Aquatic Life Use Support Attainment
of Rodman Brook - 2009

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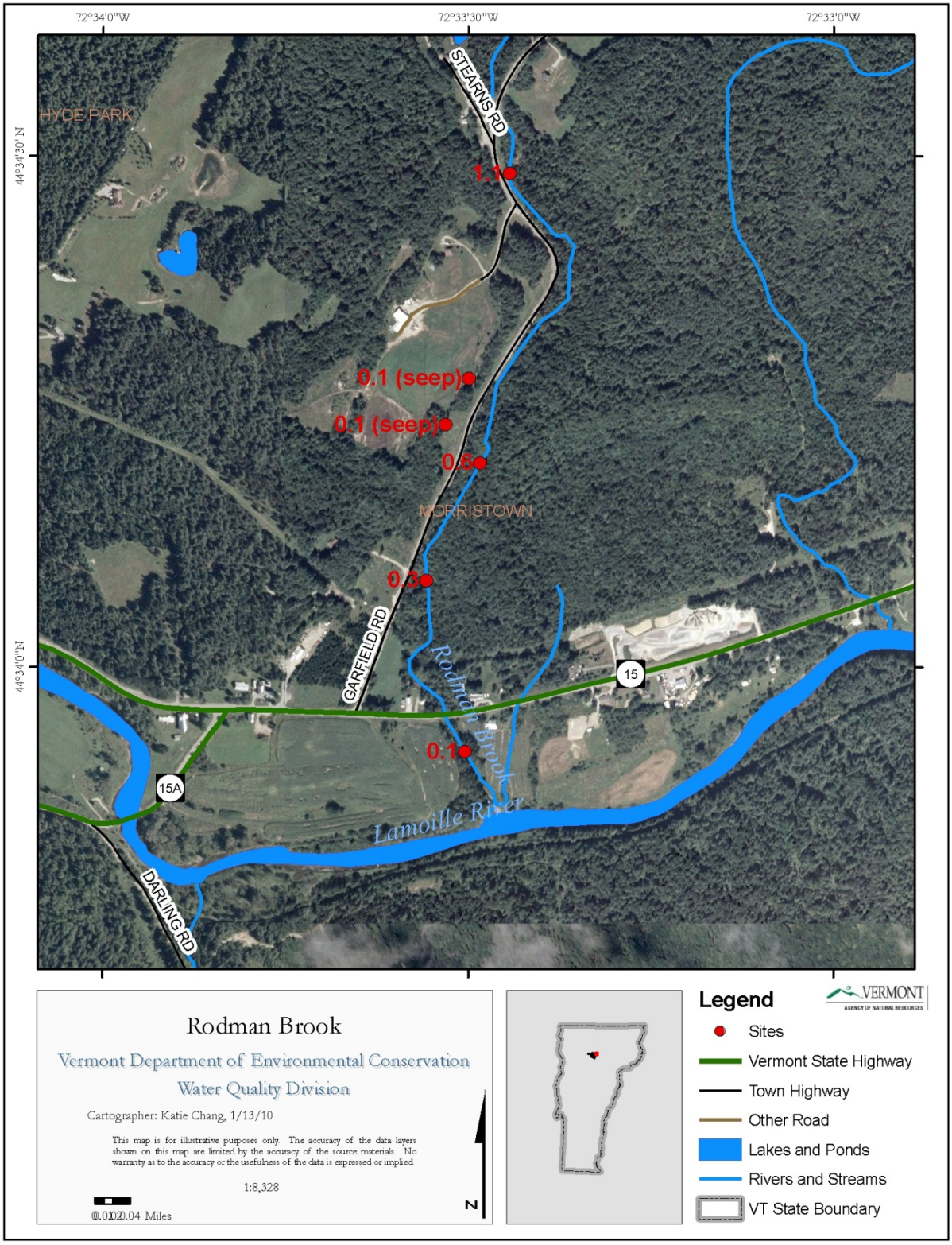
Description of water body:

Rodman Brook drains moderate elevations of a mostly forested area of Hyde Park, at its source on McKinistry Hill its highest elevation is almost 1500 feet. The total stream length is about 5.6 miles and total area drained is approximately 12.5 km^2. It is a Small High Gradient (SHG) Macroinvertebrate stream type based on its small drainage area, high elevation, and dominant "riffle" habitat. The fish Cold Water IBI (CWIBI) is applied to this type stream.

Table 1. Rodman Brook sample site location information.

River mile from mouth (RM)	Town	Site Lat./Long.	Community sampled	Drainage area (km^2)	Elevation (ft.)
0.3	Morristown	44 34 06 /72 33 33	Macroinvertebrate, Fish	11.3	690
0.6	Morristown	44 34 12 / 72 33 26	Macroinvertebrate, Fish	10.5	705
1.1	Morristown	44 34 29 / 72 33 26	Macroinvertebrate, Fish	10.2	750

Figure 1


72°34'0"W
72°33'30"W
72°33'0"W
44°34'30"N
44°34'0"N
HYDE PARK
MORRISTOWN
STEARNS RD
GARFIELD RD
DARLING RD
1.1
0.1 (seep)
0.1 (seep)
0.6
0.3
0.1
Rodman Brook
Lamoille River
15
15A
Rodman Brook
Vermont Department of Environmental Conservation
Water Quality Division
Cartographer: Katie Chang, 1/13/10
This map is for illustrative purposes only. The accuracy of the data layers shown on this map are limited by the accuracy of the source materials. No warranty as to the accuracy or the usefulness of the data is expressed or implied.
1:8,328
0 0.01 0.02 0.04 Miles
N
Legend
VERMONT
AGENCY OF NATURAL RESOURCES
Sites
Vermont State Highway
Town Highway
Other Road
Lakes and Ponds
Rivers and Streams
VT State Boundary

Impairment: The aquatic biota fails to meet the Class B Water Quality criteria at river mile 0.6.

Biological Assessment:

The physical characteristics of Rodman Brook over its entire length fit the Small High Gradient stream type (SHG) criteria for macroinvertebrate community assessment based on its small drainage area, high elevation and dominant "riffle" habitat. The fish community was assessed using the Cold Water Index of biotic integrity (CWIBI).

The fish assemblages of Rodman Brook were annually sampled between 2006 and 2007 at two sites downstream from the landfill and one site upstream. The RM 0.6 (downstream) and RM 1.1 (upstream) sites were sampled in 2005 as well.

Rodman Brook naturally supports between 4-8 native species. The Coldwater IBI (CWIBI) is applied to fish data at sites with two - four species, with sites supporting more than four species being assessed using the Mixed Water IBI (MWIBI). The CWIBI was selected for use in assessing the health of the fish community at all sites because of its small site drainage areas (10-11km2) which corresponds mostly to a two to four species assemblage and because the same four core species normally observed in coldwater streams appeared at every site every year. Because the two IBIs usually score differently with the same fish data, for the sake of consistency the CWIBI was used to standardize the assessments.

At RM 1.1, located upstream from any influences of the landfill, CWIBI scores were 30, 21, and 30 for the three years sampled corresponding to assessments of good, poor and good. The IBI from the sample collected during 2006 (21) was collected from a shorter than normal section length and may not have adequately represented conditions. Consequently the site is characterized in good condition, showing some level of background stress but compliance with the Class B WQS for the fish community. The CWIBI was primarily a result of higher than expected eurythermal species (as opposed to predominately cold water species) and a smaller than expected proportion of top carnivores (brook trout).

The RM 0.6 and 0.3 sites were selected to assess any effects from landfill leachate. The closest site to the landfill was RM 0.6. CWIBI values ranged from 24-27 (poor to fair) for the three years. The difference between the assemblages at RM 06 and the "control" site - 1.1- was that one -run density-both total and brook trout was lower at RM 0.6. Lower brook trout density dropped the RM 0.6 CWIBI values below the Class B WQS. Otherwise the sites were relatively similar on community parameters.

Species occurrence varied between the two years sampled at RM 0.3. In addition to the four "core" species, blacknose dace, slimy sculpin, brook trout and creek chub, observed at all sites, the 2006 sample included redbelly dace, brown trout, and pumpkinseed. The higher than expected proportion of blacknose dace and the appearance of Redbelly dace led to a CWIBI of 27(fair). The next years sample was comprised of a typical assemblage that resulted in a higher score of 36-very good.

Evaluation of the fish community of Rodman Brook indicated that the assemblage upstream from the landfill, while stressed, was still lower immediately downstream of the landfill and not meeting Class B WQS. At RM 0.3 however, the assemblage seem to have recovered and was once again attaining Class B WQS for fish the fish community.

Table 2 . Mixed water and coldwater IBIs, assessments and metrics for Rodman Brook sites. The metric "%anomalies" was 0 for all sites and does not appear in the table.

Site (RM)	Date	**CWIBI and assessment**	Native Richness	# Intolerant Species[1]	Insectivore %	Native Benthic Insectivores	Proportion of Coldwater Species	Creek Chub + White Sucker %	Generalist Feeder %	% Top Carnivores	Brook Trout Density (/100m^2)	No. Brook Trout years classes	Total Density # 100m2 1-run
0.3	9/11/06	**27** Fair	7	2	65	2	24	15	23	12	4.3	3	38
	9/4/07	**36** Very Good	5	2	70	2	59	4	4	26	4.8	3	18
0.6	10/14/05	**24** Poor	4	2	82	1	37	8	8	10	1.9	2	18
	8/23/06	**27** Fair	4	2	80	1	26	7	7	14	2.6	3	21
	9/4/07	**24** Poor	4	2	82	2	25	3	3	20	2.9	3	20
1.1	10/14/05	**30** Good	5	2	87	1	28	5	6	8	5.2	3	71
	8/23/06	**21**[1]	5	2	75	1	25	10	13	12	6.6	2	58
	9/4/07	**30** Good	4	2	84	1	33	6	6	10	4.1	3	41

* These samples included a fifth native species (longnose dace), requiring the assemblage to measured using the MWIBI.

1. Section fished was too short to have confidence in IBI value.

Macroinvertebrate Community

RM 0.3. The community at RM 0.3 scored *good to fair* both years it was sampled in 2006 and 2007. The Pearson Coefficient of Functional Group Similarity metric (PPCS-F) was slightly below Class B criteria. This metric was driven by the abnormally high proportion of collector-filterers and lower than expected proportion of scrapers and shredder-herbivores.

RM 0.6. The community at RM 0.6 has scored from poor to Vg-good from assessments conducted between 2005 -2007. Oligochaetes were significantly elevated in 2005 and 2006, failing to meet Class B criteria. The high percentages of Oligochaeates were dominated by the family Naididae. High densities of these tolerant Oigochaeta are typically indicative of increased pollution stress, including enrichment and/or metals. The Oligochaeta are collector-gatherers that are likely feeding on particulates associated with iron precipitate and bacteria that coated the stream substrate at this site.

Additionally EPT Richness, PPCS-F and Percent Model Affinity of Orders (PMA-O) failed Class B criteria during the 2006 assessment. These metrics were driven by increasing abundance of more pollution tolerant orders and an abnormal shift in the functional feeding composition as described above for RM 0.3. The pollution tolerant Chironomidae family were dominant at this site, likely feeding on particulates caught in the iron precipitate. The heavy iron precipitate that coated the substrate can also coat the body and respiratory surfaces of the more sensitive EPT taxa and is likely responsible for the low numbers of these sensitive taxa observed.

RM 1.1. The community at RM 1.1which served as the upper control rated very good to excellent, meeting all Class B values for SHG streams. Shredder detrivores and scrapers composed a much higher proportion of the community and collector filterers much less, as would be expected in a minimally impacted SHG stream.

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Table 3. Macroinvertebrate metrics for Rodman Brook 2005-2007 (Bolded numbers indicate exceedences).

Site	Date	Assessment	Density	Richness	EPT	PMA-O	BI	Oligochaeta %	EPT/EPT&C	PPCS-F
0.3	09/11/2006	Good-Fair	1550	41.5	20	70.2	3.46	1.7	0.59	**0.39**
	09/04/2007	Good-Fair	2200	49	27	69.8	2.69	2.9	0.66	**0.38**
0.6	10/07/2005	Fair	642	44	20	51.3	3.01	**20.2**	0.42	0.42
	09/11/2006	Poor	1248	39.5	**15**	**44.1**	2.53	**27.5**	0.35	**0.38**
	9/04/2007	Vg-good	1490	50	21.5	67.6	3.33	2.4	0.52	0.47
1.1	10/07/2005	Ex-Vgood	2296	54	27	76.9	3.35	1.7	0.8	0.55
	09/11/2006	Vgood	4556	71	37	77.2	3.08	0.6	0.75	0.51
	09/04/2007	Vg-Good	2288	52	28	69	3.73	0.5	0.69	0.45

Table 4a. Water Quality Measurements for Rodman Brook - Field and General Parameters.

Mile	Date	Time	Water Temp C	pH stnd units	Alk mg/L	Field Cond umhos	Lab Cond umhos	Cond	Color Pt Co Units	DO mg/L	DO%	Turb NTU
0.3	9/11/2006	1000	9.2	7.65	71.6	258	277	267.5		10.37	90.8	1.42
	9/4/2007	0900	12.8	7.4	77.9	292	304	298	20	9.18		1.93
0.6	10/7/2005	0930	13.5	7.44	74.1		323					1.42
	9/11/2006	1030	10	7.22	68.2	259	275	267		10.06	91.3	1.83
	9/4/2007	0900	13.2	7.22	76.7	289	300	294.5	35	9.11		1.3
1.1	10/7/2005	1030	13.5	7.36	34.2		172					0.52
	9/11/2006	1300	13.7	7.44	34.1	129	138	133.5		10.19	96	0.52
	9/4/2007	0900	15.8	7.49	33.8	146	155	150.5	12.5	8.9		0.79

Table 4b. Water Quality Measurements for Rodman Brook -Nutrients and Anions

Mile	Date	Total P ug/L	Total Diss P ug/g	Total Cl mg/L	Total SO4 mg/L	Total N mg/L	Total NOX mg/L
0.3	9/11/2006	9.09	6.14	34.8	7.32	1.5	0.4
	9/4/2007	< 5	< 5	38.7	7.97	1.85	0.64
0.6	10/7/2005	8.98	7.02	45.1	9.2	1.67	0.19
	9/11/2006	8.96	6.25	35.4	7.49	1.63	0.17
	9/4/2007	< 5	6.24	39.4	8.15	1.92	0.24
1.1	10/7/2005	6.74	5.81	23.9	7.52	0.21	0.11
	9/11/2006	7.6	5.69	17	5.8	0.24	0.14
	9/4/2007	< 5	< 5	21.1	6.41	0.3	0.18

Table 4c. Water Quality Measurements for Rodman Brook -Base Cations, Aluminum and Hardness.

Station	Date	Diss Ca mg/L	Diss Mg mg/L	Diss K mg/L	Diss Al ug/L	Total Hardness
0.3	9/11/2006	16.7	9.55	2.45		81.1
	9/4/2007	18.1	10.3	2.77	< 10	87.6
0.6	10/7/2005	16.9	9.55	2.68		81.6
	9/11/2006	14.6	8.55	2.4	< 10	71.8
	9/4/2007	17.5	10.4	2.92	< 10	86.3
1.1	10/7/2005	12.6	2.82	0.74		43.1
	9/11/2006	11.9	2.5	0.59		39.9
	9/4/2007	12	2.65	0.67	< 10	41

Table 4d. Water Quality Measurements for Rodman Brook -Priority Pollutant Metals.

Mile	Date	Diss Sb ug/L	Diss As ug/L	Diss Be ug/L	Diss Cd ug/L	Diss Cr ug/L	Diss Cu ug/L	Diss Fe ug/L	Diss Pb ug/L	Diss Mn ug/L	Diss Hg ug/L	Diss Ni ug/L	Diss Se ug/L	Diss Ag ug/L	Diss Tl ug/L	Diss Zn ug/L
0.3	9/11/2006		1.75		< 1	< 5	< 10	357	< 5	213		< 5				< 10
	9/4/2007	< 10	1.7	< 1	< 1	< 5	< 10	284	< 1	200		< 5	0.05	< 1	< 1	< 50
0.6	10/7/2005		2.75		< 1	< 5	< 10	520	< 5	159		< 5				< 10
	9/11/2006	< 10	2.84	< 1	< 1	< 5	< 10	828	< 5	201		< 5	0.04	< 1	< 1	< 10
	9/4/2007	< 1	3.11	< 1	< 1	< 5	< 10	742	< 1	214		< 5	0.1	< 1	< 1	< 50
1.1	10/7/2005		< 1		< 1	< 5	< 10	< 50	< 5	7.93	< 5	< 5				< 10
	9/11/2006		< 1		< 1	< 5	< 10	207	< 5	36.1		< 5				< 10
	9/4/2007	< 10	0.38	< 1	< 1	< 5	< 10	92.7	< 1	10.5		< 5	0.18	< 1	< 1	< 50

Table 5. Physical habitat assessment for Rodman Brook macroinvertebrate samples.

Station	Date	Embeddedness	SiltRating	Canopy%	PcSand%	IronPrecipitate %cover	Iron percip thickness
0.3	9/11/2006	3	4	80	1	100	1.4
0.3	9/4/2007	3	3	80	4	100	0.9
0.6	10/7/2005	4	1	90	2	100	2.2
0.6	9/11/2006	3	3	90	0	100	3.0
0.6	9/4/2007	5	3	100	5	100	2.2
1.1	10/7/2005	4	1	30	4	0	1.2
1.1	9/11/2006	4	2	50	0	0	0.9
1.1	9/4/2007	4	1	50	4	0	0.5

Possible Stressors. Water quality data collected at both assessments sites (RM 0.3 & 0.6) show increases in iron, manganese, chloride, magnesium, nitrogen and conductivity, which are all likely reflective of landfill leachate entering the stream.
Iron levels were about 10 times higher and manganese showed over a 20-fold increase below the landfill. Increased concentrations of iron and manganese and its associated precipitate are often associated with degraded benthic communities. There were no exceedences of water quality standards observed, suggesting that the physical impairment on the habitat caused by the iron/manganese precipitate coating the substrate is likely sufficient to degrade the biological community at these sites.

Summary and Recommendations:
Both fish and macroinvertebrate communities indicate non compliance with Class B Water Quality Standards at RM 0.6 for several of the assessments conducted. The 2007 macroinvertebrate assessment at RM 0.6 scored Vg-good; this may be due to variations in hydrological conditions preceding the assessment. Site observations indicate groundwater entering the stream channel from seeps near RM 0.6 may be contributing to the iron/manganese precipitate observed within Rodman Brook.
Further assessments should include water quality sampling of the surfacing groundwater (leachate), stream water quality sampling under a range of flow conditions and continued biological and physical assessments at established sites.