good	Good	Fair	Good	Fair	Good	Fair	Fair	Fair

IBI Scoring catagories	MWIBI	CWIBI
Excellent	41-45	42-45
Very Good	37	36
Good	33-35	33
Fair	27	27
Poor	< 27	< 27

Sample Date	6/16/1988	8/8/1989	10/16/1992	9/30/1993	9/23/1994	10/13/1999	10/2/2003	10/6/2008	9/20/2011
Species Collected	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)
Blacknose Dace	230 (74.7)	201 (54.6)	192 (67.8)	247 (77.4)	213 (70.8)	359 (78.4)	342 (84.7)	100 (76.3)	78 (60.5)
Bluntnose Minnow		19 (5.2)	2 (.7)		1 (.3)	9 (2.0)	2 (.5)	3 (2.3)	
Brook Stickleback						2 (.4)			
Common Shiner	1 (.3)	4 (1.1)			2 (.7)	15 (3.3)			
Creek Chub	28 (9.1)	58 (15.8)	68 (24.0)	53 (16.6)	72 (23.9)	37 (8.1)	29 (7.2)	7 (5.3)	39 (30.2)
Fathead Minnow			1 (.4)			5 (1.1)	2 (.5)		
Finescale Dace							1 (.2)		
Golden Shiner		2 (.5)							
Longnose Dace	41 (13.3)	56 (15.2)	19 (6.7)	15 (4.7)	7 (2.3)	18 (3.9)	24 (5.9)	17 (13.0)	7 (5.4)
Redbelly Dace				3 (.9)	2 (.7)	6 (1.3)			
Rockbass		6 (1.6)							
Smallmouth Bass		1 (.3)							
Tessellated Darter	1 (.3)	2 (.5)				3 (.7)		3 (2.3)	3 (2.3)
White Sucker	7 (2.3)	19 (5.2)	1 (.4)	1 (.3)	4 (1.3)	4 (.9)	4 (1.0)	1 (.8)	2 (1.6)

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 5.8 Ambient Biomonitoring Summary Report Town: Essex

Site ID 480000000058 WBID: VT05-09

Drainage Area (km2): 22 Latitude: 44.51361 Longitude 73.12778 Elevation (ft): 270

Description: Located below Suzie Wilson Rd bridge.

Sample Date	9/29/1992	9/29/1993	10/12/1999	9/15/2003	10/1/2004	10/6/2008	9/20/2011
Lab ID	1992.052	1993.099	1999.193	2003.063	2004.137	2008.084	2011.025
Sampling Method	KN	KN	KN	KN	KN	KN	KN
* Density/Unit	1986	1980	2532	4284	594	2606	4264
* Species Richness	27.5	27.5	35	36.5	30	39.5	38.5
* EPT Richness	10	10	12	6.5	9	11.5	11.5
EPT/Richness	0.37	0.36	0.34	0.18	0.3	0.29	0.3
E / P / T Richness	4 / 3 / 7	2 / 5 / 7	1 / 5 / 7	1 / 2 / 5	0 / 3 / 8	2 / 8 / 5	5 / 10 / 2
* EPT / EPTChiro	0.97	0.96	0.95	0.83	0.58	0.84	0.96
BI (0-5)	2.83	2.76	2.08	3.31	2.56	2.88	3.05
* BI (0-10)	5.27	5.05	3.45	5.81	4.73	5.23	5.54
Diversity	3.28	3.6	2.66	3.14	3.69	3.92	3.35
Hydopsy %	55.17	51.51	4.9	60.84	27.1	49.88	63.82
Dominant Taxa %	23.9	20.4	58.5	48.3	28.6	26.4	27.1
Dominant 3 Taxa %	60.9	55.5	74.1	63.4	47.7	53.4	61.7
Coleoptera %	11.9	8.2	6	8.4	0.6	16.4	18.3
Diptera %	6.5	15	7.7	24.7	59.9	19.4	8.5
Ephemeroptera %	2.6	1	0.2	0.3	0	0.5	0.4
Trichoptera %	77.4	72.5	16.4	65.6	29	58.4	70
Plecoptera %	0.2	2.6	64.1	0.6	10.1	2.3	0
* Oligochaeta %	0	0.5	4.9	0	0.3	1.1	0.7
OtherOrders %	1.4	0.3	0.6	0.4	0.1	1.8	2.1
* PMA-O1	52	56.7	40.3	54.3	49.9	60.7	53.6
Collector Gatherer %	4.8	5.9	8.1	15	14.7	11.8	5.4
Collector Filterer %	78.2	72.1	18.2	67.7	55.5	57.1	71.7
Predator %	2.3	10.1	6.8	6.1	5	10	2.2
Shredder - Detritus %	0.1	0.4	1.7	0.1	1.1	0.3	0
Shredder - Herbivore %	0.2	1.7	59.1	2.9	23	3.2	0.6
Scraper %	11.9	9.3	5.8	8.3	0.7	17.6	20
* PPCS-F1	0.28	0.4	0.51	0.51	0.48	0.58	0.35
Community Assessmt	F-Poor	F-Poor	Fair	Poor	F-Poor	Fair	Fair

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 7.0 Ambient Biomonitoring Summary Report Town: Essex

Site ID 480000000070 WBID: VT05-09

inage Area (km2): 21 Latitude: 44.50750 Longitude 73.11889 Elevation (ft): 318

Description: Downstream of Pinecrest Drive 100m.

Sample Date	10/4/2006	9/20/2011
Lab ID	2006.117	2011.026
Sampling Method	SW	SW
* Density/Unit	3660	236
* Species Richness	53.5	49
* EPT Richness	7	6
EPT/Richness	0.13	0.12
E / P / T Richness	2 / 1 / 7	1 / 0 / 5
* EPT / EPTChiro	0.58	0.38
BI (0-5)	2.96	2.66
* BI (0-10)	5.91	5.58
Diversity	3.76	4.32
Hydopsy %	48.51	12.29
Dominant Taxa %	39.2	21.6
Dominant 3 Taxa %	56.2	46.2
Coleoptera %	1.9	1.7
[illegible]tera %	42.4	40.3
[illegible]emeroptera %	0.2	4.2
Trichoptera %	48.9	18.6
Plecoptera %	0.3	0
* Oligochaeta %	3.3	2.1
OtherOrders %	3	33.1
* PMA-O1		
Collector Gatherer %	20.7	19.5
Collector Filterer %	62.9	15.7
Predator %	10.2	57.6
Shredder - Detritus %	2.5	2.1
Shredder - Herbivore %	2.8	4.7
Scraper %	0.7	0
* PPCS-F1		
Community Assessmt		Fair

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 8.5 — Ambient Biomonitoring Summary Report — Town: Essex

Site ID 480000000085 — WBID: VT05-09

Drainage Area (km2): 13.2 — Latitude: 44.49472 — Longitude 73.10583 — Elevation (ft): 320

Description: Located above bridge near High School.

Sample Date	10/16/1992	7/17/1996	10/8/2002	10/12/2004	10/13/2009
Event ID	1992-45	1996-03	2002-43	2004-41	2009-65
IBI Metrics	Val (Score)	Val (Score)	Val (Score)	Val (Score)	Val (Score)
Species Richness	11 (5)	10 (5)	11 (5)	10 (5)	9 (5)
# Intol. Species	(1)	(1)	(1)	(1)	(1)
# Benth. Insectivores	2 (5)	2 (5)	2 (5)	2 (5)	2 (5)
% Ck. Chub+Wt. Sucker	40.3 (1)	13.2 (3)	35.5 (1)	28.8 (3)	32.6 (3)
% Generalist Feeders	61.7 (1)	29.1 (5)	43.7 (3)	36.0 (3)	40.9 (3)
% Insectivores	38.3 (3)	70.9 (5)	56.3 (5)	64.0 (5)	59.1 (5)
% Top Carnivores	(5)	(5)	(5)	(5)	(5)
% Anomolies	.6 (5)	.0 (5)	.0 (5)	.0 (5)	.0 (5)
Density (#/100m2)	114.3 (5)	131.6 (5)	49.6 (5)	111.1 (5)	140.7 (5)
Mixed Water Index of Biotic Integrity (MWIBI)	(31)	(37)	(33)	(37)	(37)
Community Assessment	Fair		Good		Good

IBI Scoring catagories	MWIBI	CWIBI
Excellent	41-45	42-45
Very Good	37	36
Good	33-35	33
Fair	27	27
Poor	< 27	< 27

Sample Date	10/16/1992	7/17/1996	10/8/2002	10/12/2004	10/13/2009
Species Collected	Number (%)	Number (%)	Number (%)	Number (%)	Number (%)
Blacknose Dace	85 (23.6)	149 (50.3)	69 (37.7)	176 (48.4)	151 (37.8)
Bluntnose Minnow	10 (2.8)	7 (2.4)	2 (1.1)	8 (2.2)	9 (2.3)
Brook Stickleback	7 (1.9)	2 (.7)	2 (1.1)	6 (1.6)	
Common Shiner	51 (14.2)	38 (12.8)	11 (6.0)	17 (4.7)	21 (5.3)
Creek Chub	69 (19.2)	35 (11.8)	29 (15.8)	92 (25.3)	96 (24.1)
Fathead Minnow	9 (2.5)		2 (1.1)	1 (.3)	3 (.8)
Finescale Dace			1 (.5)		
Longnose Dace	34 (9.4)	38 (12.8)	18 (9.8)	28 (7.7)	50 (12.5)
Mudminnow		2 (.7)			
Pumpkinseed	1 (.3)	7 (2.4)	11 (6.0)	8 (2.2)	2 (.5)
Redbelly Dace	7 (1.9)				
Tessellated Darter	11 (3.1)	14 (4.7)	2 (1.1)	15 (4.1)	33 (8.3)
White Sucker	76 (21.1)	4 (1.4)	36 (19.7)	13 (3.6)	34 (8.5)

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 8.5 Ambient Biomonitoring Summary Report Town: Essex

Site ID 480000000085 WBID: VT05-09

inage Area (km2): 13.2 Latitude: 44.49472 Longitude 73.10583 Elevation (ft): 320

Description: Located above bridge near High School.

Sample Date	9/30/1993	10/8/2002	10/13/2009	9/20/2011
Lab ID	1993.100	2002.107	2009.121	2011.027
Sampling Method	KN	KN	KN	KN
* Density/Unit	816	758	1940	2884
* Species Richness	32.5	34.5	28	39
* EPT Richness	9.5	8	8	8
EPT/Richness	0.29	0.23	0.29	0.2
E / P / T Richness	4 / 2 / 5	3 / 2 / 6	1 / 2 / 5	3 / 2 / 3
* EPT / EPTChiro	0.57	0.37	0.93	0.87
BI (0-5)	2.94	2.89	2.74	2.78
* BI (0-10)	5.8	5.2	4.89	5.25
Diversity	4.05	3.62	3.29	3.35
Hydopsy %	37.24	3.88	46.19	56.87
Dominant Taxa %	18.5	29	32.8	37
Dominant 3 Taxa %	45.5	56.6	61	61.3
Coleoptera %	5.2	4.9	21.2	24.7
Diptera %	39.9	55.5	18.6	13.5
Ephemeroptera %	3.3	0.9	0.4	0.6
Trichoptera %	46.4	4.8	47.8	57
Plecoptera %	0.3	21.4	9.9	0.3
* Oligochaeta %	3.1	11.5	0.8	0.4
OtherOrders %	1.8	1	1.2	3.6
* PMA-O1	54.7	33.6	66.2	58.2
Collector Gatherer %	16	24.4	10.5	7.6
Collector Filterer %	46.7	12.8	47	57.8
Predator %	21.2	7.8	7.4	5.5
Shredder - Detritus %	1.2	2.8	0.8	0.4
Shredder - Herbivore %	6.7	49	10.9	2.1
Scraper %	5.7	2.8	22.9	26.5
* PPCS-F1	0.57	0.5	0.67	0.54
Community Assessmt	F-Poor	F-Poor	Poor	F-Poor

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 9.0 Ambient Biomonitoring Summary Report Town: Essex

Site ID 480000000090 WBID: VT05-09

nage Area (km2): 11 Latitude: 44.49472 Longitude 73.09611 Elevation (ft): 330

Description: Located below falls as local recreation trail crosses stream. Off 47 Fairview Rd.

Sample Date	10/8/2002	9/15/2003	10/7/2004
Lab ID	2002.108	2003.064	2004.156
Sampling Method	KN	KN	KN
* Density/Unit	2094	2928	1454
* Species Richness	39.5	43	35
* EPT Richness	14	11	13.5
EPT/Richness	0.35	0.26	0.38
E / P / T Richness	2 / 4 / 9	2 / 3 / 6	3 / 5 / 6
* EPT / EPTChiro	0.92	0.71	0.95
BI (0-5)	2.29	2.92	2.46
* BI (0-10)	4	5.31	4.29
Diversity	3.78	3.93	3.48
Hydopsy %	15.51	47.95	37.94
Dominant Taxa %	34.7	27.9	32
Dominant 3 Taxa %	53.9	52.7	61.3
Coleoptera %	17.2	14.3	9.4
Diptera %	12	29.4	13.9
Ephemeroptera %	8.4	1.4	1.2
Trichoptera %	24.2	48.4	38.6
Plecoptera %	35.4	3.3	36.2
* Oligochaeta %	0	0	0
OtherOrders %	2.8	3.3	0.7
* PMA-O1	65.5	61.6	62.8
Collector Gatherer %	4.2	21.6	5.6
Collector Filterer %	24.3	50	41.8
Predator %	9.4	10.5	9.1
Shredder - Detritus %	0.4	0.8	0.6
Shredder - Herbivore %	34.5	1.8	32.2
Scraper %	18.7	15	9.8
* PPCS-F1	0.46	0.64	0.46
Community Assessmt	G-Fair	Fair	G-Fair

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 9.5 Ambient Biomonitoring Summary Report Town: Essex

Site ID 480000000095 WBID: VT05-09

inage Area (km2): 10.25 Latitude: 44.50000 Longitude 73.09278 Elevation (ft): 340

Description: Located above Hubble Falls road crossing 1/4mi. Above large beaver pond. Access next to new house #11. Or parknear 28t Juniper Ridge Rd

Sample Date	10/12/1995	10/8/2002
Event ID	1995-41	2002-45
IBI Metrics	Val (Score)	Val (Score)
Species Richness	4 (3)	6 (3)
# Intol. Species	(1)	(1)
# Benth. Insectivores	1 (1)	1 (5)
% Ck. Chub+Wt. Sucker	27.3 (3)	5.1 (5)
% Generalist Feeders	28.3 (5)	36.0 (3)
% Insectivores	71.7 (1)	64.0 (5)
% Top Carnivores	(5)	(5)
% Anomolies	1.0 (3)	.0 (5)
Density (#/100m2)	45.6 (5)	43.1 (5)
Mixed Water Index of Biotic Integrity (MWIBI)	(27)	(35)
Community Assessment		Good

IBI Scoring catagories	MWIBI	CWIBI
Excellent	41-45	42-45
Very Good	37	36
Good	33-35	33
Fair	27	27
Poor	< 27	< 27

ple Date	10/12/1995	10/8/2002
pecies Collected	Number (%)	Number (%)
Blacknose Dace	70 (70.7)	80 (58.8)
Common Shiner	1 (1.0)	41 (30.1)
Creek Chub	27 (27.3)	
Fathead Minnow		1 (.7)
Longnose Dace	1 (1.0)	3 (2.2)
Pumpkinseed		4 (2.9)
White Sucker		7 (5.1)

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Indian Brook 9.5 Ambient Biomonitoring Summary Report Town: Essex

Site ID 480000000095 WBID: VT05-09

nage Area (km2): 10.25 Latitude: 44.50000 Longitude 73.09278 Elevation (ft): 340

Description: Located above Hubble Falls road crossing 1/4mi. Above large beaver pond. Access next to new house #11. Or parknear 28t Juniper Ridge Rd walk back to field then to stream.

Sample Date	10/12/1995	10/1/1996	10/8/2002	9/20/2011
Lab ID	1995.071	1996.087	2002.109	2011.028
Sampling Method	KN	KN	KN	KN
* Density/Unit	1527	1098	1336	2770
* Species Richness	48.5	43	41	39
* EPT Richness	24.5	15	11	12
EPT/Richness	0.5	0.35	0.26	0.31
E / P / T Richness	5 / 5 / 18	3 / 4 / 10	1 / 6 / 5	8 / 3 / 5
* EPT / EPTChiro	0.89	0.79	0.66	0.95
BI (0-5)	2.23	2.5	2.35	2.42
* BI (0-10)	4.06	4.64	4.41	4.49
Diversity	4.29	4.66	4.43	3.25
Hydopsy %	12.46	23.89	18.97	27.89
Dominant Taxa %	24.1	12.8	15.9	38.3
Dominant 3 Taxa %	44.8	29.7	35.9	66.6
Coleoptera %	8.3	16.9	20.2	16.2
D[illegible]tera %	13.9	21.3	31.4	6.3
E[illegible]emeroptera %	33.9	18.8	0.2	8.5
Trichoptera %	33.6	35.7	29.2	64.7
Plecoptera %	7.7	1.8	11.2	0.2
* Oligochaeta %	0.5	0.5	0.2	0.9
OtherOrders %	2.1	5	7.7	3.1
* PMA-O1	87.9	78.1	62.9	59.2
Collector Gatherer %	9.7	11.7	8.1	8.3
Collector Filterer %	28.1	34.5	33.6	66
Predator %	12.3	14.1	27.1	4.3
Shredder - Detritus %	5.6	2.1	7.9	0.6
Shredder - Herbivore %	2	0.3	4.1	0.5
Scraper %	14.4	23.9	19.2	20.1
* PPCS-F1	0.61	0.59	0.58	0.45
Community Assessmt	Exc	G-Fair	Fair	Fair

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation SIZE 3.5 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 3.2 | Ambient Biomonitoring Summary Report | Town: Colchester

Site ID 490200000032 | WBID: VT08-02

Drainage Area (km2): 8.2 | Latitude: 44.52256 | Longitude 73.17498 | Elevation (ft): 145

Description: Located immediately below Sunnyside Brook, below Rt 2 crossing.

Sample Date	10/10/2008	9/21/2011
Lab ID	2008.540	2011.029
Sampling Method	SW	SW
* Density/Unit	106	1240
* Species Richness	23	53
* EPT Richness	4	14
EPT/Richness		0.26
E / P / T Richness	2 / 0 / 2	4 / 4 / 6
* EPT / EPTChiro	0.09	0.55
BI (0-5)	3.39	2.54
* BI (0-10)	7.09	5.1
Diversity	3.5	4.93
Hydopsy %	0.94	15.16
Dominant Taxa %	28.3	13.5
Dominant 3 Taxa %	56.6	29.4
Coleoptera %	15.1	12.9
Diptera %	41.5	50.3
Ephemeroptera %	1.9	4.5
Trichoptera %	1.9	17.4
Plecoptera %	0	3.9
* Oligochaeta %	29.2	0.3
OtherOrders %	10.4	10.6
* PMA-O1		
Collector Gatherer %	55.7	13.9
Collector Filterer %	6.6	31.9
Predator %	25.5	24.8
Shredder - Detritus %	0	14.5
Shredder - Herbivore %	4.7	5.8
Scraper %	1.9	7.4
* PPCS-F1		
Community Assessmt		Good

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 3.3 — Ambient Biomonitoring Summary Report — Town: Colchester

Site ID 490200000033 — WBID: VT08-02

Drainage Area (km2): 5.1 — Latitude: 44.52222 — Longitude 73.17333 — Elevation (ft): 150

Description: Located just below Route 7 culvert, above Sunnyside Tributary.

Sample Date	7/19/1988	9/13/1993	10/1/2002
Event ID	1988-10	1993-57	2002-37
IBI Metrics	Val (Score)	Val (Score)	Val (Score)
Species Richness	6 (5)	14 (5)	
# Intol. Species	(1)	(1)	
# Benth. Insectivores	(1)	(1)	
% Ck. Chub+Wt. Sucker	3.4 (5)	60.3 (1)	
% Generalist Feeders	13.8 (5)	84.5 (1)	
% Insectivores	79.3 (1)	14.6 (1)	
% Top Carnivores	(5)	(5)	
% Anomolies	.0 (5)	.0 (5)	
Density (#/100m2)	17.0 (1)	265.6 (5)	
Mixed Water Index of Biotic Integrity (MWIBI)	(29)	(25)	
Community Assessment			

IBI Scoring catagories	MWIBI	CWIBI
Excellent	41-45	42-45
Very Good	37	36
Good	33-35	33
Fair	27	27
Poor	< 27	< 27

Sample Date	7/19/1988	9/13/1993	10/1/2002
Species Collected	Number (%)	Number (%)	Number (%)
Blacknose Dace	19 (65.5)	26 (10.9)	24 (11.4)
Bluntnose Minnow		5 (2.1)	33 (15.7)
Brook Stickleback		4 (1.7)	
Brown Bullhead		2 (.8)	1 (.5)
Common Shiner		13 (5.4)	14 (6.7)
Creek Chub	1 (3.4)	138 (57.7)	71 (33.8)
Fallfish		3 (1.3)	1 (.5)
Fathead Minnow	1 (3.4)	20 (8.4)	49 (23.3)
Finescale Dace	4 (13.8)		1 (.5)
Mudminnow		1 (.4)	
Pumpkinseed		5 (2.1)	5 (2.4)
Redbelly Dace	2 (6.9)	14 (5.9)	4 (1.9)
Sea Lamprey	2 (6.9)	1 (.4)	3 (1.4)
Silver Lamprey			2 (1.0)
Unidentified Cyprinid		1 (.4)	
White Sucker		6 (2.5)	2 (1.0)

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 3.3 Ambient Biomonitoring Summary Report Town: Colchester

Site ID 490200000033 WBID: VT08-02

Drainage Area (km2): 5.1 Latitude: 44.52222 Longitude 73.17333 Elevation (ft): 150

Description: Located just below Route 7 culvert, above Sunnyside Tributary.

Sample Date	10/17/2003	10/31/2005	10/2/2006	10/10/2008
Lab ID	2003.142	2005.139	2006.106	2008.541
Sampling Method	SW	SW	SW	SW
* Density/Unit	1128	559	305	67
* Species Richness	40	53	54	17
* EPT Richness	4	9	10	4
EPT/Richness	0.1	0.17	0.18	
E / P / T Richness	0 / 1 / 3	4 / 1 / 5	4 / 1 / 5	2 / 1 / 1
* EPT / EPTChiro	0.28	0.43	0.54	0.33
BI (0-5)	2.77	2.41	2.47	2.91
* BI (0-10)	5.56	4.66	4.6	5.61
Diversity	4.53	4.61	4.62	3.35
Hydopsy %	0	0.24	0	0
Dominant Taxa %	18.2	14.3	15.4	29.9
Dominant 3 Taxa %	40.7	32.7	37.4	56.7
Coleoptera %	3.3	5.7	15.7	17.9
Diptera %	63.5	53.5	33.1	32.8
Ephemeroptera %	10.9	20.8	13.1	11.9
Trichoptera %	7	3.6	3.6	3
Plecoptera %	1.8	7.6	14.4	1.5
* Oligochaeta %	9.7	5.3	1.3	0
OtherOrders %	3.6	3.6	18.7	32.8
* PMA-O1				
Collector Gatherer %	24	41.8	30.5	29.9
Collector Filterer %	11.2	10.5	3.9	1.5
Predator %	41.3	30.3	38	55.2
Shredder - Detritus %	7.6	3.6	5.9	1.5
Shredder - Herbivore %	4.6	8.6	15.4	3
Scraper %	0.3	5.3	3	3
* PPCS-F1				
Community Assessmt			Good	

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 3.5 IMPAIRED Ambient Biomonitoring Summary Report Town: Colchester

Site ID 490200000035 UPSTREAM OF THIS POINT WBID: VT08-02

Drainage Area (km2): 4.8 Latitude: 44.52083 Longitude 73.16917 Elevation (ft): 160

Description: Located above Route 7 crossing about 1/4mi within a falls area between two wetlands where the stream winds.

Sample Date	10/12/1995	10/17/2002	9/21/2011
Lab ID	1995.072	2002.124	2011.030
Sampling Method	KN	KN	KN
* Density/Unit	1636	1956	2816
* Species Richness	25.5	37	36
* EPT Richness	8.5	9	11
EPT/Richness	0.33	0.24	0.3
E / P / T Richness	4 / 2 / 5	3 / 1 / 5	2 / 4 / 5
* EPT / EPTChiro	0.93	0.7	0.9
BI (0-5)	2.75	2.91	2.45
* BI (0-10)	4.99	4.99	4.63
Diversity	3.29	4.03	3.18
Hydopsy %	35.34	26.79	23.44
Dominant Taxa %	32.6	23.7	32.8
Dominant 3 Taxa %	61.2	48.5	69.5
Coleoptera %	8.9	11.5	5.7
Diptera %	12.4	35	34.8
Ephemeroptera %	3.7	2.5	1.4
Trichoptera %	68	45.4	56.3
Plecoptera %	1.1	0.6	0.6
* Oligochaeta %	5.1	0.4	0.3
OtherOrders %	0.8	4.7	1
* PMA-O1	58.2	59.9	53
Collector Gatherer %	12.1	21.1	8.7
Collector Filterer %	71.6	48.9	82.5
Predator %	3.4	13.1	1.3
Shredder - Detritus %	0.4	3.1	1.7
Shredder - Herbivore %	0.9	4.1	1.1
Scraper %	8.6	8.4	4.7
* PPCS-F1	0.39	0.68	0.38
Community Assessmt	Fair		G-Fair

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 4.6 Ambient Biomonitoring Summary Report Town: Colchester

Site ID 490200000046 WBID: VT08-02

Drainage Area (km2): 3.9 Latitude: 44.51389 Longitude 73.15750 Elevation (ft): 250

Description: Located 100m below Trib 13 (Ethan Allen trib), just above tributary 12.

Sample Date	10/6/2010
Event ID	2010-54
IBI Metrics	Val (Score)
Species Richness	4 (3)
# Intol. Species	(1)
# Benth. Insectivores	(1)
% Ck. Chub+Wt. Sucker	(5)
% Generalist Feeders	21.4 (5)
% Insectivores	78.6 (1)
% Top Carnivores	(5)
% Anomolies	.0 (5)
Density (#/100m2)	35.0 (5)
Mixed Water Index of Biotic Integrity (MWIBI)	(31)
Community Assessment	

IBI Scoring catagories	MWIBI	CWIBI
Excellent	41-45	42-45
Very Good	37	36
Good	33-35	33
Fair	27	27
Poor	< 27	< 27

Sample Date	10/6/2010
Species Collected	Number (%)
Blacknose Dace	9 (64.3)
Brook Stickleback	2 (14.3)
Fathead Minnow	2 (14.3)
Redbelly Dace	1 (7.1)

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 4.6 Ambient Biomonitoring Summary Report Town: Colchester

Site ID 490200000046 WBID: VT08-02

Drainage Area (km2): 3.9 Latitude: 44.51389 Longitude 73.15750 Elevation (ft): 250

Description: Located 100m below Trib 13 (Ethan Allen trib), just above tributary 12.

Sample Date	10/12/2005	10/2/2006	10/13/2009	10/5/2010	9/21/2011
Lab ID	2005.127	2006.103	2009.116	2010.116	2011.032
Sampling Method	SW	SW	SW	SW	SW
* Density/Unit	305	1580	610	1056	2244
* Species Richness	24	42	41	54	44
* EPT Richness	5	6	5	8	8
EPT/Richness	0.21	0.14	0.12		0.18
E / P / T Richness	2 / 0 / 3	2 / 0 / 4	2 / 0 / 3	2 / 0 / 6	2 / 1 / 5
* EPT / EPTChiro		0.33	0.14	0.63	0.53
BI (0-5)	3.81	3.4	3.23	3.18	2.83
* BI (0-10)	7.34	6.57	6.33	6.15	5.62
Diversity	3.62	3.73	3.3	4.06	3.61
Hydopsy %	0.56	21.01	8.2	33.33	37.08
Dominant Taxa %	19.7	26.3	48.2	30.7	26.4
Dominant 3 Taxa %	50	59.7	65.6	52.5	62.6
Coleoptera %	2.8	1.3	2	3	3.9
Diptera %	0	49.6	63.9	32.4	46.5
Ephemeroptera %	5.6	0.8	0.7	2.8	0.9
Trichoptera %	1.7	22	8.9	35.6	40.6
Plecoptera %	0	0	0	0	0.2
* Oligochaeta %	0	0	2.3	8	5.2
OtherOrders %	89.9	26.3	22.3	18.2	2.7
* PMA-O1					
Collector Gatherer %	24.2	29.6	20.7	27.1	14.1
Collector Filterer %	46.1	33.9	16.1	48.5	45.5
Predator %	16.9	33.7	56.1	19.1	32.4
Shredder - Detritus %	0	0.5	0.7	1.1	5
Shredder - Herbivore %	0	1	4.3	0.2	2.7
Scraper %	11.8	1	0.7	0.4	0
* PPCS-F1					
Community Assessmt		G-Fair			

*** = Most important metrics**

Water Quality Division - VT Dept. of Environmental Conservation 5/16/2013

Biomonitoring and Aquatic Studies Section

Sunderland Brook 5.3 — Ambient Biomonitoring Summary Report — Town: Colchester

Site ID 490200000053 — WBID: VT08-02

Drainage Area (km2): 1 — Latitude: 44.50833 — Longitude 73.14500 — Elevation (ft): 277

Description: Located above confluence with Trib 15, a tributary (or branch) entering Sunderland Brook from the north.

Sample Date	10/10/2002	10/17/2003	10/20/2004	10/12/2005	10/2/2006	10/10/2008
Lab ID	2002.115	2003.140	2004.182	2005.129	2006.105	2008.542
Sampling Method	SW	SW	SW	SW	SW	SW
* Density/Unit	939	814	1288	314	2148	30
* Species Richness	32	32	28	14		9
* EPT Richness	6	6	5	5		2
EPT/Richness	0.19	0.19	0.18	0.36		
E / P / T Richness	1 / 0 / 5	2 / 0 / 4	0 / 0 / 5	2 / 0 / 3		0 / 0 / 2
* EPT / EPTChiro	0.22	0.12	0.15		0.25	0.27
BI (0-5)	3.84	3.5	4.06	4.59	3.58	3.67
* BI (0-10)	6.93	6.61	7.04	7.68	6.65	6.83
Diversity	3.13	3.43	2.35	1.37	3.93	2.73
Hydopsy %	0.64	0.88	2.48	0	7.08	6.67
Dominant Taxa %	36.7	32.4	53.7	80.6	21.2	26.7
Dominant 3 Taxa %	72.8	64	82	91.8	52	66.7
Coleoptera %	1	2.4	0.6	1.8	8.8	0
Diptera %	28.8	55.5	36.3	0	28.3	43.3
Ephemeroptera %	1	0.9	0	4.7	0.6	0
Trichoptera %	6.4	5	5.3	4.7	7.4	10
Plecoptera %	0	0	0	0	0.2	0
* Oligochaeta %	0	0.6	1.2	0	3	0
OtherOrders %	62.9	35.7	56.5	88.8	51.8	46.7
* PMA-O1						
Collector Gatherer %	59.7	31.6	59	86.5	37.6	50
Collector Filterer %	6.4	11.5	6.8	4.1	18.8	6.7
Predator %	31.3	48.4	29.5	7.6	25.3	30
Shredder - Detritus %	1.9	7.4	4.3	0.6	3	13.3
Shredder - Herbivore %	0	0	0.3	0	0.2	0
Scraper %	0.3	0	0	0	0.2	0
* PPCS-F1						
Community Assessmt						

*** = Most important metrics**

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VHB PIONEER

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Village of Essex Junction

7056 US Route 7
Post Office Box 120
North Ferrisburgh, Vermont 05473
802.485.7788
FAX 802.425.7799

Memorandum

To: James L. Jutras
Dennis Lutz
Village of Essex Junction
Town of Essex

Date: May 29, 2009

Project No: 57300.00

From: Jake W. Riley
Fluvial Geomorphologist

Re: 2008 Biomonitoring in Sunderland Brook

Introduction

At the request of the Village of Essex Junction and the Town of Essex, VHB Pioneer (VHBP) has prepared this memorandum to summarize the results of 2008 biomonitoring conducted in Sunderland Brook. In October 2008, VHBP conducted macroinvertebrate sampling at three sites in Indian and Sunderland Brooks to supplement the periodic sampling conducted by The Vermont Department of Conservation (VTDEC).

Due to historical biomonitoring results, Sunderland Brook was listed on the State of Vermont 303(d) list of impaired surface waters from river mile (RM) 3.5 to RM 5.3. Due to the high density of residential development in the Indian Brook watershed, anthropogenic activities previously identified in the 303(d) listing as causing the impairment were stormwater runoff, land development and erosion. On August 21, 2008, the U.S. Environmental Protection Agency (EPA) approved a Total Maximum Daily Load (TMDL) for Sunderland Brook from RM 3.5 to RM 5.3 with stormwater identified as the pollutant.

Site Descriptions and Methods

Sunderland Brook is located in Chittenden County in the Towns of Essex and Colchester. Sunderland Brook flows from its headwaters in the Village of Essex Junction through a suburban watershed and over five miles before discharging into the Winooski River.

In October 2008, VHB Pioneer conducted macroinvertebrate sweep net samples at three sites in Sunderland Brook. In progressing from downstream to up, the sites sampled in 2008 were located at RM 3.1, RM 3.3 and RM 5.3 (see Biomonitoring Stations Overview map on page 1 of Attachment for site locations). Biomonitoring sites RM 3.1 and RM 3.5 are located very near the VT Route 2/Roosevelt Highway crossing, with RM 3.1 located downstream of Sunnyside Brook and RM 3.5 located just upstream. Biomonitoring site RM 5.3 is located just downstream of

Essex Junction and it is in closer proximity to residential and commercial development (see page 1 of the Attachment).

Macroinvertebrate sampling is typically conducted using paired kick net samples, however, excessive sedimentation in Sunderland Brook at all of the sites forced the sampler to alter the commonly used method and perform one sweep net instead. Due to the silty habitat and extremely low densities, the 2008 Sunderland Brook macroinvertebrate data are not appropriate for making aquatic life support determinations based on the State of Vermont biocriteria for class B2-3 streams. For the purpose of providing historic context and site by site analysis, six low gradient stream parameters have been calculated for, the 2008 Sunderland Brook samples. These parameters include density, percent pollution tolerant species (macroinvertebrates with a biotic index greater than 7), percent pollution intolerant species (macroinvertebrates with a biotic index less than 3), number of COTE (Coleoptera, Odonata, Trichoptera, and Ephemeroptera), number of chironomidae and percent non-insecta taxa present (Steve Fiske, personal communication 4/2/09).

Results

The VTDEC has conducted periodic macroinvertebrate sampling between 2002 and 2006 at four different sites along Sunderland Brook. VTDEC sampled at RM 1.1 in 2003, at river mile (RM) 3.3 in 2003, 2005, 2006, at RM 4.6 in 2006, and at RM 5.3 in 2002, 2003, and 2004. Macroinvertebrate community results from this periodic sampling indicated that water quality has been "fair/good" at sites RM 1.1, RM 3.3 and RM 4.5 and "fair/poor" at site RM 5.3 (VT DEC).

2008 sampling metrics are displayed in Table 1 and the metrics with the best score have been shaded gray. Note that for the Density, percent intolerant, COTE and Chironomidae a higher score indicated better water quality, while a higher score for percent tolerant and percent non-insecta indicates poorer water quality. The lotic benthos sheet for this site is included on page 2 of the Attachment.

Table 1: 2008 Essex Junction Biomonitoring
Sunderland Brook - Sweep Net Data

Site	Density	%Tolerant (BI>7)	% Intolerant (BI<3)	# COTE	# Chironomidae	% Non Insecta
SB RM 3.1	106	25	3	11	6	37
SB RM 3.3	67	19	12	10	3	18

Table 1: 2008 Essex Junction Biomonitoring Sunderland Brook - Sweep Net Data						
Site	Density	%Tolerant (BI>7)	% Intolerant (BI<3)	# COTE	# Chironomidae	% Non Insecta
SB RM 5.3	30	47	0	2	2	47
SB MEAN	67.6	30.3	5	7.7	3.7	34

Biomonitoring Site RM 3.1

RM 3.1, located below the confluence of Sunnyside Brook, was a new sampling location for the 2008 sampling season. The purpose of this location was to determine the potential impact of Sunnyside Brook flow when compared to the upstream station at RM 3.3. In comparing the 2008 results between the three sites, RM 3.1 had the highest density, number of chironomidae, and number of COTE, indicating better water quality conditions at this location when compared to the other sampled locations in Sunderland Brook. However, RM 3.1 also had a very low percent of pollution intolerant species and a high percent of non insecta, indicating poor water quality conditions. However, Steve Fiske, of the VTDEC, reviewed the 2008 data and assessment methodology and indicated that despite the low scores, the stream condition in the vicinity of the RM 3.1 was in good, although showing some alteration.

RM Site 3.1 was not an ideal location for kick net sampling and the macroinvertebrate assemblage sampled did not provide representation of stream health when compared with historic metrics. Due to an absence of historic sampling data (new site) VHBP recommends that biomonitoring and water chemistry sampling site RM 3.1 should be assessed by VTDEC and/or VHBP in 2009 to determine if sampling should be continued at this location. Other options to consider are discontinuing sampling entirely or moving the site to new location further downstream that is more conducive to kick net sampling.

Biomonitoring Site RM 3.3

Site RM 3.3 is located just upstream above the confluence of Sunnyside Brook. In 2008, site RM 3.3 had the lowest percent of pollution tolerant species, the highest percent of pollution intolerant species and the lowest percent of non insecta compared to RM 3.2 and RM 5.3. The taxa observed at RM 3.3 indicate improved water quality conditions relative to the other stations on Sunderland Brook. Steve Fiske indicated the stream reach was in good condition. However, RM 3.3 also had an extremely low density indicating altered macroinvertabrate habitat conditions.

Table 2: 2003 to 2008 Essex Junction Biomonitoring RM 3.3 Sunderland Brook - Sweep Net Data						
Year	Density	%Tolerant (BI>7)	% Intolerant (BI<3)	# COTE	# Chironomidae	% Non Insecta
2003	1004	22	10	12	18	11
2005	558	10	23	18	17	7
2006	305	5	28	19	18	10
2008	67	19	12	10	3	18

Since 2003, macroinvertabrate assemblage metrics have generally declined at RM 3.3 (See Table 2). The density, percent of pollution intolerant species, COTE, and Chironomidae have all declined since 2006, while the percent of pollution tolerant species and percent of non insecta has simultaneously increased. All of these trends in the six parameters for low gradient streams indicate a shift in stream geomorphology and macroinvertabrate habitat conditions at RM 3.3. The habitat modification at this site is likely due in large part to beaver activity and to a lesser extent, stormwater runoff. The lotic benthos sheet for this location is included on page 3 of the Attachment. We recommend that biomonitoring be conducted by VTDEC and/or VHBP at RM 3.3 in 2008.

Biomonitoring Site RM 5.3

In 2008, the macroinvertebrate assemblage sampled at RM 5.3 indicate the most degraded macroinvertabrate habitat conditions in Sunderland Brook when compared to the six parameter values at RM 3.1 and RM 3.3. The density value was low, combined with the highest percent of pollution tolerant species, no pollution intolerant species, the lowest COTE, lowest Chironomidae and highest percent of non insecta.

Table 3: 2002 to 2008 Essex Junction Biomonitoring RM - 5.3 Sunderland Brook - Sweep Net Data						
Year	Density	%Tolerant (BI>7)	% Intolerant (BI<3)	# COTE	# Chironomidae	% Non Insecta
2002	939	63	6	11	12	61
2003	813	42	3	12	7	35
2004	1,288	59	1	9	12	57
2008	30	47	0	2	2	46

There are contradictory trends in the six low gradient parameters; however, overall changes in values indicate degrading macroinvertabrate habitat conditions at RM 5.3. The most noticeable change is in the density value which was extremely low and has decreased significantly from previous values in 2002, 2003, and 2004. Again this site is undergoing geomorphic changes including sedimentation and the results do not clearly indicate whether the beavers or continued stormwater runoff impacts are contributing to the observed decline in macroinvertebrate habitat. Based on a review of the macroinvertebrate data, Steve Fiske rated Sunderland Brook as fair at this location. The lotic benthos sheet for RM 5.3 is included on page 4 of the attachment.

Water Chemistry

Water chemistry sampling was conducted at RM 3.3 and 5.3 by VTDEC from 2003 to 2006 for pH, chloride (Cl), sulfate (SO4), calcium (CA), sodium (NA) and potassium (Mg). The results indicate that the parameters tested are within acceptable ranges. In addition VTDEC also sampled for turbidity (NTU), phosphorus (P), nitrogen (N), nitrogen oxide (NOx), arsenic (As), iron (Fe), manganese (Mn), and Zinc (Zn). Although below the average allowable chronic concentration criteria of 1,000 ug/l, a single sample iron concentration of 959 micrograms per liter (ug/l) and an average concentration of 634 ug/l from the three samples taken at RM 5.3, are of potential concern. Other water chemistry results did not indicate adverse water chemistry effects at the sampling locations. The results of the water chemistry sampling are presented on page 5 of the Attachment. VHBP recommends that additional water chemistry sampling for nitrate, phosphorus, *E. coli*, turbidity, and total suspended solids at this location.

RM 5.3 Find
Random Sample
Phosphorus, Nitrate
E Coli, Turbidity
Suspended Solids

Conclusions

Sunderland Brook macroinvertabrate habitat conditions are trending negatively based on an analysis of the macroinvertebrate assemblage from 2008 sweep net sampling at three sites within Sunderland Brook. Within Sunderland Brook, the most altered macroinvertabrate habitat conditions are at RM 5.3 based on the six parameters calculated for low gradient streams. Altered macroinvertabrate habitat conditions at RM 5.3 are likely due to changes in flow from the developed areas of the Town of Essex and the Village of Essex Junction. The 2008 values at RM 3.1, RM 3.3 and RM 3.5 indicate degrading macroinvertebrate habitat conditions relative to historical values.

We recommend yearly biomonitoring continue in Sunderland Brook to monitor stream health. However, the location of the sampling sites and sampling methodology should be agreed upon with VTDEC in order to provide more definitive analysis regarding macroinvertabrate habitat and trends in water quality. Should 2009 sampling occur it should be conducted side-by-side with VTDEC personnel. In addition to biomonitoring, VHBP recommends that a program of baseflow and event-based water chemistry sampling be developed to better identify the pollutant sources that are contributing to the continued impairment in Sunderland Brook. Parameters sampled would include nitrate, phosphorus, *E. coli*, turbidity, total suspended solids and iron. Water quality sampling at both flow conditions will reveal background in-stream water chemistry and the impacts of stormwater on water chemistry within Sunderland Brook.

Other Sampling

Baseline & Event