Fitzgerald Environmental Associates, LLC.

Applied Watershed Science & Ecology

Crosby Brook Phase 1
Stream Geomorphic Assessment Report

October 31, 2007

Prepared for:

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1.0 Executive Summary

This report summarizes data collected by Fitzgerald Environmental Associates, LLC. for the Crosby Brook watershed in Brattleboro and Dummerston, Vermont. The watershed was identified for assessment by the Vermont Agency of Natural Resources (VTANR) and the Windham County Natural Resources Conservation District due to its impaired biotic condition, and the Phase 1 approach of the VTANR Stream Geomorphic Assessment (SGA) Protocol (VTDEC, 2006) was utilized for data collection and analysis. Below is a summary of the key background information and findings from the Phase 1 analysis:

- The Crosby Brook watershed 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 the North and South Branches, which join near Exit 3 of Interstate 91. The North Branch, due to its larger drainage area, has been considered the Mainstem in this analysis. A total of 16 reaches (10.1 stream miles) have been analyzed for Phase 1 data.
- 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%, and a majority of its reaches have A and B-type valley geometry.
- The land cover of the watershed is occupied by a mixture of forested lands (60.7%), agricultural lands (10.7%), and to a lesser degree by various types of developed lands and wetlands. 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)
- The lower reaches of Crosby Brook in the vicinity of I-91 have been greatly impacted by the encroachment of development on the stream corridor. This impact has led to a simplified channel planform, reduced floodplain access and the removal of streamside vegetation. In addition, the discharge of increased runoff from impervious surfaces in this area is likely causing an increase in sediment loading from exogenous (e.g., surface runoff) and endogenous (e.g., bank erosion and gullying) sources.
- Based on the results of the Phase 1 analysis, a total of 9 reaches (6.8 stream miles) have been identified for future assessment using the SGA Phase 2 approach. These include the lower 6 reaches on the Mainstem (M01 through M06), and the lower 3 reaches on the South Branch (T1.01 through T1.03). The Phase 2 SGA data will form the basis for future stream corridor and fluvial erosion hazard planning efforts in the watershed.

2.0 Introduction & Geographic Setting:

The Windham County Natural Resources Conservation District (WCNRCD) identified the Crosby Brook watershed in Dummerston and Brattleboro, Vermont for assessment of fluvial geomorphic conditions. Fitzgerald Environmental Associates, LLC. (FEA) was retained by WCNRCD to carry out Phase 1 and 2 assessments following the Stream Geomorphic Assessment (SGA) Protocols developed by VTANR. Biotic samples collected by VTANR throughout the Crosby Brook watershed have consistently shown an impaired condition. The impairment is thought to be caused by increased sediment loading in the lower reaches of the watershed resulting from urbanization during the past 10 to 20 years. The SGA data will aid 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 by WCNRCD and VTANR.

Figure 1. Watershed Location Map

The Crosby Brook watershed is located in the Lower Connecticut 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. Stemming from Route 5 and the Exit 3 area is a commercial-industrial zone within the northern limits of the City of Brattleboro. There are numerous road crossings and 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 are summarized for the watershed in Table 1 of Appendix A. The watershed is 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)

3.0 Geologic & Geomorphic Setting:

The underlying geology of the Crosby Brook watershed is comprised of quartz and limestone bedrock characteristic of the Waits River formation in the Lower Connecticut River basin (Doll et al., 1961). The Black Mountain formation, located to the west of the watershed, is a 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 gullying (such as gully located on Pepsi property along Route 5).

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.

Crosby Brook has two main branches, referred to by VTANR as the North and South Branches. Due to the larger watershed area draining the North Branch, it was 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 South Branch (M01). Prior to the confluence with the South Branch near I-91 exit 3, the North Branch drainage area is 3.7 square miles. The South Branch (T1) drainage area at the confluence is 1.8 square miles. Separate summaries of the watershed data collected during the Phase 1 analysis are provided below for both branches. These summaries include descriptions of the watershed zones and specific reaches where land cover and soils characteristics indicate potential areas for channel adjustments and fluvial erosion hazards. Following these descriptions are recommendations for future monitoring and data collection that would aid in the identification of projects that that could protect, sustain, or restore fluvial geomorphic

equilibrium conditions; through the implementation of either passive or active stream corridor management strategies.

Maps depicting the subwatershed and reach boundaries, as well as impact ratings are found in Appendix A. Tables summarizing the data compiled through the Phase 1 analysis are found in Appendix B. These tables include summaries of the watershed land use and land cover (Table 1), the physical conditions and reference stream types in the watershed (Table 2), impact ratings and priorities for future assessment (Table 3), and predicted stream channel adjustment processes (Tables 4). The relative reach impact score was evaluated to determine the priority for future Phase 2 assessment. Generally, reaches with higher impact scores received a higher priority ranking. Data specific to each reach are summarized in the reach summary sheets in Appendix C. These data form the basis for the impact ratings and prioritization as described above.

4.0 Data Collection Methods

The Phase 1 SGA approach (VTDEC, 2006) utilizes the Stream Geomorphic Assessment Tool (SGAT), a GIS extension developed by VTANR for the collection of reach and watershed scale data. In addition to the GIS and remote sensing effort, a cursory field assessment ("windshield survey") is included for the verification of stream and valley forms, significant channel features and the location of man-made infrastructure. The Phase 1 SGA 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 SGA data also aids in the identification of specific stressors affecting the physical conditions of the stream channels and structures (e.g., bridges and culverts). Included in the Phase 1 approach is a rigorous Quality Assurance Protocol carried out by VTANR staff to ensure the integrity of the final dataset. A summary of the data checked through this process is included in Appendix D.

5.0 Mainstem Summary (M01-M09; T2.01-T2.02)

The Mainstem of Crosby Brook originates along a farm to the east of Black Mountain in the northern part of the watershed. Below the farm the channel descends to the east through a steep, confined valley along Middle Road. In this zone of the watershed, the watershed is mostly forested with some areas of agricultural lands. Below the Norse Hollow Road crossing, the channel enters an unconfined, rural setting in the vicinity of

Route 5. Continuing downstream of Interstate 91, the Crosby Brook channel enters an area of dense urbanization along Routes 5 and 9. Downstream of this urbanized area, the channel follows Connecticut River Drive to the south before turning east and discharging to the Connecticut River. Below are narrative descriptions of three zones of the Mainstem watershed summarized during the Phase 1 analysis:

Upper Watershed Zone (M06 to M09)

The upper watershed zone of this tributary area above Norse Hollow Road is occupied by forested terrain that has been only minimally impacted by low-density residential development and agricultural land use. Due to the steep topography of this watershed zone, B and C-type reference channels (Rosgen, 1994) are found where the valley setting is more confined and substrates are coarser. Road encroachment on the stream corridor has had the greatest impacts in this watershed zone. Due to limited human impacts in this zone, only one reach (M06) has been identified from the Phase 1 analysis as having a high priority for further assessment using the Phase 2 approach. Reach M09 received a high impact rating due to channel straightening and agricultural impacts, however the small dimensions of the headwaters channel makes it inappropriate for a complete Phase 2 assessment.

Figure 2. Depositional feature and widening in M06 below Middle Road.

- **M06:** This Mainstem reach is found along Middle Road upstream of the Norse Hollow Road crossing. The reach is characterized by a moderate-gradient, cobble-bottomed channel with B-type reference geometry. This reach has received a moderately-high impact rating due to the road encroachment which has led to a reduced floodplain and corridor. Some depositional features were observed during the field visit (Figure 2), indicating the potential for future lateral adjustments.

Middle Watershed Zone (M03 through M05; T2.01 & T2.02)

The middle zone of the watershed is found along Route 5 and Middle Road up to the crossing with Norse Hollow Road. Throughout the middle zone of the watershed most of the mainstem reaches are characterized by coarse-bottomed channels with C-type reference geometry found in unconfined valley settings. The subtributary stemming from the third Mainstem reach (T2) is found in very steep terrain (channel slopes greater than 3%) in a narrow and confined valley setting. Impacts from road encroachment and historic channel straightening were observed in this watershed zone during the windshield survey. From the Phase 1 analysis, three reaches have been identified as having high impact ratings and high priorities for further assessment.

Figure 3. Bank erosion in lower M05.

- **M05:** This Mainstem reach is found within an unconfined alluvial valley east of Middle Road. The location of the present-day channel within the wide valley indicates that much of the reach was historically straightened for agriculture purposes. The reach is characterized by a low-gradient, gravel-bottomed channel with E-type reference geometry. A high degree of lateral adjustment and bank erosion was noted during the windshield survey in the lower reach (Figure 3).

- **M04:** This Mainstem reach is found along Route 5 from the Middle Road crossing down to the Ryan Road crossing. The reach is characterized by a moderate-gradient, gravel-bottomed channel with C-type reference geometry. This reach has received a high impact rating due to the road encroachments and channel straightening along Route 5. Numerous depositional features were observed during the field visit below the Middle Road crossing (Figure 4), indicating the potential for future lateral adjustments.

Figure 4. Depositional features in upper reach M04.

- **M03:** This Mainstem reach is found to the west of Route 5 and I-91 from the Ryan Road crossing down to the confluence with the subtributary (T2). The reach is characterized by a moderate-gradient, gravel-bottomed channel with C-type reference geometry. This reach has received a high impact rating due to the depositional features observed during the field visit (Figure 5), and the highly altered meander geometry. These observations indicate that the reach is recovering from historic

straightening when the surrounding land was used for agriculture. In addition, the aggradation observed in the lower reach has been exacerbated by the supply of fine sediment from the deep gully entering from the east along I-91.

Figure 5. Depositional features and widening in lower reach M03.

Lower Watershed Zone (M01 & M02)

The lower watershed zone is found from the I-91 crossing down to the outlet to the Connecticut River. In this zone the channel slope lessens and the unconfined valley becomes broad. Under reference conditions we would expect to find C-type channels with a highly sinuous planform. However extensive channel straightening and urban encroachment has led to a highly simplified channel with degraded habitat. From the Phase 1 analysis, both reaches have been identified as having high impact ratings and high priorities for further assessment.

- **M02:** This Mainstem reach is found from the confluence with the subtributary (T2) down to the confluence with the South Branch (T1). M02 has had severe historic impacts to the planform (73% of the channel has been straightened) resulting from the construction of I-91 and from commercial development along the Route 5 corridor. In addition, a section of the reach behind the Quality Inn on Route 5 lacks a vegetative buffer greater than 25 feet, causing bank erosion (Figure 6) and likely elevating the surface water temperature during the summer months due to lack of canopy cover.

Figure 6. Bank erosion and lack of woody vegetative buffer in M02.

- **M01:** This reach is found from the confluence with the South Branch down to the outlet to the Connecticut River. This reach has had significant direct impacts to the channel boundary conditions (channel straightening in 84% of reach), and the changes in planform and abundant depositional features indicate that it has a high potential to undergo lateral migration (Figure 7). The adjacent commercial and industrial land use is causing significant fine sediment delivery to the channel, and the lack of buffer vegetation is likely elevating the surface water temperature during the summer months due to lack of canopy cover.

Figure 7. Depositional features below the I-91 Exit 3 box culvert.

6.0 South Branch Summary (T1.01-T1.05)

The South Branch of Crosby Brook originates in forested terrain to the east of Black Mountain in the northwestern part of the watershed. Below the Dutton Farm Road crossing the channel descends to the east through a steep, confined valley to the west of Kipling Road. In this zone of the watershed, the watershed is mostly forested with an area of agricultural land use that has directly impacted the stream corridor (T1.04). To the south of the Kipling Road, the channel enters an unconfined setting in a wide alluvial valley. Below this valley, the South Branch channel again descends through a narrowly confined valley along Black Mountain Road. Nearing I-91, the South Branch is found in an unconfined valley prior to the confluence with the Mainstem near Exit 3. Below are narrative descriptions of three zones of the South Branch watershed summarized during the Phase 1 analysis.

Upper Watershed Zone (T1.04 & T1.05)

The upper watershed zone of this tributary area is occupied by forested terrain interspersed with agricultural land use. Due to the steep topography of this zone (channel slopes greater than 4%), A and B-type reference channels are found where the valley setting is more confined and substrates are coarser. The on-stream impoundment associated with the large farm located along Kipling Road (T1.04) is likely causing an elevation in stream temperature during the summer months. In addition, the impoundment may be contributing to channel adjustments in the downstream reach due to changes in the sediment transport regime. However, due to the small drainage area of this headwaters reach (and small channel dimensions), it is not currently recommended for further assessment using the Phase 2 approach. An alternative stream monitoring approach to assess the impacts of the pond through the collection of temperature data below the impoundment during the summer months is recommended.

Middle Watershed Zone (T1.03)

Reach T1.03 is found in a wide alluvial valley to the west of Kipling Road (Figure 8). Under reference conditions we would expect to see a low-gradient, sand-bottomed channel with E-type channel geometry. Agricultural land use has significantly impacted the channel form and buffer conditions in this reach, resulting in a channel with a simplified planform due to straightening (over 90%

of channel length has been straightened). This reach has been identified as having a high impact rating and a high priority for further assessment.

Figure 8. Wide alluvial valley associated with Reach T1.03

Lower Watershed Zone (T1.01 & T1.02)

The lower watershed zone is found from the Black Mountain Road area down to the confluence with the Mainstem. Under reference conditions we would expect to find B and C-type channels; however extensive channel straightening and road encroachment has led to channel instability and degraded habitat conditions in both reaches. From the Phase 1 analysis, both reaches have been identified as having high impact ratings and high priorities for further assessment.

- **T1.02:** This reach is found from the reach break with T1.03 down to a change in valley slope and confinement near Crescent Drive. T1.02 has a diversity of channel forms due to changes in channel slope and confinement, and impacts associated with the encroachment of Black Mountain Road on the floodplain. In the upper and lower parts of the reach, we would expect to find C-type channel geometry given the unconfined valley setting. However downstream of the Dickinson Road crossing and along Black Mountain Road we would expect to find A and B-type channel geometry in a confined valley setting. Numerous mass failures are located along the right bank throughout the reach, including

one 40 foot landslide in the lower reach (Figure 9). A moderate degree of channel incision was observed downstream of the landslide which is likely contributing to the slope instability. Detailed channel geometry measurements will be collected during the Phase 2 analysis to better characterize the adjustments and channel evolution stage in this area.

Figure 9. Large landslide in lower T1.02

- **T1.01:** This reach is found from a change in valley slope near Crescent Road down to the confluence with the Mainstem. Direct impacts to the channel boundary conditions have occurred in this reach (channel straightening in 53% of reach), and sedimentation of sand and fine gravel was noted during the field visit. The encroachment of Black Mountain Road along the channel in the upper reach has resulted in a simplified channel planform and plane bed morphology (Figure 10). Detailed channel geometry measurements will be collected during the Phase 2 analysis to determine the departure of sediment transport processes from reference conditions.

Figure 10. Plane bedform and road encroachment in upper T1.01

7.0 Conclusions

The Phase 1 approach for Crosby Brook has provided initial data to describe the watershed's topographic, geologic and anthropogenic settings. The watershed conditions vary significantly depending on the adjacent land use (historic and current), the degree of channel straightening, and the impacts of urbanization on the hydrologic and sediment regimes. Many reaches in this watershed are predicted to have moderate to severe channel adjustment processes with fair to poor geomorphic conditions (see Table 4 in Appendix B). As a result, a total of 9 reaches have been recommended for future Phase 2 assessment. The Phase 2 analysis will be conducted by FEA in spring of 2008. The analysis will provide key data required to characterize the altered hydrologic and sediment regimes at the watershed scale, and channel adjustment processes along the channel network. The Phase 2 data will also form the basis for future stream corridor and fluvial erosion hazard planning efforts in the watershed.

8.0 References

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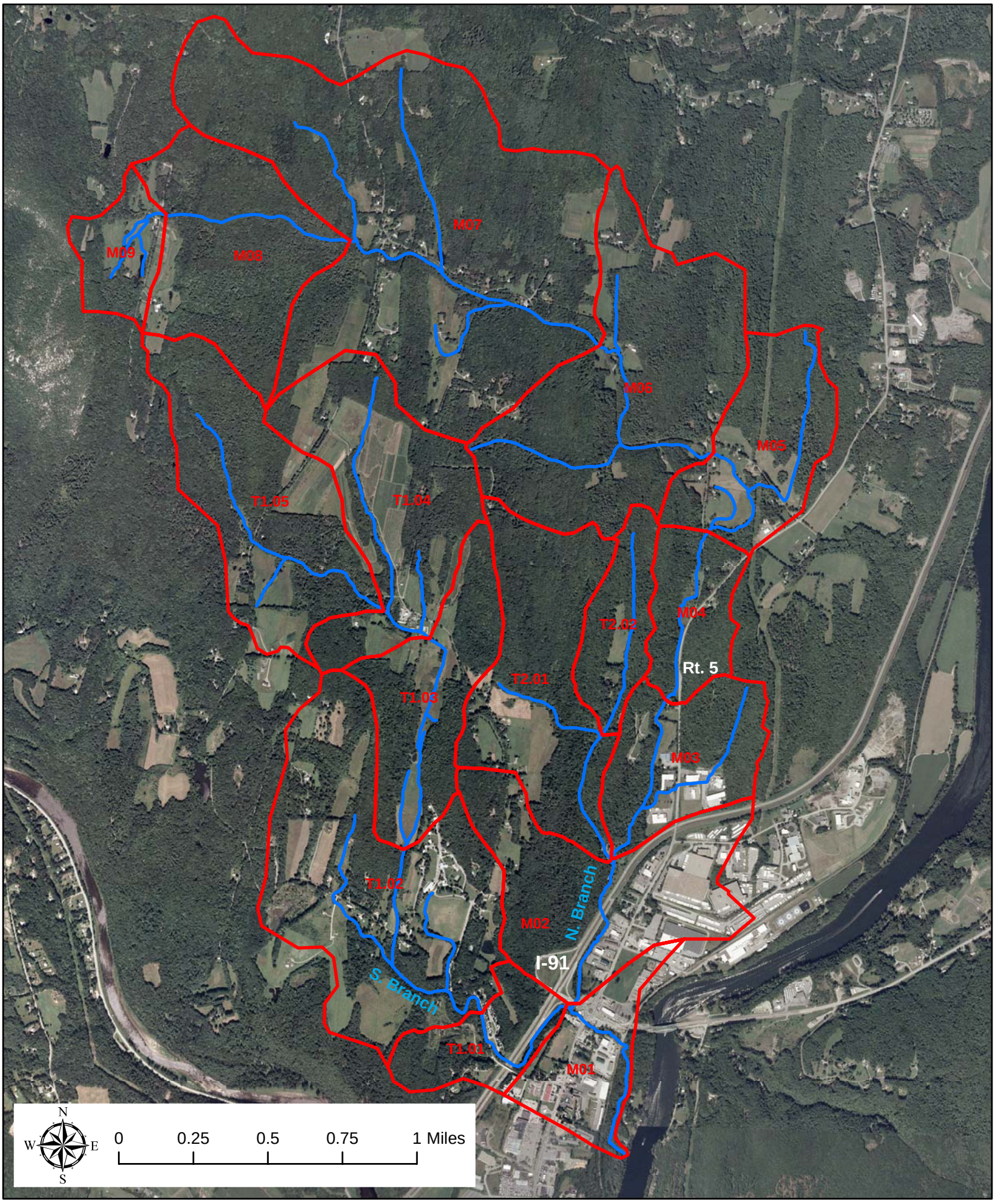
APPENDIX A

SUBWATERSHED MAPPING



Crosby Bk Subwatersheds

Crosby Bk Surface Waters

Crosby Brook
Phase 1 SGA Watershed Map

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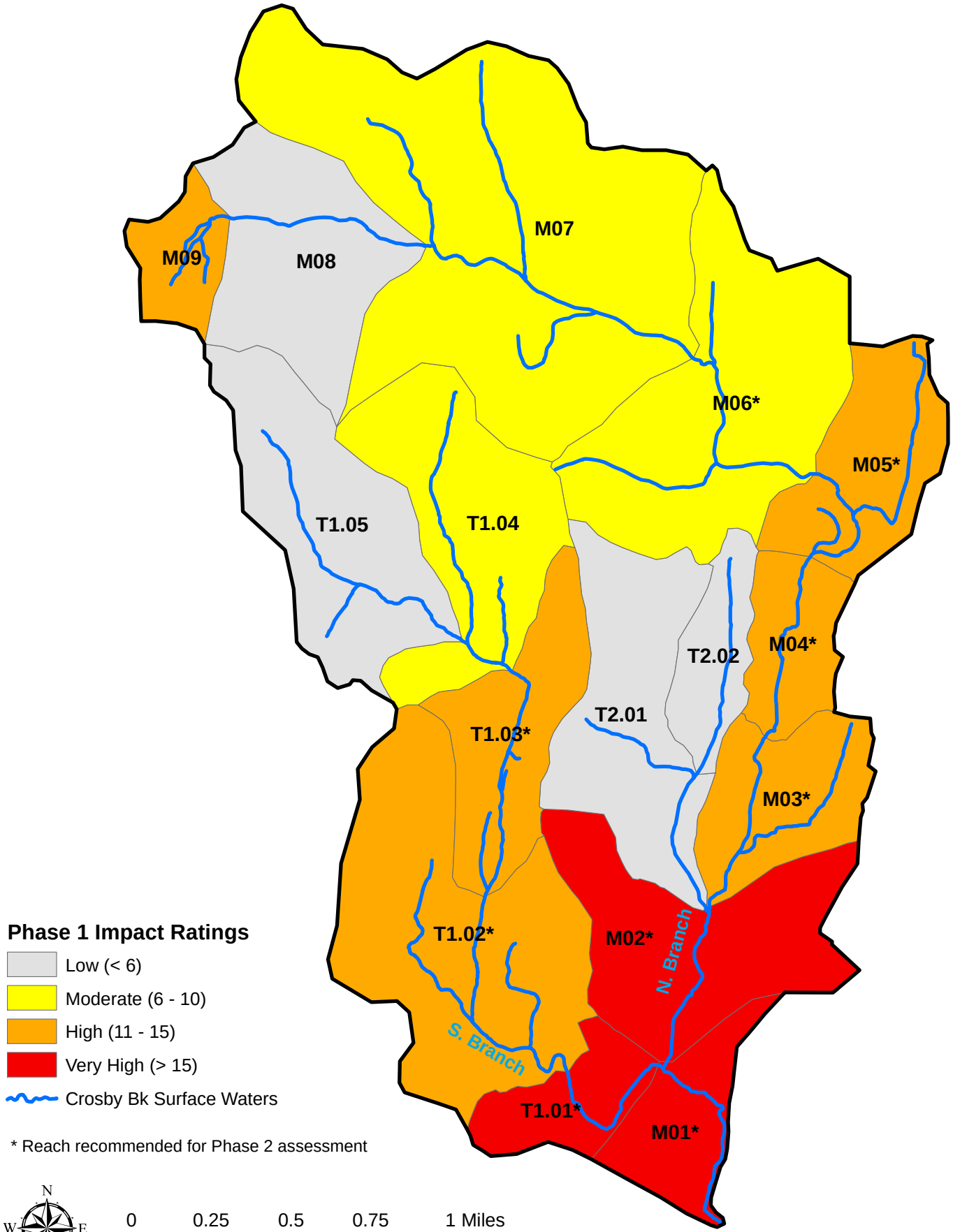

Crosby Brook
Phase 1 SGA Impact Ratings

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APPENDIX B

WATERSHED SUMMARY DATA

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

Table 2. Crosby Brook Preliminary Stream Types (Step 2)

Reach ID	Elevation Up (ft.)	Elevation Down (ft.)	Valley Length (ft.)	Valley Slope (%)	Channel Length (ft.)	Channel Slope (%)	Sinuosity	Watershed Area (sq. mi.)	Channel Width (ft.)	Valley Width§ (ft.)	Confinement Ratio	Confinement Type*	Reference Stream Type**	Bedform†	Dominant Bed Substrate
M01	269	226	3389	1.27	3624	1.2	1.07	5.69	28.2	175	6.2	BD	C	Riffle-Pool	Gravel
M02	289	269	2774	0.72	2871	0.7	1.03	3.71	23.3	227	9.7	BD	C	Riffle-Pool	Gravel
M03	325	289	2965	1.21	3160	1.1	1.07	2.81	20.6	125	6.1	BD	C	Riffle-Pool	Gravel
M04	371	325	3050	1.51	3370	1.4	1.1	2.58	19.9	220	11.1	SC	C	Riffle-Pool	Gravel
M05	377	371	2000	0.30	2393	0.3	1.2	2.43	19.4	400	20.7	VB	E	Dune-Ripple	Sand
M06	472	377	3685	2.58	3869	2.5	1.05	2.18	18.4	90	4.9	NW	B	Plane Bed	Cobble
M07	630	472	4950	3.19	5114	3.1	1.03	1.59	16.1	50	3.1	SC	B	Step-Pool	Cobble
M08	886	630	3450	7.42	3454	7.4	1	0.47	9.4	15	1.6	NC	A	Step-Pool	Cobble
M09	945	886	1550	3.81	1650	3.6	1.06	0.11	4.9	25	5.1	NW	B	Step-Pool	Cobble
T1.01	308	269	2640	1.48	2722	1.4	1.03	1.82	17.1	130	7.6	BD	C	Riffle-Pool	Gravel
T1.02	509	308	4440	4.53	4486	4.5	1.01	1.68	16.5	30	1.8	NC	B	Step-Pool	Cobble
T1.03	518	509	3854	0.23	4073	0.2	1.06	1.07	13.5	381	28.2	VB	E	Dune-Ripple	Sand
T1.04	561	518	830	5.18	998	4.3	1.2	0.81	11.9	40	3.4	NC	B	Step-Pool	Cobble
T1.05	827	561	5279	5.04	5411	4.9	1.03	0.41	8.9	15	1.7	NC	A	Step-Pool	Cobble
T2.01	374	289	2425	3.51	2477	3.4	1.02	0.5	9.7	55	5.7	SC	B	Step-Pool	Cobble
T2.02	551	374	3644	4.86	3697	4.8	1.01	0.13	5.3	15	2.8	SC	A	Step-Pool	Cobble

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

§ Valley Widths esitmated remotely for all reaches

** per Rosgen (1994)

† per Montgomery & Buffington (1997)

Table 3. Crosby Brook Impact Ratings (Step 8)

	Step Number† with Impact Score*																Total	Phase 2
Reach ID	**4.1**	**4.2**	**4.3**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**6.1**	**6.2**	**6.3**	**6.4**	**6.5**	**6.6**	**7.2**	**7.3**	**Score**	**Reach****
M01	2	2	1	0	0	0	2	0	2	2	2	1	2	2	0	2	20	**Yes**
M02	2	2	1	0	1	0	2	0	2	2	2	2	2	2	0	2	22	**Yes**
M03	1	2	2	0	0	0	0	0	0	0	2	2	1	2	0	0	12	**Yes**
M04	1	2	2	0	0	0	2	0	2	0	1	1	1	0	0	2	14	**Yes**
M05	1	1	2	0	0	0	2	0	0	0	1	2	2	2	0	0	13	**Yes**
M06	1	2	0	0	1	0	1	0	2	1	1	0	0	0	0	1	10	**Yes**
M07	1	2	0	0	0	0	0	0	2	0	2	2	0	0	0	1	10	No
M08	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	No
M09	2	2	2	1	0	0	2	0	0	0	0	1	2	2	0	0	14	No
T1.01	2	2	0	0	1	0	2	0	2	0	2	1	2	2	0	2	18	**Yes**
T1.02	2	2	0	0	0	0	2	0	2	0	2	1	0	0	0	1	12	**Yes**
T1.03	1	1	2	0	0	0	2	0	0	0	0	1	2	2	0	0	11	**Yes**
T1.04	1	2	2	1	0	0	2	0	0	0	0	1	0	0	0	0	9	No
T1.05	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	No
T2.01	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	No
T2.02	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	No

* 0 = Not Significant or No Data; 1 = Low; 2 = High

† Step 4: Land Cover and Reach Hydrology
Step 5: Channel Modifications
Step 6: Floodplain Modifications and Planform Changes
Step 7: Bed and Bank Condition

** Notes if reach is recommended for inclusion in Phase 2 analysis

Table 4. Crosby Brook Predicted Channel Adjustment Processes (Step 9)

	9.1 Predicted Adjustment Scores				9.2 Reach Condition		9.3 Reach
Reach ID	**Degradation**	**Aggradation**	**Widening**	**Planform**	**Project***	**Statewide***	**Sensitivity**
M01	**10**	9	7	8	Poor	Fair	High
M02	**11**	9	7	**11**	Poor	Fair	High
M03	2	5	**6**	**6**	Fair	Good	High
M04	6	**9**	5	5	Fair	Good	High
M05	4	4	2	**6**	Fair	Good	High
M06	**6**	5	3	5	Fair	Good	Moderate
M07	4	3	2	0	Good	Reference	Moderate
M08	2	1	0	0	Reference	Reference	High
M09	6	**8**	7	**8**	Poor	Fair	Moderate
T1.01	**9**	8	7	7	Poor	Fair	High
T1.02	**8**	6	7	0	Fair	Good	Moderate
T1.03	4	4	2	4	Good	Good	High
T1.04	4	5	4	0	Good	Good	Moderate
T1.05	2	3	0	0	Reference	Reference	High
T2.01	2	1	0	0	Reference	Reference	Moderate
T2.02	2	3	0	0	Reference	Reference	High

* Conditions relative to the Crosby Brook watershed ("project") versus overall Vermont ("statewide")

Note: **Bold** values indicate the dominant adjustment processes (when moderate to severe; value > 5)

APPENDIX C

PHASE 1 REACH REPORTS

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M01**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From confluence with the Connecticut River up to reach break by Brattleboro**
1.2 Towns:
1.3 Downstream Latitude: **42.88**
1.3 Downstream Longitude: **-72.55**

Step 2. Stream Type

2.1 Elevation Upstream: **269**
2.1 Elevation Downstream: **226**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3389** feet. **0.64** Miles.
2.3 Valley Slope: **1.27** %
2.4.Channel Length: **3624** feet. Miles.
2.5 Channel Slope: **1.19** %
2.6 Sinuosity: **1.07**
2.7 Watershed Area: **6** Square Miles
2.8 Channel Width: **28** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **None**
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact 73.0** %
3.3 Sub-dominant Geological Mat.: **Alluvial**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**A**	**73.0** %
Flooding:	**None/Rare**	**77.0** %
Water Table Deep:	**6.0**	**77.0** %
Water Table Shallow:	**6.0**	**77.0** %
Erodibility:	**High -**	**57.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **66.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **48.0** %
Current Sub-Dominant Land Cover:

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**26-50**
Sub-dominant:	**51-100**	**0-25**
Length w/ less than 25 ft.:	**0**	**393**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **4** %
5.3 Bank Armoring: **1 %**
Left **92** Right **0.0**
5.4 Channel Straightening: **3054** **84 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **579** ft. **15 %**

	One Side	Both Sides	
Road:	**557** ft.	**0.0**	ft.
Railroad:	**254** ft.	**0.0**	ft.
Berm:	**0.0** ft.	**0.0**	ft.
Improved Path:	**0.0** ft.	**0.0**	ft.
6.2 Development:	**579** ft.	**1141**	ft.

6.3 Channel Bars: **Multiple**
6.4 Meander Migration:
6.5 Meander Width: **28.2** Ratio: **1.0**
6.6 Wavelength: **28.2** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Bridge**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	1 Low	2 High	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	13

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M02**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From confluence with trib north to above I-91**
1.2 Towns: **Brattleboro**
1.3 Downstream Latitude: **42.89**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **289**
2.1 Elevation Downstream: **269**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2774** feet. **0.53** Miles.
2.3 Valley Slope: **0.72** %
2.4.Channel Length: **2871** feet. Miles.
2.5 Channel Slope: **0.70** %
2.6 Sinuosity: **1.03**
2.7 Watershed Area: **4** Square Miles
2.8 Channel Width: **23** feet.
2.9 Valley Width: **227** feet.
2.10 Confinement Ratio: **10**
2.10 Confinement Type: **Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **None**
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact 69.0** %
3.3 Sub-dominant Geological Mat.: **Glacial**
3.4 Left Valley Side **Hilly**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**A**	**69.0** %
Flooding:	**None/Rare**	**89.0** %
Water Table Deep:	**6.0**	**89.0** %
Water Table Shallow:	**6.0**	**89.0** %
Erodibility:	**High -**	**45.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **71.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Urban** **51.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**>100**
Sub-dominant:	**51-100**	**26-50**
Length w/ less than 25 ft.:	**234**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **11** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **2089** **72 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **955** ft. **33 %**

	One Side	Both Sides
Road:	**1369** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
6.2 Development:	**955** ft.	**0.0** ft.

6.3 Channel Bars: **Side**
6.4 Meander Migration:
6.5 Meander Width: **23.3** Ratio: **1.0**
6.6 Wavelength: **23.3** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	2 High	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	15

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M03**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From north of interstate I-91 to just above Ryan Rd.**
1.2 Towns: **Brattleboro, Dummerston**
1.3 Downstream Latitude: **42.89**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **325**
2.1 Elevation Downstream: **289**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2965** feet. **0.56** Miles.
2.3 Valley Slope: **1.21** %
2.4.Channel Length: **3160** feet. Miles.
2.5 Channel Slope: **1.14** %
2.6 Sinuosity: **1.07**
2.7 Watershed Area: **3** Square Miles
2.8 Channel Width: **21** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **None**
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **86.0** %
3.3 Sub-dominant Geological Mat.: **Glacial**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**C**	**86.0** %
Flooding:	**Frequent**	**86.0** %
Water Table Deep:	**1.5**	**86.0** %
Water Table Shallow:	**0.0**	**86.0** %
Erodibility:	**High -**	**10.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **75.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **30.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**51-100**	**>100**
Sub-dominant:	**0-25**	**26-50**
Length w/ less than 25 ft.:	**1180**	**0**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **2** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides	
Road:	**0.0**	ft. **0.0**	ft.
Railroad:	**0.0**	ft. **0.0**	ft.
Berm:	**0.0**	ft. **0.0**	ft.
Improved Path:	**0.0**	ft. **0.0**	ft.
6.2 Development:	**0.0**	ft. **0.0**	ft.

6.3 Channel Bars: **Mid-channel**
6.4 Meander Migration:
6.5 Meander Width: **90.0** Ratio: **4.4**
6.6 Wavelength: **360.0** Ratio: **17.4**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	2 High	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	1 Low	2 High	0 N.S.	0 N.S.	7

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M04**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From Ryan Rd. the channel extends north until it crosses under**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.90**
1.3 Downstream Longitude: **-72.55**

Step 2. Stream Type

2.1 Elevation Upstream: **371**
2.1 Elevation Downstream: **325**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3050** feet. **0.58** Miles.
2.3 Valley Slope: **1.51** %
2.4.Channel Length: **3370** feet. Miles.
2.5 Channel Slope: **1.36** %
2.6 Sinuosity: **1.10**
2.7 Watershed Area: **3** Square Miles
2.8 Channel Width: **20** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **None**
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **94.0** %
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils
Hydrologic Group: **C** **97.0** %
Flooding: **Frequent** **94.0** %
Water Table Deep: **1.5** **94.0** %
Water Table Shallow: **0.0** **94.0** %
Erodibility: **High -** **4.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **78.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **50.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**0-25**	**>100**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**835**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **3** %
5.3 Bank Armoring: **2 %**
Left **149** Right **0.0**
5.4 Channel Straightening: **1545** **45 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**1911** ft. **0.0**	ft.
Railroad:	**0.0** ft. **0.0**	ft.
Berm:	**0.0** ft. **0.0**	ft.
Improved Path:	**0.0** ft. **0.0**	ft.
6.2 Development:	**0.0** ft. **0.0**	ft.

6.3 Channel Bars: **Side**
6.4 Meander Migration:
6.5 Meander Width: **60.0** Ratio: **3.0**
6.6 Wavelength: **160.0** Ratio: **8.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	2 High	1 Low	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	1 Low	0 N.S.	0 N.S.	0 N.S.	9

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M05**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From the reach break at Middle Road the channel makes a wide bend**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.91**
1.3 Downstream Longitude: **-72.55**

Step 2. Stream Type

2.1 Elevation Upstream: **377**
2.1 Elevation Downstream: **371**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2000** feet. **0.38** Miles.
2.3 Valley Slope: **0.30** %
2.4.Channel Length: **2393** feet. Miles.
2.5 Channel Slope: **0.25** %
2.6 Sinuosity: **1.20**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: **19** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **E**
Bedform: **Dune-Ripple**
Sub-class Slope: **None**
Bed Material: **Sand**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact 74.0** %
3.3 Sub-dominant Geological Mat.: **Alluvial**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Flat**
3.5 Soils

Hydrologic Group:	**A**	**39.0** %
Flooding:	**None/Rare**	**74.0** %
Water Table Deep:	**6.0**	**39.0** %
Water Table Shallow:	**6.0**	**39.0** %
Erodibility:	**High -**	**73.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **78.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **21.0** %
Current Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**0-25**
Sub-dominant:	**0-25**	**None**
Length w/ less than 25 ft.:	**0**	**2214**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **2237** **93 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
6.2 Development:	**0.0** ft.	**0.0** ft.

6.3 Channel Bars: **Point**
6.4 Meander Migration:
6.5 Meander Width: **19.4** Ratio: **1.0**
6.6 Wavelength: **19.4** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	1 Low	2 High	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	10

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M06**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From Houghton Rd. the channel extends northward and the reach**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.91**
1.3 Downstream Longitude: **-72.55**

Step 2. Stream Type

2.1 Elevation Upstream: **472**
2.1 Elevation Downstream: **377**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3685** feet. **0.70** Miles.
2.3 Valley Slope: **2.58** %
2.4.Channel Length: **3869** feet. Miles.
2.5 Channel Slope: **2.46** %
2.6 Sinuosity: **1.05**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: **18** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrow**
2.11 Reference Stream Type: **B**
Bedform: **Plane Bed**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact** **63.0** %
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**A**	**58.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**95.0** %
Water Table Shallow:	**6.0**	**95.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **80.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **32.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**>100**
Sub-dominant:	**>100**	**51-100**
Length w/ less than 25 ft.:	**0**	**63**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **5** **7** %
5.3 Bank Armoring: **0 %**
Left **0.0** Right **49**
5.4 Channel Straightening: **56** **1 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **264** ft. **6 %**

	One Side	Both Sides
Road:	**1159** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
6.2 Development:	**264** ft.	**0.0** ft.

6.3 Channel Bars: **Point**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	1	0	1	0	2	1	0	0	0	0	0	0	8
Low	High	N.S.	N.S.	Low	N.S.	Low	N.S.	High	Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M07**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From reach break the channel moves in a more confined setting and**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.92**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **630**
2.1 Elevation Downstream: **472**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **4950** feet. **0.94** Miles.
2.3 Valley Slope: **3.19** %
2.4.Channel Length: **5114** feet. Miles.
2.5 Channel Slope: **3.09** %
2.6 Sinuosity: **1.03**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: **16** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **94.0** %
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**B**	**73.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**78.0** %
Water Table Shallow:	**6.0**	**78.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **79.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **28.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**>100**
Sub-dominant:	**51-100**	**51-100**
Length w/ less than 25 ft.:	**198**	**0**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **2** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**1557** ft. **0.0**	ft.
Railroad:	**0.0** ft. **0.0**	ft.
Berm:	**0.0** ft. **0.0**	ft.
Improved Path:	**0.0** ft. **0.0**	ft.
6.2 Development:	**0.0** ft. **0.0**	ft.

6.3 Channel Bars: **Multiple**
6.4 Meander Migration: **Braiding**
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5
Low	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M08**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **Reach starts west of Dutton Farm Road through a heavily forested**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.92**
1.3 Downstream Longitude: **-72.57**

Step 2. Stream Type

2.1 Elevation Upstream: **886**
2.1 Elevation Downstream: **630**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3450** feet. **0.65** Miles.
2.3 Valley Slope: **7.42** %
2.4.Channel Length: **3454** feet. Miles.
2.5 Channel Slope: **7.41** %
2.6 Sinuosity: **1.00**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: **9** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan:
3.2 Grade Control:
3.3 Dominant Geologic Mat.: **Till** **65.0** %
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Steep**
3.5 Soils

Hydrologic Group:	**C**	**65.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**100.** %
Water Table Shallow:	**6.0**	**100.** %
Erodibility:	**High -**	**78.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **79.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **82.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**None**
Length w/ less than 25 ft.:	**---**	**---**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type:
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**

	Left	Right
5.4 Channel Straightening:		**0.0**

5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	ft.	ft.
Railroad:	ft.	ft.
Berm:	ft.	ft.
Improved Path:	ft.	ft.
6.2 Development:	ft.	ft.

6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **None**
7.2 Bank Height: **No Data**
7.3 Ice/Debris Jam Potential: **Not Evaluated**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook North Branch** Reach **M09**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From Black Mountain Road to Headwaters in farm field**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.92**
1.3 Downstream Longitude: **-72.58**

Step 2. Stream Type

2.1 Elevation Upstream: **945**
2.1 Elevation Downstream: **886**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **1550** feet. **0.29** Miles.
2.3 Valley Slope: **3.81** %
2.4.Channel Length: **1650** feet. Miles.
2.5 Channel Slope: **3.58** %
2.6 Sinuosity: **1.06**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: **5** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrow**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **75.0** %
3.3 Sub-dominant Geological Mat.: **Other**
3.4 Left Valley Side **Hilly**
3.4 Right Valley Side **Hilly**
3.5 Soils

Hydrologic Group:	**B**	**71.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**75.0** %
Water Table Shallow:	**6.0**	**75.0** %
Erodibility:	**High -**	**75.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **68.0** %
Current Sub-Dominant Land Cover: **Urban**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **42.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**0-25**	**0-25**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**0**	**532**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **Irrigation**
Type: **Small Withdrawal**
Use: **Other**
5.2 Bridges and Culverts: **2** **4** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **588.9** **35 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**0.0** ft. **0.0**	ft.
Railroad:	**0.0** ft. **0.0**	ft.
Berm:	**0.0** ft. **0.0**	ft.
Improved Path:	**0.0** ft. **0.0**	ft.
6.2 Development:	**0.0** ft. **0.0**	ft.

6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: **4.9** Ratio: **1.0**
6.6 Wavelength: **4.9** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	1 Low	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	11

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook South Branch** Reach **T1.01**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From confluence with mainstem reach crosses under I-91and ends on**
1.2 Towns: **Brattleboro**
1.3 Downstream Latitude: **42.89**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **308**
2.1 Elevation Downstream: **269**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2640** feet. **0.50** Miles.
2.3 Valley Slope: **1.48** %
2.4.Channel Length: **2722** feet. Miles.
2.5 Channel Slope: **1.43** %
2.6 Sinuosity: **1.03**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: **17** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Broad**
2.11 Reference Stream Type: **C**
Bedform: **Riffle-Pool**
Sub-class Slope: **None**
Bed Material: **Gravel**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Ice-Contact 100.** %
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**A**	**100.** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**100.** %
Water Table Shallow:	**6.0**	**100.** %
Erodibility:	**High -**	**47.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **61.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Shrub**
Current Dominant land Cover: **Urban** **63.0** %
Current Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**26-50**	**51-100**
Sub-dominant:	**0-25**	**>100**
Length w/ less than 25 ft.:	**0**	**0**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **9** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **1430** **52 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**1484** ft. **0.0**	ft.
Railroad:	**0.0** ft. **0.0**	ft.
Berm:	**0.0** ft. **0.0**	ft.
Improved Path:	**0.0** ft. **0.0**	ft.
6.2 Development:	**0.0** ft. **0.0**	ft.

6.3 Channel Bars: **Mid-channel**
6.4 Meander Migration:
6.5 Meander Width: **17.1** Ratio: **1.0**
6.6 Wavelength: **17.1** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
2 High	2 High	0 N.S.	0 N.S.	1 Low	0 N.S.	2 High	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	13

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook South Branch** Reach **T1.02**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From reach break along Black Mountain Rd.**
1.2 Towns: **Brattleboro**
1.3 Downstream Latitude: **42.88**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **509**
2.1 Elevation Downstream: **308**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **4440** feet. **0.84** Miles.
2.3 Valley Slope: **4.53** %
2.4.Channel Length: **4486** feet. Miles.
2.5 Channel Slope: **4.48** %
2.6 Sinuosity: **1.01**
2.7 Watershed Area: **2** Square Miles
2.8 Channel Width: **16** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **60.0** %
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**A**	**39.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**72.0** %
Water Table Shallow:	**6.0**	**72.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **63.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Urban** **31.0** %
Current Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**0-25**	**0-25**
Length w/ less than 25 ft.:	**0**	**188**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **2** **2** %
5.3 Bank Armoring: **3 %**
Left **337** Right **0.0**
5.4 Channel Straightening: **2161** **48 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**1846** ft. **0.0**	ft.
Railroad:	**0.0** ft. **0.0**	ft.
Berm:	**0.0** ft. **0.0**	ft.
Improved Path:	**0.0** ft. **0.0**	ft.
6.2 Development:	**0.0** ft. **0.0**	ft.

6.3 Channel Bars: **Multiple**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	2	0	2	0	0	0	0	0	0	0	7
Low	High	N.S.	N.S.	N.S.	N.S.	High	N.S.	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook South Branch** Reach **T1.03**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **In open farming valley to Kipling Rd.**
1.2 Towns: **Brattleboro, Dummerston**
1.3 Downstream Latitude: **42.89**
1.3 Downstream Longitude: **-72.57**

Step 2. Stream Type

2.1 Elevation Upstream: **518**
2.1 Elevation Downstream: **509**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3854** feet. **0.73** Miles.
2.3 Valley Slope: **0.23** %
2.4.Channel Length: **4073** feet. Miles.
2.5 Channel Slope: **0.22** %
2.6 Sinuosity: **1.06**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: **13** feet.
2.9 Valley Width: **381** feet.
2.10 Confinement Ratio: **28**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **E**
Bedform: **Dune-Ripple**
Sub-class Slope: **None**
Bed Material: **Sand**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **78.0** %
3.3 Sub-dominant Geological Mat.: **Other**
3.4 Left Valley Side **Extremely Steep**
3.4 Right Valley Side **Extremely Steep**
3.5 Soils

Hydrologic Group:	**C**	**83.0** %
Flooding:	**Frequent**	**78.0** %
Water Table Deep:	**1.5**	**78.0** %
Water Table Shallow:	**0.0**	**78.0** %
Erodibility:	**High -**	**7.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **65.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **32.0** %
Current Sub-Dominant Land Cover: **Wetland**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**0-25**	**0-25**
Sub-dominant:	**>100**	**None**
Length w/ less than 25 ft.:	**0**	**1731**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **3708** **91 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides	
Road:	**0.0**	ft. **0.0**	ft.
Railroad:	**0.0**	ft. **0.0**	ft.
Berm:	**0.0**	ft. **0.0**	ft.
Improved Path:	**0.0**	ft. **0.0**	ft.
6.2 Development:	**0.0**	ft. **0.0**	ft.

6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: **13.5** Ratio: **1.0**
6.6 Wavelength: **13.5** Ratio: **1.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	1 Low	2 High	0 N.S.	0 N.S.	0 N.S.	2 High	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	2 High	2 High	0 N.S.	0 N.S.	10

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook South Branch** Reach **T1.04**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **A short stretch east of Kipling Rd. about 1000'**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.90**
1.3 Downstream Longitude: **-72.57**

Step 2. Stream Type

2.1 Elevation Upstream: **561**
2.1 Elevation Downstream: **518**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **830** feet. **0.16** Miles.
2.3 Valley Slope: **5.18** %
2.4.Channel Length: **998** feet. Miles.
2.5 Channel Slope: **4.31** %
2.6 Sinuosity: **1.20**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: **12** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **a**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **83.0** %
3.3 Sub-dominant Geological Mat.: **Ice-Contact**
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**63.0** %
Flooding:	**None/Rare**	**99.0** %
Water Table Deep:	**6.0**	**36.0** %
Water Table Shallow:	**6.0**	**36.0** %
Erodibility:	**High -**	**98.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **63.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Crop**
Current Dominant land Cover: **Forest** **51.0** %
Current Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**0-25**	**0-25**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**399**	**0**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **Irrigation**
Type: **Small Withdrawal**
Use: **Other**
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **793.7** **79 %**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	**0.0** ft.	**0.0** ft.
Railroad:	**0.0** ft.	**0.0** ft.
Berm:	**0.0** ft.	**0.0** ft.
Improved Path:	**0.0** ft.	**0.0** ft.
6.2 Development:	**0.0** ft.	**0.0** ft.

6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **None**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	1	0	0	0	2	0	0	0	0	0	0	0	0	0	6
Low	High	Low	N.S.	N.S.	N.S.	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Crosby Brook South Branch** Reach **T1.05**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **Extends north for about a mile along Black Mountain Road.**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.90**
1.3 Downstream Longitude: **-72.57**

Step 2. Stream Type

2.1 Elevation Upstream: **827**
2.1 Elevation Downstream: **561**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **5279** feet. **1.00** Miles.
2.3 Valley Slope: **5.04** %
2.4.Channel Length: **5411** feet. Miles.
2.5 Channel Slope: **4.92** %
2.6 Sinuosity: **1.03**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: **9** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Narrowly Confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **99.0** %
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**91.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**1.5**	**74.0** %
Water Table Shallow:	**0.5**	**74.0** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **71.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **47.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**26-50**
Length w/ less than 25 ft.:	**0**	**220**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **1** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides	
Road:	**0.0**	ft. **0.0**	ft.
Railroad:	**0.0**	ft. **0.0**	ft.
Berm:	**0.0**	ft. **0.0**	ft.
Improved Path:	**0.0**	ft. **0.0**	ft.
6.2 Development:	**0.0**	ft. **0.0**	ft.

6.3 Channel Bars: **Point**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Culvert**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Low	High	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Unnamed Tributary** Reach **T2.01**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **From mainstem reach extends north into mixed forest.**
1.2 Towns: **Brattleboro, Dummerston**
1.3 Downstream Latitude: **42.89**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **374**
2.1 Elevation Downstream: **289**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **2425** feet. **0.46** Miles.
2.3 Valley Slope: **3.51** %
2.4.Channel Length: **2477** feet. Miles.
2.5 Channel Slope: **3.43** %
2.6 Sinuosity: **1.02**
2.7 Watershed Area: **1** Square Miles
2.8 Channel Width: **10** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **B**
Bedform: **Step-Pool**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Alluvial** **46.0** %
3.3 Sub-dominant Geological Mat.: **Till**
3.4 Left Valley Side **Very Steep**
3.4 Right Valley Side **Very Steep**
3.5 Soils

Hydrologic Group:	**C**	**71.0**	%
Flooding:	**None/Rare**	**53.0**	%
Water Table Deep:	**6.0**	**53.0**	%
Water Table Shallow:	**6.0**	**53.0**	%
Erodibility:	**High -**	**52.0**	%

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed
Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **74.0** %
Current Sub-Dominant Land Cover: **Field**
4.2 Corridor
Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **60.0** %
Current Sub-Dominant Land Cover: **Shrub**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**26-50**	**26-50**
Length w/ less than 25 ft.:	**---**	**---**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type:
Use:
5.2 Bridges and Culverts: **0** **0** %
5.3 Bank Armoring: **0.0**

	Left	Right
5.4 Channel Straightening:		**0.0**

5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides
Road:	ft.	ft.
Railroad:	ft.	ft.
Berm:	ft.	ft.
Improved Path:	ft.	ft.
6.2 Development:	ft.	ft.

6.3 Channel Bars: **Not Evaluated**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **Not Evaluated**
7.2 Bank Height: **Not Evaluated**
7.3 Ice/Debris Jam Potential: **Not Evaluated**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Low	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	

Crosby Brook

Phase 1 - Reach Summary Report

Basin: **Lower Connecticut**
Stream Name: **Unnamed Tributary** Reach **T2.02**
Topo Maps: **PUTNEY**
Date Last Edited: **Wed, October 17, 2007**
Watershed: **West River**
Sub-watershed: **Connecticut River -- Bellows Falls to Vernon Dam**
Is Reach an Impoundment? **No** Quality Control Status: **Step 2 done**

Step 1. Reach Location

1.1 Reach Description: **In the woods west of Middle Road.**
1.2 Towns: **Dummerston**
1.3 Downstream Latitude: **42.90**
1.3 Downstream Longitude: **-72.56**

Step 2. Stream Type

2.1 Elevation Upstream: **551**
2.1 Elevation Downstream: **374**
2.1 Is Gradient Gentle? **No**
2.2 Valley Length: **3644** feet. **0.69** Miles.
2.3 Valley Slope: **4.86** %
2.4.Channel Length: **3697** feet. Miles.
2.5 Channel Slope: **4.79** %
2.6 Sinuosity: **1.01**
2.7 Watershed Area: **0** Square Miles
2.8 Channel Width: **5** feet.
2.9 Valley Width: feet.
2.10 Confinement Ratio: **0**
2.10 Confinement Type: **Semi-confined**
2.11 Reference Stream Type: **A**
Bedform: **Step-Pool**
Sub-class Slope: **None**
Bed Material: **Cobble**

Step 3. Basin Characteristics:

3.1 Alluvial Fan: **None**
3.2 Grade Control: **None**
3.3 Dominant Geologic Mat.: **Till** **100.** %
3.3 Sub-dominant Geological Mat.:
3.4 Left Valley Side **Steep**
3.4 Right Valley Side **Very Steep**

3.5 Soils

Hydrologic Group:	**C**	**59.0** %
Flooding:	**None/Rare**	**100.** %
Water Table Deep:	**6.0**	**100.** %
Water Table Shallow:	**6.0**	**100.** %
Erodibility:	**High -**	**99.0** %

7.4 Comments:

Step 4. Land Cover - Reach Hydrology

4.1 Watershed

Historic Land Cover: **Forest**
Current Dominant land Cover: **Forest** **78.0** %
Current Sub-Dominant Land Cover: **Crop**

4.2 Corridor

Historic Land Cover: **Field**
Current Dominant land Cover: **Forest** **56.0** %
Current Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer	Left Bank	Right Bank
Dominant:	**>100**	**>100**
Sub-dominant:	**None**	**26-50**
Length w/ less than 25 ft.:	**0**	**490**

4.4 Ground Water Inputs: **None**

Step 5. Instream Channel Modifications

5.1 Flow Regulation - (old): **None**
Type: **None**
Use:
5.2 Bridges and Culverts: **1** **1** %
5.3 Bank Armoring: **0.0**
Left **0.0** Right **0.0**
5.4 Channel Straightening: **0.0** **0.0**
5.5 Dredging History: **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads old **0.0** ft. **0.0**

	One Side	Both Sides	
Road:	**0.0**	ft. **0.0**	ft.
Railroad:	**0.0**	ft. **0.0**	ft.
Berm:	**0.0**	ft. **0.0**	ft.
Improved Path:	**0.0**	ft. **0.0**	ft.
6.2 Development:	**0.0**	ft. **0.0**	ft.

6.3 Channel Bars: **None**
6.4 Meander Migration:
6.5 Meander Width: **N/A** Ratio: **0.0**
6.6 Wavelength: **N/A** Ratio: **0.0**

Step 7. Windshield Survey

7.2 Bank Erosion: **0.00 ft.**
7.2 Bank Height: **0.00 ft.**
7.3 Ice/Debris Jam Potential: **Not Evaluated**

4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	Total
1 Low	1 Low	1 Low	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	0 N.S.	3

APPENDIX D

QA/QC SUMMARY

MEMORANDUM

TO: Evan Fitzgerald

FR: Shannon Pytlik, Agency of Natural Resources, River Management Section

DATE: October 16, 2007

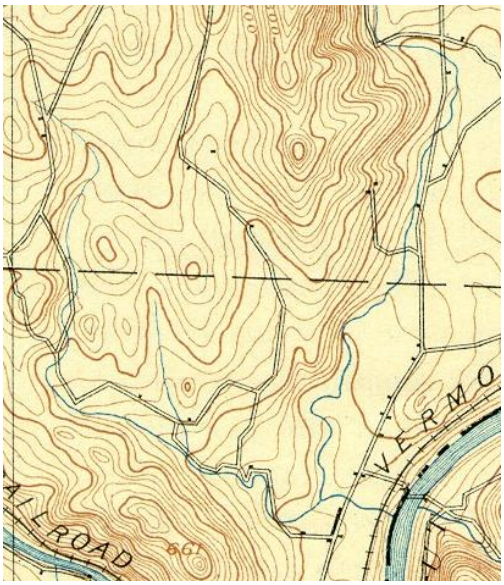
RE: Crosby Brook Phase 1 QA

Reponses to QA comments are provided in **bold red** by Evan Fitzgerald.

General comments:
If you do not have a sub class slope than you need to enter "none". If it is left blank we don't know if you skipped that step or not.
Updated in DMS (EPF, 10/17/07).

In general, for those reaches where you did not define a valley wall there should not be a value entered for valley width. In these situations you should estimate the confinement and enter just that value and leave the valley width blank. Unless you measured the valley wall in the windshield survey, which would be fine. What happens is when people measure the valley width on the topos they tend to way overestimate it, then streams that should be A or B stream types come out as C's.
Updated for all reaches except M02 and T1.03 (EPF, 10/17/07).

M01
Looks like the entire lower section was moved at some point



1893 topo map from UNH

Unless this topo is wrong (and the 1935 that shows the same location, in 1954 it is in the current location) I would say the entire lower section was straightened. Something to look out for when you are in the field.
Updated straightening for lower reach (EPF, 10/17/07).

If you index the lower section as straightened than you would also change the belt width and wave length to the channel width.
Updated in DMS (EPF, 10/17/07).

It also looks like there is a road along the eastern side of the lower reach that barely shows up on the orthos, but I can see it on the topo map.
Updated road encroachment for lower reach (EPF, 10/17/07).

M02 – Looks like you should have a sub dominant buffer width for the right bank for the area near the highway. 25-50 maybe?
Updated subdominant to 26-50ft (EPF, 10/17/07).

M03 – Left valley looks fairly flat on topo map, but after walking it I think it is more steep that it appears.
Updated to steep (EPF, 10/17/07).

M04 – Looks like some of the road in the corridor did not get indexed. This reach does not look like it has a very broad confinement to me. This may be a good example of where not to measure the valley width and just estimate the confinement.
Added road encroachment along Middle Rd. Updated confinement to semi-confined (EPF, 10/17/07).

M05 – Most of this reach looks straightened and most of the wide valley is alluvial parent material, indicating at one time the river flowed through the valley. Right valley looks steep.
Updated straightening for most of reach, and right VW to steep (EPF, 10/17/07).

M06 – I am not quite sure how to handle the pond. It does not show up on the VT Dams layer but there must be some type of impoundment. Also the area upstream looks like it has no buffer. Should not have a valley width unless you measured it in the field.
This pond is not an on-stream pond – there was a digitizing error during VHD development. The channel is located to the south of the pond in the woods. Removed valley width entry (EPF, 10/17/07).

M07 – Should not have a valley width unless you measured it in the field.
Updated in DMS (EPF, 10/17/07).

T1.01 – I would not enter a value for valley width. You can see on the topo that this reach looks confined, yet the calculation came out as broad resulting in a C stream type.
The upper part of this reach would be unconfined under reference conditions, based on my field observations and the channel slope (1.4%). I think the lower reach

appears confined due to the fill along the left bank from I-91 construction. The old topos support this idea too. I've removed the valley width entry but have left stream type as C and confinement as broad (EPF, 10/17/07).

T1.02 – I would not enter a value for valley width.
Removed valley width entry (EPF, 10/17/07).

All other reaches – If there is no valley wall you probably should not enter the valley width.
Removed valley width entries (EPF, 10/17/07).