

Crosby Brook Phase 2 Stream Geomorphic Assessment Summary

July 21, 2008



Prepared by:

Evan P. Fitzgerald, Principal Watershed Scientist



Fitzgerald Environmental Associates, LLC.

Applied Watershed Science & Ecology

Prepared for:



EXECUTIVE SUMMARY	i
1.0 INTRODUCTION AND PROJECT OVERVIEW.....	1
2.0 WATERSHED BACKGROUND	1
2.1 GEOGRAPHIC SETTING AND LAND USE HISTORY.....	1
2.2 GEOLOGIC & GEOMORPHIC SETTING	5
2.3 ECOLOGICAL SETTING	7
2.4 CHANNEL AND FLOODPLAIN MANAGEMENT HISTORY.....	8
2.5 RECENT BIOLOGICAL SAMPLING	9
3.0 DATA COLLECTION METHODS.....	10
4.0 RESULTS	11
4.1 WATERSHED SCALE STRESSORS	11
4.1.1 <i>Hydrologic Regime Impacts</i>	11
4.1.2 <i>Sediment Regime Impacts</i>	13
4.2 REACH SUMMARIES	15
4.3 STRUCTURES SUMMARY	32
5.0 CONCLUSIONS AND FUTURE WORK.....	35
6.0 REFERENCES.....	37

- Appendix A.** Reach Mapping
- Appendix B.** DMS Reach Summary Data
- Appendix C.** QA/QC Summary
- Appendix D.** VTDEC Biotic Sampling Data
- Appendix E.** Bed Substrate Histograms (CD-ROM)
- Appendix F.** Cross-section plots (CD-ROM)
- Appendix G.** Photos and Log (CD-ROM)

List of Figures and Tables

Figure 1. Watershed Location Map	2
Figure 2. Subwatershed Map	3
Figure 3. 1954 Topographic Survey of Lower Watershed	4
Figure 4. 1962 Aerial Photograph of Reach M02.....	5
Figure 5. 2003 Aerial Photograph of Reach M02.....	5
Figure 6. Channel Straightening in Reach M02.....	9
Figure 7. Response of Sensitive Biota to Impervious Cover	12
Figure 8. Temperature Data Summary.....	13
Figure 9. Gully on Pepsi Property.....	13
Figure 10. Histogram of Bed Substrate Above the Gully.....	14
Figure 11. Histogram of Bed Substrate Below the Gully	14
Figures 12 – 46. Reach Specific Photos.....	16-32

Table 1. Watershed Land Cover	2
Table 2. Reference Reach Characteristics	6
Table 3. Stream Crossings Summary.....	33
Table 4. Phase 2 Reach Summary Statistics	B1

Executive Summary

- Fitzgerald Environmental Associates, LLC. (FEA) was retained by WCNRCD in 2007 to carry out Phase 1 and 2 assessments following the Stream Geomorphic Assessment (SGA) Protocols developed by VTDEC.
- The Crosby Brook watershed is located in the towns of Brattleboro and Dummerston. It has a drainage area of 5.7 square miles and outlets to the Connecticut River south of Route 9. Its surface waters are divided into two main branches, which join near Exit 3 of Interstate 91. The Mainstem channel network has an overall slope of 2.3%, and a majority of its reaches have B and C-type valley geometry. The South Branch, with a drainage area of 1.8 square miles, has an overall channel slope of 3.1%. A majority of its reaches have A and B-type valley geometry.
- A total of 16 reaches were identified during the Phase 1 analysis for the 10.1 mile channel network. Based on an analysis of impact ratings generated from the Phase 1 data, 9 reaches were selected for further Phase 2 assessment in 2008, including 6 reaches on the Mainstem and 3 reaches on the South Branch.
- During the Phase 2 surveys, the division of Mainstem reaches resulted in a total of 9 segments, while the division of SB reaches resulted in a total of 7 segments. Each segment was walked entirely and detailed physical data was collected using the SGA Phase 2 methods. This included a summary of geomorphic stability (RGA rating), habitat conditions (RHA rating), and channel evolution stage and stream sensitivity.
- Stream type departures were noted on three segments in the lower watershed: M02, T1.01, and T1.02-B. The extreme changes in channel geometry outside of the normal range of adjustments indicated that these areas are highly sensitive to further watershed impacts.
- The lower zone of the watershed is experiencing the greatest degree of channel adjustment and decline in physical habitat. These adjustments, in conjunction with riparian buffer loss and increased stormwater runoff, are leading to a decline in biotic integrity. The large gully on the mainstem has had a severe impact on the lower watershed conditions (e.g., supply of fine sediment to the channel), and the deleterious effects of recent commercial development and floodplain encroachment in this zone of the watershed is also evident.
- Of the 17 assessed bridges and culverts, only 11 accommodate 75% of the bankfull channel width. In addition, 7 structures are causing significant upstream or downstream erosion.

1.0 Introduction and Project Overview

The Windham County Natural Resources Conservation District (WCNRCD) identified the Crosby Brook watershed in Dummerston and Brattleboro, Vermont for assessment of fluvial geomorphic conditions. The study is part of a larger effort to characterize the physical and biotic conditions of the watershed and to aid in the identification of stressors on aquatic biota communities. Fitzgerald Environmental Associates, LLC. (FEA) was retained by WCNRCD in 2007 to carry out Phase 1 and 2 assessments following the Stream Geomorphic Assessment (SGA) Protocols developed by the Vermont Department of Environmental Conservation (VTDEC, 2007).

Biotic samples collected by VTDEC throughout the Crosby Brook watershed have consistently shown an impaired condition in the lower reaches of the watershed (VTDEC, 2005). The impairment is thought to be caused by increased sediment loading and elevated stream temperatures in the lower and middle reaches of the watershed resulting from urbanization and channelization since the construction of Interstate 91 in the 1960's. A discussion of recent biological sampling data that summarized the environmental stressors on the aquatic communities is included in section 2.5.

Phase 1 data was collected by FEA for the entire watershed in 2007 and summarized for the Mainstem and South Branch (FEA, 2007). A total of 16 reaches were identified during the Phase 1 analysis for the 10.1 mile channel network. Based on an analysis of impact ratings generated from the Phase 1 data, 9 reaches were selected for further Phase 2 assessment in 2008, including 6 reaches on the mainstem and 3 reaches on the South Branch (SB). The Phase 1 and 2 SGA data will aid WCNRCD and VTDEC in the identification of sediment loading areas and channel adjustments that are degrading habitat conditions. In addition, the SGA data will form the basis for future stream corridor and fluvial erosion hazard planning efforts in the watershed.

2.0 Watershed Background

2.1 Geographic Setting and Land Use History

The Crosby Brook watershed is located in the Lower Connecticut River Basin in southeastern Vermont (Figure 1). The watershed has a drainage area of 5.7 square miles and outlets to the Connecticut River just south of the Route 9 river crossing. It is dissected by Interstate 91 in the lower reaches and Route 5 to the northeast (Figure 2). Stemming from Route 5 and the Exit 3 area is a commercial-industrial zone within the northern limits of the Town of Brattleboro. There are numerous road crossings and



Figure 1. Watershed Location Map

significant urbanization of the stream corridor in between the I-91 northbound lane and commercial land to the west of Route 5. There are fewer roads in upper watershed where a mostly forested landscape is interspersed with farmland along Black Mountain Road and Dutton Farm Road. Land cover data based on imagery from 2005 are summarized in Table 1. The watershed is currently 60% forested, with approximately 10% covered by agricultural lands (including extensive orchards). Residential lands occupy 10% of the watershed, with lesser amounts occupied by commercial/industrial lands (4.4%) and transportation corridors (6.4%). The watershed has a moderate degree of impervious cover (8.7%), within a range (5-10%) associated with decline of channel stability and biotic integrity in small urbanizing watersheds in Chittenden County (Fitzgerald, 2007).

Table 1. Land Cover for Crosby Brook Watershed

Land Cover Type*	Entire Watershed	North Branch [†]	South Branch
Forested	60.2%	63.5%	53.2%
Agriculture	10.7%	6.6%	19.6%
Residential	9.9%	9.4%	10.8%
Commercial/Industrial	4.4%	6.3%	0.4%
Transportation	6.4%	6.4%	6.3%
Water & Wetland	8.4%	7.8%	9.7%

* 2002 LandSat Data from UVM Spatial Analysis Lab (SAL, 2005)

† Upslope watershed beginning at Reach M02

Historically, the impacts of agricultural practices on the Vermont landscape played an important role in the legacy effects on waterways like the Crosby Brook. Prior to the forest clearing associated with human settlement, logging, and farming, the Crosby Brook watershed would have been a mixture of deciduous and coniferous forest. Deforestation and grazing, largely from sheep farms and other agriculture, likely left much of the watershed devoid of trees at one time or another (Albers, 2000). This landscape change had a tremendous impact on waterways like the Crosby Brook. Exposed soil on steep slopes was eroded and carried to the channel where it aggraded in areas with less slope

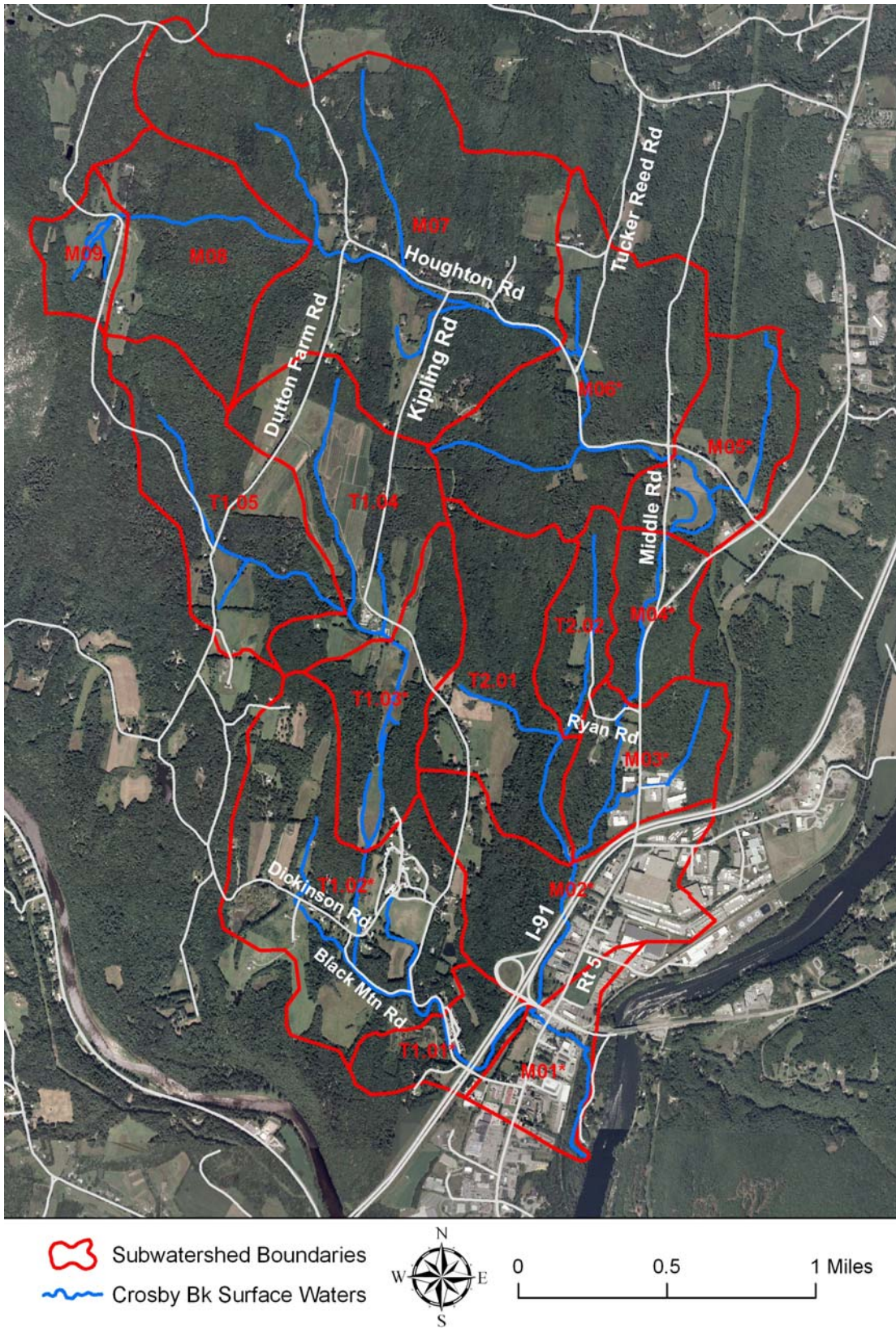


Figure 2. Crosby Brook subwatershed map. Starred reach names were selected for Phase 2 surveys.

(e.g., intersection of Routes 5 and 9); a legacy that still influences the way Vermont's rivers and streams are managed today.

During the 20th century, significant changes occurred within the Crosby Brook watershed that can be documented with historical surveys and imagery. The construction of Interstate 91 (I-91) and Route 5 reshaped the slope and profile of 3 of the lower reaches in the watershed. Prior to I-91 construction, the Crosby Brook channel occupied a wide, alluvial valley north of the confluence of both branches (Figure 3). This wide valley likely had numerous floodplain wetlands that helped attenuate fine sediment and floodflows from the upper watershed. With the construction of I-91 and the channelization of the mainstem to the west of Route 5, commercial development was likely facilitated due to the filling of floodplain wetlands. Today, commercial development in the lower watershed is dense and is the source of numerous stressors on the physical stability and habitat conditions (Figures 4 and 5).

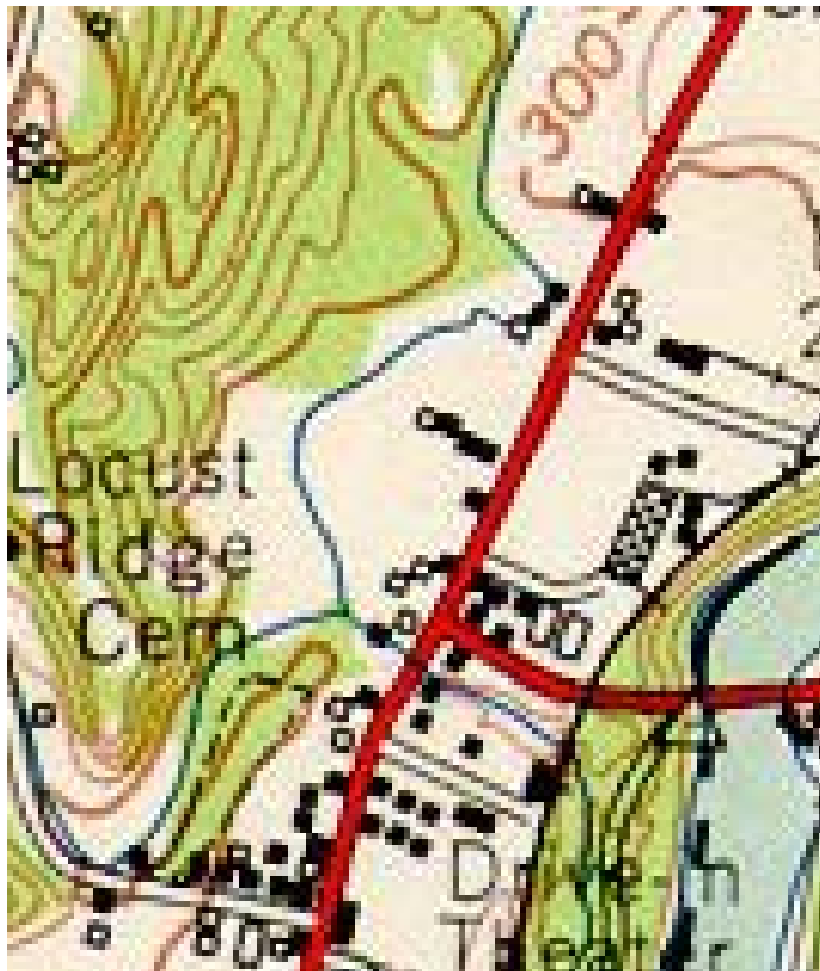


Figure 3. 1954 Topographic Survey of the area north of Brattleboro at the junction of Routes 5 and 9 prior to I-91 construction (UNH, 2008).



Figures 4 & 5. Aerial photographs from 1962 (left) and 2003 (right) showing channel straightening and an increase in commercial land use over time north of I-91 Exit 3.

2.2 Geologic & Geomorphic Setting

The underlying geology of the Crosby Brook watershed is comprised of quartz and limestone bedrocks characteristic of the Waits River Formation in the Lower Connecticut River basin (Doll et al., 1961). The Gile Mountain Formation, which is similar to the Waits River Formation and contains a mixture of schist and marble, is found in the eastern section of the watershed. The weathering of the sea bottom sediments in both of these formations results in basic soils that support communities of rich woods species. The Black Mountain formation, located to the west of the watershed, is an igneous pluton comprised of granite bedrock.

The presence of Glacial Lake Hitchcock had a profound effect on the surficial geology of the area. This lake extended from central Connecticut north through the Connecticut basin to St. Johnsbury during the retreat of the Laurentide ice sheet beginning approximately 18,000 years ago (Ridge and Larson, 1990). The great size of the lake, combined with the erosive forces of the glacier moving over bedrock surfaces allowed for

the development of annual layering of fine sediments known as varves. The varves, formed by the seasonal variations in sediment supply to the lake, can be observed throughout the lower watershed where slopes have become exposed due to erosion and gullyng.

In addition to the fine sediment deposits (e.g., clay) associated with Lake Hitchcock, a layer of dense glacial till is present throughout the watershed. Overlying the till in some areas are sand deposits that likely formed due to ice-contact (Springston, 2007). The sand deposits found along the steep valley side slopes in the lower watershed appear to be susceptible to landslides, as evidenced by the large failing slope in lower reach T1.02. Lesser amounts of large scale alluvial deposits are found in the wide, low-sloped valleys associated with reaches M05 and T1.03.

Table 2. Crosby Brook Reference Reach Characteristics

Reach	Phase	Drainage	Channel	Channel	Channel	Valley					
	2	Area	Length	Slope	Width	Width [§]	Confinement	Stream	Bedform [†]		
	Data	(sq. mi.)	(mi)	(%)	(ft.)	Sinuosity	(ft.)	Ratio	Type*	Type**	
M01	Yes	5.7	0.7	1.2	28.2	1.07	150	5.3	NW	C	Riffle-Pool
M02	Yes	3.7	0.5	0.7	23.3	1.03	227	9.7	BD	C	Riffle-Pool
M03	Yes	2.8	0.6	1.1	20.6	1.07	200	9.7	BD	C	Riffle-Pool
M04	Yes	2.6	0.6	1.4	19.9	1.10	100	5.0	NW	C	Riffle-Pool
M05	Yes	2.4	0.5	0.3	19.4	1.20	400	20.7	VB	E	Riffle-Pool
M06	Yes	2.2	0.7	2.5	18.4	1.05	150	8.1	BD	C	Riffle-Pool
M07	No	1.6	1.0	3.1	16.1	1.03	50	3.1	SC	B	Step-Pool
M08	No	0.5	0.7	7.4	9.4	1.00	15	1.6	NC	A	Step-Pool
M09	No	0.1	0.3	3.6	4.9	1.06	25	5.1	NW	B	Step-Pool
T1.01	Yes	1.8	0.5	1.4	17.1	1.03	120	7.0	BD	C	Riffle-Pool
T1.02	Yes	1.7	0.8	4.5	16.5	1.01	40	2.4	SC	B	Step-Pool
T1.03	Yes	1.1	0.8	0.2	13.5	1.06	381	28.2	VB	E	Dune-Ripple
T1.04	No	0.8	0.2	4.3	11.9	1.20	40	3.4	NC	B	Step-Pool
T1.05	No	0.4	1.0	4.9	8.9	1.03	15	1.7	NC	A	Step-Pool
T2.01	No	0.5	0.5	3.4	9.7	1.02	55	5.7	SC	B	Step-Pool
T2.02	No	0.1	0.7	4.8	5.3	1.01	15	2.8	SC	A	Step-Pool

* NW = Narrow; SC = Semi-confined; BD = Broad; VB = Very Broad

§ Valley Width estimated remotely for *italicized* values

** per Rosgen (1994)

† per Montgomery & Buffington (1997)

Crosby Brook has two main branches, referred to by VTDEC as the Mainstem and South Branch (SB). Due to the larger watershed area draining the northern branch, it was also chosen as the “Mainstem” channel in the SGA analysis. All reaches of this branch are ordered alphanumerically (beginning with M01), including the lowermost reach below

the confluence with the SB (reach M01). Prior to the confluence with the SB near I-91 exit 3, the mainstem drainage area is 3.7 square miles. The SB, referred to in the SGA database as T1 because it is the first major tributary to the mainstem, has drainage area at the confluence of 1.8 square miles. Table 2 summarizes the reference stream characteristics for the 16 study reaches.

The mainstem channel network has an overall slope of 2.3%, and a majority of its reaches have C-type channel geometry under reference conditions. Reaches along the mainstem are found in a wide array of confinement types, from very broad along Middle Road to confined in the upper reaches above Dutton Farm Road. Including the reaches assessed for Phase 2 data, grade controls were noted in reaches M01, M03, M04, and M06. During the Phase 2 surveys, the division of mainstem reaches resulted in a total of 9 segments, which are described in further detail in Section 4.2.

The SB channel network has an overall slope of 3.1%, and a majority of its reaches have A and B-type channel geometry. Many of the SB reaches are found in confined valley settings, with the exception of T1.01 and T1.03. Within the 3 reaches assessed for Phase 2 data, grade controls were noted only in reach T1.02. During the Phase 2 surveys, the division of SB reaches resulted in a total of 7 segments, which are described in further detail in Section 4.2.

2.3 Ecological Setting

The Crosby Brook watershed is found within the Southern Vermont Piedmont Biophysical Region (Thompson and Sorenson, 2000). This region is found along the eastern border of Vermont and extends from White River Junction down to Massachusetts. It is characterized by gentle rolling hills and bedrock geology that supports Northern Hardwood Forest communities. Some areas of igneous intrusions (e.g., granitic plutons) support rare communities, such as the Pitch Pine-Oak-Heath community found a top Black Mountain to the west of the Crosby Brook watershed. Rich soils of loam and silt along the Connecticut River that once supported extensive areas of silver maple (*Acer saccharinum*) and ostrich fern (*Matteuccia struthiopteris*) were converted to agricultural use during European settlement in the late 18th century. Within the Crosby Brook watershed (along Route 5), these areas were long used for agriculture but have since been converted to commercial uses.

Elevations within the watershed range from 220 feet at the confluence with the Connecticut River, up to approximately 1,100 feet at the base of Black Mountain. With an average annual rainfall of 45 inches and a temperate climate, the forest cover is

comprised primarily of mixed hardwood tree species, with areas of white pine (*Pinus strobus*) and eastern hemlock (*Tsuga Canadensis*) found within younger growth and along steeper slopes, respectively. During the Phase 2 surveys, some aggressive invasive species were noted along the channel network. Along the mainstem, garlic mustard (*Alliaria petiolata*), a low growing biennial herb that is particularly aggressive at outcompeting native ground cover, was observed in many locations. Along the SB in the vicinity of Black Mountain Road, Japanese knotweed (*Polygonum cuspidatum*) was also noted along the exposed banks and was contributing to bank instability by shading out native woody vegetation.

Extensive wetlands occupy two large areas within the watershed (NWI, 2003). Along the mainstem, a significant wetland which was likely cleared and converted to pasture during European settlement, is found along Reach M05. Along the SB, a large wetland complex is found within the wide alluvial valley of Reach T1.03. The southern area of this wetland complex was historically drained and is now utilized for recreational fields, while the northern portion is intact and has abundant beaver activity. The low lying areas around I-91 Exit 3 likely had extensive floodplain wetlands that were disconnected from the channel and filled during I-91 construction. The National Wetlands Inventory mapping does not indicate significant wetlands in this area today.

Historically, Crosby Brook has supported a healthy population of brook trout (*Salvelinus fontinalis*), a fact that is well known by local fishermen. In addition, other common coldwater species associated with brook trout would be present in the watershed under reference conditions, such as slimy sculpin (*Cottus cognatus*), blacknose dace (*Rhinichthys atratulus*), and creek chub (*Semotilus atromaculatus*). A summary of current biological community based on recent VTDEC sampling is included in Section 2.5.

2.4 Channel and Floodplain Management History

Extensive channel straightening was carried out on both branches during the construction of I-91 in the late 1950's and early 1960's (see Figures 4 and 5). Straightening in the lower watershed has been problematic for water quality and habitat conditions by causing: 1) a simplification of the channel morphology and a loss of habitat for aquatic biota, 2) wetland floodplain disconnection in Reaches M01 and T1.01, and 3) increased sediment transport capacity to the lowest reach of the watershed, M01, where biotic conditions have suffered the greatest decline (VTDEC, 2005). Although the riparian vegetation has recovered along stretches of both reaches, the bank armoring and adjacent berms prevent the redevelopment of sinuosity and floodplain in what would otherwise be an alluvial, sediment attenuating zone of the watershed.

In addition to historical impacts from the I-91 construction, recent commercialization of the Route 5 corridor has likely increased runoff to the channel, and in some cases has resulted in direct alteration to the channel planform. In Reach M02, the area immediately downstream of the I-91 crossing was more recently straightened to make way for a car dealership (Figure 6). Additional straightening in the lower watershed such as this has exacerbated the problems summarized above, and led to further degraded biotic integrity.

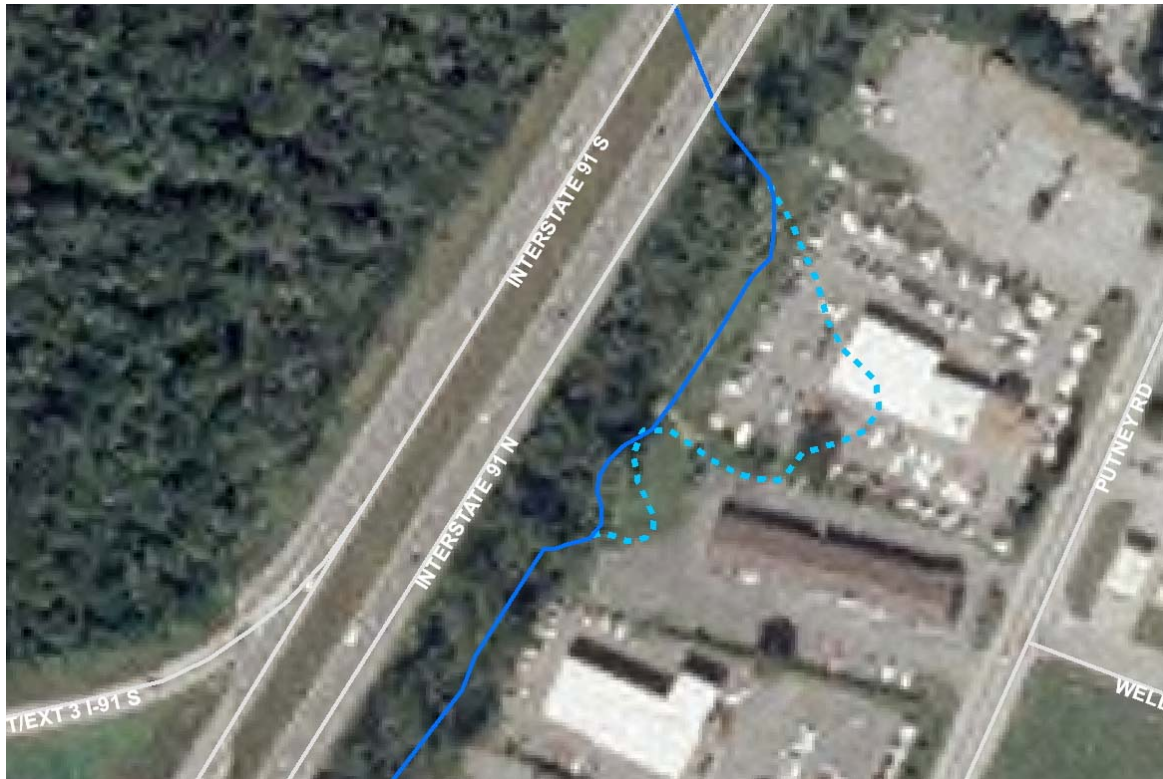


Figure 6. Area of straightening to accommodate increased commercial development. The 1962 channel location is shown as dashed blue and the current location is solid blue.

2.5 Recent Biological Sampling

Crosby Brook is classified as a Class B/Coldwater fishery per the Vermont Water Quality Standards. VTDEC undertook an extensive sampling effort in the watershed beginning in 2002 in order to better understand the environmental stressors on the aquatic community (VTDEC, 2005). The macroinvertebrate and fish communities were sampled at 9 locations along the mainstem and SB. The reaches were sampled over the course of 3 years to better understand the temporal changes in the watershed. In addition, the sample sites spanned from the mouth to headwaters to assess the impact of increased in urban land use and riparian modifications in a downstream direction along both channel networks. An excerpt of the data and findings has been included in Appendix D. The findings indicate that the upper reaches of both branches have adequate habitat conditions

to support the expected macroinvertebrate communities. However, below I-91 the fish and macroinvertebrate communities of both branches decline to fair and poor conditions. The lowest sample site prior to the confluence with the Connecticut River has consistently shown fair and poor macroinvertebrate assemblages. Based on the assemblage characteristics, the lower areas of the watershed appear to be stressed by temperature, siltation of the bed substrate with fine sediments, and habitat alterations resulting from channel straightening.

3.0 Data Collection Methods

The Vermont River Management Program (RMP) has invested many person-years of effort into developing a state-of-the-art system of Stream Geomorphic Assessment (SGA) protocols. The SGA protocols are intended to be used by resource managers, community watershed groups, municipalities and others to identify how changes to land use affect hydro-geomorphic processes at the landscape and reach scale, and how these changes alter the physical structure and biotic habitat of streams in Vermont. The SGA protocols have become a key tool in the prioritization of restoration projects that will 1) reduce sediment and nutrient loading to downstream receiving waters such as Lake Champlain and the Connecticut River, 2) reduce the risk of property damage from flooding and erosion, and 3) enhance the quality of instream biotic habitat. The protocols are based on defensible scientific principles and have been tested widely in many watersheds throughout the state. Data collected for the Crosby Brook watershed using the protocols forms the basis for the preliminary project identification carried out as part of the River Corridor Planning effort.

The SGA protocols include three phases (VTDEC, 2007). Phase 1 assessments employ remote sensing techniques, along with limited field verification, to identify background conditions in the watershed. The Phase 1 approach results in watershed-scale data about the landscape (e.g., soils and land cover) and the stream channel (e.g., slope and form), providing a basis for understanding the natural and human-impacted conditions within the watershed. The Phase 2 approach builds upon Phase 1 data through the collection of reach-specific data about the current physical conditions. Characterization of reach conditions utilizes a suite of quantitative (e.g., channel geometry, pebble counts) and qualitative (e.g., pool-riffle habitat) measurements to calculate two indices: Rapid Geomorphic Assessment (RGA) Score; Rapid Habitat Assessment (RHA) score. Using the RGA scores in conjunction with knowledge about the background or “reference” conditions, a sensitivity rating is developed to describe the degree to which the channel will adjust to human impacts in the future. Phase 3 surveys involve the collection of detailed, reach-scale survey data for use in project development and monitoring.

Phase 1 data were collected by FEA for the entire watershed in 2007 and summarized for the mainstem and SB (FEA, 2007). A total of 16 reaches were identified during the Phase 1 analysis for the 10.1 mile channel network, and 9 reaches were selected for further Phase 2 assessment in 2008, including 6 reaches on the mainstem and 3 reaches on the SB. A total of 16 segments were assessed for Phase 2 data, and data were entered into the Data Management System (DMS). All major human impacts and natural features noted during the Phase 2 surveys were indexed in a GIS using the Feature Indexing Tool (FIT; VTDEC, 2007). Reach summary statistics and DMS reach sheets are included in Appendix B. Bed substrate histograms and cross-section plots are included in Appendices E and F on a CD-ROM, respectively. Digital photographs are also included in Appendix G on the CD-ROM.

RMP staff shared responsibility with FEA for the Quality Assurance and Control (QA/QC) of the Phase 1 and 2 datasets. The DMS database for Phase 2 reaches was finalized in June, 2008. A QA/QC summary is included in Appendix C.

4.0 Results

The following section summarizes the results of the field observations and data analysis. Section 4.1 summarizes watershed-scale stressors on the physical stability and habitat conditions of the channel as well as broad approaches to addressing these stressors. Section 4.2 summarizes reach-scale conditions and stressors. A discussion of broad-scale projects that will be further explored during the forthcoming River Corridor Planning phase of the Crosby Brook study is included in Section 5.0. Reach-scale mapping and data summaries are included in Appendices A and B, respectively.

4.1 Watershed Scale Stressors

4.1.1 Hydrologic Regime Impacts

The impacts of urbanization on waterways has been studied across many ecoregions of the US (CWP, 2003), with a growing body of evidence showing the high sensitivity of stream systems to development. Many stream ecologists across the country have shown that urban land use has detrimental effects on aquatic biota (Coles et al., 2004; Fitzpatrick et al., 2004), and watershed scientists have long known that urban land use increases sediment and nutrient loading to receiving waters (CWP, 2003). Research is beginning to show the effects of stormwater runoff on relative sediment yield due to channel

instability (Trimble, 1997; Nelson and Booth, 2002), and on physical habitat conditions (Coles et al., 2004; McBride and Booth, 2005).

The Crosby Brook watershed has a moderate degree of impervious cover, with much of it concentrated in the lower watershed. By comparing the response of sensitive biota in the lower Crosby Brook to other study sites in urbanizing watersheds in Chittenden County (Figure 7), we see a similar response. The Crosby Brook watershed, although only moderately urbanized, supports a reduced community of sensitive biota. Further development within the watershed without the use of the effective stormwater BMPs to mitigate these impacts could further degrade the biotic communities in the lower watershed.

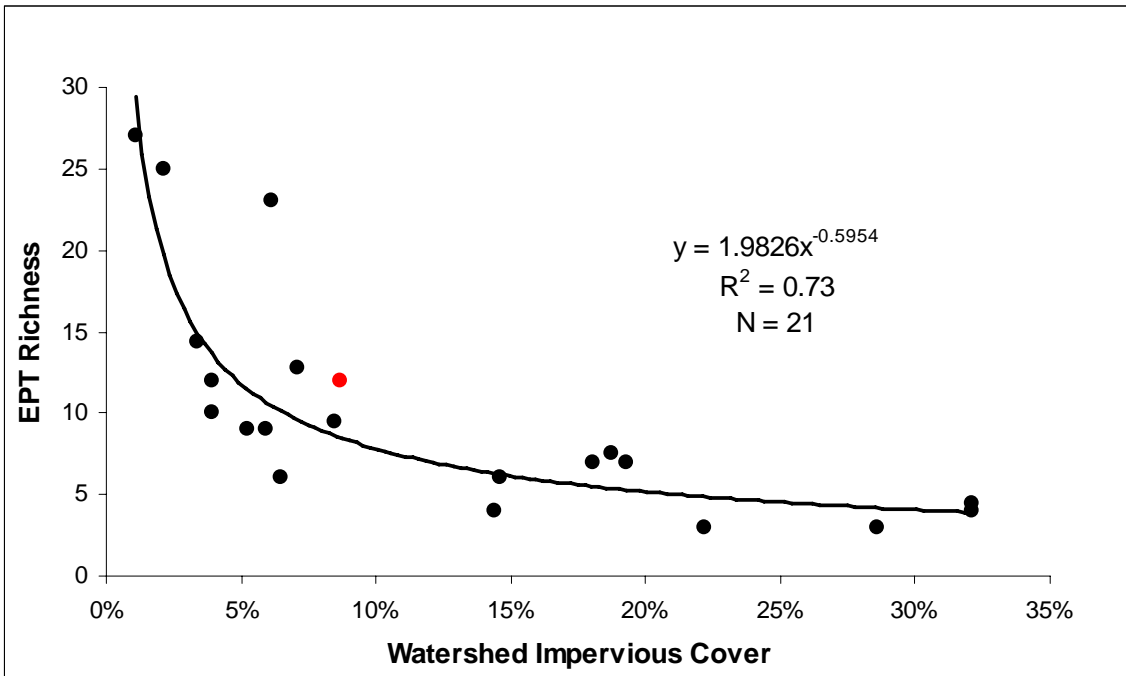


Figure 7. Response of sensitive macroinvertebrates to impervious cover for study sites in Chittenden County (Fitzgerald 2007). Crosby Brook data point (VTDEC, 2005) for Reach M01 shown in red.

Seasonal temperature data collected by VTDEC for sites on the mainstem and SB of Crosby Brook show elevated temperatures in the lowest reach (M01). During the late summer months, numerous consecutive days had stream temperatures that exceeded the upper tolerance limits of brook trout. Elevated temperatures in M01 are likely brought on by a number of direct and indirect impacts from urbanization, including 1) loss of riparian vegetation along the stream banks resulting in greater solar radiation, 2) brief summer rainfall events carrying excess heat energy from adjacent impervious cover directly to the channel, and 3) reduced influx of cooler groundwater to the channel.

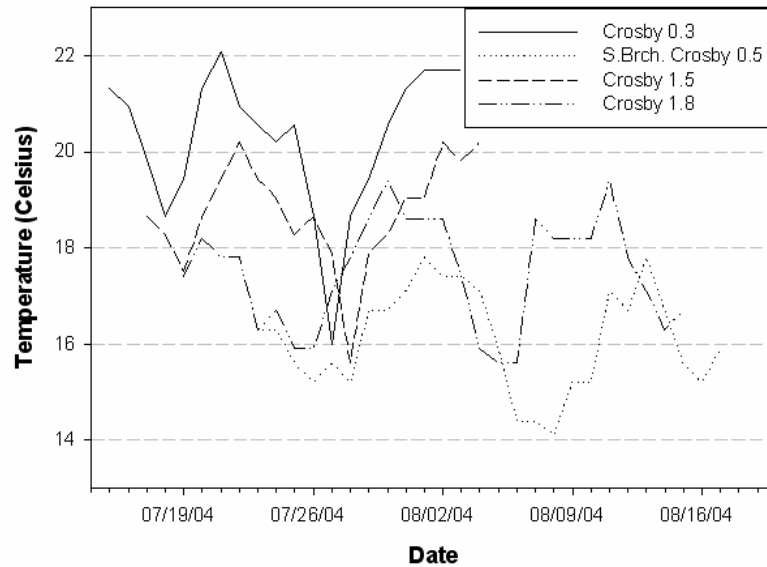


Figure 8. VTDEC (2005) temperature data for 3 mainstem and one SB sample site, with values reflecting stream miles upstream of outlet (mainstem) or confluence (SB).

4.1.2 Sediment Regime Impacts

A high degree of sedimentation of fine sands has been observed in the lower reaches of Crosby Brook, contributing to the degraded biological conditions. While some upland and instream sources of fine sediment have been observed and mapped by VTDEC in the past, including the large gully on the mainstem (Figure 9), this study sought to: 1) understand the relative impact of known sediment sources, and 2) identify and map additional sources of sediment in the watershed.



Figure 9. Gully on Pepsi Property draining to lower Reach M03.

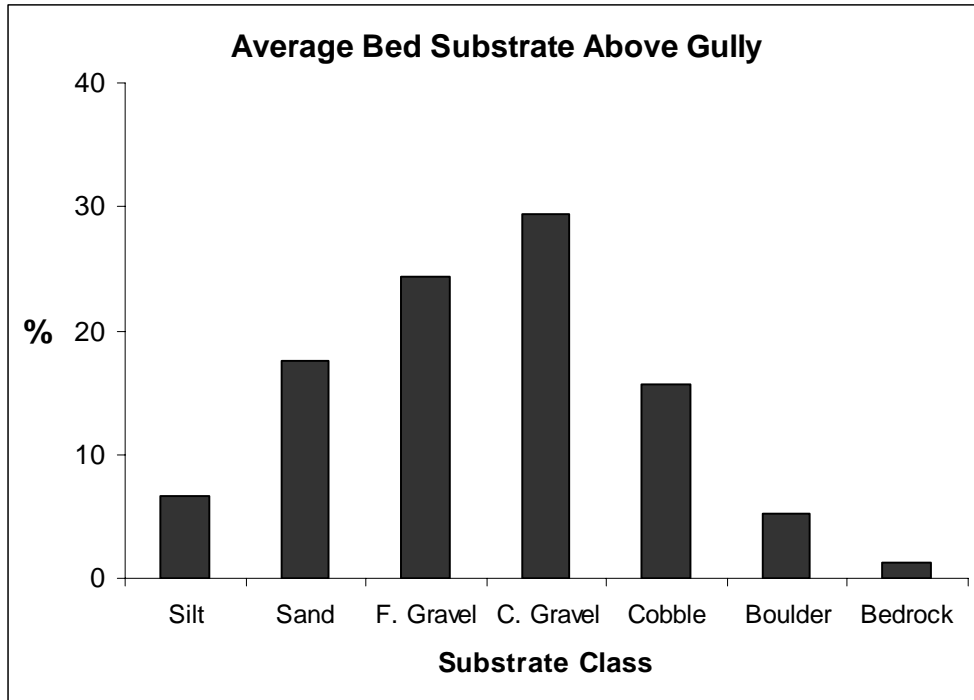


Figure 10. Average bed substrate for all assessed reaches above gully (average channel slope = 1.5%).

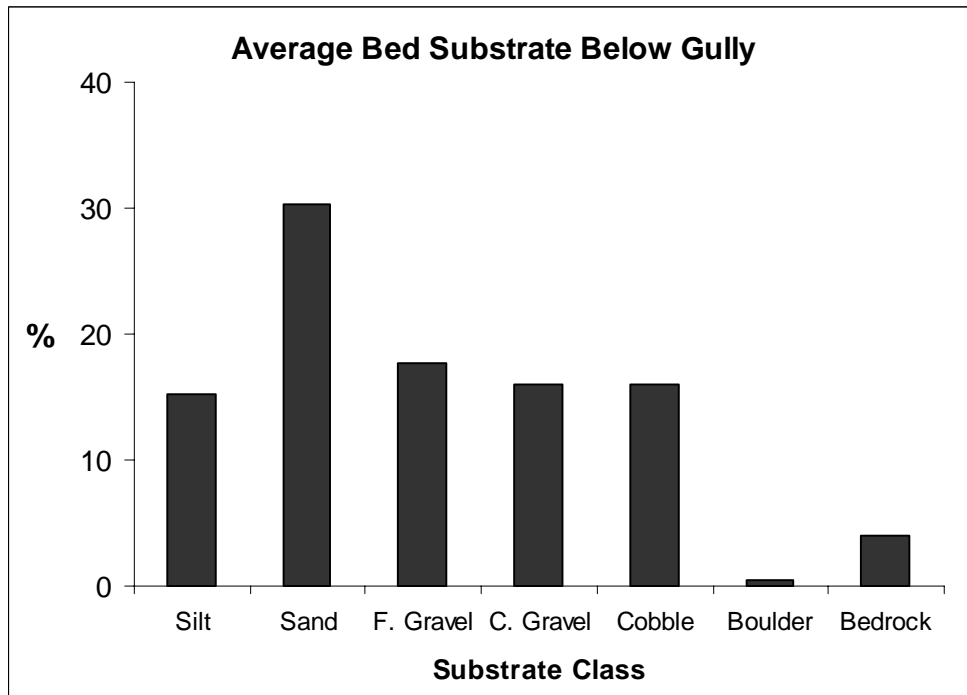


Figure 11. Average bed substrate for all assessed reaches below gully (average channel slope = 1.1%).

The volume of sediment delivered by the mainstem gully was calculated by VTDEC to be 32,000 ft³, or the equivalent of 85 dump truck loads of fine sediment since the

initiation of the headcut in approximately 1960 (VTDEC Stormwater, 2007). Using the bed substrate data collected during the Phase 2 surveys, average bed substrate histograms were compiled for the sample sites above and below the gully confluence with the mainstem. Upstream of the gully, where sediment sources are mainly limited to mass failures along the channel boundaries, the modal substrate class was coarse gravel (16 – 64mm), with a normal distribution around the mode (Figure 10). Below the gully, there is a clear and sharp increase in the degree of fine sediments in the channel, with a modal class of sand and a distribution that is skewed towards the finer classes. The increase in fine sediments reduces fish and macroinvertebrate habitat by filling pools, embedding larger substrate, and reducing dissolved oxygen levels. The net effect of increased fine sedimentation and impacts to the hydrologic regime are seen in the reduced richness values in the lowest reaches.

The mass failure in segment T1.02-A along Black Mountain Road is also a significant source of sediment in the SB channel. However, a similar data summary compiled for reaches upstream and downstream of the slope failure do not show a distinct difference as seen in the mainstream reaches. Further discussion of the sediment impacts associated with the mass failure is included in the T1.02-A segment summary in the following section.

4.2 Reach Summaries

Mainstem Reaches

M01-A

Segment M01-A is found from the confluence with the Connecticut River up to a change in slope where the channel turns west towards the railroad tracks. The segment is 0.4 miles long and has an overall channel slope of approximately 3.0%. The semi-confined valley setting and low entrenchment ratio ($ER = 1.2$) indicated A_b channel geometry (Rosgen, 1994) with step-pool bed morphology (Montgomery and Buffington, 1997). Near the mouth there is a high degree of deposition of fine sands and silts (Figure 12), and the formation of bar features appears unnatural for the high-gradient nature of the channel. There are two large grade controls in the middle and upper section of the reach that control potential vertical adjustments, and likely act as a barrier for fish migration from downstream (Figure 13). VTDEC fish sampling results indicate that fish species typically observed in small tributaries to the Connecticut River were absent above the lowermost waterfall (VTDEC, 2005). One stream ford provides access across the channel from Connecticut River Drive, and has resulted in minor impacts to the channel from the removal of riparian vegetation.



Figure 12. Fine sediment deposition in lower M01-A Figure 13. Large grade control in middle of M01-A

A very high degree of sedimentation was observed throughout the segment, even in higher gradient areas. The cross-section taken in a high gradient portion of reach shows a high sedimentation of fines despite the high transport capacity. The bed is dominated by cobble (42%), however the plot of substrate classes indicates an increase in sand and silt sediments (38%). Because of the bedrock controls and limited direct impacts to the channel, the majority of the segment is stable (RGA condition “Good”, CEM stage I); however there is significant aggradation in the lower segment as noted above. There is good habitat diversity due to numerous pools and a protected riparian corridor and buffer (RHA condition “Good”); however upslope sources of fine sediments are severely compromising habitat quality. The LWD density for this reach was above the average for mainstem reaches (108 pieces/mile).

M01-B

Segment M01-B is found from a break in slope near the railroad tracks up to the confluence with the SB. The segment is 0.3 miles long and has an overall channel slope of approximately 0.5%. Under reference conditions we would expect this segment to be found in a broad, alluvial valley that supports a meandering channel profile. Encroachments from the railroad, Route 9, and commercial development upon the channel have reduced the available floodplain area. As a result, the channel is found in an altered, semi-confined valley setting with a lower than expected entrenchment ratio (ER = 2.8). Channel and floodplain measurements indicated C-type channel geometry with riffle-pool bed morphology. Numerous slope failures were noted along the right bank of the segment, some reaching heights of 12 feet (Figure 14). Channel incision (IR = 1.5), likely caused by a decreased belt-width and floodplain area as well as increased in stormwater runoff from nearby impervious cover, is exacerbating the increased sediment supply from the slope failures through further downcutting at the slope toes. Bank armoring was present along the left bank mid-segment, and the limited woody buffer

vegetation in the upper reach (Figure 15) likely results in increased summer stream temperatures.



Figure 14. Mass failure in lower M01-B



Figure 15. M01-B above Route 5 crossing.

A very high degree of fine sedimentation was observed throughout segment. The cross-section taken in a high gradient portion of reach shows a high sedimentation of fine sediments. The bed is dominated by sand (49%), with lesser amounts of fine gravel (27%) and silts (13%). Due to the change in valley morphology and the moderate to high channel incision noted throughout, the segment is moderately unstable with a high degree of vertical and lateral adjustment processes (RGA condition “Fair”, CEM stage II). There is fair to good habitat diversity due to numerous pools and riffles, however the increase in fine sediments and limited buffer and corridor protection resulted in a decreased habitat score (RHA condition “Fair”). VTDEC sampling data indicate that the presence of a well-defined riffle-pool profile in the lower segment supports a good to fair biotic community, however the impacts of increased fine sediments were noted in the high proportion of species tolerant to pollution. The LWD density for this reach was well below the average for mainstem reaches (47 pieces/mile).

M02

Reach M02 is found from the confluence with the SB up to the confluence with the next major tributary (T2) upslope of the I-91 crossing. The reach is 0.5 miles long and has an overall channel slope of 0.7%. Under reference conditions we would expect this reach to be found in a broad, alluvial valley that supports a meandering channel profile. Extensive channel straightening (approximately 90% of reach length) from the construction of I-91 and more recent encroachments from commercial development along Route 5 has reduced the channel to a simplified form with no floodplain access and limited habitat diversity. Similar to Segment M01-B, M02 is found in an altered, semi-confined valley setting with a very low entrenchment ratio ($ER = 1.5$). Channel and floodplain

measurements indicated the reach has undergone a stream type departure from C-type geometry with riffle-pool bedform to F-type geometry dominated by plane bed features (Figure 16). Despite the increased channel slope, sediment supply from upslope sources (e.g., gully on Pepsi property) appears to be exceeding transport capacity, as a high degree of sand and fine gravel sedimentation was observed below the I-91 crossing.



Figure 16. Plane bed morphology in lower M02



Figure 17. Large mass failure in upper M02

Above the I-91 crossing near the reach break with M03, the channel has begun to redevelop sinuosity in the absence of hard bank armoring. It is evident that a slope change (e.g., headcut) initiated by the I-91 construction migrated upslope through this area, as the channel profile at the reach break suggests stage IV of channel evolution (Schumm, 1977). This concept is further supported by the widening and aggradation (stage III) observed in the lower section of reach M03 downstream of a grade control. In upper M02, the redevelopment of a sinuous planform has caused recent slope failures that supply large amounts of sand sediments (fill from I-91 construction) to the channel (Figure 17).

Due to the departure in valley and channel morphology and the high channel incision, the segment is considered extremely sensitive to further human impacts (RGA condition “Poor”, CEM stage II). There is very limited habitat diversity due to extensive straightening, increase in fine sediments, and limited buffer and corridor protection (RHA condition “Poor”). VTDEC sampling data indicate that the fish and macroinvertebrate communities have been highly impacted, supporting fair to poor conditions. The LWD density for this reach was the lowest for any of the mainstem reaches (30 pieces/mile).

One remaining area of undeveloped corridor in the lowermost section of M02 is worth noting from a project identification perspective. This area is found from the Exit 3 ramp up to the first commercial development within the stream corridor (Figure 18).

Approximately 550 feet of undeveloped land is found to the east and west of the current channel, however the channel has shown no signs of redeveloping a sinuous planform due to the historic channel straightening and deepening. This area will be explored in further detail during the preliminary project identification effort.



Figure 18. Undeveloped corridor in lower M02 immediately upstream of the Exit 3 ramp.

M03

Reach M03 is found from the confluence with the T2 up to a break in channel slope immediately upstream of Ryan Road. The reach is 0.6 miles long and has an overall channel slope of 1.1%. The broad valley and channel measurements indicated the reach has C-type geometry with riffle-pool bedform. A grade control is found mid-reach that has limited the extent to which channel adjustments caused by I-91 construction affect the reach. Below this grade control significant channel widening was observed, with aggradation from the adjacent gully on the Pepsi property exacerbating these adjustments (Figure 19). Above the grade control, a more sinuous planform was observed, however channel incision was still noted in this area ($IR = 1.5$). A small berm was noted along the left bank of the historically-straightened section adjacent the open field. The potential removal of this berm to increase floodplain access in the upper reach will be further explored during the preliminary project identification effort. The culvert beneath Ryan

Road is perched, causing minor erosion downstream, and likely limiting the migration of fishes upstream (Figure 20).



Figure 19. Aggradation and widening in lower M03.



Figure 20. Perched culvert beneath Ryan Road.

Due to the increased aggradation from the gully and ongoing channel incision and widening, the channel has a very high sensitivity to ongoing impacts (RGA condition “Fair”, CEM stage III). Overall the habitat conditions of the reach were fair to good, with good epifaunal substrate and cover. However, a relatively high degree of embeddedness from increases in fine sand (23% of bed substrate) resulted in a reduced habitat score (RHA condition “Fair”). The LWD density for this reach was very high due to the healthy riparian buffer in the lower reach and high recruitment (105 pieces/mile).

M04

Reach M04 is found from the Ryan Road crossing up to the Middle Road crossing. The reach is 0.6 miles long and has an overall channel slope of 1.4%. The broad valley and channel measurements indicated the reach has C-type geometry with riffle-pool bedform. Some areas of the valley are narrow to confined where the Route 5 embankments occupy the historic valley, however there is still accessible floodplain within these areas. A cross section taken mid-reach indicates good floodplain connectivity with little channel incision (Figure 21). A grade control is found in the lower reach that limits potential vertical adjustments along the channel network. In the upper reach where the valley widens, the site of an old beaver impoundment has altered the riparian vegetation (Figure 22). A second cross section taken in this location indicates similar channel dimensions and substrate to the lower reach. Moderate aggradation of gravel associated with two large debris jams was noted immediately downstream of the Middle Road crossing. If further aggradation occurs, erosion and flooding downstream of the road crossing could become problematic.



Figure 21. Accessible floodplain mid-reach in M03. Figure 22. Old beaver impoundment in upper M04.

The channel stability and floodplain connectivity was good throughout the reach. (RGA condition “Good”, CEM stage I). Overall the habitat conditions of the reach were good, with excellent epifaunal substrate and cover and limited embeddedness (RHA condition “Good”). The LWD density for this reach was very high due to the healthy riparian buffer in the lower reach and high recruitment potential (113 pieces/mile).

M05

Reach M05 is found from just upstream of the first Middle Road crossing up to the second Middle Road crossing to the north. The reach is 0.6 miles long and has an overall channel slope of 0.3%. The very broad valley and low width-to-depth ratio of the channel indicated the reach has E-type geometry with riffle-pool bedform. The wide alluvial valley probably formed in conjunction with the channel meandering throughout, however historic channel straightening appears to have relocated the channel along the left valley wall to make way for pasture or hay fields. A cross section taken mid-reach indicates good floodplain connectivity with little channel incision ($IR=1.1$; Figure 23), despite the presence of some terraces in the lower and upper reach. One minor tributary enters the main channel from the east and has developed a large gully that extends 70 feet upstream. This gully is supplying large amounts of sediment to the channel, resulting in aggradation and a large mass failure immediately downstream. This area will be explored in further detail during the preliminary project identification effort.



Figure 23. Cross-section mid-reach in M05.



Figure 24. Lack of riparian buffer in upper M05.

The channel stability and floodplain connectivity was good throughout the reach, with some evidence of floodplain redevelopment in the upper and lower reach (Figure 24; RGA condition “Good”, CEM stage IV). Overall the habitat conditions of the reach were fair, with good epifaunal substrate and cover and limited embeddedness, but with reduced riparian vegetation and buffer in the upper reach (RHA condition “Fair”). The LWD density for this reach was very low due to the lack of a healthy riparian buffer on the right bank and limited recruitment potential (44 pieces/mile).

M06-A

This is a short segment found just upstream of the Middle Road crossing. The segment is 0.2 miles long and has channel slope of 2.8%. The segment is situated in a broad valley prior to a transition to a narrow valley in the upslope segment. Channel dimensions measured at the cross section indicate the segment has C_b geometry with riffle-pool bedform. There are two large mass failures mid-segment along the right bank where the channel cuts into the steep valley slope, comprised of sand substrate (Figure 25). These slope failures appear to be worsened by channel incision brought on by a small area of dredging immediately upslope. There is a small cistern that diverts water to an adjacent pond (Figure 26), and the gravel deposition upslope of the diversion was removed (time frame of removal is not clear) to protect the instream structure.



Figure 25. Mass failure in Segment M06-A.



Figure 26. Cistern pond diversion in M06-A.

Channel incision was evident at the cross section in the upper segment ($IR = 1.9$). The channel stability and floodplain connectivity was fair throughout the lower segment, resulting in a segment with a moderate degree of vertical adjustment and a very high sensitivity to further human impacts (RGA condition “Fair”, CEM stage II). Overall the habitat conditions of the segment were good, with adequate epifaunal substrate and cover and limited embeddedness, and with healthy riparian vegetation and buffer (RHA condition “Good”). The LWD density for this segment was slightly below the average for the mainstem reaches (72 pieces/mile).

M06-B

This segment is found from a change in valley width and slope up to the crossing of Houghton Road. The segment is 0.2 miles long and has channel slope of 3.2%. The segment is situated in a narrowly confined valley prior to another transition back to a broad valley in the upslope segment. Channel dimensions measured at the cross section indicated B-type geometry with step-pool bedform, and cobble substrate. Although Houghton Road occupies part of the historical valley, and has reduced the floodplain area ($ER = 1.6$), the segment has adequate vertical controls and appeared stable with excellent step-pool formation (Figure 27). One grade control was noted in the lower segment. The culvert beneath Houghton road is undersized but did not show signs of significant erosion or scour at the outfall (Figure 28).



Figure 27. Step-pool bedform in M06-B.



Figure 28. Houghton Road culvert in upper M06-B

Although the floodprone area was reduced by the presence of the adjacent road, resulting in a lower than expected entrenchment ratio ($ER = 1.6$), no channel incision was noted at the cross section. The channel stability was good throughout, resulting in a segment with a limited adjustment processes and a moderate sensitivity to further human impacts (RGA condition “Good”, CEM stage II). Overall the habitat conditions of the segment were good, with excellent epifaunal substrate and cover and limited embeddedness (RHA condition “Good”). The LWD density was average for the mainstem reaches (85 pieces/mile).

M06-C

This segment is found from the first crossing of Houghton Road up to the second crossing. The segment is 0.3 miles long and has channel slope of approximately 1.0%. It is situated in a broad valley following a transition from the confined valley in the downstream segment. Channel dimensions measured at the cross section indicated C-type geometry with riffle-pool bedform, and coarse gravel substrate (Figure 29). Good floodplain connectivity was noted throughout, and field measured channel dimensions corresponded well to those predicted by the VTDEC hydraulic geometry regressions (VTDEC, 2007). One area of increased aggradation of gravel and sand was observed mid-reach and is caused by two large debris jams. Immediately upstream of the Tucker Reed Road crossing are direct channel impacts associated with a residence on the right bank. Lack of woody buffer vegetation is causing bank erosion on the right bank, and an old dam (with a defunct sluice gate) once used to create an on-stream pond is still in place (Figure 30). The channel has been reshaped immediately upstream of the structure, and hard bank armoring is protecting the upslope banks from eroding. However, the upstream banks are very high (due to historic aggradation behind the dam) and will likely fail in the long-term.



Figure 29. C-type geometry in M06-C.



Figure 30. Dam and sluice gate in upper M06-C.

Despite the direct channel impacts noted in the upper segment, the overall stability was good throughout, resulting in a segment with a limited to minor adjustment processes (RGA condition “Good”, CEM stage I). The overall habitat conditions of the segment were good, with reference riffle-pool formation and limited embeddedness (RHA condition “Good”). The LWD density for this segment was very high due to the healthy riparian buffer and high recruitment potential, as well as the large debris jam mid-segment (194 pieces/mile).

South Branch (SB) Reaches

T1.01

This is the lowermost reach of the SB of Crosby Brook. It is found from the confluence with the mainstem up to a sharp bend in the channel along Black Mountain Road. The reach is 0.5 miles long and has channel slope of 1.4%. Due to the impacts from the construction of I-91, the reach has undergone a similar departure from reference conditions as nearby Reach M02. Under reference conditions we would expect this reach to be found in a broad, alluvial valley that supports a meandering channel profile. Extensive channel straightening (approximately 50% of reach length) from the construction of I-91 and encroachments along Black Mountain Road has reduced the channel to a simplified form with no floodplain access and limited habitat diversity. The reach is currently found in an altered, narrow valley setting with an unnaturally low entrenchment ratio ($ER = 1.5$). Channel and floodplain measurements indicated the reach has undergone a stream type departure from C-type geometry with riffle-pool bedform to F-type geometry dominated by plane bed features (Figure 31).



Figure 31. F-type geometry in upper T1.01.



Figure 32. Severe bank erosion below I-91 culvert.

Two other areas of the reach are noteworthy. In the lowermost section of the reach, approximately 200 feet upstream of the confluence with the mainstem, there is an adjacent intact wetland along the right bank. This wetland extends for approximately 350 feet along the channel, providing valuable floodplain access prior to the channel entering the highly urbanized zone. This wetland floodplain will be further explored for protection during the project identification effort. Secondly, there is severe bank erosion occurring on the right bank downstream of the I-91 culvert (Figure 32). Although this erosion is not immediately endangering adjacent infrastructure, it represents a significant supply of sediment to the channel.

Due to the departure in valley and channel morphology and the high channel incision (due to human elevated floodplain), the reach is considered extremely sensitive to further human impacts (RGA condition “Fair”, CEM stage II). There is very limited habitat diversity due to extensive straightening and limited buffer and corridor protection (RHA condition “Fair”). VTDEC sampling data indicate that the fish and macroinvertebrate communities have not been impacted by the historic impacts to the channel, as good to excellent conditions were noted during two years of sampling. The LWD density for this reach was average for the SB reaches (47 pieces/mile).

T1.02-A

This segment was delineated to capture the short, unconfined section of channel associated with the large mass failure along Black Mountain Road. It is found from the sharp bend in the channel along Black Mountain Road up to 200 feet south of the intersection with Kipling Road. The segment is 0.2 miles long (1000 feet), and the field measured channel slope was 2.2%. One headcut was noted in the lower reach that is causing a disconnect between the channel and floodplain. Two channel cross sections were measured to better understand the variability in channel incision within the segment.

One cross section in the lower segment below the headcut revealed severe incision (IR = 1.9), while another above the headcut indicated only minor incision (IR = 1.1). The incised section of the segment represents a majority (~70%), and has likely been exacerbating the increased supply of sediment to lower reaches from the mass failure (Figure 33) and other bank failures (Figure 34).



Figure 33. Large mass failure in upper T1.02-A.



Figure 34. Bank erosion mid-segment T1.01-A.

The large mass failure is found along the right bank, and measures 130 feet in length by 35 feet in height. Based on observations by Brattleboro Town officials, the slope failure has become worse in recent years. A review of historical photography from 1962 suggests that the failure did not exist at that time (Figure 35), and has perhaps developed as a result of increased incision at the site since that time period.



Figure 35. 1962 aerial photograph of T1.02-A. Red arrow points to current site of mass failure.

Due to the severe incision and channel adjustment features, this segment is considered highly sensitive to further human impacts (RGA condition “Fair”, CEM stage II). The habitat diversity is compromised by aggradation of fine sediments from the slope failure, and a loss of bed features due to the channel incision (RHA condition “Fair”). The LWD density for this segment was slightly above the average for SB reaches (58 pieces/mile).

T1.02-B

This segment found the intersection of Kipling and Black Mountain Roads up to the next road crossing. The segment is 0.3 miles long and has channel slope of approximately 5.6%. Due to the impacts from the encroachment of Black Mountain Road, the segment has undergone a departure from reference conditions. Under reference conditions we would expect this reach to have B_a channel geometry, and a narrow but accessible floodplain. Extensive channel encroachment (95% of segment length) from the road bed and berm along Black Mountain Road has reduced the channel to a simplified form with no floodplain access and limited habitat diversity. The channel currently has an unnaturally low entrenchment ratio (ER = 1.3), and a disconnected, human elevated floodplain (IR/HEF = 2.6). Channel and floodplain measurements indicated the reach has undergone a stream type departure from B-type to F-type geometry (Figure 36). Step-pool bed morphology was dominant, but large stretches of channel also exhibited plane bedform. Severe bank erosion is extensive along the right bank (Figure 37), but is limited along the left bank due to road bed armoring.

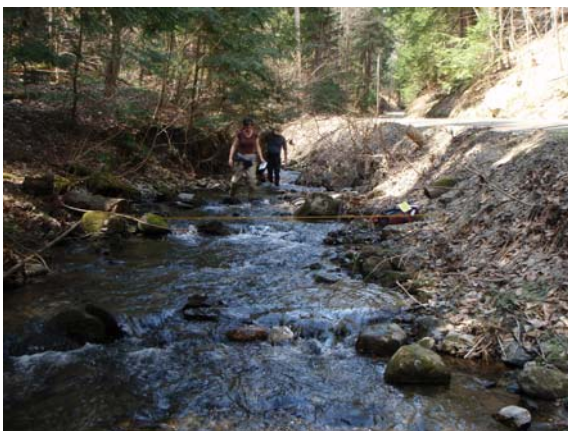


Figure 36. F-type geometry in T1.02-B.



Figure 37. Bank erosion in lower T1.02-B.

Due to the departure in valley and channel morphology and the high channel incision (due to human elevated floodplain), the segment is considered extremely sensitive to further human impacts (RGA condition “Poor”, CEM stage II). There is very limited habitat diversity due to extensive encroachment and limited buffer and corridor

protection (RHA condition “Fair”). The LWD density for this segment was slightly above the average for SB reaches (59 pieces/mile).

T1.02-C

This short segment is found from the last Black Mountain Road crossing up to a sharp change in channel slope and valley confinement at the Dickinson Road crossing. The segment is 475 feet long and has channel slope of approximately 7.0%. Immediately upstream of the road crossing is an 18 foot waterfall, followed by a series of grade controls in the lower segment. There is excellent step-pool formation mid-segment (Figure 38), followed by another series of ledge grade controls in the upper segment (Figure 39). Channel and floodplain measurements indicate a stable A-type channel.



Figure 38. Step-pool bedform in T1.02-C.



Figure 39. Bedrock grade controls in upper T1.02-C.

The segment is stable and has good riparian buffer protection. Reference conditions were noted for channel stability and habitat conditions (RGA/RHA conditions “Reference”). The LWD density for this segment was slightly above the average for SB reaches (55 pieces/mile).

T1.02-D

This short segment (700 feet) was delineated to describe the change in channel and valley dimensions that occur immediately downstream of the Dickinson Road crossing. At this point the valley widens to an unconfined setting, and the channel slope decreases to approximately 0.5%. An old impoundment (with a breached dam) is located at the segment break below Dickinson Road. This impoundment appears to be aggrading fine sediment from upslope areas (Figure 40), and a significant source of road sediment runoff was noted during the field assessment on the upstream side of the road crossing (Figure 41). Brattleboro Town officials were made aware of the problem during a site visit in April, 2008. The culvert beneath Dickinson Road is severely undersized (3.0 feet width)

with respect to the upstream stable channel width (9 feet). This has the effect of increasing flooding in the field along the right bank upstream of the crossing, perhaps alleviating flooding problems downstream along Black Mountain Road where more undersized culverts exist. Nevertheless, the inadequate capacity of the culvert to accommodate larger streamflows has resulted in a partially failed headwall on the upslope end – a problem that will likely need to be addressed by the Town in the near future.



Figure 40. Old impoundment in lower T1.02-D



Figure 41. Sediment source from Dickinson Road.

The channel dimensions indicate E-type channel geometry with some riffle-pool formation in the upper segment. Some channel incision was noted in the cross section mid-segment ($IR = 1.6$). A small terrace is forming along the lower banks that suggests stage II of channel evolution. Due to the incision and lack of a healthy riparian buffer, fair physical stability and habitat was noted (RGA/RHA conditions “Fair”). Due to limited recruitment potential, the LWD density for this segment was well below the average for SB reaches (16 pieces/mile).

T1.02-E

This short segment is found from the change in channel slope and valley confinement 700 feet upstream of Dickinson Road crossing up to the reach break with T1.03. The segment is 950 feet long and has channel slope of approximately 2.5%. Two defunct dams (Figure 42) that historically served impoundments for cattle (drinking water) were noted in the lower segment. While a minor degree of aggradation of fine sediment is occurring behind these structures, little to no channel adjustments are found in their immediate vicinity. The segment ends where the valley widens and the channel slope decreases (Figure 43).



Figure 42. Old dam in lower T1.02-E.



Figure 43. Reach break at T1.03.

The segment has B-type channel dimensions and plane bedform (reference bedform). Overall the channel is stable and has good riparian buffer protection. Good conditions were noted for channel stability and habitat conditions (RGA/RHA conditions “Good”). The LWD density for this segment was slightly above the average for SB reaches (45 pieces/mile).

T1.03

Reach T1.03 is found from a drastic change in valley confinement up to Scott’s Farm on Kipling Road. The reach is 0.8 miles long and has an overall channel slope of 0.2%. The very broad valley and low width-to-depth ratio of the channel indicated E-type geometry with dune-ripple bedform. The wide alluvial valley probably formed in conjunction with channel meandering processes over time, however historic channel straightening appears to have relocated the channel in the lower reach along the left valley wall to make way for pasture or hay fields, and now athletic fields.



Figure 44. Cross section in T1.03.

A cross section taken in the lower reach indicates good floodplain connectivity with minor channel incision ($IR=1.3$; Figure 44). A berm follows the left bank within 20 to 25 feet of channel for much of lower and middle reach. This berm may have been part of old farm road, and does not severely disconnect channel from floodplain, since a majority of floodplain width is on the right bank. The channel dimensions change mid-reach for approximately 700 feet where the near bank vegetation changes from herbaceous to shrub-sapling. Within this area the channel becomes wider and deeper, but E-type channel

dimensions were measured to verify that no segmentation was necessary.

Some bank erosion was noted in the vicinity of the second channel crossing mid-reach. Downstream of the culvert and crossing (providing access to the World Learning pond) there is an area of failed bank armoring and erosion (3 feet high; Figure 45). Upstream of this crossing, the channel enters an area of beaver activity where the riparian vegetation becomes dominated by herbaceous plants and alders (Figure 46).



Figure 45. Bank erosion mid-reach below a crossing. Figure 46. Herbaceous buffer in upper T1.03.

The channel stability and floodplain connectivity was fair, with some evidence of incision in lower reach (RGA condition “Fair”, CEM stage II). Overall the habitat conditions of the reach were fair, with impacts attributed to reduced riparian vegetation and historic channel straightening (RHA condition “Fair”). The LWD density for this reach was very low due to the lack of a healthy riparian buffer on the right bank and limited recruitment potential (18 pieces/mile).

4.3 Structures Summary

The VTDEC Bridge and Culvert Assessment Protocol (VTDEC, 2007) was utilized to collect data for structures found on the selected Phase 2 reaches. The data was entered into the DMS, and summarized below in Table 3.

Table 3. Summary of Stream Crossings

Reach/ Seg- ment	Road Name	Road Type	Location	Struct. Height (ft)	Stream Width (ft)	Struct. Width (ft)	Struct/ Stream Width*	Flood- plain Filled?	Stream Approach	COMMENTS
M01-B Bridge	Railroad	Rail- road	Railroad crossing just upstream of segment break.	9.5	20.0	19.0	95%	Partially	Channelized Straight	Stable structure, heavily armored on upstream end. Armoring prevent native woody vegetation from re-developing on upstream end.
M01-B Bridge	Route 5	Paved	Route 5 crossing.	5.4	22.0	30.0	136%	Entirely	Channelized Straight	Large side bar on upstream left bank may be forming more due to runoff and snow removal from Mobil parking lot than from bridge being undersized.
M01-B Bridge	I-91 Ramp	Paved	I-91 Exit 3 ramp.	7.0	21.8	20.0	92%	Partially	Channelized Straight	Large side bar developed on left bank downstream end, causing deposition within structure.
M02 Bridge	I-91	Paved	I-91 crossing (2 lanes).	4.5	23.0	25.0	109%	Partially	Mild Bend	Very high degree of sedimentation. Little clearance due to aggradation of fine sediment.
M03 Culvert	Ryan Rd.	Gravel	Just west of intersection with Route 5.	7.0	23.8	7.0	29%	Partially	Naturally Straight	Only minor failing of bank armoring on downstream end, mainly on right bank. Not endangering road or short-term integrity of structure.
M04 Culvert	Middle Rd.	Paved	Just north of intersection with Route 5.	7.0	21.0	7.0	33%	Partially	Channelized Straight	Culvert height is 7.0' but due to aggraded material in structure clearance is only 4.3'
M05 Culvert	Middle Rd.	Paved	Just south of intersection with Houghton Rd.	7.0	16.0	7.0	44%	Partially	Mild Bend	Some bank erosion beginning to occur downstream of structure where armoring is failing. Vicinity of road well armored and erosion not yet endangering road or embankment.
M06-B Bridge	Drive- way	Gravel	Driveway stemming from Houghton Rd mid-segment.	10.6	18.0	18.5	103%	Partially	Naturally Straight	No significant impacts from bridge. Segment is heavily armored and grade control is present immediately downstream.
M06-B Culvert	Hough- ton Rd.	Paved	Houghton Rd crossing upper.	7.0	16.0	9.0	56%	Partially	Mild Bend	Minor failing of armoring on downstream end - not endangering road or structural integrity.

Crosby Brook Phase 2 Stream Geomorphic Assessment Summary
 July 21, 2008

Reach/ Seg- ment	Road Name	Road Type	Location	Struct. Height (ft)	Stream Width (ft)	Struct. Width (ft)	Struct/ Stream Width*	Flood- plain Filled?	Stream Approach	COMMENTS
M06-C Bridge	Tucker Reed Rd.	Gravel	Just east of intersection with Houghton Rd.	5.0	18.0	6.2	34%	Partially	Mild Bend	Armoring on right bank upslope is failing, and bank is eroding behind it. Lawn from house extends up to edge of armoring - could be stabilized in long-term with woody vegetation planting.
M06-C Culvert	Hough- ton Rd.	Paved	At reach break with M07.	6.0	18.0	6.5	36%	Partially	Naturally Straight	Scour and deposition on the left bank downstream of structure, with some channel incision.
T1.01 Culvert	I-91	Paved	I-91 crossing (2 lanes).	7.0	17.0	11.0	65%	Partially	Channelized Straight	Very high degree of bank erosion on right bank downstream of structure. Erosion limited to ~200' below crossing and is not endangering infrastructure in right corridor.
T1.01 Culvert	Black Mtn. Rd.	Paved	Just south of intersection with Crescent Dr.	4.0	17.0	4.0	24%	Entirely	Sharp Bend	Culvert is severely undersized, however aggradation above is not endangering road/structure currently. Town officials recognize that structure is undersized.
T1.02-B Arch	Black Mtn. Rd.	Gravel	Upper Black Mt Rd crossing.	4.9	17.5	7.0	40%	Partially	Naturally Straight	Minor scour at upstream end on left bank, but nearby grade controls limit vertical adjustments. Tributary entering on right bank downstream end is incised and banks are eroding along road.
T1.02-D Culvert	Dickin- son Rd.	Gravel	Just east of intersection with Black Mt Rd.	3.0	9.0	3.0	33%	Partially	Mild Bend	Town officials note that culvert is undersized and headwall is failing on upstream end. Culvert holds back high flows and allows upstream segment D to access floodplain on right bank despite channel incision.
T1.03 Bridge	NA - Trail	Trail	Lower athletic field access trail.	3.5	4.3	16.5	384%	Partially	Naturally Straight	Structure not significantly impacting channel. Floodprone width is constricted, but floodplain is wide and accessible upstream and downstream.
T1.03 Culvert	NA - Trail	Trail	Access trail to SIT pond.	5.0	12.0	5.0	42%	Partially	Channelized Straight	Severe bank erosion on downstream end of culvert due to limited boundary resistance from lack of native plants/trees.

* Bolded values are structure widths less than 75% of the bankfull channel width.

Of the 17 structures assessed, only 11 accommodate 75% of the bankfull channel width. This width is typically cited in transportation design standards (MMI, 2008), and while it is not the 100% value recommended by VTANR, it represents a point of comparison for assessing compatibility of the structure with channel equilibrium conditions.

Structures that are both incompatible from a bankfull width approach *and* causing significant upstream or downstream erosion include the following: M05, Middle Road Culvert; M06-C, Tucker Reed Road bridge; M06-C, Houghton Road culvert; T1.01, I-91 culvert; T1.03, Trail culvert. Structures that have severe aggradation above or below that is threatening the long-term integrity of the structure include the following: M02, I-91 bridge; M04, Middle Road culvert. These structures should be considered high-priority for replacement by town and state agencies, and will be explored in further detail in the forthcoming River Corridor Planning phase of the Crosby Brook study.

5.0 Conclusions and Future Work

The watershed and reach scale stressors described above indicate that the lower zone of the watershed is experiencing the greatest degree of channel adjustment and decline in physical habitat. Channel adjustments, in conjunction with riparian buffer loss and increased stormwater runoff are leading to a decline in biotic integrity. While the large gully on the mainstem has certainly had a severe impact on the lower watershed conditions (especially in the supply of fine sediment to the channel), the deleterious effects of recent commercial development and floodplain encroachment in this zone of the watershed is also evident. Without steps to address the watershed and reach-scale level stressors affecting the channel conditions, habitat conditions will continue to decline and will be less likely to support a reference biotic community in the future.

The Crosby Brook study of geomorphic and habitat conditions will continue in 2008 with a more detailed review of the watershed and reach-scale stressors. This effort will involve the following components that will aid in the identification of projects that could protect, sustain, or restore fluvial geomorphic equilibrium conditions, through the implementation of either passive or active stream corridor management strategies:

1. Development of stressor identification and departure analysis maps.
2. Summary of potential projects to address stressors causing channel instability and degraded physical habitat.

3. Prioritized “active” and “passive” restoration projects, and further development of three identified projects, including landowner outreach and conceptual designs.
4. Fluvial Erosion Hazard (FEH) Zone mapping and analysis to a) compare FEH zoning overlays with alternative corridor management strategies developed from the study, and b) summarize existing land assets (e.g., wetlands, town-owned lands) and liabilities (e.g., structures) within the corridor at the reach scale.

6.0 References

- Albers, J., 2000, *Hands on the Land: A History of the Vermont Landscape*, MIT Press, Cambridge, MA.
- Coles, J. F., Cuffney, T.F., McMahon, Gerard, and Beaulieu, K.M. 2004. The Effects of Urbanization on the Biological, Physical, and Chemical Characteristics of Coastal New England Streams. U.S. Geological Survey Professional Paper 1695, 47 p.
- CWP - Center for Watershed Protection, 2003, Impacts of Impervious Cover on Aquatic Systems. Watershed Protection Research Monograph:39-49.
- Doll, C.G., Cady, W.M., Thompson, J.B., and M.P. Billings, 1961, Centennial Geologic Map of Vermont: Vermont Geologic Survey, Available at: www.anr.state.vt.us/dec/geo/centmap.htm. Accessed October, 2007
- FEA – Fitzgerald Environmental Associates, LLC., 2007, Crosby Brook Phase 1 Stream Geomorphic Assessment Report. Prepared for the Windham County Natural Resources Conservation District.
- Fitzgerald, E. P., 2007, Linking urbanization to stream geomorphology and biotic integrity in the Lake Champlain Basin, Vermont [M.S. Thesis]: Burlington, Vermont, University of Vermont, 121 p.
- Fitzpatrick, F. A., M. A. Harris, T. L. Arnold, and K. D. Richards. 2004. Urbanization influences on aquatic communities in northeastern Illinois streams. *Journal of the American Water Resources Association* 40:461-475.
- McBride, M., and D. B. Booth. 2005. Urban impacts on physical stream condition: Effects of spatial scale, connectivity, and longitudinal trends. *Journal of the American Water Resources Association* 41:565-580.
- Montgomery, D. R., & Buffington, J. M., 1997, Channel-reach morphology in mountain drainage basins, *Geological Society of America Bulletin*, 109(5), 596-611.
- MMI – Milone and MacBroom, Inc., 2008, The Vermont Culvert Geomorphic Compatibility Screening Tool, Prepared for the Vermont River Management Program

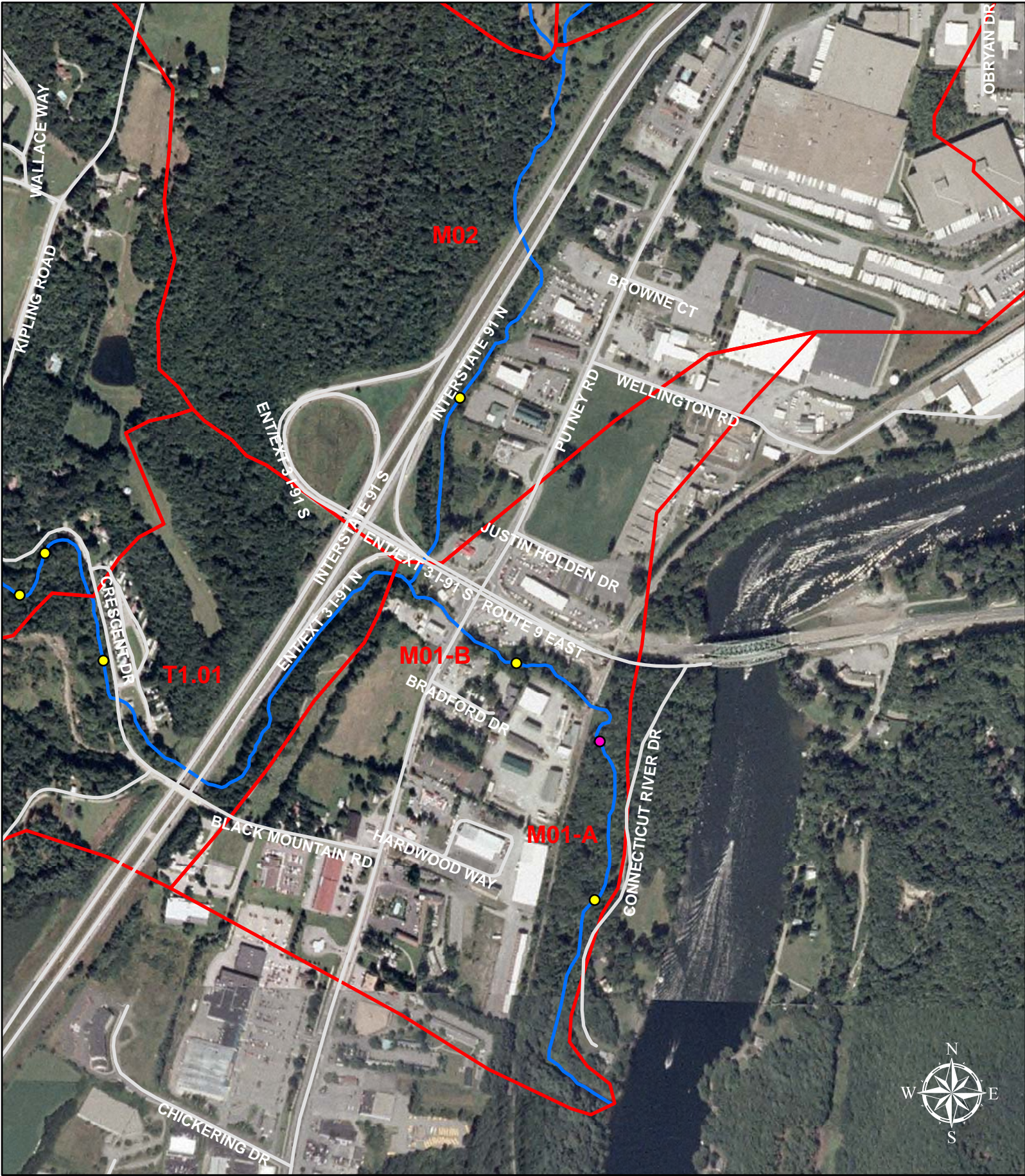
- Nelson, E. J., and D. B. Booth. 2002. Sediment sources in an urbanizing, mixed land-use watershed. *Journal of Hydrology* 264:51-68.
- NWI - National Wetlands Inventory, 2003, US Fish and Wildlife Service Digital Publication of the National Wetlands Inventory Data from 1983. Available at: www.vcgi.org. Accessed April, 2007
- Ridge, J.C. and Larsen, F.D., 1990, Re-evaluation of Antevs' New England varve chronology and new radiocarbon dates of sediments from Glacial Lake Hitchcock: *Geological Society of America*, v. 102, p. 889-899
- Rosgen, D. L., 1994, A classification of natural rivers, *Catena*, 22(3), 169 - 199.
- Schumm, S. A., 1977, *The Fluvial System*, John Wiley and Sons, New York.
- Springston, G., 2007, Memorandum to Laurence Becker re: "Erosion along Crosby Brook in Brattleboro" following a July 31, 2007 field visit.
- Thompson, E.H., and E.R. Sorenson, 2000, *Wetland, Woodland, Wildland: A Guide to the Natural Communities of Vermont*, Vermont Department of Fish and Wildlife and The Nature Conservancy.
- Trimble, S. W. 1997, Contribution of stream channel erosion to sediment yield from an urbanizing watershed, *Science* 278:1442-1444.
- UNH - University of New Hampshire, Historical topographic maps for New England. Available at: <http://docs.unh.edu/nhtopos/nhtopos.htm>
Accessed April, 2008
- University of Vermont Spatial Analysis Laboratory, 2005, Landsat Based Land Cover/Land Use Dataset for Vermont. Available at: www.vcgi.org. Accessed April, 2006
- VTDEC (Vermont Department of Environmental Conservation), 2005, *The Biological Condition of Crosby Brook and Exploration of the Environmental Stressors on Aquatic Communities*, April, 2005





VTDEC (Vermont Department of Environmental Conservation), 2007, Stream Geomorphic Assessment Handbook - Phase 1 & 2 Protocols. Vermont Agency of Natural Resources Publication. Available at:
http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_geoassesspro.htm.

VTDEC (Vermont Department of Environmental Conservation) Stormwater Section, 2007, Sediment Sources in the Crosby Brook Watershed, Powerpoint summary presented to public in May, 2007.

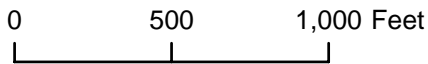
Appendix A

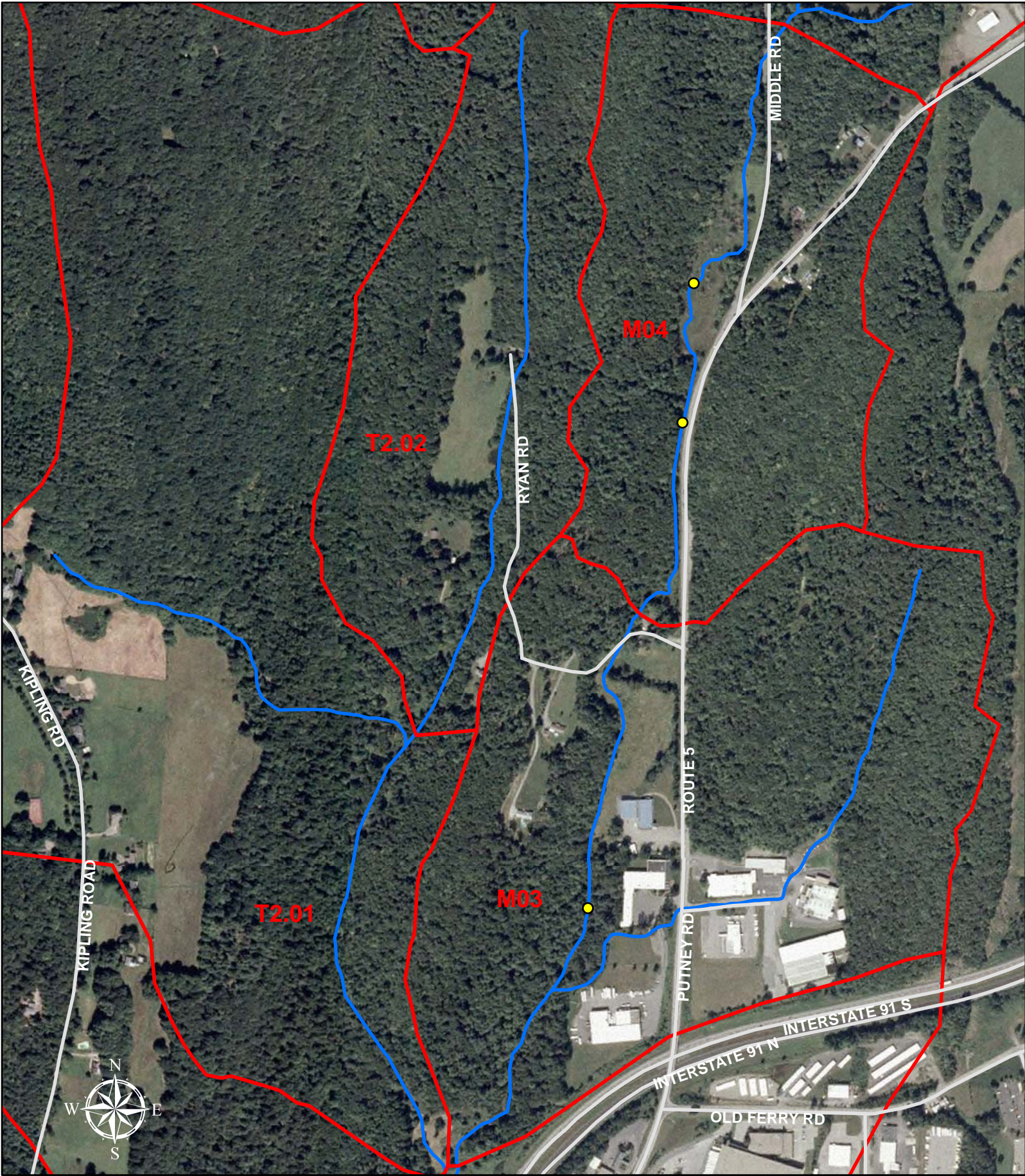
Crosby Brook Reach Mapping







-  Subwatershed Boundaries
-  Segment Breaks
-  Cross Section Locations
-  Crosby Bk Surface Waters

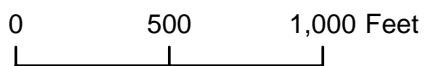
Crosby Brook Phase 2 Mapping
Segments M01-A, M01-B, M02 & T1.01

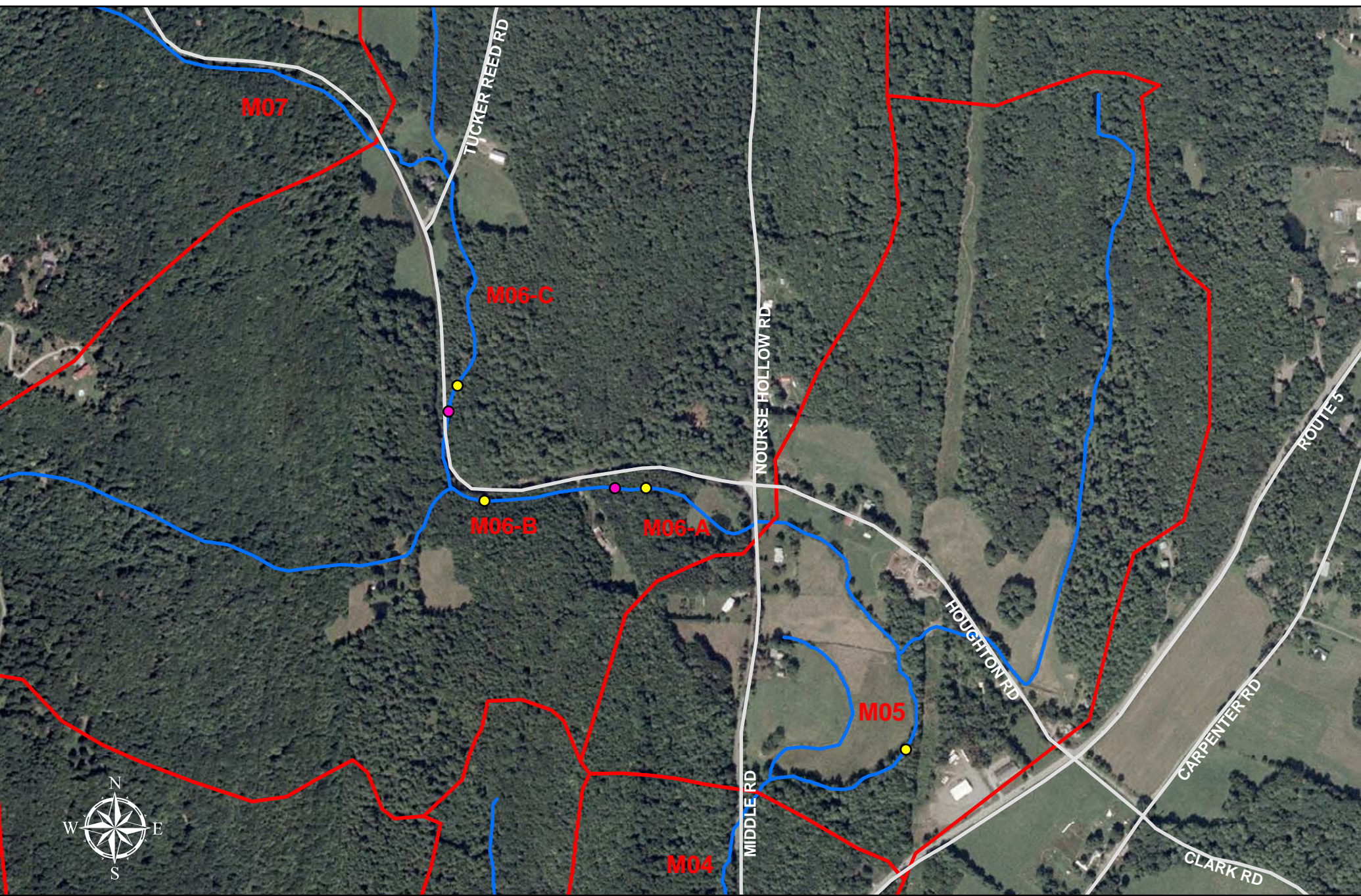








-  Subwatershed Boundaries
-  Segment Breaks
-  Cross Section Locations
-  Crosby Bk Surface Waters

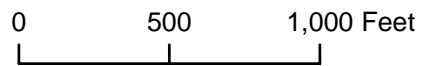
**Crosby Brook Phase 2 Mapping
Reaches M03 & M04**

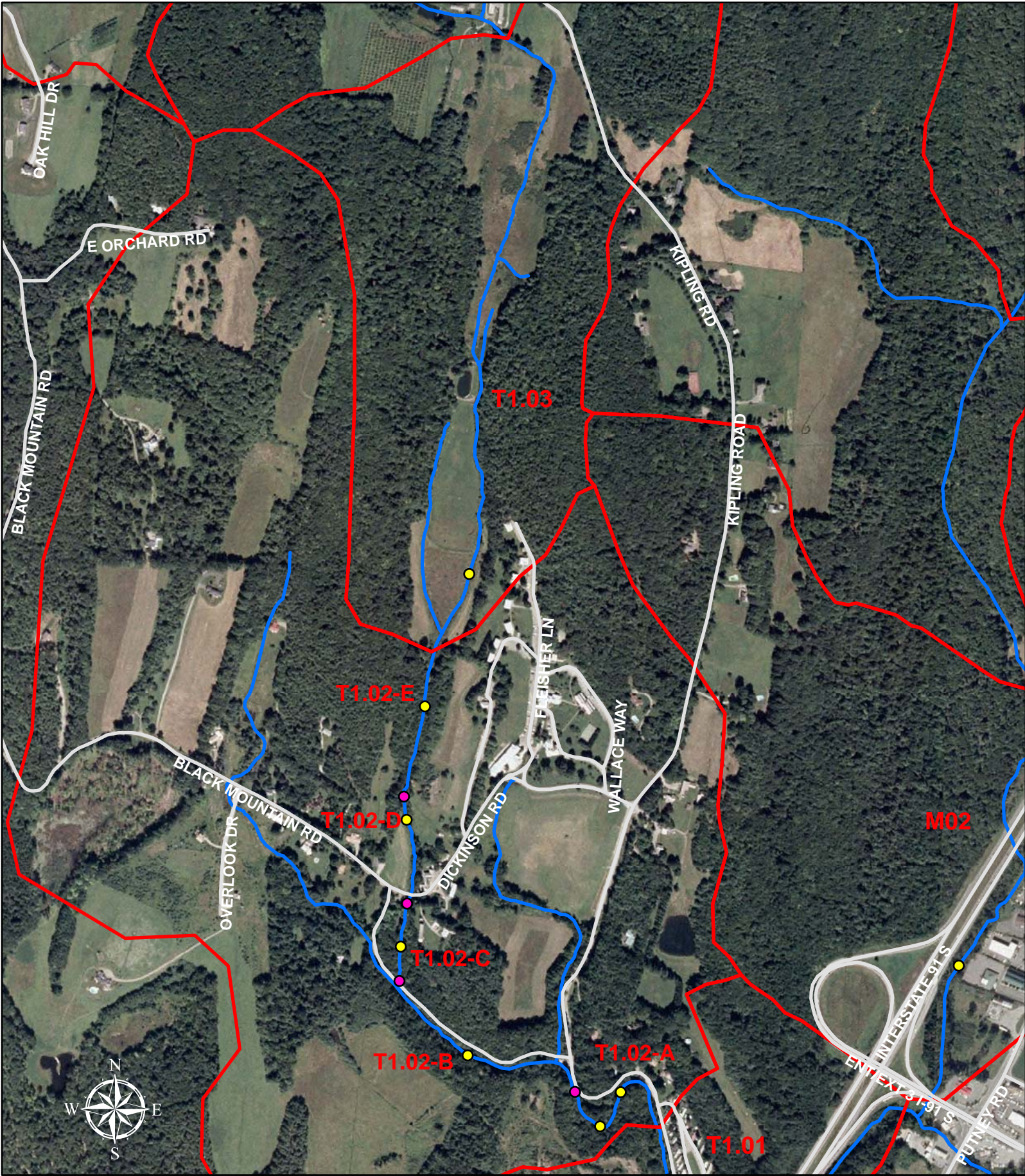








-  Subwatershed Boundaries
-  Segment Breaks
-  Cross Section Locations
-  Crosby Bk Surface Waters

**Crosby Brook Phase 2 Mapping
Reaches M05 & M06**






-  Subwatershed Boundaries
-  Segment Breaks
-  Cross Section Locations
-  Crosby Bk Surface Waters

Crosby Brook Phase 2 Mapping
Reaches T1.02 & T1.03

0 500 1,000 Feet




Appendix B
Reach Summary Data

Appendix B - Phase 2 Reach Summary Statistics

Reach/ Segment	Stream Type	Dominant Bed Material	Bedform	STD*	Reference Stream Type†	Reference Bed Material†	Reference Bedform†	RHA Score	RHA Condition	RGA Score	RGA Condition	Reach Sensitivity	CEM**	CEM** Stage
M01-A	A	Gravel	Step-Pool	No				0.70	Good	0.74	Good	High	F	I
M01-B	C	Sand	Riffle-Pool	No				0.42	Fair	0.41	Fair	Very High	F	II
M02	F	Gravel	Plane Bed	Yes	C	Gravel	Riffle-Pool	0.34	Poor	0.33	Poor	Extreme	F	II
M03	C	Gravel	Riffle-Pool	No				0.63	Fair	0.48	Fair	Very High	F	III
M04	C	Gravel	Riffle-Pool	No				0.72	Good	0.68	Good	High	F	I
M05	E	Gravel	Riffle-Pool	No				0.57	Fair	0.64	Good	High	F	IV
M06-A	C	Gravel	Riffle-Pool	No				0.71	Good	0.61	Fair	Very High	F	II
M06-B	B	Cobble	Step-Pool	No				0.73	Good	0.68	Good	Moderate	F	II
M06-C	C	Gravel	Riffle-Pool	No				0.73	Good	0.66	Good	High	F	I
T1.01	F	Gravel	Plane Bed	Yes	C	Gravel	Riffle-Pool	0.53	Fair	0.38	Fair	Extreme	F	II
T1.02-A	C	Gravel	Riffle-Pool	No				0.63	Fair	0.45	Fair	Very High	F	II
T1.02-B	F	Gravel	Step-Pool	Yes	B	Cobble	Step-Pool	0.48	Fair	0.34	Poor	Extreme	F	II
T1.02-C	A	Bedrock	Step-Pool	No				0.86	Reference	0.85	Reference	Very Low	F	I
T1.02-D	E	Sand	Riffle-Pool	No				0.62	Fair	0.60	Fair	Very High	F	II
T1.02-E	B	Gravel	Plane Bed	No				0.72	Good	0.79	Good	Moderate	F	I
T1.03	E	Sand	Dune-Ripple	No				0.62	Fair	0.61	Fair	Very High	F	II

* STD = Stream Type Departure

** CEM = Channel Evolution Model

† = Assessed Reference Condition Prior to Stream Type Departure

Mean:	0.62	0.58
Max:	0.86	0.85
Min:	0.34	0.33

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **2,060**

Phase 2 Segment Summary page 1 of 2
 Reach # **M01** Segment: **A**
 Observers: **EPF, NP** Why Not assessed:
 Segment Location: **From mouth with Connecticut up to bend along railroad tracks upstream of second**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 17, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	548	0
height	25	0
Railroads	20	0
height	15	0
Improved Paths	0	0
height	0	0
Development	580	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Always	Always
Texture	Sand	Sand

1.5 Valley Features

Valley Width (ft)	60
Width Determination	Measured
Confinement Type	Semi-confined
Rock Gorge?	No
Human-caused Change?	No

Step 2. Stream Channel

2.1 Bankfull Width	18
2.2 Max Depth (ft)	2.70
2.3 Mean Depth (ft)	1.92
2.4 Floodprone Width (ft)	22

Notes:

This segment is highly variable, with much of the elevation lost at large grade controls, resulting in many different types of bedforms throughout. Segment slope measured at ~3%. Channel in a confined setting throughout entire segment. One active

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	0.00	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	9.38	
2.7 Entrenchment Ratio	1.22	
2.8 Incision Ratio	0.00	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	160	
2.12 Substrate Composition		
Bedrock	2%	
Boulder	2%	
Cobble	42%	
Coarse Gravel	14%	
Fine Gravel	2%	
Sand	17%	
Silt and smaller	21%	

Silt/Clay Present?	No
Detritus	5 %
# Large Woody	42
2.13 Average Largest Particle on	
Bed	8.0 inches
Bar	N/A inches

2.14 Stream Type

Stream Type:	A
Bed Material:	Gravel
Subclass Slope:	b
Bed Form:	Step-Pool

Field Measured Slope:

2.15 Reference Stream Type	
(if different from Phase 1)	
A 3 b Step-Pool	

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	84	109
Erosion Height (ft)	4.00	3.29
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	51-75	76-100
Mid-Channel Canopy	Closed	
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	51-100	>100
Sub-dominant	26-50	None
W less than 25	0	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Coniferous	Coniferous
Sub-dominant	Mixed Trees	Mixed Trees
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest	Forest
Sub-dominant	Residential	None
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant		
4.2 Adjacent Wetlands	Minimal		
4.3 Flow Status	High		
4.4 # of Debris Jams	5		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	1
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	1	2
Diagonal	Delta	Island
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	214
5.5 Dredging	None

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **2,060**

Phase 2 Reach Summary

Reach # **M01**
 Observers: **EPF, NP**

page 2 of 2
 Segment: **A**

June 13, 2008
 Completion Date: **April 17, 2008**
 Rain: **Yes**

Segment Location: **From mouth with Connecticut up to bend along railroad tracks upstream of second**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Waterfall	Mid-segment	15.00	12.00	Yes	
Waterfall	Mid-segment	20.00	17.00	Yes	
Ledge	Mid-segment	3.00	3.00	No	

4.8 Channel Constrictions None

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Confined			
7.1 Channel Degradation	15	None	No
7.2 Channel Aggradation	13	None	No
7.3 Widening Channel	15		No
7.4 Change in Planform	16		No
Total Score	59		
Geomorphic Rating	0.7375		
Channel Evolution Model	F		
Channel Evolution Stage	I		
Geomorphic Condition	Good		
Stream Sensitivity	High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type High

	Score
6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	4
6.3 Velocity/Depth Patterns	14
6.4 Sediment Deposition	11
6.5 Channel Flow Status	18
6.6 Channel Alteration	17
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 8 Right: 8
6.9 Bank Vegetation Protection	Left: 7 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 9
Total Score	139
Habitat Rating	0.695

Habitat Stream Condition **Good**

Narrative:

Reach stable due to vertical controls. High sedimentation of fines impacting bed substrate and habitat conditions. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **1,564**

Phase 2 Segment Summary page 1 of 2
 Reach # **M01** Segment: **B**
 Observers: **EPF, NP** Why Not assessed:
 Segment Location: **From just above the second waterfall at the bend by railroad tracks up to reach break with**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 17, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons
Step 1. Valley and Floodplain

1.1 Segmentation Channel Dimensions		
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
<u>Length (ft)</u>	<u>One</u>	<u>Both</u>
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	235	0
height	15	0
Improved Paths	0	0
height	0	0
Development	0	1,141
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Hilly	Hilly
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua
1.5 Valley Features		
Valley Width (ft)	80	
Width Determination	Measured	
Confinement Type	Semi-confined	
Rock Gorge?	No	
Human-caused Change?	Yes	
Step 2. Stream Channel		
2.1 Bankfull Width	22	
2.2 Max Depth (ft)	3.10	
2.3 Mean Depth (ft)	2.07	
2.4 Floodprone Width (ft)	60	

Notes:
 Channel has encroachment from railroad in lower section, and development in middle and upper sections. Valley has become confined due to encroachment, and channel incision has resulted. Narrow floodplain not filled by adjacent development is not accessible to

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	4.80	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	10.53	
2.7 Entrenchment Ratio	2.75	
2.8 Incision Ratio	1.55	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Moderate	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	150	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	0%	
Cobble	1%	
Coarse Gravel	9%	
Fine Gravel	27%	
Sand	49%	
Silt and smaller	13%	
Silt/Clay Present?	No	
Detritus	10 %	
# Large Woody	14	
2.13 Average Largest Particle on		
Bed	4.0	inches
Bar	1.5	inches
2.14 Stream Type		
Stream Type:	C	
Bed Material:	Sand	
Subclass Slope:	None	
Bed Form:	Riffle-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
<u>3.3 old</u>	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Undercut	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Mix	Mix
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	30	0
Erosion Height (ft)	2.00	0.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	160	80
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	26-50	26-50
Mid-Channel Canopy	Open	
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	26-50	26-50
Sub-dominant	0-25	0-25
W less than 25	209	393
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Commercial	Industrial
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Mass Failures	0	62
Height	0	8
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal	
4.2 Adjacent Wetlands	Abundant	
4.3 Flow Status	High	
4.4 # of Debris Jams	1	
4.5 Flow Regulation Type	None	
Flow Regulation Use		
Impoundments	None	
Impoundmt. Location		
4.6 Up/Down strm flow reg	None	
(old) Upstrm Flow Reg	None	
4.7 StormwaterInputs		
Field Ditch	0	Road Ditch 3
Other	0	Tile Drain 0
Overland Flow	0	Urb Strm Wtr Pipe 7
4.9 # of Beaver Dams	0	
Affected Length (ft)	0	

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		
<u>Mid</u>	<u>Point</u>	<u>Side</u>
0	6	2
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0
5.2 Other Features		
		<u>Braiding</u>
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>
0	0	0
5.3 Steep Riffles and Head Cuts		
<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
0	0	No
5.4 Stream Ford or Animal		
No		
5.5 Straightening		
Straightening Length: 979		
5.5 Dredging		
None		

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **1,564**

Phase 2 Reach Summary

Reach # **M01**
 Observers: **EPF, NP**

page 2 of 2
 Segment: **B**

June 13, 2008

Completion Date: **April 17, 2008**
 Rain: **Yes**

Segment Location: **From just above the second waterfall at the bend by railroad tracks up to reach break**

1.6 Grade Controls None

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	27.0	Yes	No	No	Yes
	Problem	Deposition	Above		
Bridge	30.0	Yes	No	No	Yes
	Problem	Deposition	Above		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	7	None	No
7.2 Channel Aggradation	8	None	No
7.3 Widening Channel	9		No
7.4 Change in Planform	9		No
Total Score	33		
Geomorphic Rating	0.4125		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Low	
	Score	
6.1 Epifaunal Substrate - Available Cover	11	
6.2 Pool Substrate	5	
6.3 Pool Variability	13	
6.4 Sediment Deposition	3	
6.5 Channel Flow Status	15	
6.6 Channel Alteration	6	
6.7 Channel Sinuosity	9	
6.8 Bank Stability	Left: 4	Right: 4
6.9 Bank Vegetation Protection	Left: 3	Right: 4
6.10 Riparian Vegetation Zone Width	Left: 2	Right: 5
Total Score	84	
Habitat Rating	0.42	
Habitat Stream Condition	Fair	

Narrative:

Channel incision resulting from reduced floodplain access. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **2,871**

Phase 2 Segment Summary page 1 of 2
 Reach # **M02** Segment: **0**
 Observers: **EPF, NP** Why Not assessed:
 Segment Location: **From I-91 Exit 3 ramp crossing up to confluence with T2.**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 17, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms height	0	0
Roads height	1,369	0
Railroads height	0	0
Improved Paths height	0	0
Development	956	0

1.4 Adjacent Side Left Right

Hillside Slope **Hilly** **Steep**

Continuous w/ **Sometimes** **Sometimes**

W/in 1 Bankfill **Always** **Always**

Texture **Sand** **Not Evalua**

1.5 Valley Features

Valley Width (ft) **90**

Width Determination **Measured**

Confinement Type **Semi-confined**

Rock Gorge? **No**

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **23**

2.2 Max Depth (ft) **2.10**

2.3 Mean Depth (ft) **1.39**

2.4 Floodprone Width (ft) **34**

Notes:
 Approx. 90% of reach affected by channel straightening from construction of I-91 in the 1950's. Corridor encroachment and floodplain filling within left corridor in lower reach has caused a stream type departure. Despite higher channel slope, sediment supply from

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	0.00	ft.
Human Elev Floodpln	8.10	ft.
2.6 Width/Depth Ratio	16.55	
2.7 Entrenchment Ratio	1.48	
2.8 Incision Ratio	0.00	
Human Elevated Inc Rat	3.86	
2.9 Sinuosity	Low	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	0	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	0%	
Cobble	4%	
Coarse Gravel	13%	
Fine Gravel	35%	
Sand	32%	
Silt and smaller	16%	
Silt/Clay Present?	No	
Detritus	15 %	
# Large Woody	17	
2.13 Average Largest Particle on		
Bed	8.0	inches
Bar	2.0	inches
2.14 Stream Type		
Stream Type:	F	
Bed Material:	Gravel	
Subclass Slope:	None	
Bed Form:	Plane Bed	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

Material Type **Sand** **Sand**

Consistency **Non-cohesive** **Non-cohesive**

Lower

Material Type **Gravel** **Gravel**

Consistency **Non-cohesive** **Non-cohesive**

Bank Erosion Left Right

Erosion Length (ft) **255** **48**

Erosion Height (ft) **4.29** **2.00**

Revetmt. Type **None** **None**

Revetmt. Length (ft) **0** **0**

Near Bank Veg. Type Left Right

Dominant **Shrubs/Saplin** **Shrubs/Saplin**

Sub-dominant **Deciduous** **Coniferous**

Bank Canopy Left Right

Canopy % **51-75** **51-75**

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **51-100** **51-100**

Sub-dominant **0-25** **>100**

W less than 25 **234** **0**

Buffer Veg. Type Left Right

Dominant **Deciduous** **Deciduous**

Sub-dominant **Herbaceous** **Coniferous**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Commercial** **Forest**

Sub-dominant **Shrubs/Saplin** **Commercial**

Mass Failures **69** **0**

Height **11** **0**

Gullies **0** **0**

Height **0** **0**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	3
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	5
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	7
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	4	3
Diagonal	Delta	Island
0	0	0

5.2 Other Features Braiding

Flood	Neck Cutoff	Avulsion
2	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	Yes

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **2,089**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **2,871**

Phase 2 Reach Summary
 Reach # **M02**
 Observers: **EPF, NP**
 Segment Location: **From I-91 Exit 3 ramp crossing up to confluence with T2.**

page 2 of 2
 Segment: **0**

June 13, 2008
 Completion Date: **April 17, 2008**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	25.0	Yes	No	No	Yes
	Problem	Deposition	Above,	Deposition Below	
Bridge	20.0	Yes	No	Yes	Yes
	Problem	Deposition	Above,	Deposition Below,	Scour

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	3	C to F	Yes
7.2 Channel Aggradation	8	None	No
7.3 Widening Channel	8		Yes
7.4 Change in Planform	7		Yes
Total Score	26		
Geomorphic Rating	0.325		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Poor		
Stream Sensitivity	Extreme		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	6	
6.2 Embeddedness	1	
6.3 Velocity/Depth Patterns	7	
6.4 Sediment Deposition	2	
6.5 Channel Flow Status	13	
6.6 Channel Alteration	1	
6.7 Frequency of Riffles/Steps	3	
6.8 Bank Stability	Left: 5	Right: 5
6.9 Bank Vegetation Protection	Left: 7	Right: 7
6.10 Riparian Vegetation Zone Width	Left: 4	Right: 7
Total Score	68	
Habitat Rating	0.34	
Habitat Stream Condition	Poor	

Narrative:

Channel is redeveloping a new, narrow floodplain at a lower elevation, but has not redeveloped a sinuous planform. Channel may reach equilibrium profile upstream of I-91 crossing within 10-20 years.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **3,160**

Phase 2 Segment Summary page 1 of 2
 Reach # **M03** Segment: **0**
 Observers: **EPF, NP** Why Not assessed:
 Segment Location: **From confluence with T2 up to Ryan Rd crossing.**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 18, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	357	0
height	2	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0

1.4 Adjacent Side Left Right

Hillside Slope	Steep	Steep
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Never	Sometimes
Texture	Not Evalua	Silt/Clay

1.5 Valley Features

Valley Width (ft)	200
Width Determination	Estimated
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	24
2.2 Max Depth (ft)	2.10
2.3 Mean Depth (ft)	1.66
2.4 Floodprone Width (ft)	200

Notes:
 Below grade control mid-reach the channel is in stage III of channel evolution and is aggrading sediment and widening. large gully delivering large amount of fine sediment to channel has altered the bed substrate distribution below the confluence.

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	3.20 ft.	
Human Elev Floodpln	0.00 ft.	
2.6 Width/Depth Ratio	14.34	
2.7 Entrenchment Ratio	8.40	
2.8 Incision Ratio	1.52	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Moderate	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	0	
2.12 Substrate Composition		
Bedrock	14%	
Boulder	0%	
Cobble	17%	
Coarse Gravel	28%	
Fine Gravel	7%	
Sand	23%	
Silt and smaller	11%	
Silt/Clay Present?	Yes	
Detritus	15 %	
# Large Woody	63	
2.13 Average Largest Particle on		
Bed	7.0 inches	
Bar	3.0 inches	
2.14 Stream Type		
Stream Type:	C	
Bed Material:	Gravel	
Subclass Slope:	None	
Bed Form:	Riffle-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope	Undercut
Bank Texture	<u>Left</u> <u>Right</u>
Upper	
Material Type	Gravel Gravel
Consistency	Non-cohesive Non-cohesive
Lower	
Material Type	Sand Sand
Consistency	Non-cohesive Non-cohesive
Bank Erosion	<u>Left</u> <u>Right</u>
Erosion Length (ft)	233 0
Erosion Height (ft)	3.15 0.00
Revetmt. Type	None None
Revetmt. Length (ft)	0 0
Near Bank Veg. Type	<u>Left</u> <u>Right</u>
Dominant	Coniferous Coniferous
Sub-dominant	Shrubs/Saplin Deciduous
Bank Canopy	<u>Left</u> <u>Right</u>
Canopy %	51-75 76-100
Mid-Channel Canopy	Closed
3.2 Riparian Buffer	
Buffer Width	<u>Left</u> <u>Right</u>
Dominant	>100 >100
Sub-dominant	0-25 None
W less than 25	1,180 0
Buffer Veg. Type	<u>Left</u> <u>Right</u>
Dominant	Coniferous Coniferous
Sub-dominant	Shrubs/Saplin None
3.3 Riparian Corridor	
Corridor Land	<u>Left</u> <u>Right</u>
Dominant	Forest Forest
Sub-dominant	Shrubs/Saplin None
Mass Failures	0 56
Height	0 9
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal		
4.2 Adjacent Wetlands	Minimal		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	8		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		
Step 5. Channel Bed and Planform Changes			
5.1 Bar Types			
<u>Mid</u>	<u>Point</u>	<u>Side</u>	
3	5	1	
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>	
0	0	0	
5.2 Other Features			
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>	<u>Braiding</u>
1	0	0	0
5.3 Steep Riffles and Head Cuts			
<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>	
0	1	Yes	
5.4 Stream Ford or Animal			
Yes			
5.5 Straightening			
Straightening			
Straightening Length:			
624			
5.5 Dredging			
None			
Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.			

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **3,160**

Phase 2 Reach Summary

Reach # **M03**
 Observers: **EPF, NP**

page 2 of 2
 Segment: **0**

June 13, 2008
 Completion Date: **April 18, 2008**
 Rain: **Yes**

Segment Location: **From confluence with T2 up to Ryan Rd crossing.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	5.00	5.00	Yes	
Ledge	Mid-segment	4.00	4.00	No	
Ledge	Mid-segment	1.00	1.00	No	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	7.00	Yes	No	Yes	Yes

Problem Deposition Above, Scour Below

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	10	None	Yes
7.2 Channel Aggradation	10	None	No
7.3 Widening Channel	10		No
7.4 Change in Planform	8		No
Total Score		38	
Geomorphic Rating		0.475	
Channel Evolution Model		F	
Channel Evolution Stage		III	
Geomorphic Condition		Fair	
Stream Sensitivity		Very High	

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	15	
6.2 Embeddedness	10	
6.3 Velocity/Depth Patterns	16	
6.4 Sediment Deposition	10	
6.5 Channel Flow Status	10	
6.6 Channel Alteration	6	
6.7 Frequency of Riffles/Steps	14	
6.8 Bank Stability	Left: 6	Right: 6
6.9 Bank Vegetation Protection	Left: 7	Right: 9
6.10 Riparian Vegetation Zone Width	Left: 7	Right: 9
Total Score		125
Habitat Rating		0.625
Habitat Stream Condition		Fair

Narrative:

Aggradation of fine sands and gravel downstream of grade control and gully is causing channel widening and planform adjustment. Historical headcut from I-91 crossing likely migrated up to grade control mid-reach.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **3,370**

Phase 2 Segment Summary page 1 of 2
 Reach # **M04** Segment: **0**
 Observers: **EPF, NP** Why Not assessed:
 Segment Location: **From just upstream of Ryan Rd crossing up to Middle Road crossing.**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 18, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
	<u>Length (ft)</u>	<u>One</u> <u>Both</u>
Berms	0	0
height	0	0
Roads	1,912	0
height	13	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Bedrock	Not Evalua

1.5 Valley Features

Valley Width (ft)	100
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	21
2.2 Max Depth (ft)	2.20
2.3 Mean Depth (ft)	1.52
2.4 Floodprone Width (ft)	92

Notes:
 Channel has higher degree of sinuosity in lower reach than indicated by VHD. Some floodplain accessible in narrow valley between Rt 5 berm and right valley wall. Two cross sections indicate C-type geometry with little to no incision.

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	2.20	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	13.82	
2.7 Entrenchment Ratio	4.38	
2.8 Incision Ratio	1.00	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Moderate	
2.10 Riffles Type	Complete	
2.11 Riffle/Step Spacing (ft)	110	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	0%	
Cobble	0%	
Coarse Gravel	12%	
Fine Gravel	41%	
Sand	28%	
Silt and smaller	19%	

Silt/Clay Present?	Yes
Detritus	10 %
# Large Woody	72
2.13 Average Largest Particle on	
Bed	6.0 inches
Bar	3.0 inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool
Field Measured Slope:	

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Undercut	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	54	0
Erosion Height (ft)	1.96	0.00
Revetmt. Type	Multiple	Rip-Rap
Revetmt. Length (ft)	474	103
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Deciduous
Sub-dominant	Deciduous	Coniferous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	26-50	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	51-100	>100
Sub-dominant	0-25	None
W less than 25	835	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Coniferous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Shrubs/Saplin	Forest
Sub-dominant	Commercial Shrubs/Saplin	
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant		
4.2 Adjacent Wetlands	Abundant		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	15		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	1		
Affected Length (ft)	300		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

<u>Mid</u>	<u>Point</u>	<u>Side</u>
6	3	3
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0

5.2 Other Features

		<u>Braiding</u>
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>
1	0	0

5.3 Steep Riffles and Head Cuts

<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
0	0	No
5.4 Stream Ford or Animal		No
5.5 Straightening		Straightening
Straightening Length:		1,545
5.5 Dredging		None

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **3,370**

Phase 2 Reach Summary

Reach # **M04**
 Observers: **EPF, NP**

page 2 of 2
 Segment: **0**

June 13, 2008

Completion Date: **April 18, 2008**

Rain: **Yes**

Segment Location: **From just upstream of Ryan Rd crossing up to Middle Road crossing.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	3.00	1.00	Yes	
Ledge	Mid-segment	0.00	0.00	No	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	7.00	Yes	No	Yes	Yes

Problem Deposition Above, Deposition Below, Scour

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	13	None	No
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	15		No
7.4 Change in Planform	12		No
Total Score	54		
Geomorphic Rating	0.675		
Channel Evolution Model	F		
Channel Evolution Stage	I		
Geomorphic Condition	Good		
Stream Sensitivity	High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	15	
6.2 Embeddedness	16	
6.3 Velocity/Depth Patterns	17	
6.4 Sediment Deposition	14	
6.5 Channel Flow Status	15	
6.6 Channel Alteration	8	
6.7 Frequency of Riffles/Steps	14	
6.8 Bank Stability	Left: 8	Right: 8
6.9 Bank Vegetation Protection	Left: 5	Right: 9
6.10 Riparian Vegetation Zone Width	Left: 5	Right: 9
Total Score	143	
Habitat Rating	0.715	
Habitat Stream Condition	Good	

Narrative:

Channel is stable with moderate-good floodplain availability. Normal distribution of bed substrate - supply of fines limited since reach is upstream of gully. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **2,393**

Phase 2 Segment Summary page 1 of 2

June 13, 2008 SGAT Version: 4.56

Reach # **M05** Segment: **0** Completion Date: **April 22, 2008**
 Observers: **EPF, NP, SB** Why Not assessed: Rain: **No**

Segment Location: **From just upstream of first Middle Road crossing up to second Middle Rd crossing.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0

1.4 Adjacent Side Left Right

Hillside Slope **Very Steep** **Hilly**

Continuous w/ **Sometimes** **Never**

W/in 1 Bankfill **Sometimes** **Never**

Texture **Sand** **Not Evalua**

1.5 Valley Features

Valley Width (ft) **400**

Width Determination **Estimated**

Confinement Type **Very Broad**

Rock Gorge? **No**

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width **16**

2.2 Max Depth (ft) **2.20**

2.3 Mean Depth (ft) **1.64**

2.4 Floodprone Width (ft) **350**

Provisional Step 2. (Contued)

2.5 Aband. Floodpln **2.50** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **9.45**

2.7 Entrenchment Ratio **22.58**

2.8 Incision Ratio **1.14**

Human Elevated Inc Rat **0.00**

2.9 Sinuosity **Moderate**

2.10 Riffles Type **Sedimented**

2.11 Riffle/Step Spacing (ft) **135**

2.12 Substrate Composition

Bedrock	0%
Boulder	5%
Cobble	16%
Coarse Gravel	36%
Fine Gravel	22%
Sand	16%
Silt and smaller	5%

Silt/Clay Present? **No**

Detritus **8 %**

Large Woody **20**

2.13 Average Largest Particle on

Bed	3.5	inches
Bar	2.5	inches

2.14 Stream Type

Stream Type: **E**

Bed Material: **Gravel**

Subclass Slope: **None**

Bed Form: **Riffle-Pool**

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Shallow**

Bank Texture Left Right

Upper

Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive

Lower

Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Bank Erosion Left Right

Erosion Length (ft)	98	156
Erosion Height (ft)	3.09	2.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type Left Right

Dominant	Coniferous Shrubs/Saplin	Herbaceous
Sub-dominant	Shrubs/Saplin	Herbaceous

Bank Canopy Left Right

Canopy %	51-75	26-50
----------	--------------	--------------

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	0-25
Sub-dominant	26-50	26-50
W less than 25	0	2,214

Buffer Veg. Type Left Right

Dominant	Coniferous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Hay
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Mass Failures	38	0
Height	7	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Abundant**

4.2 Adjacent Wetlands **Abundant**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **7**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments **None**

Impoundmt. Location

4.6 Up/Down strm flow reg **None**

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
4	4	7
Diagonal	Delta	Island
1	0	0

5.2 Other Features Braiding

Flood	Neck Cutoff	Avulsion
0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	Yes

5.4 Stream Ford or Animal **Yes**

5.5 Straightening **Straightening**

Straightening Length: **2,238**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Notes:
 Channel historically straightened against valley wall, and likely went through a downcutting process over time. Some evidence of terraces noted in middle and upper reach - not present in lower reach where cross-section was taken. Channel has

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **2,393**

Phase 2 Reach Summary

Reach # **M05**
 Observers: **EPF, NP, SB**

page 2 of 2
 Segment: **0**

June 13, 2008
 Completion Date: **April 22, 2008**
 Rain: **No**

Segment Location: **From just upstream of first Middle Road crossing up to second Middle Rd crossing.**

1.6 Grade Controls None

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
------	-------	--------------	------------	-----------------------	--------------------------

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	13	None	Yes
7.2 Channel Aggradation	11	None	Yes
7.3 Widening Channel	14		Yes
7.4 Change in Planform	13		No
Total Score	51		
Geomorphic Rating	0.6375		
Channel Evolution Model	F		
Channel Evolution Stage	IV		
Geomorphic Condition	Good		
Stream Sensitivity	High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Low	
	Score	
6.1 Epifaunal Substrate - Available Cover	15	
6.2 Pool Substrate	13	
6.3 Pool Variability	14	
6.4 Sediment Deposition	12	
6.5 Channel Flow Status	15	
6.6 Channel Alteration	6	
6.7 Channel Sinuosity	9	
6.8 Bank Stability	Left: 7	Right: 7
6.9 Bank Vegetation Protection	Left: 6	Right: 3
6.10 Riparian Vegetation Zone Width	Left: 5	Right: 2
Total Score	114	
Habitat Rating	0.57	
Habitat Stream Condition	Fair	

Narrative:

Channel redeveloping sinuosity following historical straightening. Good floodplain access observed throughout with some evidence of old terraces.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **882**

Phase 2 Segment Summary page 1 of 2
 Reach # **M06** Segment: **A**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From Middle Rd crossing up to change in valley confinement where channel nears**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 22, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
	<u>Length (ft)</u>	<u>One</u> <u>Both</u>
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Hilly	Extremely
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Never	Always
Texture	Not Evalua	Sand

1.5 Valley Features	
Valley Width (ft)	160
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	19
2.2 Max Depth (ft)	2.00
2.3 Mean Depth (ft)	1.29
2.4 Floodprone Width (ft)	78

Notes:
 Short segment with large mass failure along right bank. Channel does not flow through pond as indicated on VHD - channel flows around pond to south.

Small cistern located in channel to divert

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	3.80	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	14.34	
2.7 Entrenchment Ratio	4.22	
2.8 Incision Ratio	1.90	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Moderate	
2.10 Riffles Type	Complete	
2.11 Riffle/Step Spacing (ft)	150	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	0%	
Cobble	5%	
Coarse Gravel	44%	
Fine Gravel	23%	
Sand	23%	
Silt and smaller	5%	

Silt/Clay Present?	No
Detritus	10 %
# Large Woody	12

2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	3.0 inches

2.14 Stream Type	
Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	b
Bed Form:	Riffle-Pool
Field Measured Slope:	

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	25	23
Erosion Height (ft)	3.00	3.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	70	50
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Deciduous	Deciduous
Sub-dominant	Coniferous	Coniferous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	76-100	76-100
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer	
Buffer Width	<u>Left</u> <u>Right</u>
Dominant	51-100 >100
Sub-dominant	26-50 0-25
W less than 25	0 63
Buffer Veg. Type	<u>Left</u> <u>Right</u>
Dominant	Deciduous Mixed Trees
Sub-dominant	Herbaceous Coniferous

3.3 Riparian Corridor	
Corridor Land	<u>Left</u> <u>Right</u>
Dominant	Forest Forest
Sub-dominant	Commercial None
Mass Failures	0 79
Height	0 15
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None		
4.2 Adjacent Wetlands	Minimal		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	2		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		
<u>Mid</u>	<u>Point</u>	<u>Side</u>
0	3	3
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0

5.2 Other Features	<u>Braiding</u>		
Flood	<u>Neck Cutoff</u>	<u>Avulsion</u>	0
0	0	0	

5.3 Steep Riffles and Head Cuts		
<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
0	0	No
5.4 Stream Ford or Animal	Yes	
5.5 Straightening	Straightening	
Straightening Length:	176	
5.5 Dredging	Dredging	

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **882**

Phase 2 Reach Summary

Reach # **M06**
 Observers: **EPF, NP, SB**

page 2 of 2
 Segment: **A**

June 13, 2008
 Completion Date: **April 22, 2008**
 Rain: **No**

Segment Location: **From Middle Rd crossing up to change in valley confinement where channel nears**

1.6 Grade Controls None

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	17.5	Yes	No	Yes	Yes
	Problem	Scour	Above		
Culvert	7.00	Yes	No	Yes	Yes
	Problem	Deposition	Above, Scour	Below	

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		11	None	No
7.2 Channel Aggradation		12	None	No
7.3 Widening Channel		11		No
7.4 Change in Planform		15		No
Total Score		49		
Geomorphic Rating		0.6125		
Channel Evolution Model		F		
Channel Evolution Stage		II		
Geomorphic Condition		Fair		
Stream Sensitivity		Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		14
6.2 Embeddedness		10
6.3 Velocity/Depth Patterns		14
6.4 Sediment Deposition		11
6.5 Channel Flow Status		18
6.6 Channel Alteration		16
6.7 Frequency of Riffles/Steps		16
6.8 Bank Stability	Left: 6 Right: 6	
6.9 Bank Vegetation Protection	Left: 9 Right: 7	
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 5	
Total Score		141
Habitat Rating		0.705
Habitat Stream Condition		Good

Narrative:

Channel incision in vicinity of small diversion to pond where dredging was noted. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **1,245**

Phase 2 Segment Summary page 1 of 2
 Reach # **M06** Segment: **B**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From change in confinement up to Houghton Rd crossing where valley widens again.**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 22, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width
1.2 Alluvial Fan	None
1.3 Corridor Encroachments	
Length (ft)	One Both
Berms	0 0
height	0 0
Roads	1,035 0
height	15 0
Railroads	0 0
height	0 0
Improved Paths	0 0
height	0 0
Development	0 0
1.4 Adjacent Side	Left Right
Hillside Slope	Extremely Extremely
Continuous w/	Always Sometimes
W/in 1 Bankfill	Always Always
Texture	Mixed Boulder
1.5 Valley Features	
Valley Width (ft)	30
Width Determination	Measured
Confinement Type	Narrowly
Rock Gorge?	No
Human-caused Change?	Yes
Step 2. Stream Channel	
2.1 Bankfull Width	16
2.2 Max Depth (ft)	1.90
2.3 Mean Depth (ft)	1.34
2.4 Floodprone Width (ft)	26

Notes:
 Houghton Road embankment occupies approx. half of valley width, resulting in a lower entrenchment ratio than under reference conditions. Channel has adequate vertical controls and appears stable with good step-pool formation.

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	0.00 ft.
Human Elev Floodpln	14.90 ft.
2.6 Width/Depth Ratio	11.94
2.7 Entrenchment Ratio	1.63
2.8 Incision Ratio	0.00
Human Elevated Inc Rat	7.84
2.9 Sinuosity	Low
2.10 Riffles Type	Not Applicable
2.11 Riffle/Step Spacing (ft)	40
2.12 Substrate Composition	
Bedrock	6%
Boulder	12%
Cobble	40%
Coarse Gravel	15%
Fine Gravel	17%
Sand	10%
Silt and smaller	0%
Silt/Clay Present?	No
Detritus	5 %
# Large Woody	20
2.13 Average Largest Particle on	
Bed	N/A
Bar	N/A
2.14 Stream Type	
Stream Type:	B
Bed Material:	Cobble
Subclass Slope:	None
Bed Form:	Step-Pool
Field Measured Slope:	
2.15 Reference Stream Type	
(if different from Phase 1)	
B 3 Step-Pool	
3.3 old	Amount Mean Height
Failures	None 0.00
Gullies	None 0.00

Step 3. Riparian Features

3.1 Stream Banks	
Typical Bank Slope	Steep
Bank Texture	Left Right
Upper	
Material Type	Boulder/Cobbl Boulder/Cobbl
Consistency	Non-cohesive Non-cohesive
Lower	
Material Type	Boulder/Cobbl Boulder/Cobbl
Consistency	Non-cohesive Non-cohesive
Bank Erosion	Left Right
Erosion Length (ft)	46 0
Erosion Height (ft)	4.00 0.00
Revetmt. Type	None None
Revetmt. Length (ft)	0 0
Near Bank Veg. Type	Left Right
Dominant	Coniferous Coniferous
Sub-dominant	Deciduous Deciduous
Bank Canopy	Left Right
Canopy %	76-100 76-100
Mid-Channel Canopy	Closed
3.2 Riparian Buffer	
Buffer Width	Left Right
Dominant	0-25 >100
Sub-dominant	26-50 None
W less than 25	998 0
Buffer Veg. Type	Left Right
Dominant	Invasives Coniferous
Sub-dominant	Shrubs/Saplin Mixed Trees
3.3 Riparian Corridor	
Corridor Land	Left Right
Dominant	Commercial Forest
Sub-dominant	Shrubs/Saplin None
Mass Failures	0 0
Height	0 0
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	4
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	2
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		
Mid	Point	Side
0	0	1
Diagonal	Delta	Island
0	0	0
5.2 Other Features	Braiding	
Flood	Neck Cutoff	Avulsion
1	0	0
5.3 Steep Riffles and Head Cuts		
Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No
5.4 Stream Ford or Animal		
	No	
5.5 Straightening		
Straightening Length:	0	
5.5 Dredging	None	
Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.		

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **1,245**

Phase 2 Reach Summary

Reach # **M06**
 Observers: **EPF, NP, SB**

page 2 of 2
 Segment: **B**

June 13, 2008
 Completion Date: **April 22, 2008**
 Rain: **No**

Segment Location: **From change in confinement up to Houghton Rd crossing where valley widens again.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	0.00	0.00	No	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	18.5	Yes	No	No	Yes
	Problem	None			
Culvert	9.00	Yes	No	Yes	Yes
	Problem	Scour	Below		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic
7.1 Channel Degradation		11	None	Yes
7.2 Channel Aggradation		16	None	No
7.3 Widening Channel		15		No
7.4 Change in Planform		12		Yes
Total Score		54		
Geomorphic Rating		0.675		
Channel Evolution Model		F		
Channel Evolution Stage		II		
Geomorphic Condition		Good		
Stream Sensitivity		Moderate		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		15
6.2 Embeddedness		16
6.3 Velocity/Depth Patterns		15
6.4 Sediment Deposition		18
6.5 Channel Flow Status		18
6.6 Channel Alteration		8
6.7 Frequency of Riffles/Steps		16
6.8 Bank Stability	Left: 6 Right: 9	
6.9 Bank Vegetation Protection	Left: 4 Right: 9	
6.10 Riparian Vegetation Zone Width	Left: 3 Right: 9	
Total Score		146
Habitat Rating		0.73
Habitat Stream Condition		Good

Narrative:

Stable channel with many vertical controls. Road building encroached upon channel historically and reduced floodplain width. Stage II selected to indicate reduction in floodplain width from encroachment, despite the current stable channel.

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **1,742**

Phase 2 Segment Summary page 1 of 2
 Reach # **M06** Segment: **C**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From just upstream of Houghton Rd crossing up to reach break with M07 at next Houghton**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 22, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width
1.2 Alluvial Fan	None
1.3 Corridor Encroachments	
Length (ft)	One Both
Berms	0 0
height	0 0
Roads	124 0
height	15 0
Railroads	0 0
height	0 0
Improved Paths	0 0
height	0 0
Development	264 0
1.4 Adjacent Side	Left Right
Hillside Slope	Hilly Steep
Continuous w/	Sometimes Never
W/in 1 Bankfill	Sometimes Never
Texture	Mixed Not Evalua
1.5 Valley Features	
Valley Width (ft)	150
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No
Human-caused Change?	No

Step 2. Stream Channel

2.1 Bankfull Width	18
2.2 Max Depth (ft)	1.30
2.3 Mean Depth (ft)	1.10
2.4 Floodprone Width (ft)	99

Notes:
 Channel has good floodplain access throughout, with dimensions corresponding to those predicted with DHG regressions. One area of debris damming and deposition below Tucker Reed Road - appears natural.

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	1.30	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	16.36	
2.7 Entrenchment Ratio	5.50	
2.8 Incision Ratio	1.00	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Moderate	
2.10 Riffles Type	Complete	
2.11 Riffle/Step Spacing (ft)	100	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	9%	
Cobble	17%	
Coarse Gravel	40%	
Fine Gravel	19%	
Sand	11%	
Silt and smaller	4%	
Silt/Clay Present?	Yes	
Detritus	15 %	
# Large Woody	64	
2.13 Average Largest Particle on		
Bed	10.0	inches
Bar	3.0	inches
2.14 Stream Type		
Stream Type:	C	
Bed Material:	Gravel	
Subclass Slope:	None	
Bed Form:	Riffle-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
C 4	Non Riffle-Pool	
3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Shallow	
Bank Texture	Left Right	
Upper		
Material Type	Sand Sand	
Consistency	Non-cohesive Non-cohesive	
Lower		
Material Type	Boulder/Cobbl Boulder/Cobbl	
Consistency	Non-cohesive Non-cohesive	
Bank Erosion	Left Right	
Erosion Length (ft)	32 44	
Erosion Height (ft)	3.00 2.00	
Revetmt. Type	Rip-Rap Rip-Rap	
Revetmt. Length (ft)	12 64	
Near Bank Veg. Type	Left Right	
Dominant	Coniferous Coniferous	
Sub-dominant	Shrubs/Saplin Herbaceous	
Bank Canopy	Left Right	
Canopy %	76-100 76-100	
Mid-Channel Canopy	Closed	
3.2 Riparian Buffer		
Buffer Width	Left Right	
Dominant	>100 >100	
Sub-dominant	26-50 26-50	
W less than 25	0 0	
Buffer Veg. Type	Left Right	
Dominant	Coniferous Coniferous	
Sub-dominant	Shrubs/Saplin Shrubs/Saplin	
3.3 Riparian Corridor		
Corridor Land	Left Right	
Dominant	Forest Forest	
Sub-dominant	Shrubs/Saplin Residential	
Mass Failures	0 0	
Height	0 0	
Gullies	0 0	
Height	0 0	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Moderate
4.4 # of Debris Jams	9
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types			
Mid	Point	Side	
5	6	3	
Diagonal	Delta	Island	
0	0	0	
5.2 Other Features			Braiding
Flood	Neck Cutoff	Avulsion	0
1	0	0	
5.3 Steep Riffles and Head Cuts			
Steep Riffles	Head Cuts	Trib Rejuv.	
0	0	No	
5.4 Stream Ford or Animal			No
5.5 Straightening			None
Straightening Length:			0
5.5 Dredging			None
Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.			

Project: **Crosby Brook**
 Stream: **Crosby Brook North Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **1,742**

Phase 2 Reach Summary

Reach # **M06**
 Observers: **EPF, NP, SB**

page 2 of 2
 Segment: **C**

June 13, 2008
 Completion Date: **April 22, 2008**
 Rain: **No**

Segment Location: **From just upstream of Houghton Rd crossing up to reach break with M07 at next**

1.6 Grade Controls None

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	6.20	Yes	No	Yes	Yes
	Problem	Scour	Below		
Culvert	6.50	Yes	No	Yes	Yes
	Problem	Deposition	Above,	Deposition	Below, Scour

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		15	None	No
7.2 Channel Aggradation		12	None	No
7.3 Widening Channel		15		No
7.4 Change in Planform		11		No
Total Score		53		
Geomorphic Rating		0.6625		
Channel Evolution Model		F		
Channel Evolution Stage		I		
Geomorphic Condition		Good		
Stream Sensitivity		High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		13
6.2 Embeddedness		15
6.3 Velocity/Depth Patterns		15
6.4 Sediment Deposition		16
6.5 Channel Flow Status		18
6.6 Channel Alteration		10
6.7 Frequency of Riffles/Steps		18
6.8 Bank Stability	Left: 8 Right: 6	
6.9 Bank Vegetation Protection	Left: 9 Right: 6	
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 5	
Total Score		146
Habitat Rating		0.73
Habitat Stream Condition		Good

Narrative:

Stable channel with moderate sinuosity and expected channel dimensions. No evidence of terraces or abandoned floodplain.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **2,722**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.01** Segment: **0**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From confluence with north branch up to bend in Black Mountain Road at grade control.**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 23, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
	<u>Length (ft)</u>	<u>One</u> <u>Both</u>
Berms	0	0
height	0	0
Roads	1,484	0
height	18	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Hilly	Very Steep
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Sand

1.5 Valley Features

Valley Width (ft)	90
Width Determination	Estimated
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	17
2.2 Max Depth (ft)	1.65
2.3 Mean Depth (ft)	1.27
2.4 Floodprone Width (ft)	26

Notes:
 Valley width altered by I-91 berm (left bank) below the first crossing, and then by Black Mountain Rd. above the first crossing. Floodplain filled by road berms and beds, constricting channel and reducing meander development. Riffle-pool features replaced by

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	0.00	ft.
Human Elev Floodpln	3.35	ft.
2.6 Width/Depth Ratio	13.39	
2.7 Entrenchment Ratio	1.53	
2.8 Incision Ratio	0.00	
Human Elevated Inc Rat	2.03	
2.9 Sinuosity	Low	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	150	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	1%	
Cobble	6%	
Coarse Gravel	49%	
Fine Gravel	19%	
Sand	23%	
Silt and smaller	2%	

Silt/Clay Present?	Yes	
Detritus	15 %	
# Large Woody	24	
2.13 Average Largest Particle on		
Bed	5.0	inches
Bar	3.0	inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Plane Bed
Field Measured Slope:	

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	405	28
Erosion Height (ft)	1.33	3.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	654	766
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Coniferous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	26-50	76-100
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	0-25	>100
Sub-dominant	26-50	26-50
W less than 25	1,007	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Coniferous
Sub-dominant	Deciduous	Deciduous

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Residential	Forest
Sub-dominant	Forest Shrubs/Saplin	
Mass Failures	0	83
Height	0	7
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal		
4.2 Adjacent Wetlands	Minimal		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	3		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	7
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

<u>Mid</u>	<u>Point</u>	<u>Side</u>
5	6	9
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0

5.2 Other Features

		<u>Braiding</u>
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>
0	0	0

5.3 Steep Riffles and Head Cuts

<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
1	0	No
5.4 Stream Ford or Animal	No	
5.5 Straightening	Straightening	
Straightening Length:	1,431	
5.5 Dredging	None	

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **2,722**

Phase 2 Reach Summary

Reach # **T1.01**
 Observers: **EPF, NP, SB**

page 2 of 2
 Segment: **0**

June 13, 2008

Completion Date: **April 23, 2008**

Rain: **No**

Segment Location: **From confluence with north branch up to bend in Black Mountain Road at grade**

1.6 Grade Controls None

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	4.00	Yes	No	Yes	Yes
	Problem	Deposition	Above,	Scour Below	
Culvert	11.0	Yes	No	Yes	Yes
	Problem	Scour	Below		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Unconfined			
7.1 Channel Degradation	5	C to F	No
7.2 Channel Aggradation	11	None	No
7.3 Widening Channel	8		No
7.4 Change in Planform	6		No
Total Score	30		
Geomorphic Rating	0.375		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Fair		
Stream Sensitivity	Extreme		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
High	
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	10
6.3 Velocity/Depth Patterns	9
6.4 Sediment Deposition	9
6.5 Channel Flow Status	10
6.6 Channel Alteration	6
6.7 Frequency of Riffles/Steps	11
6.8 Bank Stability	Left: 7 Right: 7
6.9 Bank Vegetation Protection	Left: 5 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 8
Total Score	106
Habitat Rating	0.53
Habitat Stream Condition	Fair

Narrative:

C to F stream type departure due to floodplain filling along I-91 and Black Mountain Road. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **998**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.02** Segment: **A**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From grade control at sharp bend in Black Mtn Road up to 50m upstream of large mass**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 23, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width
1.2 Alluvial Fan	None
1.3 Corridor Encroachments	
Length (ft)	One Both
Berms	0 0
height	0 0
Roads	492 0
height	10 0
Railroads	0 0
height	0 0
Improved Paths	0 0
height	0 0
Development	0 0
1.4 Adjacent Side	Left Right
Hillside Slope	Steep Very Steep
Continuous w/	Never Sometimes
W/in 1 Bankfill	Never Always
Texture	Not Evalua Sand
1.5 Valley Features	
Valley Width (ft)	140
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No
Human-caused Change?	Yes
Step 2. Stream Channel	
2.1 Bankfull Width	20
2.2 Max Depth (ft)	2.10
2.3 Mean Depth (ft)	1.45
2.4 Floodprone Width (ft)	52

Notes:
 Severe incision occurring around 2 nick points in segment, one in lower segment and another up near large mass failure. A short section of channel with floodplain connectivity was noted in between 2 nickpoints. Cross section at that location indicates less incision

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	3.90 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	13.79
2.7 Entrenchment Ratio	2.60
2.8 Incision Ratio	1.86
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Eroded
2.11 Riffle/Step Spacing (ft)	90
2.12 Substrate Composition	
Bedrock	0%
Boulder	3%
Cobble	18%
Coarse Gravel	34%
Fine Gravel	34%
Sand	10%
Silt and smaller	2%
Silt/Clay Present?	Yes
Detritus	15 %
# Large Woody	11
2.13 Average Largest Particle on	
Bed	6.0 inches
Bar	4.0 inches
2.14 Stream Type	
Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	b
Bed Form:	Riffle-Pool
Field Measured Slope:	2
2.15 Reference Stream Type	
(if different from Phase 1)	
C 4 b Riffle-Pool	
3.3 old Amount Mean Height	
Failures	None 0.00
Gullies	None 0.00

Step 3. Riparian Features

3.1 Stream Banks	
Typical Bank Slope	Undercut
Bank Texture	Left Right
Upper	
Material Type	Sand Sand
Consistency	Non-cohesive Non-cohesive
Lower	
Material Type	Mix Mix
Consistency	Non-cohesive Non-cohesive
Bank Erosion	Left Right
Erosion Length (ft)	192 87
Erosion Height (ft)	2.95 2.74
Revetmt. Type	Rip-Rap None
Revetmt. Length (ft)	20 0
Near Bank Veg. Type	Left Right
Dominant	Deciduous Deciduous
Sub-dominant	None None
Bank Canopy	Left Right
Canopy %	76-100 76-100
Mid-Channel Canopy	Closed
3.2 Riparian Buffer	
Buffer Width	Left Right
Dominant	51-100 51-100
Sub-dominant	26-50 26-50
W less than 25	0 0
Buffer Veg. Type	Left Right
Dominant	Deciduous Deciduous
Sub-dominant	Mixed Trees Mixed Trees
3.3 Riparian Corridor	
Corridor Land	Left Right
Dominant	Forest Forest
Sub-dominant	Residential None
Mass Failures	0 132
Height	0 34
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	2
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	2
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types	
Mid Point Side	
1 2 1	
Diagonal Delta Island	
0 0 0	
5.2 Other Features	Braiding
Flood Neck Cutoff Avulsion	0
0 0 0	
5.3 Steep Riffles and Head Cuts	
Steep Riffles Head Cuts Trib Rejuv.	
2 1 No	
5.4 Stream Ford or Animal	No
5.5 Straightening	Straightening
Straightening Length:	289
5.5 Dredging	None

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **998**

Phase 2 Reach Summary
 Reach # **T1.02**
 Observers: **EPF, NP, SB**
 Segment Location: **From grade control at sharp bend in Black Mtn Road up to 50m upstream of large mass**

page 2 of 2
 Segment: **A**

June 13, 2008
 Completion Date: **April 23, 2008**
 Rain: **No**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken?	GPSTaken
Waterfall	Mid-segment	6.00	6.00	Yes	

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	4	None	No
7.2 Channel Aggradation	13	None	No
7.3 Widening Channel	7		No
7.4 Change in Planform	12		No
Total Score	36		
Geomorphic Rating	0.45		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	14
6.3 Velocity/Depth Patterns	12
6.4 Sediment Deposition	9
6.5 Channel Flow Status	10
6.6 Channel Alteration	15
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 2 Right: 2
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 10
Total Score	126
Habitat Rating	0.63

Habitat Stream Condition **Fair**

Narrative:

Channel actively incising with 2 nickpoints present. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **1,426**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.02** Segment: **B**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From change in confinement at intersection of Black Mountain Rd and Kipling Road up to**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 23, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width
1.2 Alluvial Fan	None
1.3 Corridor Encroachments	
Length (ft)	One Both
Berms	0 0
height	0 0
Roads	1,355 0
height	10 0
Railroads	0 0
height	0 0
Improved Paths	0 0
height	0 0
Development	0 0
1.4 Adjacent Side	Left Right
Hillside Slope	Very Steep Extremely
Continuous w/	Never Always
W/in 1 Bankfill	Never Always
Texture	Not Evalua Silt/Clay
1.5 Valley Features	
Valley Width (ft)	30
Width Determination	Measured
Confinement Type	Narrowly
Rock Gorge?	No
Human-caused Change?	Yes
Step 2. Stream Channel	
2.1 Bankfull Width	18
2.2 Max Depth (ft)	2.00
2.3 Mean Depth (ft)	1.33
2.4 Floodprone Width (ft)	23

Notes:
 Segment broken out to characterize impacts from Black Mtn Rd occupying 1/2 of valley. Historically, channel likely had a small floodplain developed within the semi-confined valley. Currently the lack of floodplain is causing excess stream power during

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	0.00 ft.
Human Elev Floodpln	5.20 ft.
2.6 Width/Depth Ratio	13.16
2.7 Entrenchment Ratio	1.31
2.8 Incision Ratio	0.00
Human Elevated Inc Rat	2.60
2.9 Sinuosity	Low
2.10 Riffles Type	Eroded
2.11 Riffle/Step Spacing (ft)	60
2.12 Substrate Composition	
Bedrock	0%
Boulder	23%
Cobble	21%
Coarse Gravel	29%
Fine Gravel	13%
Sand	13%
Silt and smaller	1%
Silt/Clay Present?	Yes
Detritus	8 %
# Large Woody	16
2.13 Average Largest Particle on	
Bed	12.0 inches
Bar	N/A inches
2.14 Stream Type	
Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	a
Bed Form:	Step-Pool
Field Measured Slope:	
2.15 Reference Stream Type	
(if different from Phase 1)	
3.3 old	Amount Mean Height
Failures	None 0.00
Gullies	None 0.00

Step 3. Riparian Features

3.1 Stream Banks	
Typical Bank Slope	Steep
Bank Texture	Left Right
Upper	
Material Type	Clay Clay
Consistency	Cohesive Cohesive
Lower	
Material Type	Boulder/Cobbl Boulder/Cobbl
Consistency	Non-cohesive Non-cohesive
Bank Erosion	Left Right
Erosion Length (ft)	0 219
Erosion Height (ft)	0.00 4.98
Revetmt. Type	Rip-Rap None
Revetmt. Length (ft)	337 0
Near Bank Veg. Type	Left Right
Dominant	Bare Shrubs/Saplin
Sub-dominant	Herbaceous Coniferous
Bank Canopy	Left Right
Canopy %	76-100 1-25
Mid-Channel Canopy	Closed
3.2 Riparian Buffer	
Buffer Width	Left Right
Dominant	0-25 >100
Sub-dominant	None None
W less than 25	1,331 0
Buffer Veg. Type	Left Right
Dominant	Herbaceous Coniferous
Sub-dominant	Invasives Mixed Trees
3.3 Riparian Corridor	
Corridor Land	Left Right
Dominant	Residential Forest
Sub-dominant	Bare None
Mass Failures	0 149
Height	0 13
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	3
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		
Mid	Point	Side
1	0	0
Diagonal	Delta	Island
0	0	0
5.2 Other Features	Braiding	
Flood	Neck Cutoff	Avulsion
0	0	0
5.3 Steep Riffles and Head Cuts		
Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No
5.4 Stream Ford or Animal		
	No	
5.5 Straightening	Straightening Length:	
	1,420	
5.5 Dredging		
	None	

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **1,426**

Phase 2 Reach Summary

Reach # **T1.02**
 Observers: **EPF, NP, SB**

page 2 of 2
 Segment: **B**

June 13, 2008
 Completion Date: **April 23, 2008**
 Rain: **No**

Segment Location: **From change in confinement at intersection of Black Mountain Rd and Kipling Road up**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	4.00	2.00	No	
Ledge	Mid-segment	4.00	2.00	No	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	7.00	Yes	No	Yes	Yes
	Problem	None			

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic
7.1 Channel Degradation		3	B to F	No
7.2 Channel Aggradation		11	None	No
7.3 Widening Channel		7		No
7.4 Change in Planform		6		No
Total Score		27		
Geomorphic Rating		0.3375		
Channel Evolution Model		F		
Channel Evolution Stage		II		
Geomorphic Condition		Poor		
Stream Sensitivity		Extreme		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		9
6.2 Embeddedness		13
6.3 Velocity/Depth Patterns		8
6.4 Sediment Deposition		14
6.5 Channel Flow Status		15
6.6 Channel Alteration		1
6.7 Frequency of Riffles/Steps		7
6.8 Bank Stability	Left: 8 Right: 1	
6.9 Bank Vegetation Protection	Left: 1 Right: 8	
6.10 Riparian Vegetation Zone Width	Left: 1 Right: 10	
Total Score		96
Habitat Rating		0.48

Habitat Stream Condition **Fair**

Narrative:
 Complete loss of floodplain access resulting in degradation and bank erosion. Grade controls in segment reach control vertical stability some, resulting in less slope failure in upper segment. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **477**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.02** Segment: **C**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From Black Mountain Road crossing up to change in slope immediately below Dickinson**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 23, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation Grade Controls		
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
<u>Length (ft)</u>	<u>One</u>	<u>Both</u>
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	166	0
1.4 Adjacent Side		
	<u>Left</u>	<u>Right</u>
Hillside Slope	Extremely	Extremely
Continuous w/	Always	Always
W/in 1 Bankfill	Always	Always
Texture	Bedrock	Bedrock
1.5 Valley Features		
Valley Width (ft)	35	
Width Determination	Measured	
Confinement Type	Semi-confined	
Rock Gorge?	Yes	
Human-caused Change?	No	

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	1.70	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	10.85	
2.7 Entrenchment Ratio	1.54	
2.8 Incision Ratio	1.00	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Complete	
2.11 Riffle/Step Spacing (ft)	35	
2.12 Substrate Composition		
Bedrock	51%	
Boulder	6%	
Cobble	5%	
Coarse Gravel	16%	
Fine Gravel	11%	
Sand	3%	
Silt and smaller	8%	
Silt/Clay Present?	No	
Detritus	5 %	
# Large Woody	5	
2.13 Average Largest Particle on		
Bed	N/A	
Bar	N/A	
2.14 Stream Type		
Stream Type:	A	
Bed Material:	Bedrock	
Subclass Slope:	None	
Bed Form:	Step-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
A	1	Non Step-Pool
<u>3.3 old</u>	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Bedrock	Bedrock
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	76-100	76-100
Mid-Channel Canopy	Closed	
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	>100
Sub-dominant	51-100	26-50
W less than 25	0	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	None	None
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest	Forest
Sub-dominant	Residential	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		
<u>Mid</u>	<u>Point</u>	<u>Side</u>
1	0	1
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0
5.2 Other Features		
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>
0	0	0
		<u>Braiding</u>
		0
5.3 Steep Riffles and Head Cuts		
<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
0	0	No
5.4 Stream Ford or Animal		
No		
5.5 Straightening		
Straightening Length: 22		
5.5 Dredging		
None		

Step 2. Stream Channel	
2.1 Bankfull Width	13
2.2 Max Depth (ft)	1.70
2.3 Mean Depth (ft)	1.17
2.4 Floodprone Width (ft)	20

Notes:
 Steep channel with bedrock armoring on bed and banks throughout. Homeowners (Sullivan) on upper right bank (487 Black Mtn Rd) are concerned about potential bank erosion downstream of old mill/diversion site. Met with Pat Sullivan on 4/23/08 and listened

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **477**

Phase 2 Reach Summary
 Reach # **T1.02**
 Observers: **EPF, NP, SB**
 Segment Location: **From Black Mountain Road crossing up to change in slope immediately below**

page 2 of 2
 Segment: **C**

June 13, 2008
 Completion Date: **April 23, 2008**
 Rain: **No**

1.6 Grade Controls				
Type	Location	Total	Total Height Above Water	Photo Taken / GPSTaken
Waterfall	Mid-segment	18.00	16.00	Yes
Ledge	Mid-segment	4.00	3.00	Yes
Ledge	Mid-segment	6.00	5.00	Yes

4.8 Channel Constrictions None

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Confined			
7.1 Channel Degradation	19	None	No
7.2 Channel Aggradation	16	None	No
7.3 Widening Channel	16		No
7.4 Change in Planform	17		No
Total Score	68		
Geomorphic Rating	0.85		
Channel Evolution Model	F		
Channel Evolution Stage	I		
Geomorphic Condition	Referenc		
Stream Sensitivity	Very Low		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type High

	Score
6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	18
6.5 Channel Flow Status	20
6.6 Channel Alteration	20
6.7 Frequency of Riffles/Steps	18
6.8 Bank Stability	Left: 10 Right: 10
6.9 Bank Vegetation Protection	Left: 10 Right: 10
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8
Total Score	171
Habitat Rating	0.855
Habitat Stream Condition	Referen

Narrative:

Stable bedrock-lined channel with good buffer and limited direct impacts. See step 5 for further narrative.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **668**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.02** Segment: **D**
 Observers: **EPF, NP, MC** Why Not assessed:

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 23, 2008**
 Rain: **No**

Segment Location: **From old impoundment immediately below Dickinson Rd up to change in confinement and**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width		
1.2 Alluvial Fan	None		
1.3 Corridor Encroachments			
	<u>Length (ft)</u>	<u>One</u>	<u>Both</u>
Berms	0	0	0
height	0	0	0
Roads	0	0	0
height	0	0	0
Railroads	0	0	0
height	0	0	0
Improved Paths	0	0	0
height	0	0	0
Development	219	0	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	
Hillside Slope	Hilly	Hilly	
Continuous w/	Never	Never	
W/in 1 Bankfill	Never	Never	
Texture	Not Evalua	Not Evalua	

1.5 Valley Features	
Valley Width (ft)	180
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	9
2.2 Max Depth (ft)	2.20
2.3 Mean Depth (ft)	1.55
2.4 Floodprone Width (ft)	80

Notes:
 Short segment with mowed floodplain beyond right bank buffer. Dickinson Road culvert is severely undersized, but Brattleboro Town officials claim that it holds back large flow events and allows channel to flood into adjacent field on right bank, thus reducing

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	3.60 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	5.48
2.7 Entrenchment Ratio	9.41
2.8 Incision Ratio	1.64
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Eroded
2.11 Riffle/Step Spacing (ft)	50
2.12 Substrate Composition	
Bedrock	0%
Boulder	5%
Cobble	3%
Coarse Gravel	10%
Fine Gravel	20%
Sand	47%
Silt and smaller	15%

Silt/Clay Present?	Yes
Detritus	20 %
# Large Woody	2
2.13 Average Largest Particle on	
Bed	N/A
Bar	N/A

2.14 Stream Type	
Stream Type:	E
Bed Material:	Sand
Subclass Slope:	None
Bed Form:	Riffle-Pool
Field Measured Slope:	

2.15 Reference Stream Type	
(if different from Phase 1)	
E 5 Non Riffle-Pool	

3.3 old	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks	
Typical Bank Slope	Undercut
Bank Texture	<u>Left</u> <u>Right</u>
Upper	
Material Type	Sand Sand
Consistency	Non-cohesive Non-cohesive
Lower	
Material Type	Sand Sand
Consistency	Non-cohesive Non-cohesive
Bank Erosion	<u>Left</u> <u>Right</u>
Erosion Length (ft)	0 0
Erosion Height (ft)	0.00 0.00
Revetmt. Type	None None
Revetmt. Length (ft)	0 0
Near Bank Veg. Type	<u>Left</u> <u>Right</u>
Dominant	Invasives Invasives
Sub-dominant	Deciduous Herbaceous
Bank Canopy	<u>Left</u> <u>Right</u>
Canopy %	26-50 1-25
Mid-Channel Canopy	Open

3.2 Riparian Buffer	
Buffer Width	<u>Left</u> <u>Right</u>
Dominant	26-50 26-50
Sub-dominant	None 0-25
W less than 25	0 188
Buffer Veg. Type	<u>Left</u> <u>Right</u>
Dominant	Shrubs/Saplin Shrubs/Saplin
Sub-dominant	Mixed Trees Herbaceous

3.3 Riparian Corridor	
Corridor Land	<u>Left</u> <u>Right</u>
Dominant	Shrubs/Saplin Shrubs/Saplin
Sub-dominant	Residential Residential
Mass Failures	0 0
Height	0 0
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None		
4.2 Adjacent Wetlands	None		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	0		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	1
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		
<u>Mid</u>	<u>Point</u>	<u>Side</u>
0	1	0
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0

5.2 Other Features			
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>	<u>Braiding</u>
0	0	0	0

5.3 Steep Riffles and Head Cuts		
<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
0	0	No
5.4 Stream Ford or Animal	No	
5.5 Straightening	Straightening	
Straightening Length:	431	
5.5 Dredging	None	

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **668**

Phase 2 Reach Summary
 Reach # **T1.02**
 Observers: **EPF, NP, MC**
 Segment Location: **From old impoundment immediately below Dickinson Rd up to change in confinement**

page 2 of 2
 Segment: **D**

June 13, 2008
 Completion Date: **April 23, 2008**
 Rain: **No**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	3.00	Yes	No	Yes	Yes
	Problem	Deposition Above	Scour Below		
Old	3.70	Yes	No	Yes	Yes
	Problem	Deposition Below			

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	10	None	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	12		No
Total Score	48		
Geomorphic Rating	0.6		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Low	
	Score	
6.1 Epifaunal Substrate - Available Cover	10	
6.2 Pool Substrate	14	
6.3 Pool Variability	15	
6.4 Sediment Deposition	18	
6.5 Channel Flow Status	15	
6.6 Channel Alteration	11	
6.7 Channel Sinuosity	3	
6.8 Bank Stability	Left: 8	Right: 8
6.9 Bank Vegetation Protection	Left: 8	Right: 6
6.10 Riparian Vegetation Zone Width	Left: 5	Right: 2
Total Score	123	
Habitat Rating	0.615	
Habitat Stream Condition	Fair	

Narrative:

Moderate channel incision indicates stage II of CEM. Undersized culvert at Dickinson Rd has historically allowed for channel to flood, thereby slowing channel degradation process.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **947**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.02** Segment: **E**
 Observers: **EPF, NP, SB** Why Not assessed:
 Segment Location: **From change in confinement approx. 600 ft. upstream of Dickinson Road crossing up to**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 23, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Valley Width
1.2 Alluvial Fan	None
1.3 Corridor Encroachments	
	Length (ft) One Both
Berms	0 0
height	0 0
Roads	0 0
height	0 0
Railroads	0 0
height	0 0
Improved Paths	0 0
height	0 0
Development	0 0
1.4 Adjacent Side	Left Right
Hillside Slope	Steep Steep
Continuous w/	Sometimes Sometimes
W/in 1 Bankfill	Always Always
Texture	Not Evalua Not Evalua

1.5 Valley Features	
Valley Width (ft)	50
Width Determination	Measured
Confinement Type	Semi-confined
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	17
2.2 Max Depth (ft)	1.70
2.3 Mean Depth (ft)	1.06
2.4 Floodprone Width (ft)	32

Notes:
 Short segment with confinement and slope that results in plane bedform (natural) for much of reach. One old impoundment with failing wall is storing fine sediment - not causing channel instability above or below.

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	1.90 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	15.57
2.7 Entrenchment Ratio	1.94
2.8 Incision Ratio	1.12
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Not Applicable
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	
Bedrock	0%
Boulder	10%
Cobble	26%
Coarse Gravel	18%
Fine Gravel	16%
Sand	28%
Silt and smaller	2%

Silt/Clay Present?	Yes
Detritus	15 %
# Large Woody	8
2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	N/A inches

2.14 Stream Type	
Stream Type:	B
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Plane Bed
Field Measured Slope:	

2.15 Reference Stream Type
 (if different from Phase 1)
B 4 Non Plane Bed

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks	
Typical Bank Slope	Moderate
Bank Texture	Left Right
Upper	
Material Type	Boulder/Cobbl Boulder/Cobbl
Consistency	Non-cohesive Non-cohesive
Lower	
Material Type	Mix Mix
Consistency	Non-cohesive Non-cohesive
Bank Erosion	Left Right
Erosion Length (ft)	0 0
Erosion Height (ft)	0.00 0.00
Revetmt. Type	None None
Revetmt. Length (ft)	0 0
Near Bank Veg. Type	Left Right
Dominant	Coniferous Coniferous
Sub-dominant	Deciduous Deciduous
Bank Canopy	Left Right
Canopy %	76-100 76-100
Mid-Channel Canopy	Closed
3.2 Riparian Buffer	
Buffer Width	Left Right
Dominant	>100 >100
Sub-dominant	51-100 None
W less than 25	0 0
Buffer Veg. Type	Left Right
Dominant	Coniferous Coniferous
Sub-dominant	Mixed Trees Mixed Trees
3.3 Riparian Corridor	
Corridor Land	Left Right
Dominant	Forest Forest
Sub-dominant	Shrubs/Saplin None
Mass Failures	0 0
Height	0 0
Gullies	0 0
Height	0 0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types	
	Mid Point Side
	1 0 0
	Diagonal Delta Island
	0 0 0
5.2 Other Features	Braiding
Flood	0
Neck Cutoff	0
Avulsion	0

5.3 Steep Riffles and Head Cuts		
Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No
5.4 Stream Ford or Animal		Yes
5.5 Straightening		None
Straightening Length:		0
5.5 Dredging		None

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **947**

Phase 2 Reach Summary
 Reach # **T1.02**
 Observers: **EPF, NP, SB**
 Segment Location: **From change in confinement approx. 600 ft. upstream of Dickinson Road crossing up to**

page 2 of 2
 Segment: **E**

June 13, 2008
 Completion Date: **April 23, 2008**
 Rain: **No**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	1.00	1.00	No	
Ledge	Mid-segment	2.00	1.00	No	

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Plane Bed	Score	STD	Historic
7.1 Channel Degradation		16	None	No
7.2 Channel Aggradation		15	None	No
7.3 Widening Channel		17		No
7.4 Change in Planform		15		No
Total Score		63		
Geomorphic Rating		0.7875		
Channel Evolution Model		F		
Channel Evolution Stage		I		
Geomorphic Condition		Good		
Stream Sensitivity		Moderate		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	10
6.2 Embeddedness	8
6.3 Velocity/Depth Patterns	7
6.4 Sediment Deposition	14
6.5 Channel Flow Status	18
6.6 Channel Alteration	15
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 9 Right: 9
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 10
Total Score	143
Habitat Rating	0.715
Habitat Stream Condition	Good

Narrative:

Stable channel conditions and natural plane bedform due to confinement and slope.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRC**
 Segment Length (ft): **4,073**

Phase 2 Segment Summary page 1 of 2
 Reach # **T1.03** Segment: **0**
 Observers: **EPF, NP, MC** Why Not assessed:
 Segment Location: **From change in valley width at downstream reach break up to change in channel slope at**

June 13, 2008 SGAT Version: 4.56
 Completion Date: **April 24, 2008**
 Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	1,090	0
height	4	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0

1.4 Adjacent Side **Left** **Right**

Hillside Slope **Extremely** **Extremely**

Continuous w/ **Never** **Never**

W/in 1 Bankfill **Sometimes** **Never**

Texture **Bedrock** **Not Evalua**

1.5 Valley Features

Valley Width (ft) **381**

Width Determination **Measured**

Confinement Type **Very Broad**

Rock Gorge? **No**

Human-caused Change? **No**

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	2.70	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	3.21	
2.7 Entrenchment Ratio	79.07	
2.8 Incision Ratio	1.29	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Not Applicable	
2.11 Riffle/Step Spacing (ft)	0	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	0%	
Cobble	0%	
Coarse Gravel	4%	
Fine Gravel	15%	
Sand	38%	
Silt and smaller	43%	
Silt/Clay Present?	Yes	
Detritus	20	%
# Large Woody	14	
2.13 Average Largest Particle on		
Bed	N/A	
Bar	N/A	
2.14 Stream Type		
Stream Type:	E	
Bed Material:	Sand	
Subclass Slope:	None	
Bed Form:	Dune-Ripple	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture **Left** **Right**

Upper

Material Type **Sand** **Sand**

Consistency **Non-cohesive** **Non-cohesive**

Lower

Material Type **Sand** **Sand**

Consistency **Non-cohesive** **Non-cohesive**

Bank Erosion **Left** **Right**

Erosion Length (ft) **0** **70**

Erosion Height (ft) **0.00** **3.00**

Revetmt. Type **None** **None**

Revetmt. Length (ft) **0** **0**

Near Bank Veg. Type **Left** **Right**

Dominant **Herbaceous** **Herbaceous**

Sub-dominant **Shrubs/Saplin** **Shrubs/Saplin**

Bank Canopy **Left** **Right**

Canopy % **1-25** **1-25**

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width **Left** **Right**

Dominant **51-100** **0-25**

Sub-dominant **>100** **51-100**

W less than 25 **0** **1,731**

Buffer Veg. Type **Left** **Right**

Dominant **Mixed Trees** **Herbaceous**

Sub-dominant **Shrubs/Saplin** **Shrubs/Saplin**

3.3 Riparian Corridor

Corridor Land **Left** **Right**

Dominant **Forest** **Residential**

Sub-dominant **Shrubs/Saplin** **Shrubs/Saplin**

Mass Failures **0** **0**

Height **0** **0**

Gullies **0** **0**

Height **0** **0**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Moderate
4.4 # of Debris Jams	1
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	None
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	2
Affected Length (ft)	325

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	1
Diagonal	Delta	Island
0	0	0

5.2 Other Features **Braiding**

Flood	Neck Cutoff	Avulsion
0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **3,708**

5.5 Dredging **None**

Notes:
 Channel dimensions change mid-reach for approx. 700 ft where near bank vegetation changes from herbaceous to shrub/forest. Channel becomes wider and deeper but E-type channel dimensions were measured to verify no segmentation necessary. Incision in

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Crosby Brook**
 Stream: **Crosby Brook South Branch**
 Organization: **Windam NRCD**
 Segment Length (ft): **4,073**

Phase 2 Reach Summary

Reach # **T1.03**
 Observers: **EPF, NP, MC**

page 2 of 2
 Segment: **0**

June 13, 2008

Completion Date: **April 24, 2008**

Rain: **No**

Segment Location: **From change in valley width at downstream reach break up to change in channel slope**

1.6 Grade Controls None

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
------	----------	-------	--------------------------	-------------	----------

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	16.5	Yes	No	No	Yes
	Problem	Deposition	Below		
Culvert	5.00	Yes	No	No	Yes
	Problem	Scour	Below		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		11	None	Yes
7.2 Channel Aggradation		15	None	No
7.3 Widening Channel		12		No
7.4 Change in Planform		11		Yes
Total Score		49		
Geomorphic Rating		0.6125		
Channel Evolution Model		F		
Channel Evolution Stage		II		
Geomorphic Condition		Fair		
Stream Sensitivity		Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Low	Score
6.1 Epifaunal Substrate - Available Cover		11
6.2 Pool Substrate		15
6.3 Pool Variability		18
6.4 Sediment Deposition		15
6.5 Channel Flow Status		15
6.6 Channel Alteration		10
6.7 Channel Sinuosity		3
6.8 Bank Stability	Left: 9 Right: 7	
6.9 Bank Vegetation Protection	Left: 8 Right: 4	
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 2	
Total Score		124
Habitat Rating		0.62
Habitat Stream Condition		Fair

Narrative:
 Historic straightening has left channel pushed against left valley wall. Channel moderately-connected to floodplain in most areas, with minor to moderate channel incision noted.

Appendix C
QA/QC Summary

Appendix D

VTDEC Biotic Sampling Summary

Table 2 : Macroinvertebrate community assessments from reaches sampled within Crosby Brook watershed. * Reach of lower gradient habitat then SHG model for these sites. As a result BPJ relied on for assessment and PMA-o, and PPCS-f .

Location	Site (mi)	Date	Assessment	Density	Richness	Ept	PMA-O	BI 0-10	Oligo%	Ept/Ept&C	PPCS-F
Crosby Brook	0.3	9/17/2002	Fair	302	38.0	12.0	59.6	4.36	17.6	0.80	0.57
	0.3	9/18/2003	Fair	1458	30.0	9.5	50.8	5.09	11.3	0.74	0.33
	0.3	9/3/2004	Poor	855	33.5	14.5	49.6	4.47	25.2	0.94	0.44
	0.4	9/3/2004	G-Fair *	1572	52.0	22.0	69.5*	3.54	12.7	0.71	0.55*
	0.7	9/2/2004	G-Fair *	653	38.0	16.0	79.2*	3.13	11.6	0.77	0.59*
	1.5	9/18/2003	Fair	1574	29.0	13.5	48.0	5.05	0.1	0.93	0.37
	1.5	9/3/2004	G-Fair	576	33.5	13.5	68.7	3.15	2.8	0.81	0.51
	1.8	9/3/2004	Ex-Vgood	1936	49.0	23.0	76.9	3.33	0.4	0.82	0.71
Crosby Brook South Branch	0.1	9/2/2004	Good	460	41.0	17.0	75.6	2.81	1.6	0.92	0.66
	0.5	9/18/2003	Ex-Vgood	1788	35.0	20.0	74.3	2.57	0.0	0.87	0.64
	0.5	9/2/2004	VGood	802	39.5	19.0	83.3	3.20	0.4	0.90	0.60
		1.3	9/2/2004	VGood	1780	33.0	19.0	74.7*	3.22	1.1	0.74

Table 3: Fish community assessments from reaches sampled within the Crosby Brook watershed. * Reach of lower gradient dominated habitat, as a result BPJ used for assesement.

Location	Station (mi)	Date	Assessment	CW IBI	Richness	Intol. Spp No	Blacknose Dace %	General Feed %	Top Carnivore %	Cold Water Spp %	BKT Density	BKT Age Class	Total /100m2
Crosby Brook	0.3	9/18/2003	Poor	12	4	1	57.4	39.9	2.7	2.7	0.5	1.0	35.5
	0.3	9/3/2004	Poor	12	4	1	68.1	18.8	13.0	13.0	1.9	3.0	14.5
	0.4	9/3/2004	Good		3	1	70.9	19.2	9.9	9.9	4.1	3.0	41.2
	0.5	9/25/2003	Good		3	1	75.1	16.9	8.0	8.0	6.0	3.0	74.4
	0.7	9/2/2004	Fair-Poor	(24)	2	1	89.6	0.0	10.5	10.5	1.9	3.0	18.4
	1.5	9/18/2003	Excellent	39	5	2	38.8	7.1	48.2	53.5	24.9	3.0	51.5
	1.5	9/3/2004	Very Good	39	2	1	49.1	0.0	50.9	50.9	8.6	3.0	17.0
Crosby Brook South Branch	0.1	9/2/2004	Good	33	2	1	71.2	0.0	28.9	28.9	9.7	3.0	33.6
	0.5	9/18/2003	Excellent	42	2	1	5.3	0.0	94.7	94.7	27.6	3.0	29.2
	0.5	9/2/2004	Excellent	42	2	1	1.5	0.0	98.5	98.5	32.3	3.0	32.8

Table 4: Percent composition of the major macroinvertebrate orders from reaches sampled within the Crosby Brook watershed.

Location	Site (mi)	Date	Coleoptera %	Diptera %	Ephemeroptera %	Plecoptera %	Trichoptera %	Oligochaeta %	Other %
Crosby Brook	0.3	9/17/2002	7.3	20.9	1.3	3.0	36.1	17.6	13.9
	0.3	9/18/2003	1.4	38.0	1.2	0.1	45.8	11.3	2.1
	0.3	9/3/2004	4.3	8.8	4.5	3.0	50.3	25.2	3.9
	0.4	9/3/2004	5.1	30.0	29.3	7.9	13.5	12.7	1.5
	0.7	9/2/2004	8.0	27.1	7.4	16.2	28.8	11.6	0.9
	1.5	9/18/2003	5.4	10.8	2.3	0.9	79.5	0.1	1.0
	1.5	9/3/2004	9.8	32.6	8.4	4.4	41.5	2.8	0.5
	1.8	9/3/2004	25.2	22.9	21.5	6.6	20.9	0.4	2.5
South Branch Crosby Brook	0.1	9/2/2004	7.0	22.3	20.7	36.3	8.6	1.6	3.5
	0.5	9/18/2003	6.3	17.0	49.0	8.3	19.2	0.0	0.2
	0.5	9/2/2004	7.4	16.7	36.8	17.5	20.6	0.4	0.7
	1.3	9/2/2004	16.9	29.7	7.4	11.2	31.7	1.1	2.0

Table 5: Percent composition of the macroinvertebrate major functional feeding grps from reaches sampled within the Crosby Brook watershed

Location	Site (mi)	Date	CGath%	CFilt%	Predator%	ShrdDet%	ShrdHerb%	Scraper%
Crosby Brook	0.3	9/17/2002	32.5	38.4	3.3	3.6	1.0	21.2
	0.3	9/18/2003	36.8	47.9	2.6	0.7	7.3	4.7
	0.3	9/3/2004	31.6	48.8	6.9	0.9	0.0	11.7
	0.4	9/3/2004	51.7	17.3	10.9	3.6	4.8	8.1
	0.7	9/2/2004	30.7	37.0	9.3	10.7	0.7	11.0
	1.5	9/18/2003	6.1	75.0	7.6	2.5	1.7	6.8
	1.5	9/3/2004	21.7	50.6	10.1	5.4	0.3	11.9
	1.8	9/3/2004	26.4	20.5	12.4	9.3	1.2	26.0
South Branch Crosby Brook	0.1	9/2/2004	26.6	15.5	34.2	13.7	0.4	8.8
	0.5	9/18/2003	35.3	11.2	11.9	6.5	0.0	9.6
	0.5	9/2/2004	37.6	21.4	19.9	4.0	0.2	9.4
	1.3	9/2/2004	22.7	35.3	10.8	13.7	0.2	17.3

Table 6: Habitat measures of Substrate composition (pebble ct method), Embeddedness, and Silt rating (0-5), from Crosby Brook biomonitoring sites. * Observational substrate composition only.

Location	Site	Date	Clay %	Silt %	Sand %	Gravel %	CGravel %	Cobble %	Boulder %	Ledge %	Embeddness %	SiltR 0-5	Snags
Crosby Brook	0.3	9/17/2002	0	0	9	30	35	23	2	1	50-75	3	1
	0.3	9/18/2003	0	0	7	13	19	59	1	1	25-50	3	0
	0.3	9/3/2004	0	0	13	14	45	22	4	2	50-75	3	2
	0.4*	9/3/2004	0	2	30	20	20	5	10	0	NA	2	10
	0.7*	9/2/2004	0	16	42	39	2	0	1	0	NA	2	2
	1.5	9/18/2003	0	0	8	26	37	26	3	0	25-50		4
	1.5	9/3/2004	0	1	12	23	28	29	7	0	25-50	2	8
1.8	9/3/2004	0	2	6	24	58	8	1	1	25-50	1	1	
South Branch Crosby Brook	0.1	9/2/2004	0	0	17	34	44	5	0	0	50-75	3	3
	0.5	9/18/2003	0	0	19	21	38	18	4	0	5-25	1	0
	0.5	9/2/2004	0	0	12	29	38	17	4	0	5-25	1	0
	1.3	9/2/2004	1	0	18	29	29	6	6	0	NA	2	10

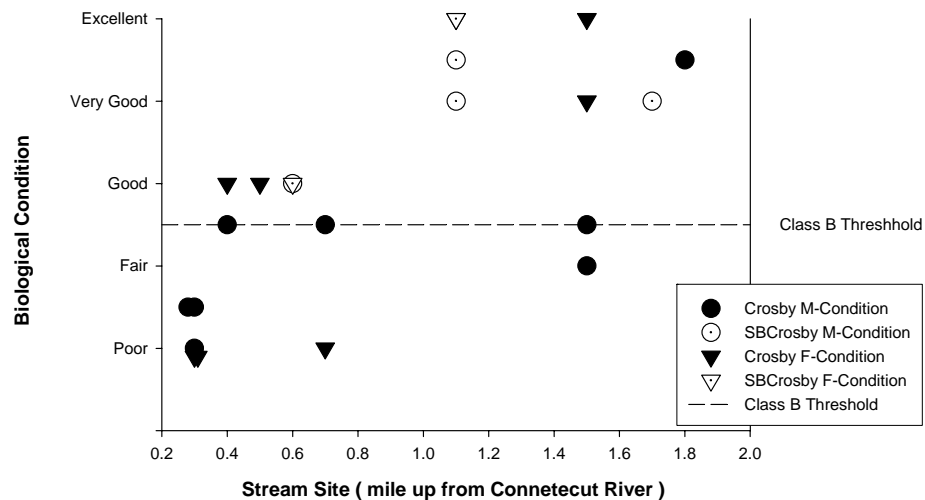
Table 7: Canopy cover, and standardized periphyton (pebble ct w alga density categories) assessments from Crosby Brook watershed biomonitoring sites. Reported as Weighted Averages (range 0-10), for three alga types Moss, Macro, Micro.

Location	Site	Date	% Canopy	Moss	Macro Algae	Micro Algae
Crosby Brook	0.3	9/17/2002	80	0.2	0.0	0.4
	0.3	9/18/2003	80	0.4	1.3	0.4
	0.3	9/3/2004	70	0.4	0.1	0.2
	0.4	9/3/2004	40			
	0.7	9/2/2004	100			
	1.5	9/18/2003	90	0.0	0.5	0.4
	1.5	9/3/2004	80	0.2	< 0.1	0.3
	1.8	9/3/2004	90	0.2	0	0.2
South Branch Crosby Brook	0.1	9/2/2004	50	0	0	< 0.1
	0.5	9/18/2003	60	0.7	<0.1	0.4
	0.5	9/2/2004	70	0.4	0.0	0.2
	1.3	9/2/2004	90	2.14	0	0.08

Summary of the biological condition of Crosby Brook

Crosby Brook and the South Branch Crosby Brook have been sampled for fish and or macroinvertebrates at a total of nine sites over three years. These assessments have allowed for an evaluation of the spatial and temporal extent of the biological condition of CB, and SBCB. **Figure 2:** illustrates the biological condition of the macroinvertebrate and fish communities longitudinally within the watershed by site and over multiple years. It is evident that the upper reaches on both CB and SBC are generally of high (Very Good to Excellent) biological condition. The exception being the CB 1.5 site where the macroinvertebrate community only rated fair to good over two consecutive years. Based on the assemblage characteristics, and habitat observations this site maybe stressed by temperature, fine particulate organic matter and channel straightening.

Figure 2: Biological Condition of both the Macroinvertebrate and Fish Assemblages at several sites on Crosby Brook and S.B Crosby Brook. Data points represent the macroinvertebrate or fish assemblage for a single sampling event from 2002-2004. Reach locations are relative miles up from confluence with the Connecticut River. SB Crosby brook data points are associated with tabular data from sites 0.1, 0.5 and 1.3. At river mile 1.0 land use changes from “rural residential” to more “urban”.



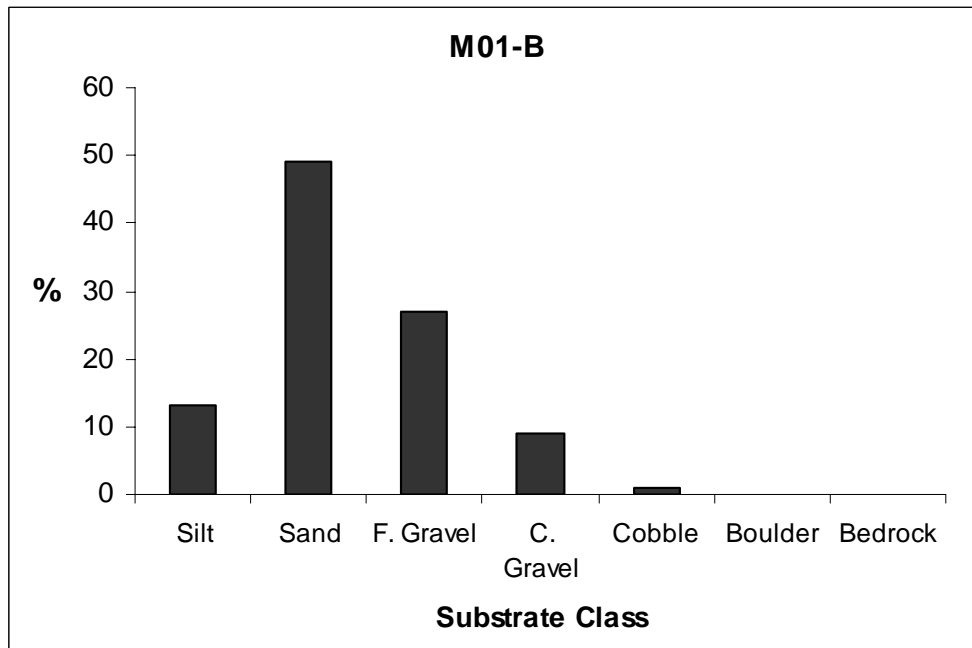
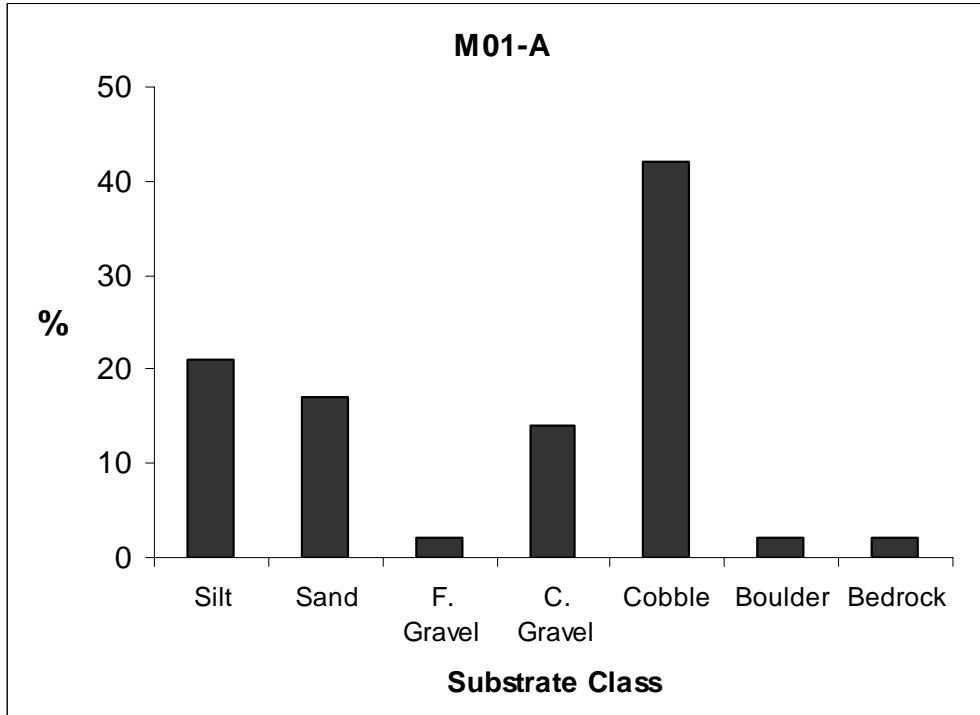
The lower part of the watershed starting from CB 0.7 down to CB 0.3, and SBC 0.1 are generally degraded compared to the upper watershed sites. Based on the assemblage characteristics, and habitat observations temperature, sediment/silt, and stream channel straightening appear to be the most likely stressors to various degrees at each individual site. Finally, it is clear that the lowest site 0.3 has been consistently assessed as fair to poor by both assemblages for three consecutive years. The assemblage characteristics and habitat observations at this site point strongly toward temperature and sediment/silt, as the primary stressors.

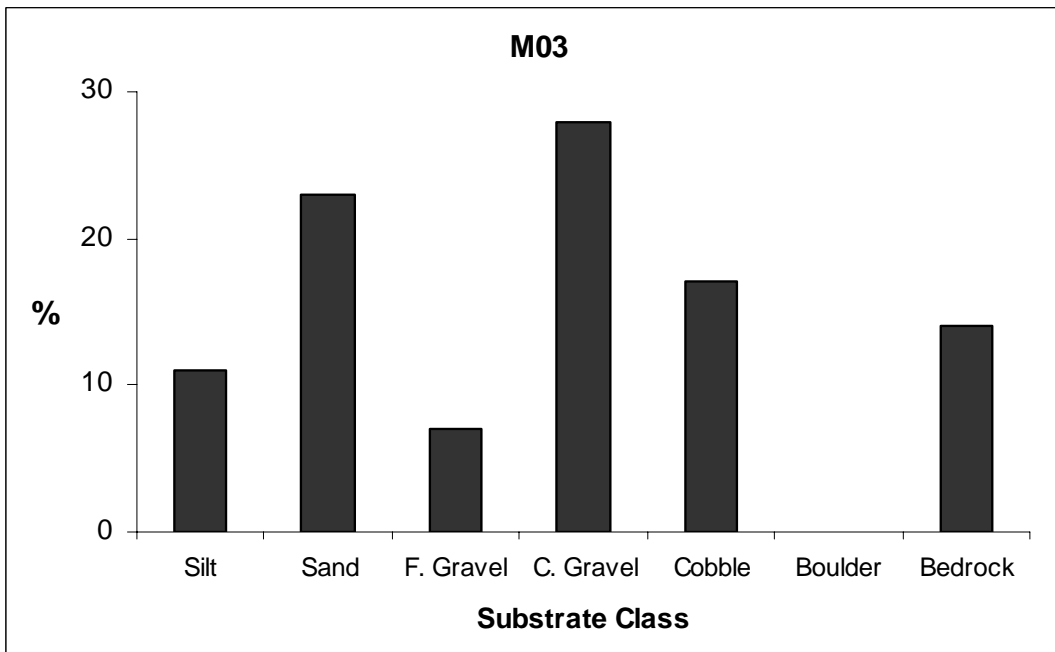
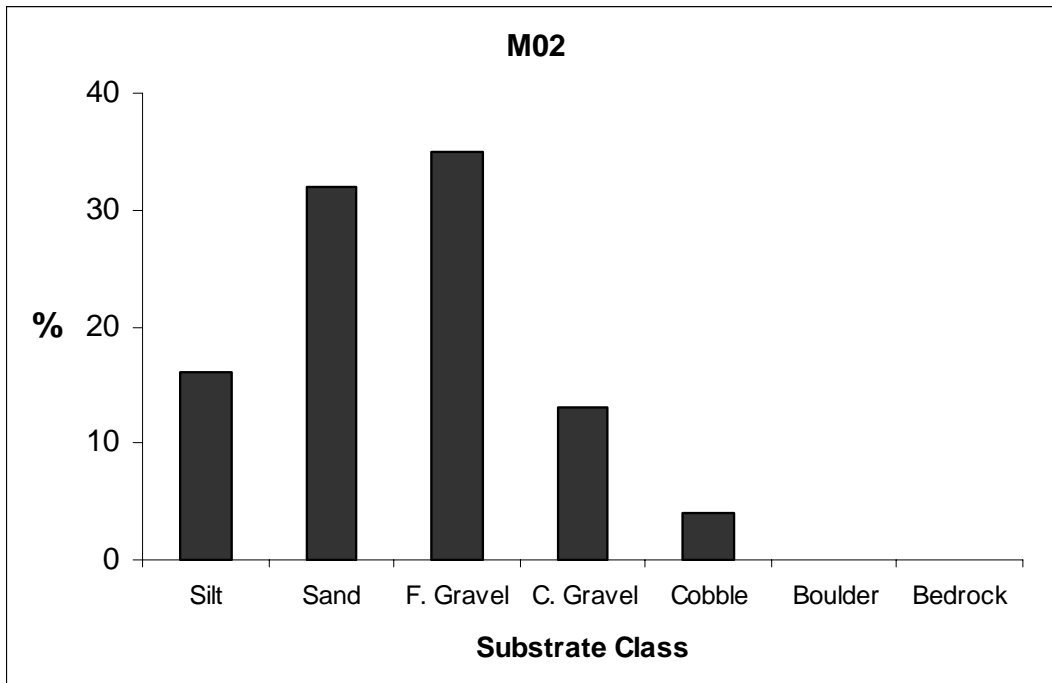
Appendix E

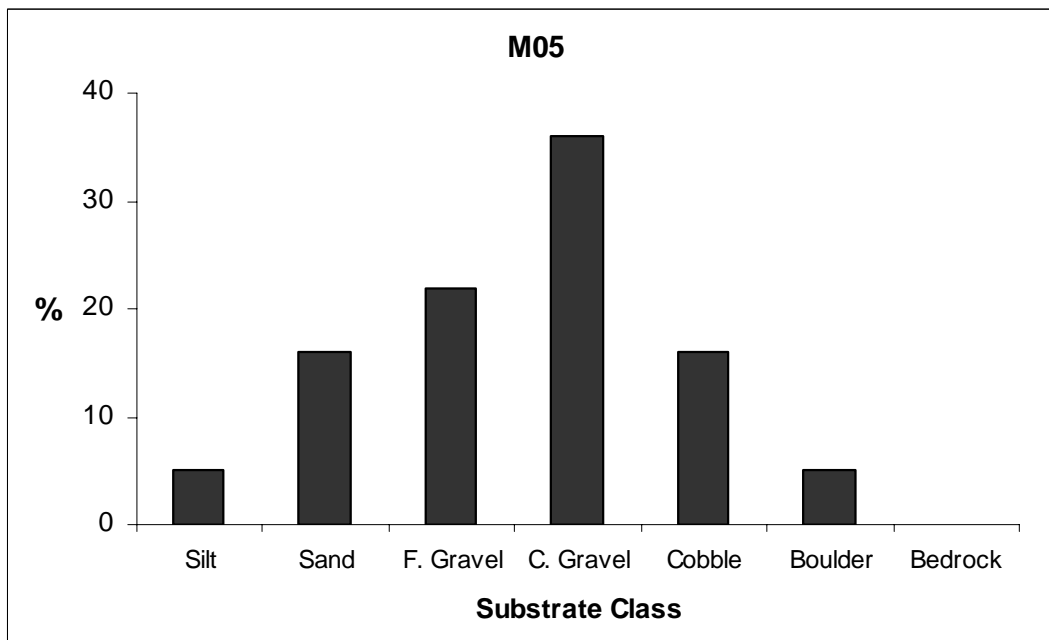
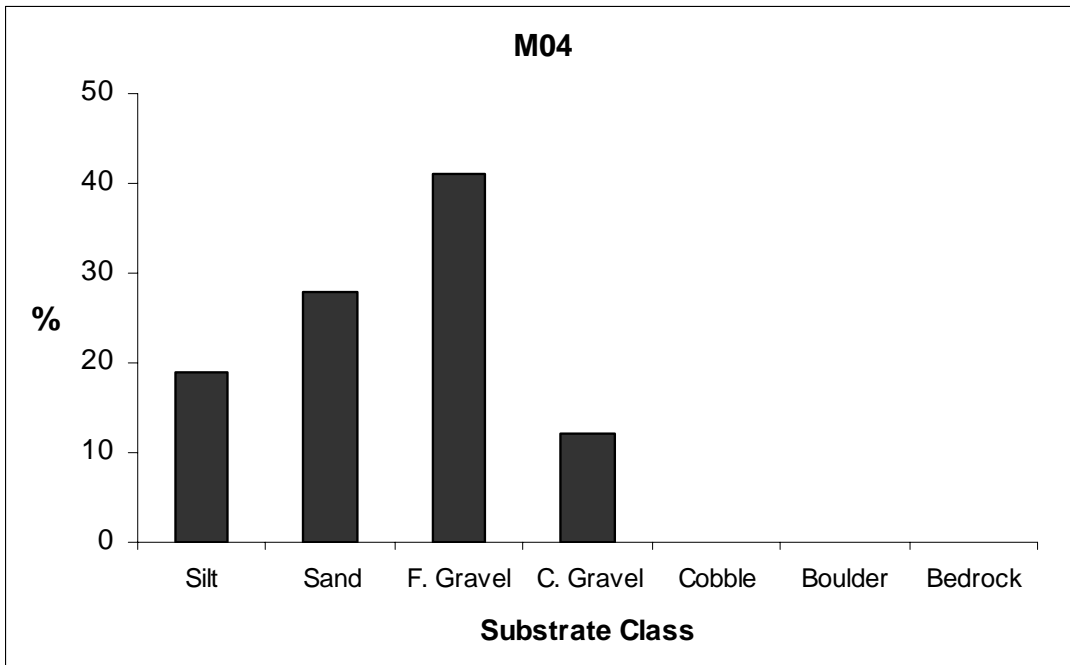
Bed Substrate Histograms (CD-ROM)

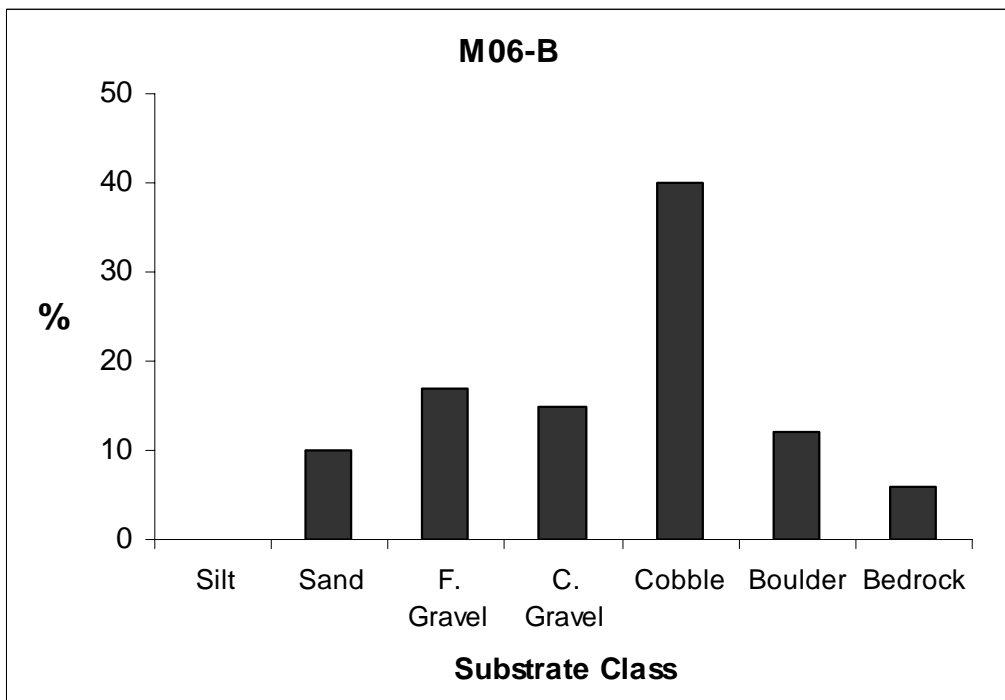
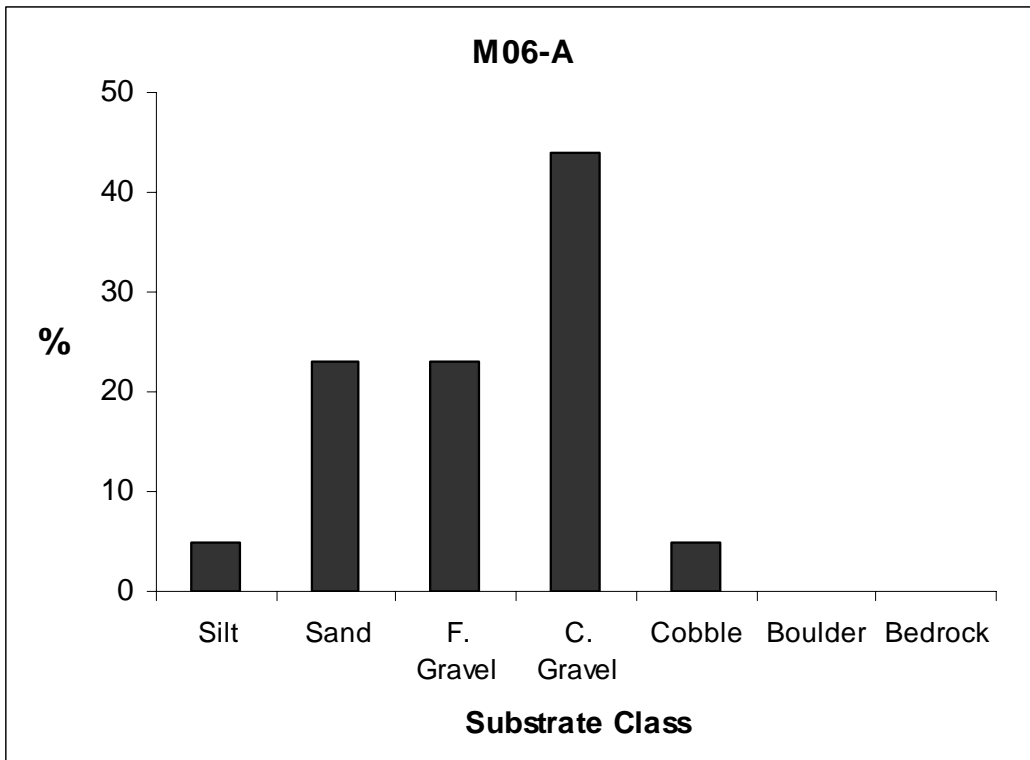
Crosby Brook Histogram Plots of Bed Substrate

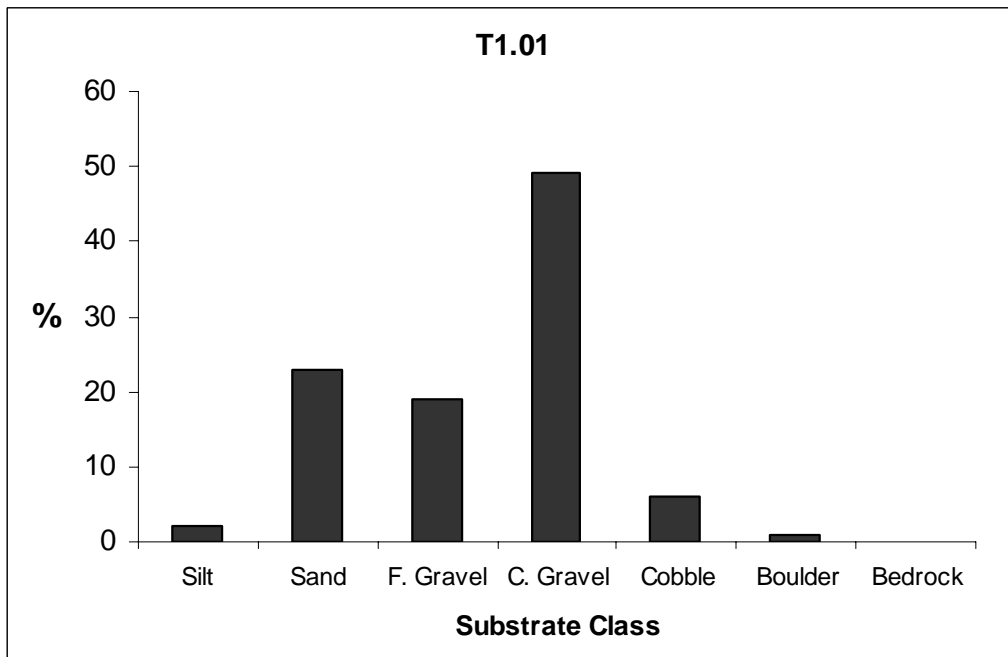
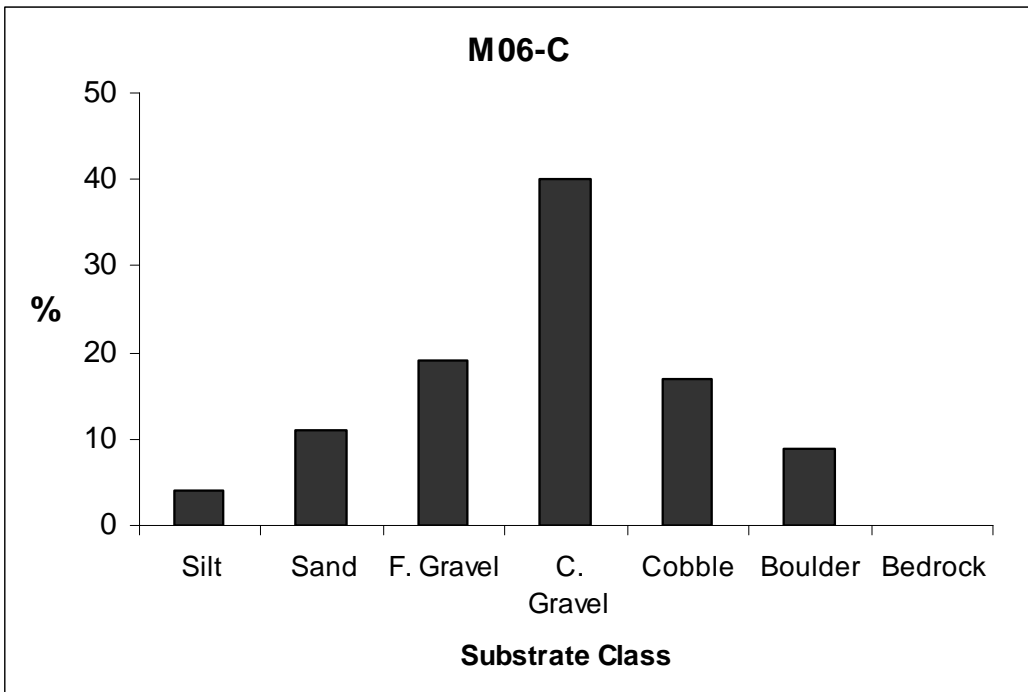
Silt < 0.06 mm Sand 0.06 - 2 mm F. Gravel 2 - 16 mm C. Gravel 16 - 64 mm Cobble 64 - 256 mm Boulder 256 - 4096 mm Bedrock > 4096 mm

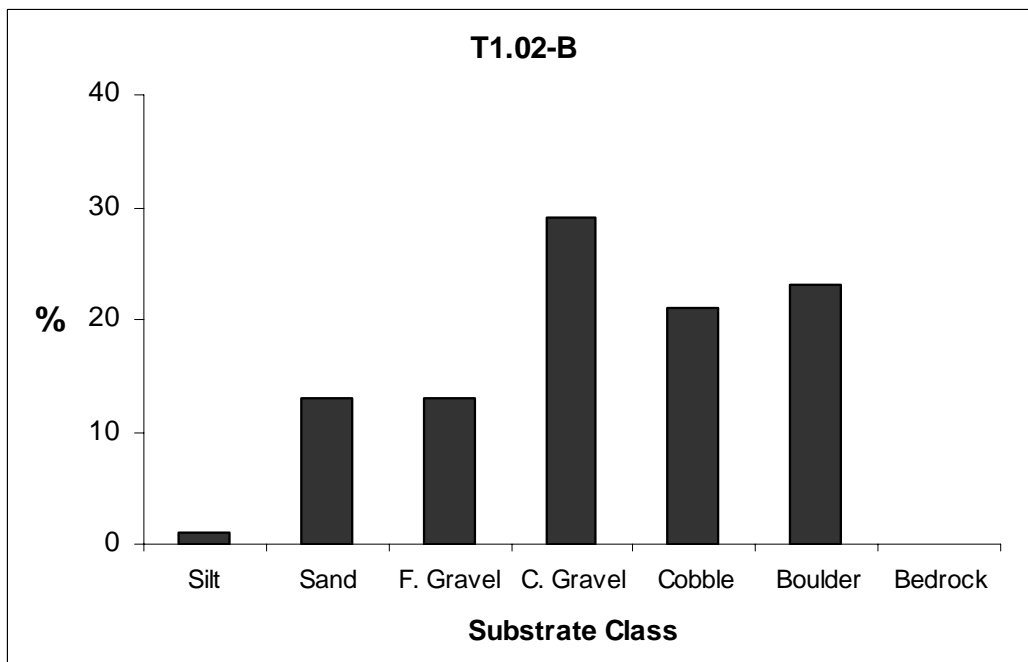
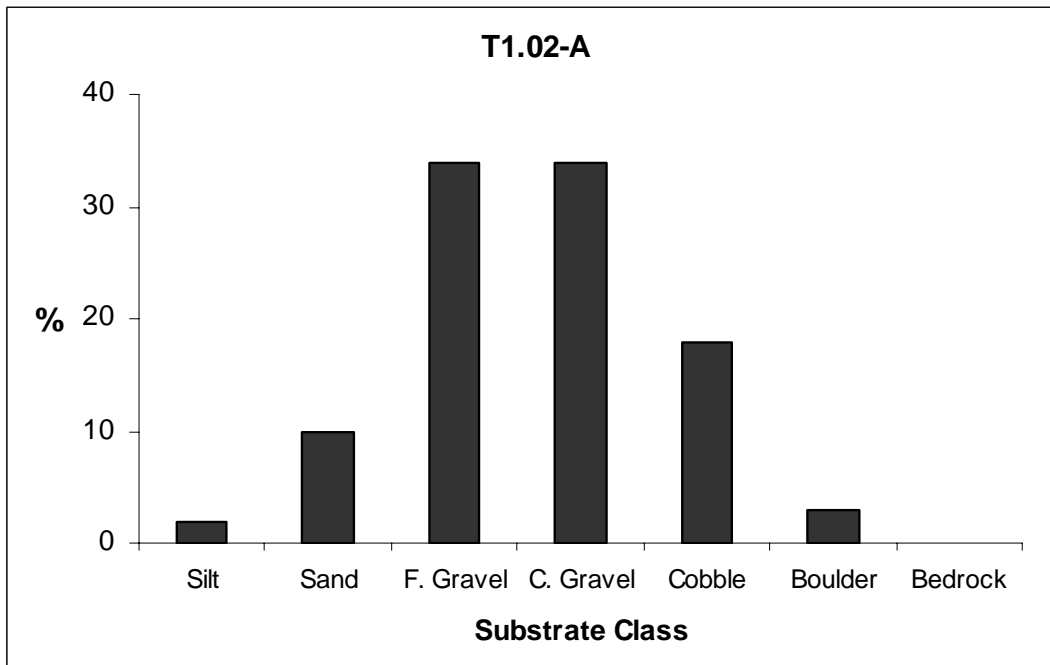


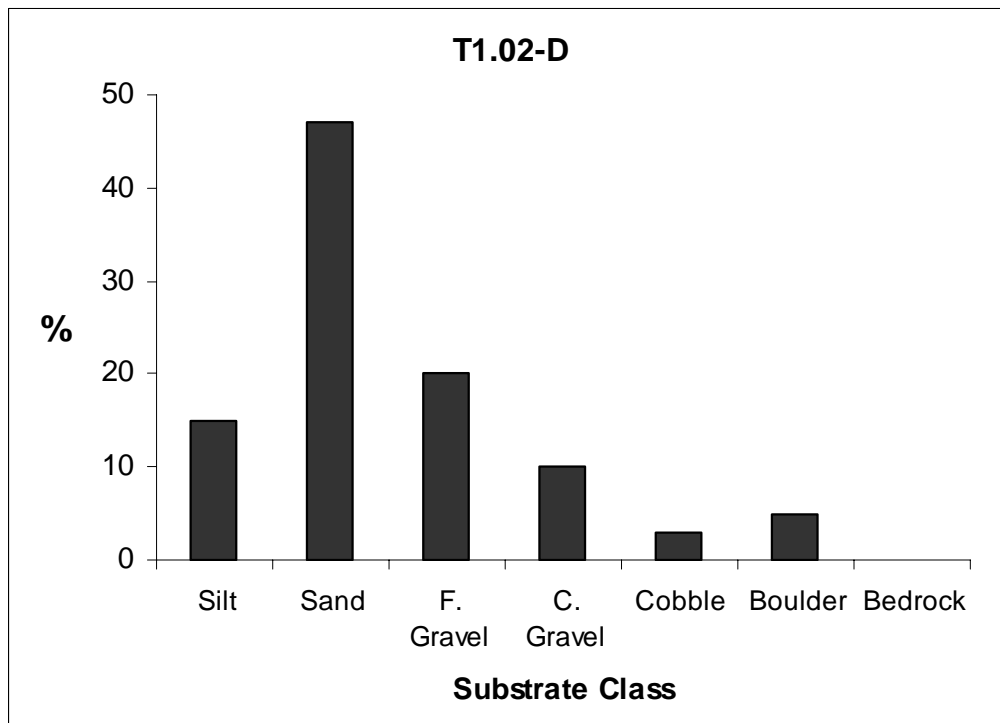
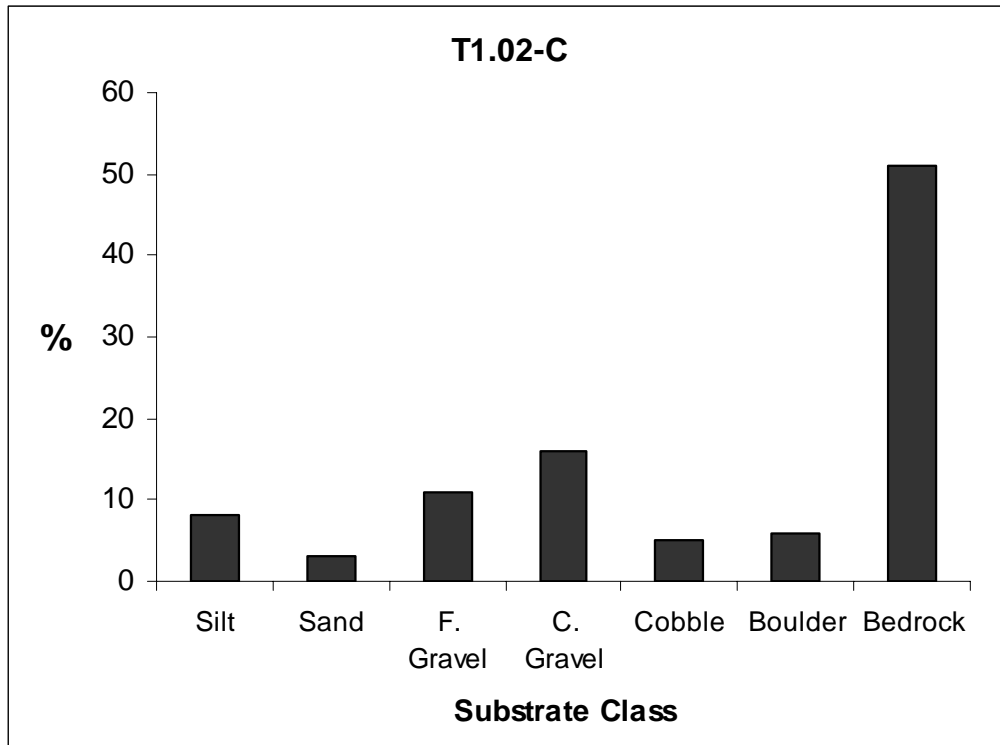


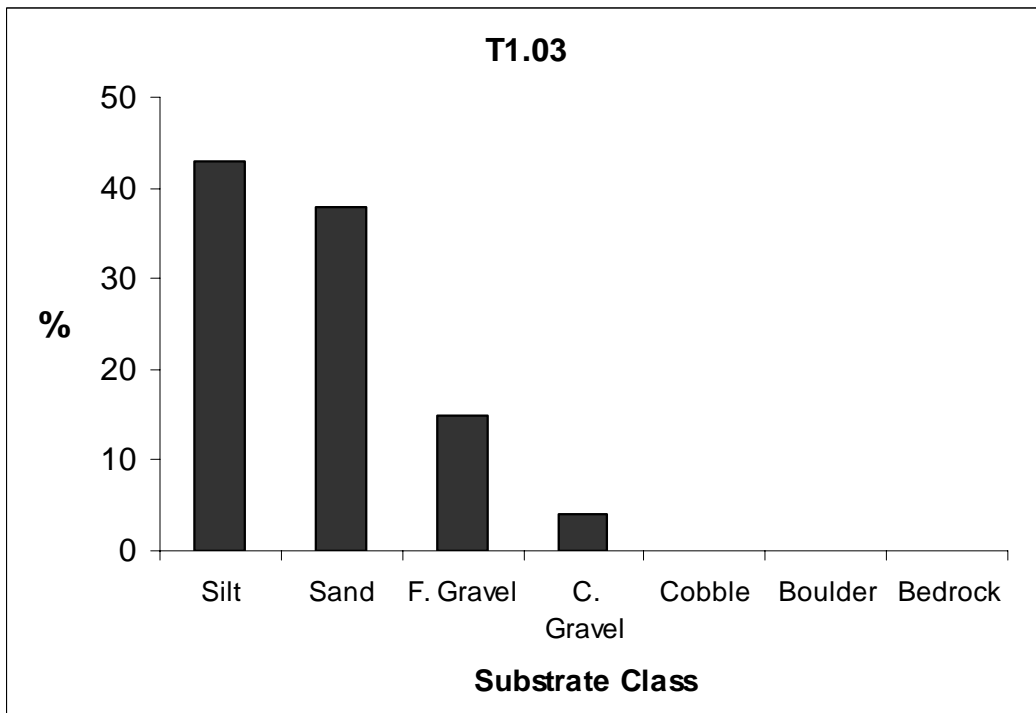
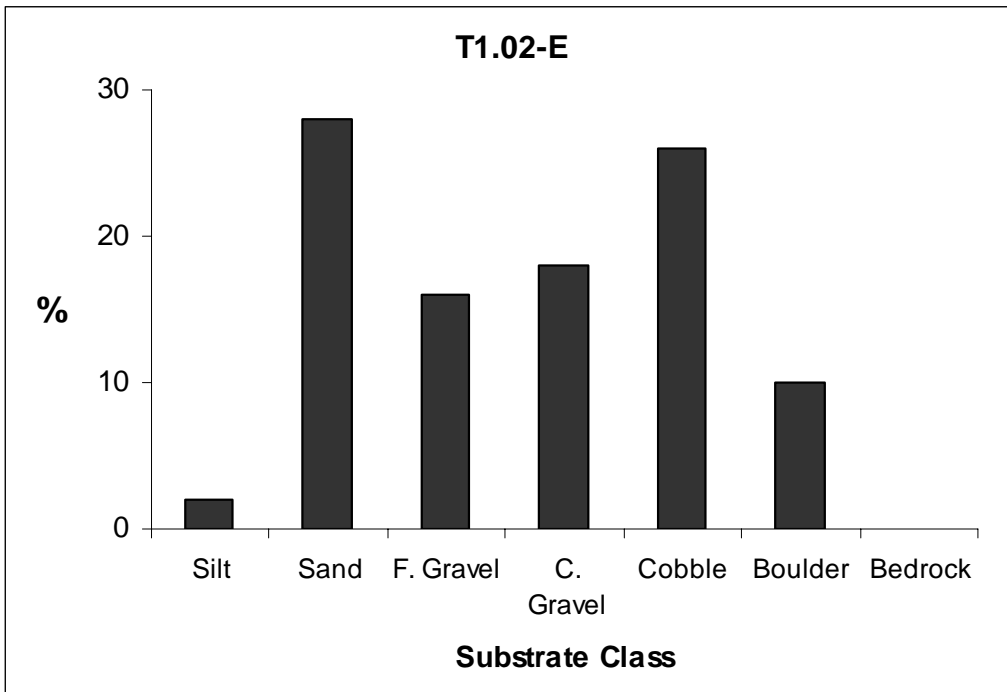












Appendix F

Cross Section Plots (CD-ROM)

Appendix G
Photos and Log (CD-ROM)