Aquatic Life Support
Assessment of Englesby Brook

Prepared by

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Biological Assessment Fact Sheet – Englesby Brook

1. *Description of Impaired Waterbody*
   - Englesby Brook is located in the City of Burlington. The brook, which drains a 2.6 km^2 urban watershed, is listed as non-support for Aquatic Life Uses over its entire length.

2. *Description of biological data used to characterize impairment:*

   - Between 1993 and 2006, the Aquatic biota was sampled on 16 occasions at 5 locations. Fish were collected at all 5 sites and macroinvertebrates at 2. Eleven of the fifteen samples could be assessed for compliance with Class B Aquatic Life Support (ALS) criteria.

   - The designation of impairment is a result of *poor* biological condition at RM 0.5 and 0.6 from both fish and macroinvertebrates. All 4 assessments for fish and all 6 assessments for macroinvertebrates rated RM 0.5 and 0.6- *poor*. Two of four fish samples taken at the RM 0.5 and 0.6 sites, yielded no fish.

   - Despite the poor condition at RM 0.5 and 0.6, the fish community scored *very good* at 0.1 when sampled in 1998. This higher score may have been influenced by new species moving into the stream from the lake.

3. *Stressor Identification:*
   - Stressors are undoubtedly related to stormwater runoff. In addition to degraded water quality, water quantity appears to be a major contributor. The stream experiences low flows to the point where mid reaches of the streambed become dry. What little water movement there is flows under the substrate. High, scouring water volumes are also experienced during, and immediately following, large precipitation events. Both unnaturally high and low discharge rates are often due to the effects of high proportion of impervious surfaces present a watershed.

4. *Summary statement: overall "weight-of-evidence" summary of findings:*
   - Englesby Brook is a severely disturbed stream as shown in the sharp divergence of measured biological metrics from the reference condition. The stream drains a highly urbanized watershed and experiences high variation in discharge, often resulting in the drying of sections of streambed during periods of low or no precipitation.

5. *Recommendations: recommended assessment needs:* Fish and macroinvertebrate communities at RM 0.1 and 0.5 should be sampled once every 5 years in conjunction with the 5-year sampling rotation used by the DEC. These sites will be sampled in 2009 since this watershed falls into the rotation schedule for this year.

Discussion of Biological Assessment Results

Description of Impaired Waterbody

Englesby Brook is located in the City of Burlington. The brook, which drains a small 2.6 km^2 urban watershed is listed as non-support for Aquatic Life Use for Class B waters over its entire length. The watershed is characterized by a highly urban environment with a relatively large amount of impervious surface. The stream is primarily of moderate gradient, beginning at the Burlington Golf Club, flowing west through residential, and eventually a mixed residual and business section, before emptying into Lake Champlain.

Description of Data Used to Characterize Impairment

Fish and macroinvertebrate **s**ample data is available from the period 1993-2006 and span locations from near the mouth, upstream to river mile (RM) 1.3 **(**Table 1). Eleven of the sixteen sample events could be evaluated for compliance with Aquatic Life Use support for Class B WQS using VTDEC protocols. All 11 assessments sampling events conducted from 1993-2006 for both fish and macroinvertebrates at RM 0.5 and 0.6 resulted in an assessment of *poor*.

Fish Community- Minimum requirements for applying the Mixed Water Index of Biotic Integrity (MWIBI) could not bet met at RM 1.0 and 1.3. The stream size was deemed too small to potentially support a fish assemblage of at least five species, and therefore no evaluation could be made at those sites.

The RM 0.1 site was sampled twice. The 1998 sample scored a MWIBI of 37 out of a possible score of 45 (corresponds to *Very Good*) -Table 2. The 1994 sample was not assessed because it was sampled outside the index period. Results from fish evaluations indicate the lower portion of the brook, near the lake, is in support of Class B Aquatic life use. The presence of species at that site that reside both along the lakeshore and in the lower reaches of tributaries (e.g. rosyface shiner and mottled sculpin) elevated the IBI score. Having ready access to the lake and a colonization source, this site could provide temporary habitat for species during less stressful periods

The current fish assemblage at RMs 0.5 and 0.6 are made up of individuals of tolerant species. The upstream areas are populated intermittently with creek chub, fathead minnow, and goldfish and perhaps blacknose dace, all of which are very tolerant to degradation. Two of the fish samples yielded no fish: RM 0.5 (2002) and RM 0.6 (1998).

Access to sites upstream of RM 0.1 by species from the lake is somewhat restricted and would take more time than is probably allowed for by frequency of reoccurring impacts to this stream. It is unknown If watershed improvements become established, whether or not the fish community will improve to a degree necessary to meet Class B standards in the mid reaches.

Macroinvertebrate Community - The macroinvertebrate assemblage failed to meet the minimum density expectation and taxa richness of animals during two of the four years assessed from 1994 to 1997 (Tables 3 and 4). The extremely low number of sensitive EPT taxa (2-3) and the dominance of the assemblage by either tolerant Oligochaeta or Diptera *Chironomidae* (EPT/EPT&c) is the primary reason to rate the assemblage as *poor*. Physical and water chemistry results appear in Table 5.

It will take both a considerable improvement in water quantity and base flow characteristics to restore the macroinvertebrate assemblage to a Class B (*good)* biological condition. It may take a number of years for colonization to occur to its full potential.

Confidence in the Implications of the Data

An valid reference condition exists for the middle and lower reaches of Englesby Brook. The high degree of departure from the minimum Aquatic Life Use criteria clearly indicates severe degradation. The DEC therefore, has a high degree of confidence in the data implications from both fish and macroinvertebrate communities.

Stressor Identification

Stressors are undoubtedly related to stormwater runoff. In addition to degraded water quality, water quantity appears to be a major contributor. The stream experiences low flows to the point where mid reach portions of the streambed dry up. During those periods, what little water there is, flows only under the substrate. High, scouring water volumes are also experienced during, and immediately following, large precipitation events. Both unnaturally high and low discharge rates are often due to the effects of high proportion of impervious surfaces present a watershed. This boom-bust environment has an extremely profound effect on aquatic organisms.

Summary statement: overall "weight-of-evidence" summary of findings:

Englesby Brook is a severely disturbed stream. Biological samples taken since 1993 have shown a sharp divergence of measured biological metrics from the reference condition. The stream drains a highly urbanized watershed and experiences high variation in discharge, often resulting in the drying of sections of streambed during periods of low or no precipitation. The DEC believes that the stream is impaired for Class B ALS from a point upstream of RM 0.1 to its origin. This is based on available biomonitoring data from RMs 0.1, 0.5, and 0.6.

Recommended Monitoring: Fish and macroinvertebrate communities at RM 0.1 and 0.5 should be sampled once every 5 years in conjunction with the 5-year sampling rotation used by the DEC. These sites will be sampled in 2009 since this watershed falls into the rotation schedule for this year.

Figure1. Biomonitoring site locations on Englesby Brook, VT. Site numbers indicate approximate river mile from the stream mouth.

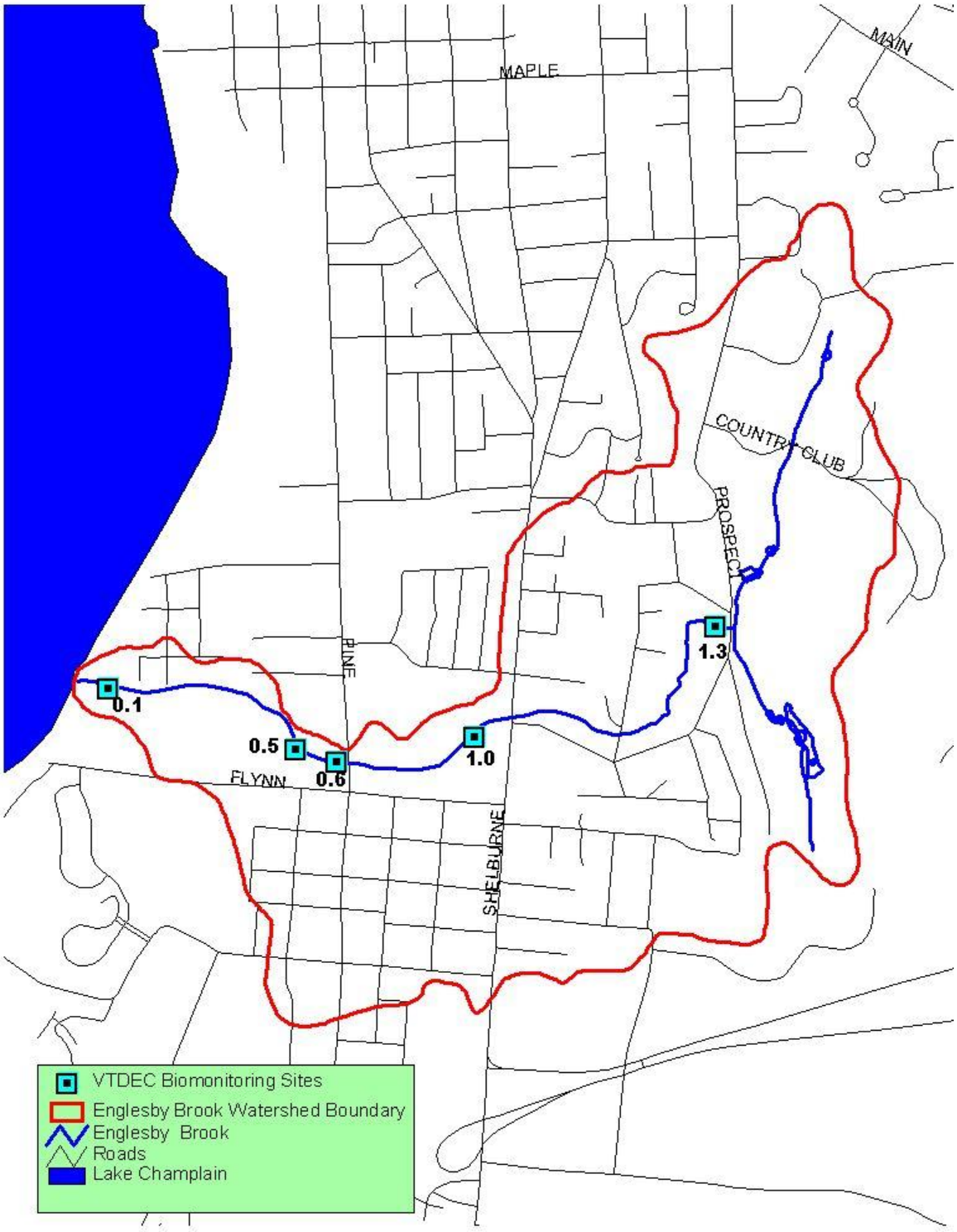

Table 1. Biological sampling Stations on Englesby Brook.

Site (RM)	Site ID	Community	Description	Latitude	Longitude	Drainage Area-km^2	Elevation (feet)
0.1	LCT330100001	Fish	adjacent to townhouses at mouth.	442728	731323	2.6	100
0.5	LCT330100005	Fish	behind apartment parking lot in wooded section	442723	731258	2.3	118
0.6	LCT330100006	Fish, Macroinvert.	10 meters below Pine Street Bridge.	442721	731254	2.2	120
1.0	LCT330100010	Fish	in run and large pool below culvert in field below Kentucky Fried Chicken and RT 7.	442726	731235	1.6	160
1.3	LCT330100013	Macroinvert.	75m below South Prospect Street crossing on Critchlow residence.	442735	731206	0.7	280

Table 2. Metrics evaluated using the Mixed Water Index of Biotic Integrity (MWIBI) and the Cold Water Index of Biotic Integrity (CWIBI).

Site (RM)	Date	**MWIBI**	Species Richness	Number of Intol. Species	Number of Benthic Insectivore Species	% White Sucker and Creek Chub	% Generalist Feeders	% Insectivores	% Top Carnivores	% Anomolies	Density (#/100m^2)
0.1	6/10/94*	**-**	8	1	3	3	59	41	0	0	27
	8/26/98	**37 -Very Good**	7	1	1	11	51	49	0	0	76
0.5	9/30/02	**9 -Poor**	0	0	0	0	0	0	0	0	0
0.6	6/10/94	**9 -Poor**	0	0	0	0	0	0	0	0	0
	9/10/98	**17 -Poor**	3	0	0	54	100	0	0	0	12
	10/04/06	**21 -Poor**	2	0	0	48	100	0	0	0	24
1.0	8/29/94	-	1	0	0	100	100	0	0	0	1
1.3	8/26/98	-	2	0	0	89	100	0	0	0	35

* Sample was taken outside index period

Table 3. Macroinvertebrate community metric data from Englesby Brook sampling sites.

Site (RM)	Date	**Community Assessment**	Density	Richness	EPT	PMA-O1	BI (0-10)	Oligochaeta%	Ept/ Ept&Chiro	PPCS-F1
0.5	10/7/2004	**Poor**	268	30	3.0	22.0	6.01	10.8	0.10	0.22
0.6	10/28/94	**Poor**	626	27.5	3.0	29.7	5.50	2.6	0.15	0.38
	10/12/95	**Poor**	140	18.0	2.0	30.7	5.21	47.1	0.30	0.41
	10/1/96	**Poor**	149	11.0	2.0	36.6	6.27	0.0		0.52
	9/22/97	**Poor**	1032	30.0	2.0	41.9	6.27	2.0	0.33	0.66
	10/4/2006	**Poor**	748	24.0	3.0	49.7	6.32	31.3	0.81	0.49
1.3	9/30/93	-	1691	27.0	5.0	47.6	5.48	12.5	0.58	0.45
	10/20/98	-	2404	27.0	3.0	44.6	5.93	4.5	0.34	0.34

Table 4. Percent composition of the major orders and functional feeding groups of the macroinvertebrate community from Englesby Brook stations.

Site (RM)	Date	Coleoptera	Diptera	Ephemero -ptera	Plecoptera	Trichop -tera	Oligoch- aeta	Other	Gatherer	Filterer	Predator	Shreder -Detrit	Shreder- Herb.	Scraper
0.5	10/7/2004	0.7	70.9	0.0	0.0	6.7	10.8	10.8	28.7	8.6	47.0	14.9	0	0.7
0.6	10/28/94	2.3	80.8	0.0	0.5	12.0	2.6	1.8	17.5	14.1	47.5	16.3	4.2	0.3
	10/12/95	2.1	33.6	0.0	0.0	13.6	47.1	3.6	50.0	15.0	17.9	1.4	13.6	2.1
	10/1/96	4.6	0.0	0.0	0.0	50.0	0.0	45.4	23.8	52.3	3.1	0.0	0.8	20.0
	9/22/97	3.3	60.8	0.0	0.0	23.6	2.0	10.3	20.6	33.9	9.0	2.0	31.6	2.7
	10/4/2006	3.7	14.7	0	0	32.1	31.3	18.2	34.8	45.2	4.8	6.4	0.5	8.3
1.3	9/30/93	1.3	32.5	0.3	0.0	37.8	12.5	15.6	21.1	40.1	34.2	0.7	1.0	1.1
	10/20/98	1.0	64.4	0.0	0.0	28.6	4.5	1.5	40.8	44.8	13.1	0.2	0.2	1.0

Table 5. Physical and habitat observations taken at time of macroinvertebrate sampling on Englesby Brook. Substrate % 's are subjective estimates for all data taken previous to 2004.

Site (RM)	Date	% Boulder	% Cobble	% Coarse Gravel	% Gravel	% Sand	% Clay	Silt Rating 0-5	% Embed	% Canopy	% Filament	% Blue Green	% Moss
0.5	10/7/2004	2	9	12	5	0	49	3	2	90			
0.6	10/28/94	10	10	40	10	10	0	5	2	30	60	10	20
	10/12/95	10	20	20	10	40	0	4	1	50	50	100	0
	10/1/96	15	50	20	10	5	0	3	1	50	60	0	15
	9/22/97	20	10	20	20	30	0	3	1	50	50	10	0
	10/4/2006	0	0	10	55	35	0	5		90			
1.3	9/30/93	10	10	50	10	5	0	4	3	50	0	40	0
	10/20/98	5	5	35	25	10	0		3	60			

Table 6. Water chemistry parameters for Englesby Brook sampling sites. RM = river mile. See end of table for parameter abbreviations.

Site RM	Sample Date	Water Temp (Deg c)	Flow	Field pH (std units)	Lab pH	Alkalinity (mg/l)	Field Cond. ᵤs/cm	Lab Cond	Color (PtCo Units)	Turb (NTUs)	TSS *	TP *	TDP *	TCl *	TSO4 *	TN *	TNOX *
0.1	10-Jun-94	12.3					891										
	11-Jan-06	1.5	Moderate					1860						488			
0.5	30-Sep-02	13.5															
	07-Oct-04	12.2	Low		7.9	234		1250		5.7	2.1	55	26	240	22	1.11	0.77
	05-Apr-06	8.3	Moderate		8.3	129	962	983		15.1		66.3	15.5	216	16.6	1.32	0.67
0.6	10-Jun-94	12.5					873										
	28-Oct-94	7			7.6	223											
	12-Oct-95	12.5			7.6	223	973										
	01-Oct-96	11.5			7.8		834										
	22-Sep-97	12			7.9				45								
	10-Sep-98	14			7.8												
	16-Feb-06	1			7.3	190	1166	1200		4.8		38		248		1.94	1.66
	04-Oct-06	12	Moderate	7.95		164		860	55	4.6		59.3	22.7	148	17.5	1.01	0.66
1.0	29-Aug-94	16.5					940										
1.3	30-Sep-93	11			8.6	140	635										
	26-Aug-98	21															
	20-Oct-98	10			7.8	292	691		65								

Site	Sample Date	DCa*	DMg*	DNa*	DK*	THC*	DAl #	Das#	DCd#	DCr#	DCu#	DFe#	DPb#	DMn#	DNi#	DZn#
0.1	10-Jun-94															
	11-Jan-06															
0.5	30-Sep-02															
	07-Oct-04	81.6	22.8	136	3.95	298	< 10	<1	<1	<5	<10	<50	<5	218		<10
	05-Apr-06	47	15.9	120	2.51	183		<1	<1	<5	<10	135	<5	73.2	<5	<10
0.6	10-Jun-94															
	28-Oct-94															
	12-Oct-95															
	01-Oct-96															
	22-Sep-97															
	10-Sep-98															
	16-Feb-06															
	04-Oct-06	52.3	17.1	88.6	3.61	201		<1	<1	<5	<10	141	<5	99.7	<5	<10
1.0	29-Aug-94															
1.3	30-Sep-93															
	26-Aug-98															
	20-Oct-98															

Explanations of abbreviations for Table 6. * units of measurement= mg/l, # units of measure=ug/l

Cond- Specific conductance	TP - Total phosphorus	Zn - Zinc
Cl - Chloride	TDP - Total dissolved phosphorus	Al - Aluminum
Na - Sodium	TN - Total nitrogen	As - Arsenic
K - Potassium	TNOX - Total nitrates-nitrites	Ag - Silver
TSO4 - Total sulfates	Fe- Iron	Be - Beryllium
Ca - Calcium	Mn - manganese	Se - Selenium
Mg- Mangnesium	Ni - Nickel	Sb - Antimony
THC- Total hardness	Cr - Chromium	Ti - Titanium
Turb - Turbidity	Cd - Cadmium	