Phase 2 Stream Geomorphic Assessment
Blood Brook Watershed
Town of Norwich
Windsor County, Vermont

February 27, 2007

Prepared by:
Daniel Ruddell, Elisabeth McLane, Staff Scientists, and
Ben Machin, Principal
Redstart Consulting

Prepared for:
Two Rivers-Ottauquechee Regional Commission,
Town of Norwich Conservation Commission, and
Vermont Agency of Natural Resources/
Department of Environmental Conservation
River Management Program

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACKNOWLEDGEMENTS

Redstart Consulting would like to thank several individuals for assisting with a Phase 2 Geomorphic Assessment of the Blood Brook Watershed. We particularly appreciate the assistance of Pete Fellows and Sally Mansur of Two Rivers –Ottauquechee Regional Commission for their careful preparation and transfer of Phase 1 data and reports as well as significant assistance in the field for the Phase 2 Assessment. Volunteers Jonathan Frishtick, Lelia Mellen, Bill Bridge, Anna Mulligan, Mani Kehler, Virginia Barlow, and Jenna Dixon also provided valuable field assistance. Kari Dolan and Staci Pomeroy of the VT Agency of Natural Resources provided extensive technical assistance and QA review of the Phase 2 data, and Lori Barg of Step by Step Community Environmental Consulting added further technical expertise. Andy Hodgdon, Norwich Road Foreman, and Linda Cook, former Norwich selectboard member, provided invaluable information on the general history of the watershed and previous flood impacts in particular. Redstart is grateful to riparian landowners within the Blood Brook Watershed who granted us access to study reaches, and numerous townsfolk and individuals in the community who were interested in talking to us and sharing their knowledge and concerns about the streams and the watershed.

EXECUTIVE SUMMARY

- Redstart Consulting (Redstart) was retained by the Two Rivers –Ottauquechee Regional Commission (TRORC), under a Vermont Emergency Planning sub-grant, to conduct a Phase 2 Stream Geomorphic Assessment of 14 reaches (sections of stream with relatively uniform physical attributes, such as valley confinement, valley slope, sinuosity, dominant bed material, and bed form) of Blood Brook and associated tributaries within the Blood Brook Watershed in Norwich. The Phase 2 study focused on 7 mainstem and 7 tributary reaches of Blood Brook, prioritized for Phase 2 Assessment on the basis of a Phase 1 Assessment conducted by TRORC earlier in 2006.

- The Vermont Agency of Natural Resources (VTANR) Department of Environmental Conservation River Management Program provided technical expertise and shared quality control/quality assurance responsibilities with Redstart. The study utilized protocols outlined in the Stream Geomorphic Assessment Phase 1 and Phase 2 Handbooks (VTANR 2006a).

- The Phase 2 data were entered into the most current version of the VTANR Stream Geomorphic Assessment database, which includes data entry, spatial documentation (for geographic information systems implementation), and built-in quality assurance components.

- The Phase 2 Rapid Stream Assessment, Rapid Geomorphic Assessment and Rapid Habitat Assessment were used to verify Phase 1 stream geomorphic data, predict channel processes, and evaluate health and condition of the riparian corridor and aquatic habitat. In Phase 1, these data were derived by TRORC personnel from topographic maps, orthophotography, and information from the Vermont Center for Geographic Information, the Town of Norwich and Norwich Conservation Commission, and a windshield survey that included a Bridge and Culvert Assessment.

- Phase 2 Rapid Stream Assessments were conducted on all 14 reaches recommended for the study. The 14 reaches were broken into 27 segments (relatively homogenous sections of stream contained within a reach that have the same reference stream characteristics but differ from other segments in the reach in one or more parameters) following the Phase 2 protocols (VTANR 2006b; see map in Section 1.0 Introduction, Fig. 2, of this report). Two reaches (M05-T3.02 and M05-T3.04, both on New Boston Brook) and two segments at the upstream ends of streams (M03-T1.03C - Bragg Brook and M09C - Blood Brook), did not receive full assessments due to the influence of impoundments and wetlands (in accordance with VTANR Phase 2 protocols).

- The Phase 2 Rapid Stream Assessment (RSA) and Rapid Geomorphic Assessment (RGA) are important for understanding the geomorphic stability of a reach. Part of the RSA field verifies a Phase 1 "reference stream type" assigned to the reach, while the RGA includes evaluations of reach condition (degree of departure of the channel from its reference stream type), channel adjustment processes (changes in the form of the channel due to natural causes or human impacts), and reach sensitivity to changes in the watershed.

- The 14 reaches selected for inclusion in the Phase 2 study were chosen in part because:

  > Five were in poor geomorphic condition and nine were found to be in only fair condition. These reaches are located in areas where the river is or has the potential to create land use conflicts.
  >
  > The upper two reaches on New Boston Brook were rated in moderate and *high* geomorphic condition and offer the most likely opportunity for "reference" reaches to be used in restoration design work. (TRORC 2006)

- Under the Phase 2 assessment, geomorphic condition was rated poor for three segments on the Blood Brook mainstem (segments M03A, M05A, and M08D) and fair for 10 other segments on the mainstem. Geomorphic condition was rated good for segment M09B, the furthest upstream reach assessed on Blood Brook.

- On the tributary reaches, geomorphic condition was rated fair for eight out of nine segments assessed in Phase 2. Segment M03-T1.03B, the furthest upstream reach assessed on Bragg Brook, was rated good. The upper reaches of New Boston Brook were not assessed due to the influence of wetlands and impoundments.

- The Phase 2 RGA was also used to evaluate the stage of channel evolution, assessing processes occurring in the stream in light of a predictable range of dynamic responses expected in streams due to their relationship with surrounding and watershed landforms (VTANR 2006a – Program Introduction, VTANR 2006c – Appendix C). The mainstem of Blood Brook generally appeared to be at stage II (primarily degradation and loss of access to floodplain) to stage III (continued degradation, plus widening and lateral migration) in the upstream reaches, with the lower reaches moving further into stage III.

- Stream segments evaluated in Phase 2 on the tributary reaches of Charles Brown and New Boston Brooks were assessed as being in Stage II channel evolution (degradation and loss of access to floodplain), with bed degradation limited by the presence of bedrock and ledge in some of these segments. Three out of six segments on Bragg Brook were at stage III (widening and lateral migration), with segments M03-T1.01A and M03-T1.03A listed at stage II. M03-T1.03B (upstream end of Bragg Brook - Stage I, in regime) was a notable exception to the predominant stages of channel evolution on Bragg Brook.

- The Rapid Habitat Assessment (RHA) rating generally paralleled the RGA results, with 17 of 23 segments rated as fair for both assessments. One segment midstream (M03-T1.03A) on Bragg Brook was rated good for both the RHA and

RGA. Differences between the RHA and RGA ratings occurred for four segments on the Blood Brook mainstem and one on Bragg Brook, primarily due to presence of bank and buffer vegetative protection and occurrence of different velocity and depth patterns in the stream; all rated higher on the RHA than the RGA.

- A Bridge and Culvert Assessment conducted by TRORC personnel assessed 43 structures (16 bridges, 27 culverts, and 2 arches) within the Blood Brook Watershed using VTANR protocols (TRORC 2006; VTANR 2006c, Appendix G). Thirty-eight of those structures were located in reaches included in the Phase 2 study. All were confirmed as being on a list of 40 of 43 structures that were flagged by a VTANR potential Failure Modes Report for geomorphic incompatibility (https://anrnode.anr.state.vt.us/ssl/sga/security/frmLogin.cfm; after login, datasets/structures/Upper Connecticut/Blood Brook/reports; TRORC 2006). This flagging identified minor to major issues ranging from sedimentation and scouring related to structure size and orientation to the stream, to potential failures due to outflanking, scour, or ice or debris jams. Recommendations for stream crossings are a minimum of bankfull width, with ideal sizing 1.2 to 1.5 times bankfull width to permit full sediment and water transport, along with installations designed to facilitate aquatic organism passage (VTANR guidelines in preparation); minimum guidelines have been met on many of the newer town installations in Norwich.

- Results from this Phase 2 assessment in the Blood Brook watershed indicate that, with the exception of the reaches at the tops of the Blood Brook mainstem and tributary streams, the reaches identified in Phase 1 for further assessment are experiencing adjustment processes likely related to both historic and active channelization of portions of the stream, including bulldozing following a flood in 1973 and a large flow and sediment increase resulting from a one-time water line rupture upslope of Bragg Brook (pers comms., Andy Hodgdon, Norwich Road foreman, Dec. 2006, and Linda Cook, former Norwich selectboard member, Sept. 2006). This channelization initiated a process of bed degradation (incision) that has limited access of the stream to much of its historical floodplain; migration of degradation processes through these reaches has been limited to some extent by the presence of bedrock and grade controls in several areas. Subsequent, ongoing adjustment processes involving lateral migration, erosion, and downstream deposition are also occurring, as the stream attempts to reestablish equilibrium and moderate and balance the increased power and velocity of the stream by developing a new floodplain and adjusting its slope.

- Based on this Phase 2 study, recommendations highlight protection of the river corridor, particularly limiting further encroachment; establishment of wooded buffers where these are lacking; re-establishing access to floodplains; and limiting further bed degradation. High priority should be given to the development of a Stream Corridor Management Plan, which can be used to identify and prioritize protection and restoration projects to implement these objectives along with willing landowners and potential partners.

1.0 INTRODUCTION

A Phase 1 Stream Geomorphic Assessment (SGA) was completed in the summer of 2006 by Two Rivers –Ottauquechee Regional Commission (TRORC). The Phase 1 report identified priority reaches for Phase 2 assessment. Fieldwork for the Phase 2 assessment was conducted by Elisabeth McLane and Daniel Ruddell of Redstart Consulting (Redstart) with the help of Pete Fellows and Sally Mansur (TRORC), Ben Machin (Redstart), and volunteers Jonathan Frishtick of the Norwich Conservation Commission, Lelia Mellen, Bill Bridge, Anna Mulligan, Mani Kehler, Virginia Barlow, and Jenna Dixon. The Phase 2 assessment was completed in the fall of 2006.

The Blood Brook Watershed has a watershed size of 18.6 square miles and lies almost entirely within the Town of Norwich in east central Vermont, draining the central portion of the town from the hills to the north and west to the confluence of Blood Brook and the Connecticut River in the southeast corner of the township. The Phase 2 study focused on 7 mainstem and 7 tributary reaches of Blood Brook, with a combined length of approximately 14 miles for the assessed reaches. Watershed (Fig. 1) and reach location (Fig. 2) maps are included for reference.

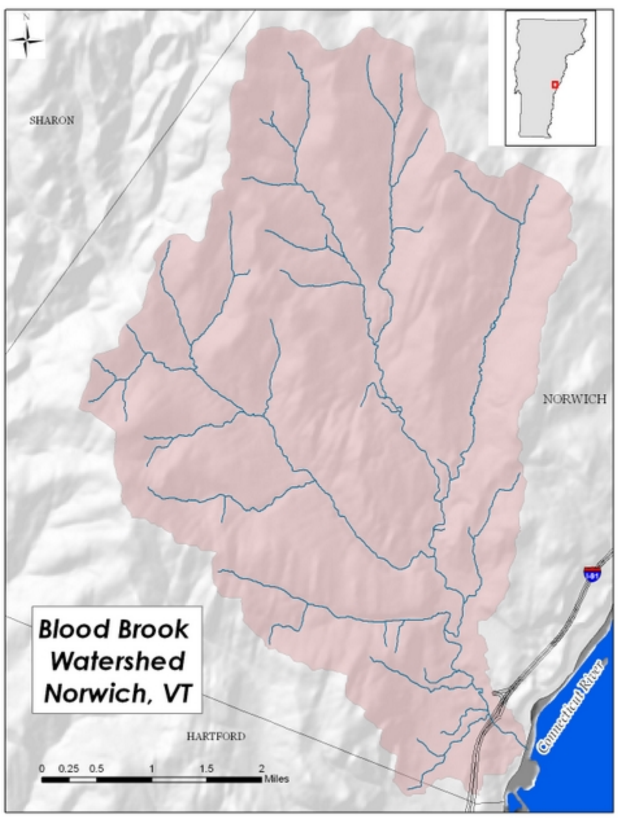

Figure 1. Watershed location map

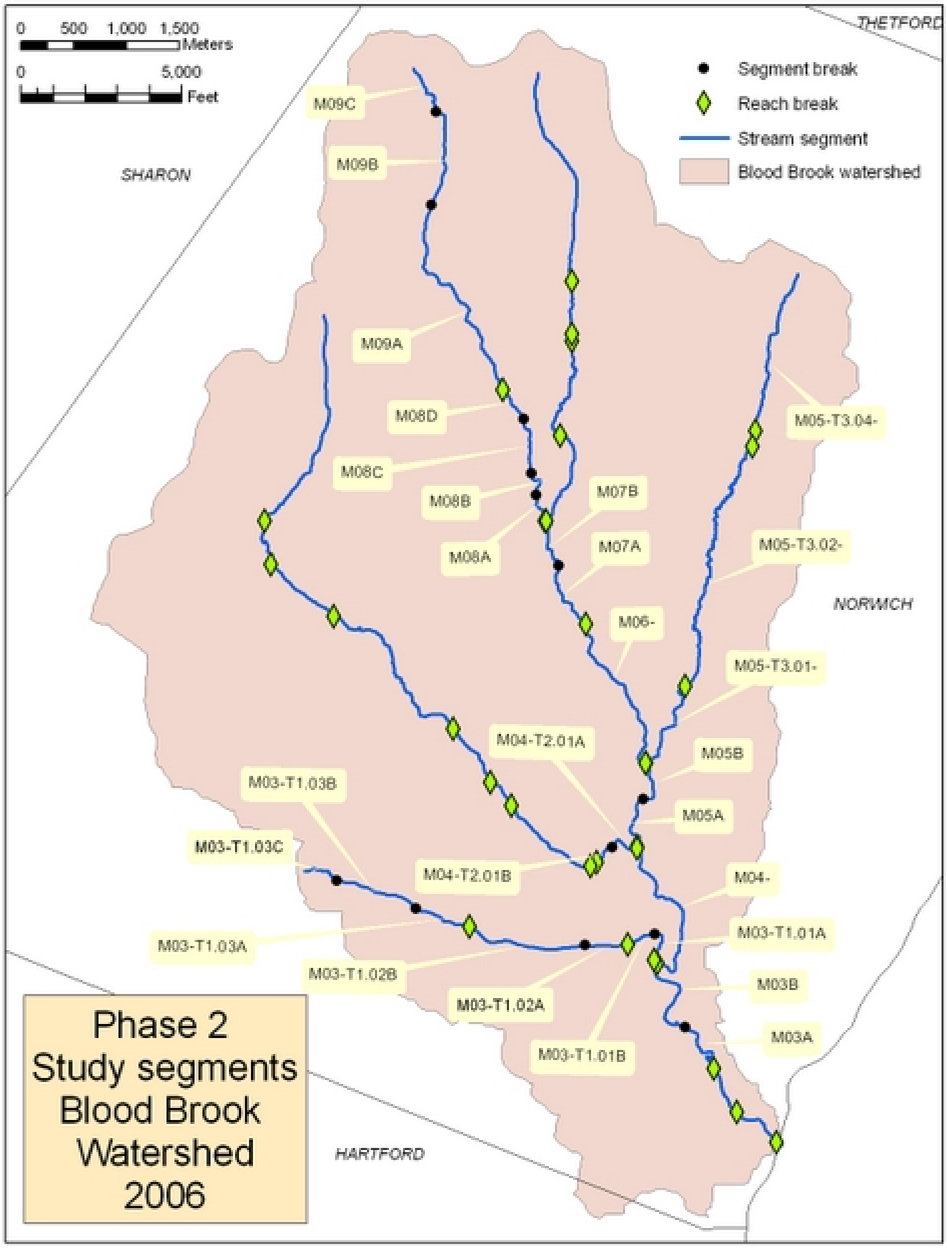

Figure 2. Reach/segment location map for the Blood Brook Watershed Phase 2 study.

2.0 METHODOLOGY

The Phase 2 assessment followed procedures specified in the Vermont Stream Geomorphic Assessment Phase 2 Handbook (VTANR 2006b). All assessment data were recorded on the VTANR Phase 2 field data sheets.

2.1 Field Protocols

The VTANR's Phase 2 stream geomorphic assessment protocol includes seven steps. These steps are as follows:

1. 1. Valley and River Corridor
2. 2. Stream Channel
3. 3. Riparian Banks, Buffers and Corridor
4. 4. Flow Modifiers
5. 5. Channel, Bed and Planform Changes
6. 6. Rapid Habitat Assessment (RHA)
7. 7. Rapid Geomorphic Assessment (RGA)

The parameters and protocols used for undertaking each of the above steps are outlined in the Phase 2 Handbook (VTANR 2006b).

Each Phase 2 reach was walked and field mapped to determine segment breaks. Narrative summaries of the reaches are included in Section 6. Photos were taken at each study cross-section and other areas of significance. A photo log is included as Appendix A. Photos are digitally provided on the attached CD.

Phase 2 Steps 2, 5, 6 and 7 were not completed for two reaches (M05-T3.02 and M05-T3.04) and two segments (M03-T1.03C and M09C), per protocols, because the influence of impoundments and wetlands make it difficult to measure or assess the parameters used for these steps.

2.2 Data entry and QA Review

Field data were entered into the most current version of the Vermont Agency of Natural Resources Stream Geomorphic Assessment Database (SGA Database) (https://anrnode.anr.state.vt.us/ssl/sga/security/frmLogin.cfm). Phase 1 data were updated, where appropriate, using the field data from the Phase 2 assessment; these changes are tracked and documented within the database.

Spatial data for bank erosion, grade control structures, bank revetments, beaver dams, debris jams, depositional features, and other important features were documented within all segments and entered into the spatial component of the statewide data base (the Feature Indexing Tool, FIT) via the Stream Geomorphic Assessment Tool (SGAT) ArcView extension, which permits geographic information systems implementation of the data. These data and an updated, SGAT-based ArcView project are included on the attached CD.

Quality assurance/quality control checks were initially conducted by Redstart utilizing the QA/QC tools developed by VTANR and implemented through the SGA Database in

November 2006. Data were submitted to VTANR for QA/QC review in November 2006. VTANR completed a QA check in December 2006, and Redstart and VTANR each completed second and third QA checks in January 2007 (https://anrnode.anr.state.vt.us/ssl/sga/security/frmLogin.cfm).

2.3 Reach Identification

The Blood Brook Watershed Phase 1 Report (TRORC 2006) recommended 7 mainstem and 7 tributary reaches of Blood Brook for inclusion in the Phase 2 study. Half (n = 7) of these reaches were identified as riffle-pool systems of various confinement types in the Phase 1 study, with the remainder identified as either Step-pool (n = 4) or Plane bed (n = 3) systems (Table 1). The Phase 1 reach condition for these reaches ranged from poor to good, while reach sensitivity ranged from moderate to high.

Table 1. Reaches recommended for Phase 2 Assessment, with preliminary Phase 1 reference stream type

Reach ID	Channel Length (mi)	Channel Slope (%)	Confinement	Stream Type	Bedform	Reach Condition	Reach Sensitivity
Blood Brook mainstem							
M03	1.1	1.25	Very Broad	C	Riffle-Pool	Poor	High
M04	1.1	0.88	Very Broad	C	Riffle-Pool	Fair	Moderate
M05	0.6	2.00	Very Broad	C	Plane Bed	Poor	Moderate
M06	1.0	2.15	Narrow	C	Plane Bed	Poor	Moderate
M07	0.8	1.83	Very Broad	C	Riffle-Pool	Fair	Moderate
M08	0.9	3.00	Very Broad	B	Riffle-Pool	Fair	Moderate
M09	2.3	4.41	Narrowly Confined	B	Riffle-Pool	Fair	Moderate
Bragg Brook							
M03-T1.01	0.4	4.90	Semi Confined	C	Plane Bed	Fair	High
M03-T1.02	1.0	5.94	Narrowly Confined	B	Step-Pool	Fair	Moderate
M03-T1.03	1.1	7.25	Narrowly Confined	B	Step-Pool	Good	Moderate
Charles Brown Brook							
M04-T2.01	0.3	3.24	Semi Confined	B	Plane Bed	Fair	Moderate
New Boston Brook							
M05-T3.01	0.6	2.91	Narrow	C	Step-Pool	Poor	Moderate
M05-T3.02	1.9	0.80	Very Broad	C	Riffle-Pool	Fair	High
M05-T3.04	1.1	2.01	Very Broad	C	Riffle-Pool	Fair	High

3.0 BANKFULL CHANNEL DIMENSIONS

Measurements of channel dimensions were made using a depth rod, a measuring tape, a handheld tape ruler, and a hand level. Channel dimensions were measured at cross over (riffle) locations, and at least one cross-section was conducted per stream segment (with the exception of 2 reaches and 2 segments not assessed due to impoundments or wetlands; see Section 2.1). The cross section data were entered in the SGA Database (see sec. 2.2). The stream geometry data are summarized in Appendix B.

In general, Phase 2 field assessment verified the Phase 1 preliminary stream typing of the Blood Brook watershed reaches selected for study as Rosgen B (moderately entrenched with a moderate width/depth ratio) and C (slightly entrenched with a moderate to high width/depth ratio) type channels (Table 2; VTANR 2006c, Appendix I). Segments M03-T1.01A (E type) and M03-T1.03B (A type) on Bragg Brook represented the only deviations from a B or C stream typing.

Table 2. Stream type by segment from Phase 2 assessment

Segment ID	Entrench-ment Ratio	Width/ Depth Ratio	Sinuosity	Stream Type	Bed Material	Bedform
Blood Brook mainstem						
M03-A	2.6	18.8	Moderate	C	Gravel	Riffle-Pool
M03-B	1.7	16.4	Moderate	B	Gravel	Riffle-Pool
M04-0	13.7	23.2	Moderate	C	Cobble	Riffle-Pool
M05-A	6.3	21.5	Moderate	C	Cobble	Riffle-Pool
M05-B	3.2	33.1	Low	C	Cobble	PlaneBed
M06-0	4.2	15.4	Moderate	C	Cobble	PlaneBed
M07-A	5.7	15.3	Moderate	C	Cobble	Riffle-Pool
M07-B	2.2	20.9	Low	B	Cobble	PlaneBed
M08-A	9.0	16.5	Moderate	C	Gravel	Riffle-Pool
M08-B	1.2	13.6	Moderate	B	Gravel	Riffle-Pool
M08-C	4.0	8.7	Moderate	C	Cobble	Riffle-Pool
M08-D	2.1	20.5	Moderate	B	Gravel	Riffle-Pool
M09-A	2.8	14.7	Moderate	C	Cobble	Riffle-Pool
M09-B	1.9	15.3	Low	B	Cobble	Riffle-Pool
M09-C	NA	NA	NA	NA	NA	NA
Bragg Brook						
M03-T1.01-A	2.7	9.0	Low	E	Gravel	PlaneBed
M03-T1.01-B	4.9	14.9	Moderate	C	Gravel	PlaneBed
M03-T1.02-A	1.9	12.5	Moderate	B	Cobble	Step-Pool
M03-T1.02-B	1.9	16.3	Low	B	Cobble	Step-Pool
M03-T1.03-A	1.7	18.5	Moderate	B	Gravel	Riffle-Pool
M03-T1.03-B	1.7	8.5	Low	A	Cobble	Step-Pool
M03-T1.03-C	NA	NA	NA	NA	NA	NA

Table 2. Stream type by segment from Phase 2 assessment

Segment ID	Entrench-ment Ratio	Width/ Depth Ratio	Sinuosity	Stream Type	Bed Material	Bedform
Charles Brown Brook						
M04-T2.01-A	1.7	13.4	Low	B	Cobble	PlaneBed
M04-T2.01-B	3.2	13.7	Moderate	C	Cobble	PlaneBed
New Boston Brook						
M05-T3.01-0	4.8	12.5	Moderate	C	Cobble	Step-Pool
M05-T3.02-0	NA	NA	NA	NA	NA	NA
M05-T3.04-0	NA	NA	NA	NA	NA	NA

4.0 RAPID GEOMORPHIC ASSESSMENT (RGA)

The Blood Brook Watershed Phase 1 assessment predicted that reaches recommended for Phase 2 assessment along the Blood Brook mainstem (M03 to M09) and Bragg Brook (M03-T1.01 to M03-T1.03) were in poor to fair condition, while reaches on Charles Brown (M04-T2.01) and New Boston Brooks (M05-T3.01 to M05-T3.04) were in fair to good condition (Table 3). Based on the Phase 2 Rapid Geomorphic Assessment (RGA), geomorphic condition did range from poor to fair on the Blood Brook mainstem, with the exception of segment M09B on the upper reach, which rated good. On Bragg Brook, Phase 2 assessments were all fair, with the exception of M03-T1.03B toward the top of the Brook, assessed as good. Geomorphic condition was rated fair for all segments assessed in Phase 2 on Charles Brown and New Boston Brooks. The Phase 2 stream geomorphic condition results are summarized for all segments in Appendix B.

Phase 2 RGA results indicated that many assessed reaches were experiencing multiple concurrent adjustment processes. Due to a high degree of long-standing road encroachment along the majority of the assessed reaches, channelization of the stream was evidenced by riprap and berm placement to protect investments in infrastructure. Overwidening and planform change have thus been artificially restricted at a cost of significant investment, and a more dominant process of degradation was often noted as both active and historic in nature. All reaches along the Blood Brook mainstem exhibited active degradational processes. Two segments within these reaches were noted as exceptions to a primary current process of bed degradation along Blood Brook: M03B (historic bed degradation but limited from further incision by the presence of bedrock and grade controls), and M09B (the furthest upstream reach assessed in Phase 2, bedrock-controlled and exhibiting minimal disturbance within the riparian corridor).

While degradation was a dominant process in the upstream portions of the main stem, downstream reaches exhibited significant aggradation, with numerous depositional bar features developing, and a dominant widening adjustment processes evidenced by signinficant bank erosion and lateral migration processes.

Degradation was a dominant adjustment process in all but two segments of the tributary reaches assessed in Phase 2 (Bragg, Charles Brown, and New Boston Brooks). The exception on Bragg Brook was M03-T1.03B (stable and bedrock-controlled) at the upstream end of Bragg Brook. Mass failures above reach M03-T1.02 appear to be largely related to a late 1970s, one-time failure of a water line leading from town-owned wells near the Connecticut River to a 3 million gallon water tank on Dutton Hill, and were largely stabilizing at the time of this study (pers. comm., Andy Hodgdon, Norwich Road Foreman, Dec. 2006).

On Charles Brown Brook, M04-T2.01A was another exception to a primary current adjustment process of bed degradation. Here, however, there was incision but it was noted as a largely historical process that is now limited from significant further incision by waterfalls with ledge and bedrock grade controls. Bed degradation in the upstream segment of this reach (M04-T2.01B) was still noted as the dominant adjustment process.

Table 3. Comparison of Phase 1 and Phase 2 assessments of stream geomorphic condition and primary adjustment processes

		Phase 1 Data				Phase 2 Data			
Reach/ Segment	**Total Impact**	**Phase 1 Confine-ment[1]**	**Phase 1 Stream Type**	**Phase 1 Adjustment Process**	**Phase 1 Condition**	**Phase 2 Stream Type**	**Phase 2 Confine-ment[1]**	**Phase 2 Adjustment Process[2]**	**Phase 2 Condition**
<u>Blood Brook mainstem</u>									
M03A	21	VB	C4	Degrading/Aggrading	Poor	C4	VB	Aggrading	Poor
M03B	21	VB	C4			C4	VB	Planform	Fair
M04-0	17	VB	C3	Degrading	Fair	C3	VB	Widening/Planform	Fair
M05A	18	VB	C3	Degrading	Poor	C3	VB	Widening	Poor
M05B	18	VB	C3			C3	B	Degrading	Fair
M06-0	15	NW	C3	Degrading	Poor	C3	NW	Degrading	Fair
M07A	12	VB	C3	Aggrading	Fair	C3	NW	Degrading	Fair
M07B	12	VB	C3			B3	SC	Degrading	Fair
M08A	14	VB	B4	Degrading/Aggrading	Fair	C4	VB	Degrading	Fair
M08B	14	VB	B4			B4	B	Degrading	Fair
M08C	14	VB	B4			E3	VB	Aggrading	Fair
M08D	14	VB	B4			B4	SC	Degrading	Poor
M09A	11	NC	B3	Aggrading/Degrading	Fair	C3	NW	Degrading	Fair
M09B	11	NC	B3			B3	NC	Stable	Good
M09C	11	NC	B3			NA	VB	NA	NA

[1]Confinement: VB = Very Broad, B = Broad, SC = Semi confined, NW = Narrow, NC = Narrowly confined
NA = Not assessed

[2] Dominant current process: degradation was generally partly historic, and if Phase 2 Step 7adjustment scores were tied, degrading is not listed as currently dominant

Table 3. Comparison of Phase 1 and Phase 2 assessments of stream geomorphic condition and primary adjustment processes

		Phase 1 Data				Phase 2 Data			
Reach/ Segment	**Total Impact**	**Phase 1 Confine-ment[1]**	**Phase 1 Stream Type**	**Phase 1 Adjustment Process**	**Phase 1 Condition**	**Phase 2 Stream Type**	**Phase 2 Confine-ment[1]**	**Phase 2 Adjustment Process[2]**	**Phase 2 Condition**
Bragg Brook									
M03-T1.01A	13	SC	C4	Degrading/Aggrading	Fair	C4	SC	Aggrading	Fair
M03-T1.01B	13	SC	C4			C4	NW	Aggrading	Good
M03-T1.02A	12	NC	B3	Aggrading	Fair	B3	NC	Degrading	Fair
M03-T1.02B	12	NC	B3			B3	NC	Widening	Fair
M03-T1.03A	9	NC	B3	Degrading/Aggrading/ Widening	Good	B4	NC	Degrading	Fair
M03-T1.03B	9	NC	B3			B3	NC	Stable	Reference
M03-T1.03C	9	NC	B3			NA	VB	NA	NA
Charles Brown Brook									
M04-T2.01A	12	SC	B3	Degrading	Fair	B3	SC	Planform	Fair
M04-T2.01B	12	SC	B3			C3	SC	Degrading	Fair
New Boston Brook									
M05-T3.01-0	17	NW	C3	Aggrading/Degrading	Poor	C3	NW	Degrading	Fair
M05-T3.02-0	11	VB	C4	Aggrading/Widening/ Planform	Fair	NA	VB	NA	NA
M05-T3.04-0	10	VB	C4	Aggrading	Fair	NA	VB	NA	NA

[1]Confinement: VB = Very Broad, B = Broad, SC = Semi confined, NW = Narrow, NC = Narrowly confined NA = Not assessed
[2] Dominant current process: degradation was generally partly historic, and if Phase 2 Step 7adjustment scores were tied, degrading is not listed as currently dominant

4.1 Channel Evolution Model

Based on the observed evidence of the processes noted above, the Phase 2 RGA was also used to evaluate the stage of channel evolution. Schumm (1977 and 1984) has described five stages of channel evolution (F-stage model), paraphrased from the SGA protocols (VTANR 2006c, Appendix C) as follows:

I. Stable – in regime, reference to good condition. Insignificant to minimal adjustment; planform is moderate to highly sinuous.
II. Incision – Fair to poor condition, major to extreme channel degradation. High flow events are contained in the channel, and channel slope is typically increased.
III. Widening/Migration – Fair to poor condition, major to extreme widening and aggradation.
IV. Stabilizing – Fair to good condition, major reducing to minor aggradation, widening and planform adjustments
V. Stable – In regime, reference to good condition. Insignificant to minimal adjustment.

The Blood Brook mainstem (reaches M03 to M09) appeared to be at stage II or III of the channel evolution model in the upstream reaches, with the lower reaches (below Reach M06) further along in stage III (Table 4). Incision ratios, ranging from 1.1 in segment M03B to 3.4 in segment M08D, indicated limited access to floodplain throughout much of the mainstem. Segment M09B (Stage I) was a notable exception to the Stage II-III evolution along Blood Brook; this was the furthest upstream reach fully assessed on the mainstem, is largely bedrock controlled, and had minimal disturbance within the riparian corridor.

Recounts of local history indicate that bulldozing of the stream channel occurred along Turnpike Rd. and Beaver Meadow Rd (Blood Brook mainstem), and Beaver Meadow Rd. from the “Norwich Pool” impoundment downstream (Charles Brown Brook) following a flood in 1973 (pers. comms., Linda Cook, former selectboard member, and Andy Hodgdon, Norwich Road Foreman). When a stream is straightened and channelized, the slope of the channel is increased and the sinuosity of the stream decreased; both of these factors contribute to an increase in velocity and power of the stream to erode its bed and banks (VTANR 2006, Appendix C). Channelization cuts off access to floodplain, and bed erosion can further aggravate this process (Stage II).

When access to the floodplain is lost, the velocity and power of the stream to erode its banks and bed increase, as annual high flows are increasingly contained within the channel (Stages II-III). The stream will attempt to regain equilibrium between the power produced and the materials being moved by decreasing slope and increasing sinuosity, often evidenced by aggravated erosion and downstream aggradation (redeposition of materials). Active flood chutes and erosion also reflect efforts to diffuse the power of the stream through lateral migration (planform adjustment) as the stream tries to establish a new floodplain at a lower elevation. Reaches along the Blood Brook mainstem in particular were undergoing Stage III lateral migration (planform adjustment) processes,

Table 4. Stage of channel evolution, incision ratio, and comparison of RGA and RHA assessments for Phase 2 reaches

Reach/Segment	Channel evolution stage[1]	Incision ratio	Rating RGA	Rating RHA
Blood Brook				
M03-A	III (F)	2.2	Poor	Fair
M03-B	IIb (D)	1.1	Fair	Fair
M04-0	III (F)	1.8	Fair	Fair
M05-A	III (F)	1.3	Poor	Fair
M05-B	III (F)	1.7	Fair	Fair
M06-0	II (F)	1.9	Fair	Fair
M07-A	II (F)	2.0	Fair	Fair
M07-B	III (F)	1.7	Fair	Fair
M08-A	III (F)	1.5	Fair	Fair
M08-B	III (F)	3.2	Fair	Fair
M08-C	III (F)	1.7	Fair	Fair
M08-D	III (F)	3.4	Poor	Fair
M09-A	II (F)	1.7	Fair	Fair
M09-B	I (D)	1.2	Good	Reference
M09-C	NA	NA	NA	NA
Bragg Brook				
M03-T1.01-A	III (F)	1.5	Fair	Fair
M03-T1.01-B	III (F)	1.2	Fair	Fair
M03-T1.02-A	IIb (D)	1.2	Fair	Good
M03-T1.02-B	III (F)	2.0	Fair	Fair
M03-T1.03-A	II (F)	1.8	Fair	Fair
M03-T1.03-B	I (D)	1.0	Good	Good
M03-T1.03-C	NA	NA	NA	NA
Charles Brown Brook				
M04-T2.01-A	IIc (D)	1.3	Fair	Fair
M04-T2.01-B	II (F)	1.2	Fair	Fair
New Boston Brook				
M05-T3.01-0	II (F)	1.7	Fair	Fair
M05-T3.02-0	NA	NA	NA	NA
M05-T3.04-0	NA	NA	NA	NA

[1] (F) or (D) stage evolution model primarily based on resistance to erosion of bed material: see text
NA = Not assessed

evidenced by the presence of unvegetated mid-channel bars, large point bars and other depositional features, along with active flood chutes. Much of this adjustment appears related to channelization of a historical nature based on maintenance of the stream's relationship to road encroachments and instream culverts.

On Bragg Brook, segment M03-T1.03B towards the upstream end of the stream was assessed as being in Stage I, in regime and relatively stable. The stream was observed to be in Stage II in segments M03-T1.01A and M03-T1.03A. Degradation in these segments is likely related, at least in part, to a one-time failure of a water line leading to a 3 million gallon water tank on Dutton Hill above Bragg Brook (see sec. 4.0), which appears to have sufficiently increased flow to start a process of downcutting and subsequent efforts by upstream sections of the stream to lower its elevation of the degraded bed. In segments M03-T1.02A and M03-T1.03B, downcutting has been limited by bedrock and ledge grade controls that limit active degradation. In these segments, a different process of channel evolution from that summarized above is occurring (D-stage model), whereby a stream with a bed significantly more resistant to erosion than its banks moves more rapidly into aggradation and lateral adjustment processes (VTANR 2006c, Appendix C). In this model, a stream that departs from a stable Stage I moves through subsequent processes paraphrased as follows:

IIb. Limited incision, migration of headcuts and erosion of riffle features leading to formation of planebed. Subsequent evolution can occur, but it is not uncommon for a Bc planebed stream type to persist for decades

IIc. Widening/Migration – Stream attempts to re-establish equilibrium through bank erosion and redeposition, increasing channel length and sinuosity as weak riffle-pool features are added to the planebed through aggradation

IId. Aggradation and widening, planform adjustment - Stream becomes extremely depositional and may become braided; water shifts through different channels and chute cutoffs, continues to erode banks, and eventually begins to reestablish riffle-pool features through aggradation that begins to narrow the channel to a single thread

III. Stabilizing – Widening and planform adjustments; stream moves back to pre-adjustment channel dimension, pattern and profile that may or may not be at a lower elevation in the landscape; sedimant transport capacity (energy grade) moves back into balnce with the sediment loadng regime within the watershed

Segment M03-T1.02A was assessed as being in Stage IIb of a D-stage evolution. The aggradation and migration processes in this segment are reduced by a combination of the bedrock and ledge grade controls present and a relatively steeper slope of the stream (subslope class a for >4% slope) in this segment. However, it should be noted that a stream type such as this can be dramatically altered by rapid or catastrophic channel avulsions onto more erodible sediments nearby, leaving the former channel abandoned (VTANR 2006c, Appendix C).

Tributary reaches assessed in Phase 2 on Charles Brown and New Boston Brooks were observed to be in a similar Stage II of channel evolution as the upper reaches of the Blood Brook mainstem. Degradation was the dominant adjustment process, but this process was limited in the downstream segment (M04-T2.10A) of Charles Brown Brook due to the presence of ledge and bedrock grade controls, and this segment was assessed at Stage IIc of the D-stage evolution model. As noted in sec. 4.0 above, segment M03B on the Blood Brook mainstem also had bedrock and grade controls lending stability to the stream, and it was assessed at Stage IIb of the D-stage evolution model.

5.0 RAPID HABITAT ASSESSMENT (RHA)

The results of the Rapid Habitat Assessment (RHA) generally paralleled the RGA results, with 17 of 23 segments rated as fair for both assessments (Table 4). Segment M03-T1.02A on Bragg Brook was rated good for both the RHA and RGA. With channel and bed characteristics also reflected in the RGA, any differences in these ratings are often related to bank and buffer protection and availability of habitat variety due to differing flow patterns.

On Bragg Brook, segment M03-T1.03B was rated a very high good (0.83, with good scores usually ranging from 0.65-0.84 and reference from 0.85-1.00), and VT Fish and Wildlife personnel have tagged and relocated a number of wild brook trout in this stream before and after construction projects on the road along the stream (pers. comm., Andy Hodgdon, Town Road Foreman, December 2006).

Segment M09-B, near the top of the Blood Brook mainstem, was rated Reference for its high-quality habitat in a largely undisturbed setting and merits further attention for protection of that habitat. Special consideration of the high-quality upper reaches of the Blood Brook watershed, including the segments of Bragg and Blood Brooks assessed in this study, would be consistent with suggestions outlined in an Open Space Priorities Informal Plan proposed by members of the Norwich Conservation Commission and Norwich Special Places (NCC 2004).

Higher ratings on the RHA than the RGA for segments M03A and M05A warrant a qualifier. These segments rated fair rather than poor on the RHA partly due to the presence of forested buffers and riparian corridors. It should be noted, however, that much of the vegetation in these segments, particularly M03A, consists of the non-native invasive species honeysuckle and buckthorn.

Summary data reports by segment from the SGA database are in Appendix C and include the RHA ratings; RHA conditions for all segments are summarized in Appendix B.

6.0 PHASE 2 NARRATIVES BY REACH

Results of the Phase 2 assessments are briefly characterized by reach number in this section, and potential projects are identified in most of the reaches. Phase 2 summary

reports of data entered into the statewide SGA Database
(https://anrnode.anr.state.vt.us/ssl/sga/security/frmLogin.cfm)
are presented by reach and segment in Appendix C.

"Left bank" and "right bank" in the reach descriptions are referenced looking downstream. Reach maps in the narrative summaries may include a "belt-width corridor" drawn on either side of the stream. The width of this corridor is based on over 30 years of research and data collected from hundreds of streams around the world, and approximates the extent of lateral adjustments likely to occur over time in a meandering stream type (VTANR 2006c, Appendix H). "Human investments within the belt width inevitably result in structural constraints placed on the channel adjustment process to protect those investments and address associated threats to public safety. These threats will be largely avoided by recognizing the hazards created by development, incompatible with channel adjustments, within the critical belt width" (VTANR 2006b, p.17).

6.1 Blood Brook mainstem - Reach M03

Reach M03, the most downstream reach of the Blood Brook watershed assessed in Phase 2, was broken into two segments. The downstream section, M03A, was segmented primarily due to bank and buffer conditions and the presence of a major dogleg in the lower section. M03-B was segmented primarily on the basis of two series of grade controls present in the segment, with an 18 ft waterfall included in the downstream series and a 10 ft falls included upstream.

Segment M03-A is located between a large debris catcher maintained by state road crews at the entrance to a culvert beneath Route 5 on the downstream end, and the tail end of waterfall influences beneath Elm St. upstream (Fig. 3). The segment appears to have undergone some historical straightening. Field observation confirmed preliminary Phase 1 typing as a Rosgen C gravel riffle-pool system based on cross-sections and pebble counts. M03-A was one of three segments in the Phase 2 study to be classed in poor condition on the Rapid Geomorphic Assessment, and was the only segment to be rated extremely sensitive to watershed changes. The bedform was bordering on plane bed in many areas, with widely-spaced riffles beginning to reform through aggradation.

The valley in this segment was very broad, but the incision ratio was calculated as 2.2, indicating very limited access to the floodplain. Absence of active head cuts or other bed degradation features indicated that the incision was primarily historic, though current active incision is also occurring. Numerous depositional features including mid-channel, point, side, and diagonal bars were present in the segment, as well as two active flood chutes, indicating current dominant processes of aggradation, widening, and planform change as the stream tries to establish a new floodplain at a lower elevation. Eroding banks averaging 4-5 ft in height were noted on roughly 40% of the left bank and 10-15% of the right bank in the segment, with an additional 10-15% of the right bank having been riprapped for bank stabilization. Banks on both sides of the stream were dominated by non-cohesive gravel substrates on the lower banks and sand on the upper banks.

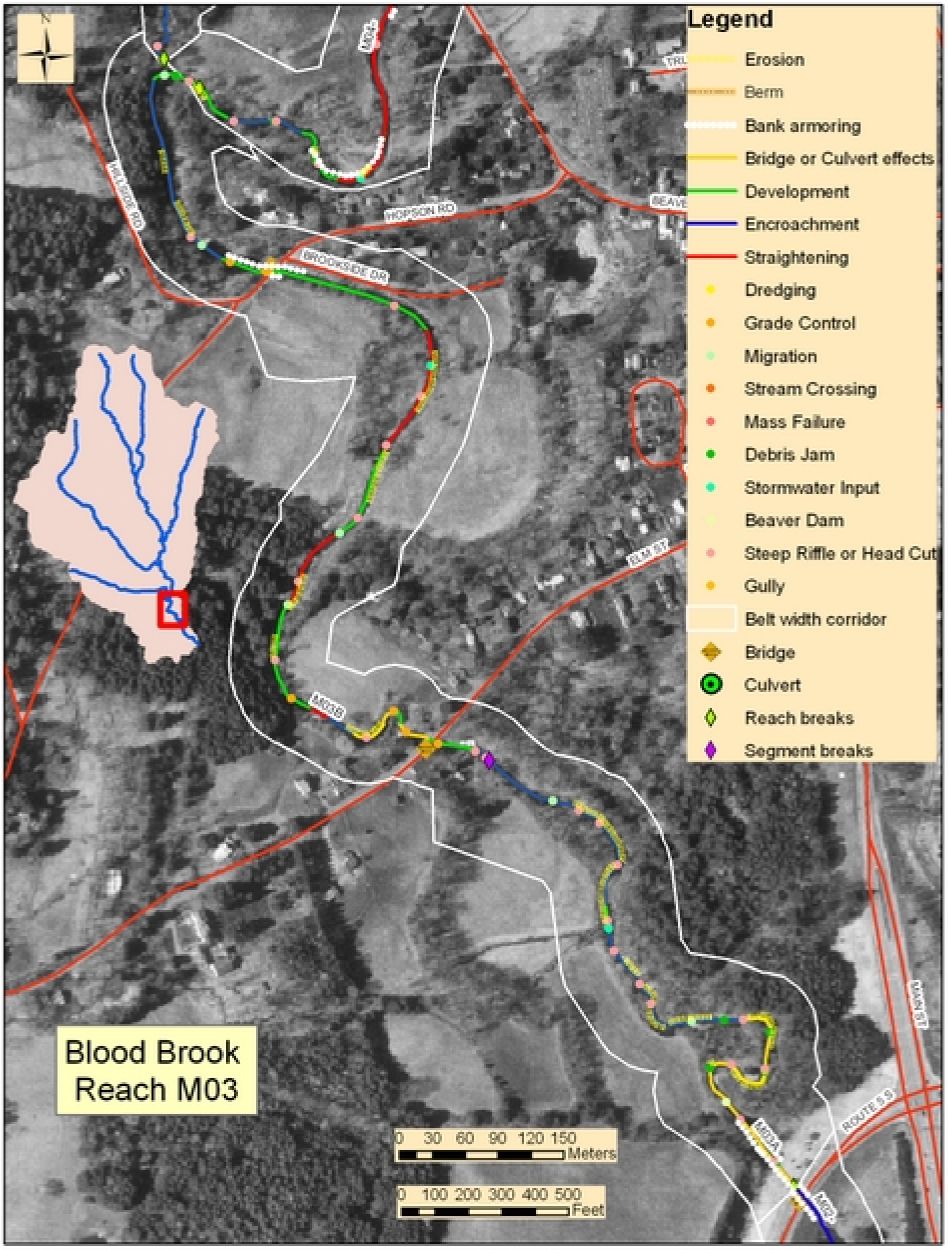

Figure 3. M03 reach map. Erosion in Fig. 4 is at the head of a bend leading into the major dogleg in the downstream segment M03A, shortly before the stream passes through a long culvert underlying the massive embankments of Rte. 5 at the tail end of the reach. Waterfalls at Elm St. (Fig. 5) and above Hopson Rd. were dominant features in the upstream segment M03B.

Although the buffer width generally exceeded 100 ft on the left bank in segment M03A, invasive species (primarily honeysuckle and buckthorn) dominated the near bank and buffer vegetation on both sides and was also significant in the understory of the forest that represented the dominant left bank riparian corridor use. Beaver activity was noted in the lower section of the segment, with a small instream impoundment placed to take advantage of the dogleg in the stream and affecting an estimated 90 ft of the segment.

Hay fields represented the dominant land use in the right bank riparian corridor, and buffer width on this side was predominantly 51-100 ft. but dropped to less than 5 ft in portions of the segment. This was most notable on 100 ft of the outside bend leading to the dogleg in this segment (Fig. 4). Due to the non-cohesive nature of the bank materials in this section, this area was identified as a potential neck-cutoff and is strongly recommended for river corridor protection and buffer revegetation.

Figure 4. Eroding banks at the head of a bend entering the dogleg in segment M03A.

Segment M03B runs from below waterfalls at Elm St. to just above the confluence with Bragg Brook (Reach M03-T3.01) below Hillside cemetery. M03B was found to be a B gravel riffle-pool stream, a stream type departure from the Phase 1 preliminary C reference type. This change was primarily due to greater entrenchment from historic incision that limited floodplain access of the stream in much of this segment. Waterfalls at Elm St downstream (Fig. 5) and Hopson Rd. upstream were the most notable features in the segment. The presence of these grade controls and numerous areas of exposed bedrock contribute substantially to limiting further degradation of the streambed. A relatively low incision ratio of 1.1 is likely related to the presence of these features, and indicates some access to floodplain in parts of the segment. Confinement was very broad despite minor encroachment in the river corridor by development.

Erosion was noted on outside bends through much of the segment (roughly 20% of the left bank and 5% of the right bank, averaging about 3 ft in height). Erosion was primarily located just upstream of each of the sets of waterfalls and in the midstream portion of the segment where buffer widths dropped from 51-100 ft on the right bank and >100 ft on the left bank to a 5-25 ft width on both banks. These diminished buffers were related to mowing of hay fields present in the midstream portion of the segment, in contrast to the primary forest use in the riparian corridor of both banks through most of the segment. Riprap was in place at the upper end of these hayfields and continued upstream to include both sides of the adjacent Hopson Rd. bridge, where residential development was also noted in the belt-width based river corridor.

Figure 5. Waterfalls at Elm St in the lower end of segment M03-B consist of a series of falls, ledge, and bedrock grade controls important to the stability of the stream in this segment.

Sediment storage features were numerous in segment M03B, including mid, point, side, and diagonal bars, as well as 4 active flood chutes. The combination of erosion, aggradation and active flood chutes were indicative of ongoing planform adjustment processes. Erosion is likely to continue to be high at this stage, and the bedrock and grade controls present in the segment will mean that banks are more likely to erode than the bed material.

Potential project identification - Reach M03: Establishment of a protected belt-width river corridor in both segments would be beneficial to the stability and habitat condition of the stream, by accommodating stream meander geometry. The active widening and planform adjustment impacts (particularly bank erosion and lateral migration) in this reach are likely to remain high because of the stage of channel evolution and the extreme sensitivity to disturbances or stressors of the downstream segment. Protecting the river corridor will enable the stream to adjust toward equilibrium conditions and serve to minimize future flood and erosion hazards. Several of the privately owned properties in Segment A appear to have conservation easements held by the Upper Valley Land Trust. Willing landowners might be engaged to investigate funding opportunities through the Conservation Reserve Enhancement Program administered by the Natural Resources Conservation Service, which will provide financial incentives for farmers willing to establish adequate buffers and corridor protection.

The massive embankments underlying Route 5 at the end of the segment, where the stream enters a long culvert, are almost perpendicular to the stream. Due to this situation, efforts to ensure stream access to the floodplain upstream in the reach, or installing overflow culverts at this crossing, would help provide a flood mitigation measure. The Vermont Agency of Transportation might be a potential partner to approach during the river corridor planning process.

6.2 Blood Brook mainstem - Reach M04

Reach M04 is located between the confluence of Bragg Brook (Reach M03-T3.01), below Hillside cemetery, and the confluence of the Blood Brook mainstem and Charles Brown Brook (Reach M04-T2.01) just upstream of the Moore Lane. Bridge (Fig. 6). The reach was not segmented for the Phase 2 study. Field assessment of Reach M04 confirmed Phase 1 typing as a Rosgen C cobble riffle-pool stream type. Confinement was

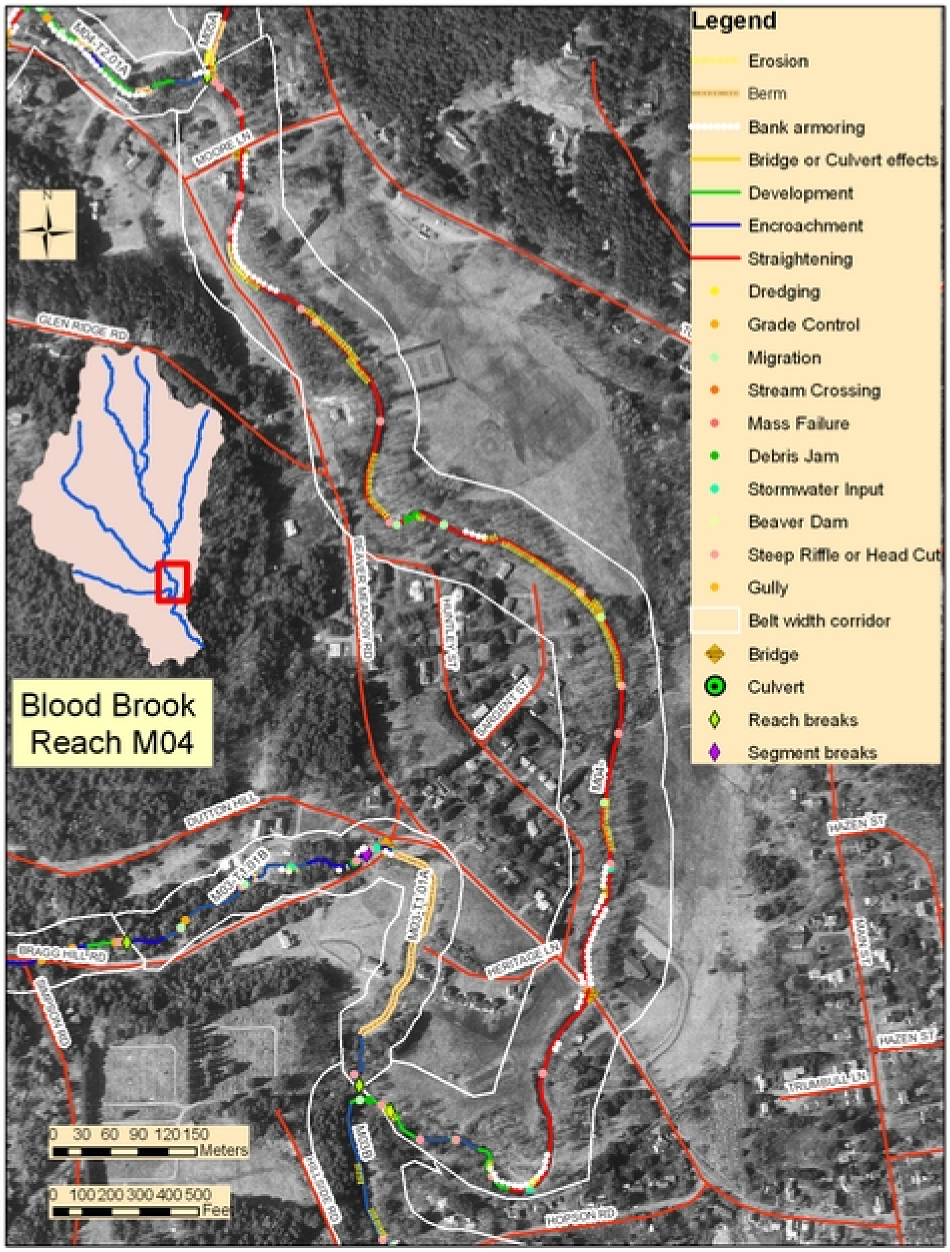

Figure 6. Map for Reach M04 indicates dominant presence of Norwich playing fields and tennis courts, plus adjacent hayfields, along the left bank; right bank corridor includes substantial residential development.

very broad, and the gentle gradient of the channel slope was consistent with its valley setting. The dominant and subdominant land uses were hay production and residential land use, respectively, in the floodplain within the left bank riparian corridor. The dominant land use in the right bank riparian corridor was residential development. The Norwich playing fields and tennis courts, along with contiguous hayfields, occupy a portion of the riparian corridor along approximately 50% of the left bank of the reach Buffer widths of 51-100 ft. in the area of these fields were characteristic of the dominant buffer width throughout the reach on this side of the stream, with narrower buffers of 26-50 ft. not uncommon in areas where fields and lawns were mowed closer to the stream. In the right bank riparian corridor, a characteristic buffer width of just 5-25 ft reflected mowing of both residential and hay lands.

With substantial human investments in the riparian corridor, bank armoring was frequently observed. Erosion was noted on roughly 20% of the left bank and 15% of the right bank in this reach; an additional 10% of the left bank and 15% of the right bank were riprapped. Sediment storage was represented by mid, point, side, and diagonal bars, and four flood chutes were noted in the reach. Long-term residents and town officials (road foreman and former selectboard member) recall this area being bulldozed after flooding in 1973, and some of these flood chutes may be relics of channelization or straightening of the stream at that time. The combination of aggradation and erosion are contributing to lateral migration of the stream in this reach, and widening and planform change were noted as the dominant current processes.

6.3 Blood Brook mainstem - Reach M05

Reach M05 is located between the confluence of the Blood Brook mainstem and Charles Brown Brook (Reach M04-T2.01), just upstream of the Moore Lane bridge, and the confluence with New Boston Brook (Reach M05-T3.01) near the junction of Turnpike and New Boston roads (Fig. 7). Phase 1 preliminary typing of the overall reach was mostly confirmed by field observation, with the stream characterized as a Rosgen C cobble type. The bedform was noted as riffle-pool, however, in contrast to Phase 1 typing as planebed which was likely based on observation of changes resulting from bulldozing rather than a naturally-occurring bedform. The Phase 1 bedform was updated to reflect a riffle-pool expectation for this stream.

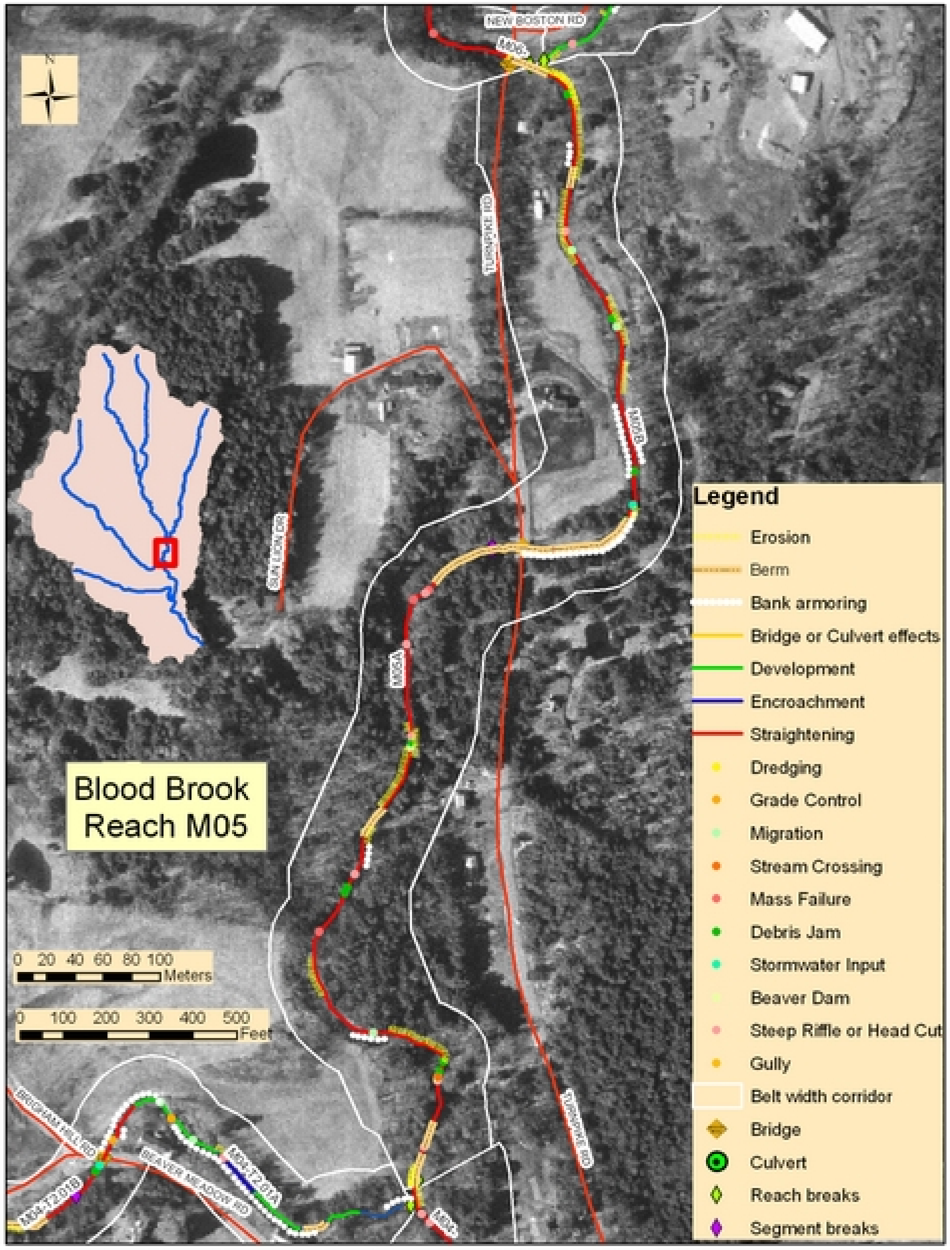

Figure 7. Map of Reach M05 includes significant erosion, two mass failures, and bank armoring and revetments placed to control erosion throughout the reach. Lowest section of segment M05A contains a plugged flood chute east of the hayfield above the confluence with Charles Brown Brook that has restricted stream access to some of the historical floodplain.

Recounts of local flood history indicate that bulldozing was extensive from this reach up the Blood Brook mainstem into segment M09A following the 1973 flood. This was evidenced in the field in this reach by a frequent lack of bed protection and exposure of lodgement till (Fig. 8), along with windrows of stone (sometimes used as riprap or berms) ranging from cobble to boulder size along both banks, and a likely access point for a bulldozer in the downstream section.

Figure 8. Sections of the Blood Brook mainstem and Charles Brown Brook were bulldozed after a flood in 1973. Windrows of stone pushed from the stream are mixed with additional riprap in this portion of M05-B. The grey stripe in the bed of the stream is exposed lodgment till with no bed protection.

Upon completion of the initial walkthrough, the stream was broken into two segments for Phase 2 assessment. M05 was segmented out primarily on the basis of buffer width, which generally exceeded 50 ft on both banks through most of the segment. M05B was segmented due to corridor encroachments and significant riprapping to protect investments in the belt-width corridor.

Segment M05A begins at the mouth of Charles Brown Brook above the Moore Ln. bridge and extends upstream to shortly below the bridge on Turnpike Rd. at Sun Lion Rd. Confinement type for the segment was very broad. The stream type was consistent with Phase 1 preliminary identification as a Rosgen Cb (b subslope classification for a steeper 2-4% slope than is typical for gentle gradient C streams). Bedform was noted as weak riffle-pool with runs bordering on plane bed, primarily due to historic removal of larger particles and subsequent deposition of finer substrates moving the system back toward riffle-pool establishment.

Roughly 15% of the left and 20% of the right bank in the segment exhibited erosion averaging over 3 ft in height, and two mass failures were noted on the right bank in the mid and upstream portions of the segment (Fig. 9). With minimal development in the belt-width corridor, only and 3% and 4% of the left and right banks, respectively, were riprapped. However, roughly 20% of the segment was bermed, primarily in the area just downstream of the bridge at Turnpike Rd below Sun Lion Drive.

M05B extends from just below the bridge on Turnpike Rd. at Sun Lion Rd. upstream to the confluence with New Boston Brook (Reach M05-T3.01) near the junction of Turnpike and New Boston roads. As with segment M05A, stream type was Rosgen Cb but bedform was noted as plane bed rather than riffle-pool. Local residents recall that bulldozing efforts in this segment included rerouting of a former meander bend to the edge of a hayfield in the lower third of the segment. Lack of bed protection and frequent lodgement till exposure were observed, particularly in the lower half of the segment.

Erosion was extensive, with roughly 40% of the left bank eroded to an average of 4 ft in height and an additional 45% of the segment riprapped on this side. Roughly 10-15% of the right bank was eroded, with 15% riprapped. Erosion included areas of significant bank failure where the bank was composed of non-cohesive gravel and silt substrates, or underlain by lodgement till or clay (Fig. 9).

Figure 9. Mass failure in M05A (left) and bank failure in M05B (right) are indicative of channel adjustment processes in Reach M05.

Right bank corridor land use was primarily residential and hayfield, and buffer widths on this side were 5-25 ft and dropped to less than 5 ft in several areas, with lack of a bank canopy through the lower portion of the segment. Left bank corridor use was noted as forest and the buffer was >100 ft, but bank canopy was moderate (51-75%), much of the tree cover on this side of the stream was quite young, and there is a strong herbaceous component to the buffer vegetation.

Sediment storage included mid, point, side and diagonal bars, but these were not as extensive as in downstream segments. Several headcuts and tributary rejuvenation at the top of the segment were also noted, indicating active degradational processes (in spite of the relatively hard nature of the lodgement till in the bed) along with the widening that is occurring. Two active flood chutes were also noted in the segment, further indicating active lateral migration as the stream attempts to regain equilibrium.

Potential project identification - Reach M05: Much of the stone that formerly armored the bed in this section of Blood Brook was windrowed along the stream sides following the 1973 flood, as in many streams in central Vermont that experienced similar floods in the 1970s. While these efforts were intended to improve the capacity of the stream to convey floodwaters, the resulting increased velocity of the stream and slope of the channel often initiated downcutting and erosion processes that are ongoing decades later, as evidenced in the Blood Brook watershed. Some bed protection is naturally beginning to evolve through deposition from further upstream, but with lodgement till exposure frequent in segment M05-B, much of this material continues to be transported over the top of the till in annual high flows. While relatively resistant to erosion, this till is also at risk of being torn away in chunks given floodwaters of sufficient erosive capacity. With much of the stone from windrowing still close at hand, it might be feasible to place some of this material back on the streambed to increase roughness of the bed and decrease stream erosive power.

It appears that some of the stone removed from the bed was also used to plug an old flood chute (or possibly the former stream channel) in the lower portion of segment M05A, possibly to divert the channel away from the edge of a nearby hayfield. Removing this plug could potentially access a greater floodplain for the stream with a minimum of damage, as the area below it is largely wooded at this point and has no substantial development above the mouth of Charles Brown Brook (Fig. 7).

6.4 Blood Brook mainstem - Reach M06

This reach extends from the confluence of New Boston and Blood Brooks and continues upstream on Blood Brook past four town-road crossings to a point 5,444 feet upstream, just before a new house development on the right bank. It drains 6.04 sq. mi. and was left unsegmented. The stream had a C-type channel (occasionally confined to a B-type) with a cobble substrate. Human manipulations such as straightening and dredging have altered the natural riffle-pool bedform and replaced it with planebed features in many areas. Degradation and aggradation are both major processes taking place and the stream shows signs of channel widening (Fig. 10).

Figure 10. Recent dredging (left) and mass failure (right) in Reach M06.

Road encroachment and channel constrictions were fairly common. The stream passed under five bridges, through one culvert, and past one unfinished bridge abutment. Several of these create some constriction of the channel. Four were associated with town road crossings. One of the private bridges had reportedly washed out several times, and the former bridge was being replaced at the time of this assessment. Bank erosion in this area was noticeable, and the channel just upstream had been recently dredged (Fig. 10).

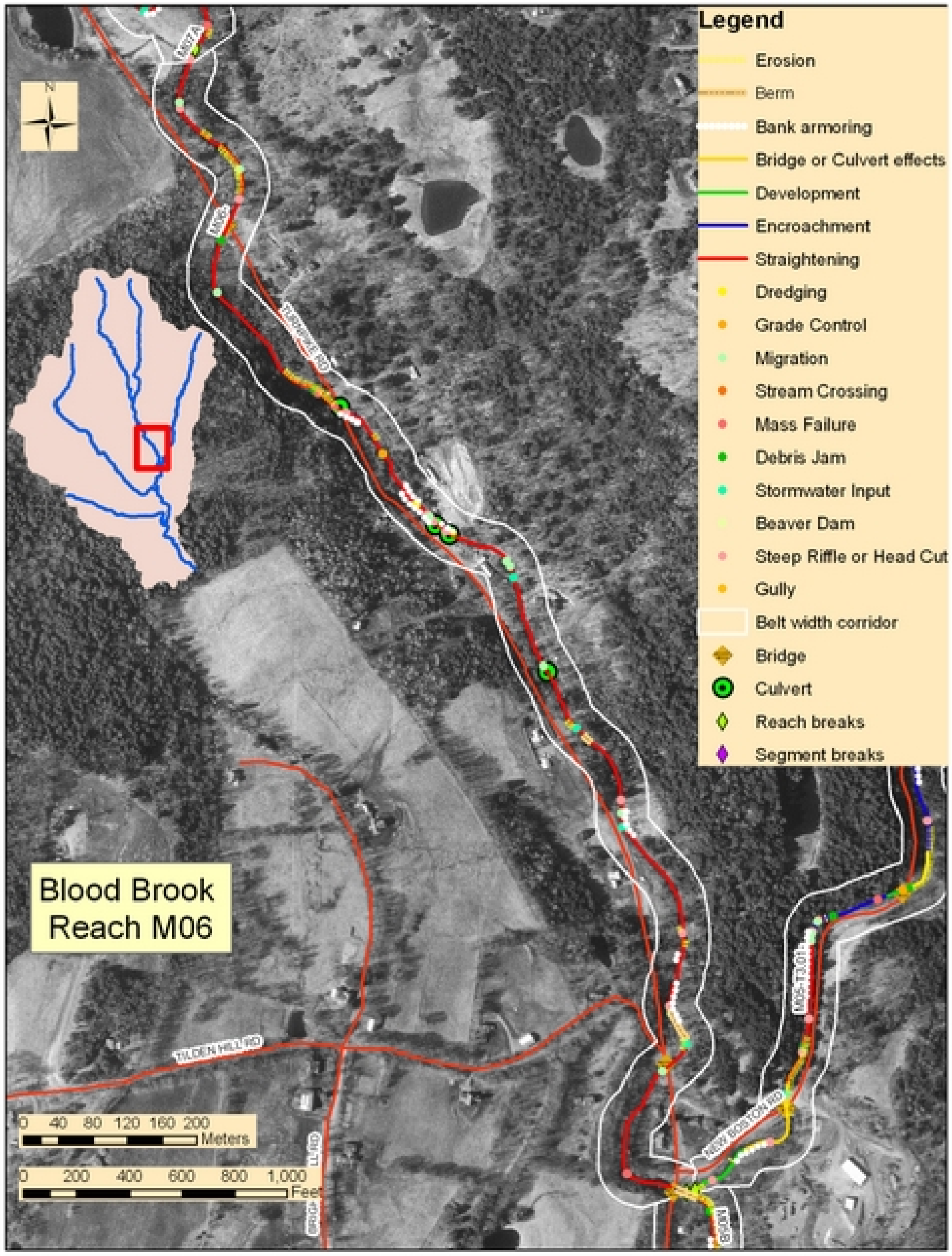

Figure 11. Reach map for M06 shows frequent road encroachment along with numerous bridges and culverts.

Potential project identification Reach M06: This reach would particularly benefit from efforts to reduce channel constrictions by upgrading culverts and bridges to accommodate annual high bankfull flows and sediment transport. The constrictions are worth special consideration in corridor planning because they are likely to have a future impact on the integrity of the road infrastructure. This reach should be a high priority for inclusion in stream corridor protection planning that would identify areas where the stream can be allowed to access floodplain and find other ways to accommodate the adjustment processes that Blood Brook is currently undergoing. In addition, dredging may contribute to downcutting processes in this reach and measures for arresting upstream migration of headcuts may need to be considered.

6.5 Blood Brook mainstem - Reach M07

This reach begins where M06 left off and extends 4,379 feet upstream to the confluence with a tributary entering on the left bank shortly before Upper Turnpike Road (Fig. 12).

M07 drains 5.54 sq. mi. and was divided into two segments of 2,570 and 1,809 feet. The segments differed in buffer and levels of encroachment as well as human-caused differences in stream type. The lower segment (M07A) was a C-type stream dominated by cobble substrates and had a weak riffle-pool bed form. This segment showed frequent encroachment in the river corridor from development and roads, and vegetated buffers were lacking in much of the reach. This section of stream had been straightened in the past and there were distinct indications of degradation (Fig. 13). The upper segment (M07B) was a B-type stream due to historic degradation that has caused a loss of floodplain access. There were still some signs of active degradation, but aggradation and channel widening were the more dominant processes.

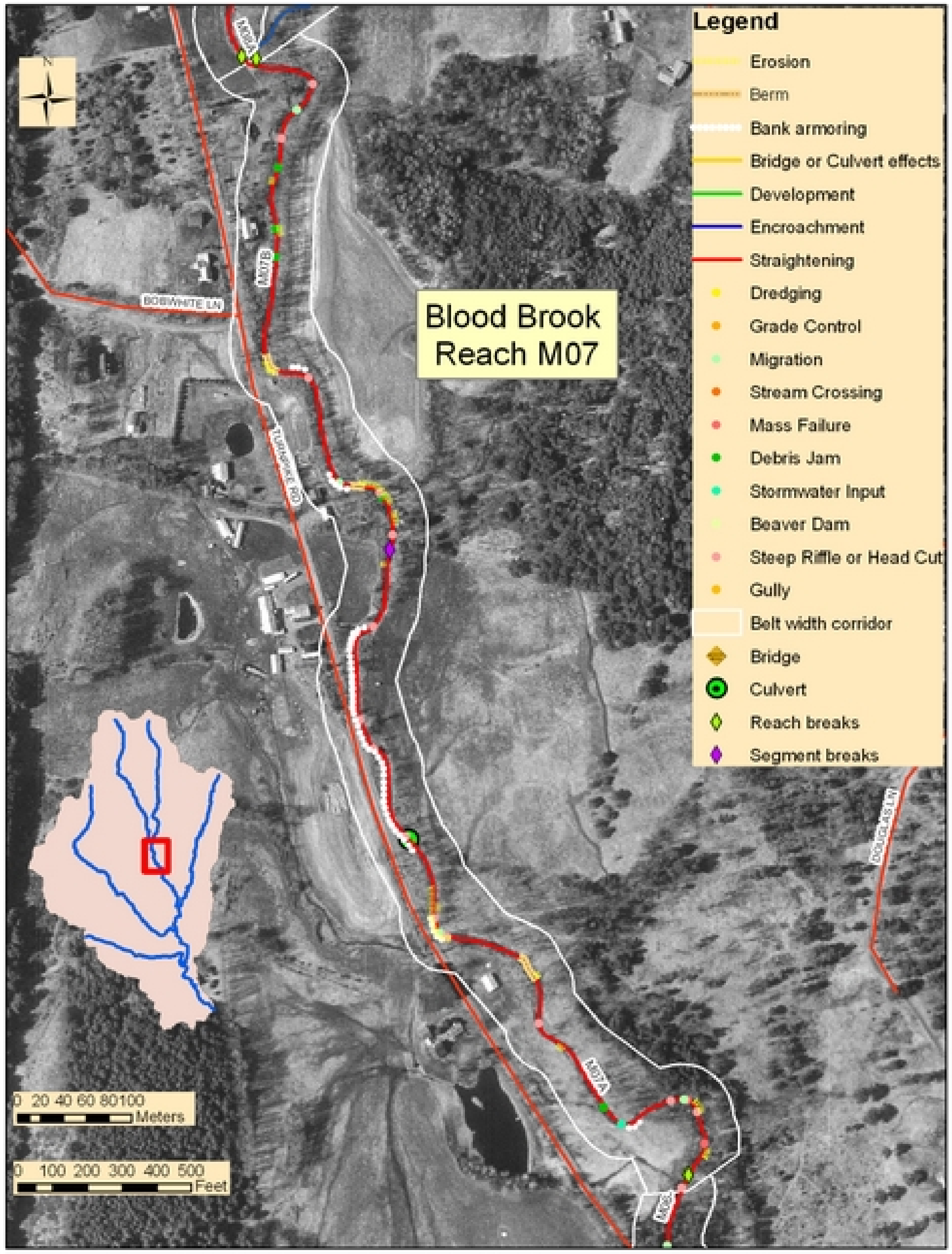

Figure 12. Reach map for M07.

Figure 13. Lack of buffers, headcuts, undercut banks and exposed lodgment till were all noted in Reach M07.

Potential project identification – Reach M07: There were two places in segment M07B where potential floodplain might be accessed more readily with a small amount of intervention. The lower end of the segment contained an old channel (which may periodically be accessed as a flood chute) walled off by a berm. Removal of the berm and opening of this channel might help dissipate stream energy at an abrupt turn in the stream. The very top of M07B had a similar situation, minus the berm, where an old flood chute could be encouraged to take more of the flow and relieve some pressure from the stream on the banks (Fig. 14). A wider buffer would benefit areas of M07A.

Figure 14. An opportunity may exist to access some additional floodplain on the right bank of the stream in M07B to help relieve pressure on the left bank at high flows.

6.6 Blood Brook mainstem - M08

Reach M08 extends from the confluence of the Blood Brook mainstem and an unnamed tributary (Reach M07-T3.01), below the junction of Turnpike and Upper Turnpike Rds., to just above a culvert beneath Old Orchard Ln. on the upstream end. Stream encroachment from Turnpike, Upper Turnpike, and Needham Roads., Old Orchard Lane, and numerous private driveways extend virtually throughout the reach and contribute to increased impervious surfaces, stormwater inputs, and reduced buffers in some areas (Fig. 15). The reach was broken into four segments after the initial walk-through, primarily on the basis of changes in confinement and stream/floodplain relationships as the proximity of the valley wall to the stream varied through the reach. The overall reach was assessed as a C type and the Phase 1 assessment was updated to reflect this field assessment. In portions of the reach, however, the stream was channelized against the valley walls, which likely occurred sometime in the 1800s in order to maintain agricultural land; segments M08B and M08D were thus assigned a modified B reference type.

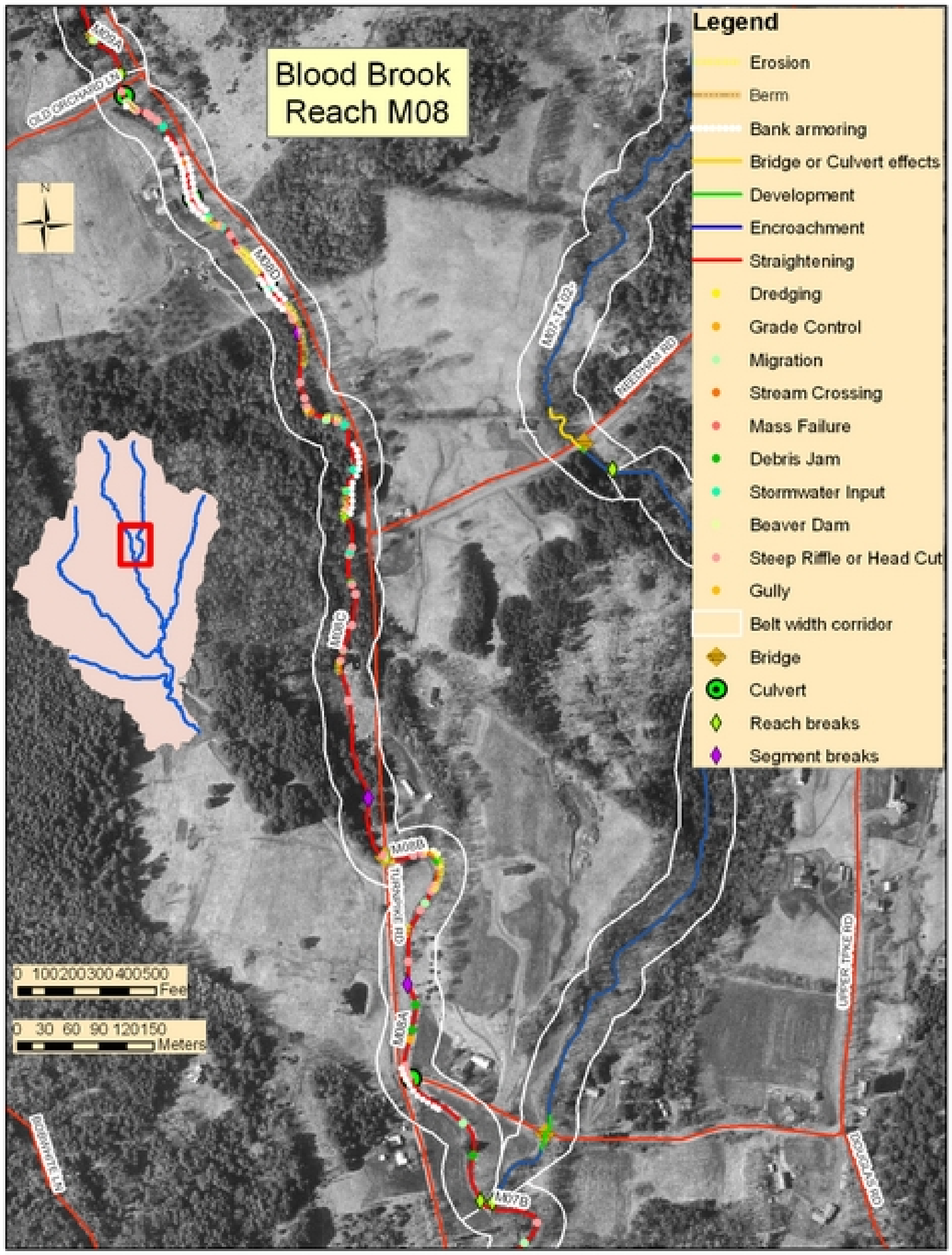

Figure 15. Map for Reach M08 on the Blood Brook mainstem indicates frequent road encroachment and numerous culverts within the reach.

Segment M08A extends from the lower end of the reach to a check dam grade control installed approximately 150 ft above the junction of Turnpike and Upper Turnpike Rds. In contrast to the Phase 1 preliminary typing of the stream as a B channel, this portion of the reach was observed to be a Rosgen C gravel riffle-pool system. As noted above, the type difference was attributed to a naturally wider available floodplain due to the valley wall being located further from the stream in this segment, and the stream's ability to access that floodplain.

Confinement was very broad despite minor human-caused narrowing of the valley due to elevated road fill. Erosion was minimal in the segment, though there was 229 ft of riprap on the right bank in the middle of the segment, the bulk of it just downstream of the culvert under Upper Turnpike Rd. at the junction with Turnpike. Road encroachment was the primary issue in the segment, with roughly 40% of the upper portion affected. Although the steep banks by the road in this segment were currently vegetated, erosion threatened to undercut the same road just upstream in the next segment, and widening or lateral adjustment in this segment could quickly become an issue given the highly erodible nature of the bank materials. An elevated pipe from under Turnpike Rd carries overflow from a pond perched above the floodplain, and bed degradation in association with this outfall appears to be a primary reason for installation of the check dam a short distance upstream (Fig. 16). The check dam was in good shape at this time, and given the degree of incision downstream may be playing a significant role in preventing upstream migration of headcuts.

Figure 16. An elevated pipe carrying overflow from a pond above the floodplain daylights on the steep banks below Turnpike Rd. in segment M08-A (left). Degradation of erodible bed materials below this outfall has formed a 3 ft. deep pool, and concern about upstream migration of this downcutting may be a primary reason for installation of a check dam just upstream of this point (right).

Sediment storage was minimal in segment M08-A, consisting of 1 diagonal and 3 side bars, though steep riffles were associated with deposition above and below the culvert. Hayfields were the dominant land use in both sides of the riparian corridor, and buffers were limited in most areas to 5-25 ft in width. on both sides with some wider buffers present in portions of both sides.

M08-B starts at the check dam approximately 150 ft above the junction of Turnpike and Upper Turnpike Rds and extends upstream to approximately 250 ft above the next bridge upstream on Turnpike Rd., across from 914 Turnpike Rd. The valley wall was continuous with much of the left bank, but the valley is wide and the confinement was noted as broad in this segment; deep entrenchment due to historic incision has created a new valley wall on the right bank. Hayfields dominated the right bank corridor land use, and the bridge in the midstream section of the segment was aligned at a relatively sharp angle to the stream corridor (Fig. 17). The combination of these factors further supports the supposition that the stream has likely been maintained against the left valley wall over time. The angle of this bridge, and its arrangement with an adjoining driveway, also form a floodprone constriction to the stream and combine with the presence of abundant large woody debris in the next upstream segment to make this structure a concern in a flood event.

The stream was very entrenched in this segment, and an entrenchment ratio of 1.2 indicates the stream's lack of access to the floodplain. The segment was classified as a Rosgen B gravel riffle-pool system. Erosion averaging 3.5 ft in height was evident along 25% of the left bank, and a mass failure 25 ft in height was present on this side of the stream shortly downstream of the Turnpike Rd bridge where the stream meets the left bank valley wall. Brush was placed just above the mass failure near the edge of a residential lawn in order to reduce scour (Fig. 17). Right bank erosion averaging 4.5 feet in height was observed along 10% of the right bank.

Buffer widths in segment M08-B were fair to good, with 26-50 ft width along the hay fields on the right bank and greater than 50 ft elsewhere through the segment. Most of the left bank buffer actually exceeded 100 ft, with the steep slopes on this side generally forested.

Figure 17. Brush in the foreground was placed just upstream of a 25-ft. mass failure (background) at a hard bend in segment M08B on Blood Brook, where the stream meets the left valley wall.

M08C begins across from 914 Turnpike Rd and extends upstream to the edge of a wooded area downstream of a private culvert under the driveway leading to 1037 Turnpike Rd., and was segmented due to a change in confinement and differences in corridor land use and buffers. The valley widens again in this segment, and the confinement was noted as very broad. Stream type differed from the initial Phase 1 B typing of the overall reach, and was instead typed as a Rosgen C cobble, subslope b (2-4% slope) riffle-pool system. The cross section data indicated an E type stream due to a very low width/depth ratio, but the stream channel widens shortly downstream and remains wider through the remainder of the segment; the cross-section may have been located too close to culvert influences in the next segment upstream to have been representative. Although some silt and clay was noted on the upper right bank, general bank materials were non-cohesive and increases in flow, as noted below, are likely to begin to erode these banks, as was observed further downstream of the cross-section.

The terrace above the right bank was logged within the last 10 years, and the hydrology of a small tributary appears changed as a gully had begun to open below this terrace well back from the stream. Tributary rejuvenation was noted at the confluence of this tributary with segment M08C. A stream ford set up to access the log landing should be removed and was noted as an active headcut (Fig. 18), and other headcuts were noted in relation to stormwater inputs in the segment. Four stormwater inputs were noted, as a number of road ditch culverts have been recently installed; one of these also carries overflow from a pond.

Figure 18. A log dam in segment M08-C (left) that appears to have been installed as part of a stream ford to access a log landing has been eroded and is now forming an active headcut with the potential to migrate upstream rapidly (right).

Erosion was noted along roughly 10% of both right and left banks, averaging 2-3 ft in height, and an additional 10-15% of the left bank was riprapped. Depositional features were common, with sediment storage noted in mid-channel, point, side, diagonal, and one delta bar. Twenty-seven pieces of large woody debris were observed in the segment, which can offer habitat and sediment storage advantages in the segment.

Buffers were fair to good for the most part, with > 100 ft through most of segment M08C on the right bank and predominantly 51-100 ft on the left bank, though this was reduced along Turnpike Rd. and adjacent to some residential development.

Segment M08D was typed as a Rosgen B gravel riffle-pool stream, which differed from preliminary Phase 1 typing as a step-pool system. Steep valley walls on the right bank in particular indicated that deep incision in this segment may predate historic times, but cross-section data also indicated more recent abandonment of floodplain at a lower elevation. A series of three undersized culverts in short succession combine with the valley walls to form a semi-confined setting for the stream in this segment, although an entrenchment ratio of 2.1 indicated that the stream is moderately entrenched and maintains some access to the floodplain.

Right bank corridor use was residential and pasture, and buffer widths were limited to 5-25 ft width with some areas of 26-50 ft on this bank. Horses have access to the stream at one point, with fencing placed to provide the stream as their water supply; Japanese knotweed covers a portion of the right bank near this point. Although left bank corridor use was noted as predominantly forest with some residential, road encroachment contributed to limiting the buffer width to 26-50 ft, narrowing to 5-25 ft in significant portions of the segment. Erosion was noted on 10-15% of both banks, averaging 3 ft high on the left bank and 3.5 ft on the right bank. Roughly 25% of the left bank and 55% of the right bank were riprapped, and another 15% of the segment was bermed on one (10%) or both (5%) banks.

The perpendicular orientation of the driveways and road above the culverts in this segment present floodprone constrictions that, in conjunction with their close proximity to Turnpike Rd., would make this area a concern in a flood event. Soils in this area are highly erodible, although much of the banks are riprapped. The significant amount of riprap and berming in this segment will increase the likelihood of continued bed degradation. The presence of active headcutting in the next downstream segment suggests that high flow events could cause these cuts to migrate upstream rapidly, and the structural integrity of some of these culverts could be a concern in such a scenario (Fig. 19).

Figure 19. Indications of scour undermining this culvert make the possibility of upstream migration of headcuts a concern for structural integrity. Sediment deposition above, not as heavy at this culvert as some others in the study, indicates a structure may not be adequately sized to transport sediment as well as water at bankfull flows.

Aggradation was a common process observed in the Phase 2 assessment, however, with sediment storage including mid, side, and diagonal bars as well as one point and one delta bar. Deposition was particularly prevalent upstream of some of the culverts in the segment, indicating that the culverts may not be adequately sized to transport sediment as well as water at bankfull flows (Figure 19).

Potential project identification – Reach M08: A check dam installed at the head of segment M08A appeared to be functional and helping to limit upstream migration of headcutting. However, such structures are temporary, require high maintenance, and can contribute to further instability in the stream. The degree of confinement of the stream in much of this reach suggests that this structure is valuable in protecting the culverts and roadbanks upstream, as continued downcutting will eventually lead to elevated widening and lateral migration processes; consideration should be given to some grade control. This reach, along with M09 upstream, should also be a high priority for analysis of stream meander geometry and identification of areas where floodplain access may be facilitated, along with strong emphasis on river corridor protection and limiting of further encroachment. Floodplain access might be most easily considered in segment M08A of this reach, while the bridge just downstream of 914 Turnpike Rd, noted above in the segment M08B discussion, would offer a more challenging opportunity to access floodplain that might be considered if any major replacement efforts become necessary. In addition, management of invasive plants (knotweed), while not integral to protecting and enhancing geomorphic health, could be investigated and partnerships with willing landowners could be developed. Early detection and rapid response are great advantages in such efforts, and establishment of wooded buffers would help provide shading that can act as a deterrent to the spread of knotweed.

6.7 Blood Brook mainstem – Reach M09

This reach begins just above Old Orchard Lane and continues for 12,259 feet to the head of Blood Brook (Fig. 21). It drains 1.94 square miles and was divided into three segments for this study. The lowest segment (M09A) is 7,259 feet in length and was characterized by multiple road crossings and significant road and development impacts. It was typed as a Rosgen C channel (in contrast to the Phase 1 preliminary assessment as a B type) dominated by cobble substrate and a weak riffle-pool bed form. The stream in this segment passed through 8 culverts, all of which constrict the channel to some degree and a few of which cause severe constrictions. The very lower end of segment M09A was noticeably more incised (Fig. 20).

Figure 20. M09A was noticeably incised, limiting access to historic floodplain.

The middle segment (M09B) is 3,221 feet in length and was characterized by multiple ledge and waterfall grade controls and exemplary buffering. This segment was consistent with Phase 1 typing as a Rosgen B-type channel and was also dominated by a cobble substrate. Bed form varied between riffle-pool and step-pool. There was an old beaver impoundment in the middle of this segment that was not holding water. The upper segment (M09C) of this reach is 1,779 feet in length and was dominated by a broad valley and wetlands created by beaver activity. This upper segment was not further evaluated due to the wetland and impoundment influences, per Phase 2 protocols.

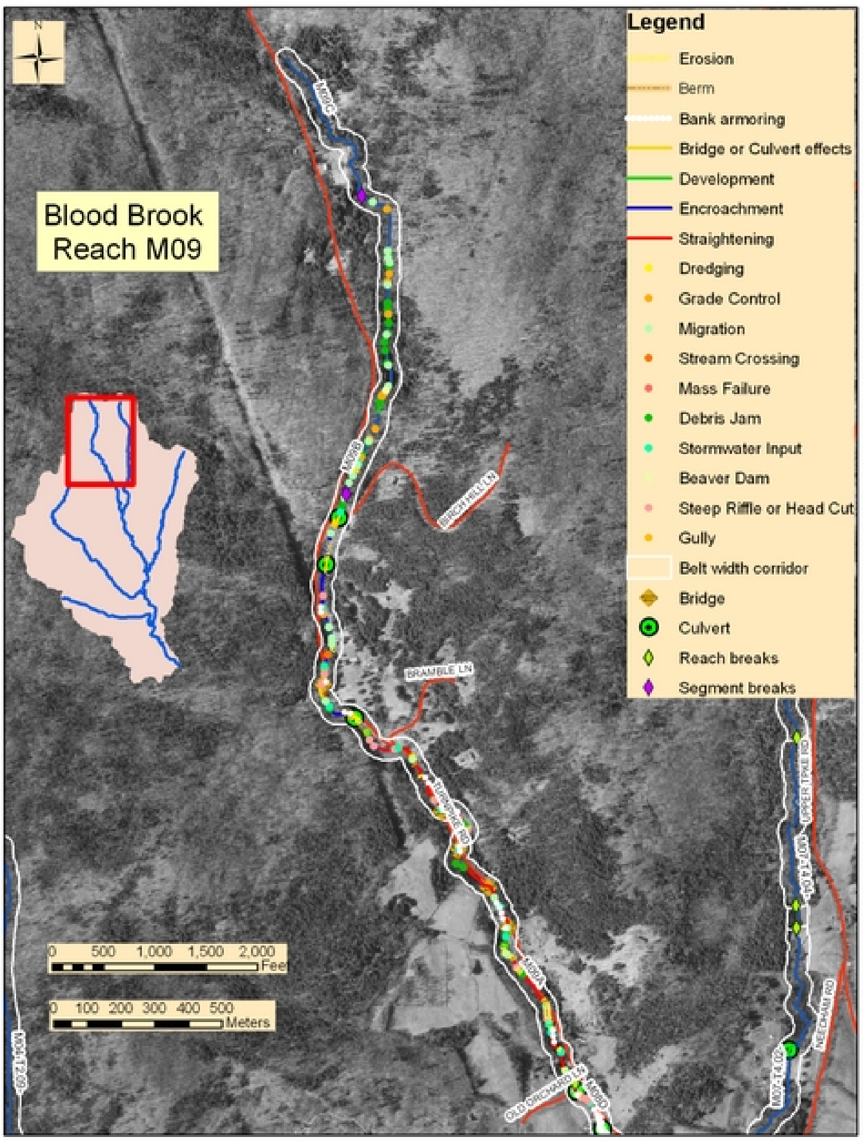

Figure 21. Reach M09 features reference conditions in segment M09B and an abandoned beaver impoundment in the headwaters of Blood Brook. M09A on the downstream end has a number of road encroachments and numerous culverts and shows some signs of incision.

Potential project identification – ReachM09: The primary issues in the lower segment of this reach were road encroachment and channel constrictions, and high priority should be given to river corridor protection and limiting further encroachment. Additional projects for this area could focus on the replacement of undersized culverts (over time) and limiting migration of headcuts and bed degradation, as well as the potential for allowing buffers to regenerate in areas of housing encroachment. Please refer to the general discussion of development of a stream corridor protection plan included in Section 7 – Recommendations within the main body of this Blood Brook Watershed Phase 2 report for further discussion of these issues.

Segment M09B was rated in good condition on rapid geomorphic and reference on rapid habitat assessment scores, and offers a benchmark in this watershed for helping analyze meander geometry of the stream in a healthy condition, as well as excellent possibilities for protecting the relatively intact corridor from encroachment and development to avoid potential future landuse conflicts and erosion hazards. The presence of bedrock and ledge grade controls naturally limits upstream migration of bed degradation processes (Fig. 22).

Figure 22. Segment M09B was rated in good condition on the Rapid Geomorphic and reference on the Rapid Habitat Assessment in Phase 2.

6.8 Bragg Brook – Reach M03-T1.01

M03-T1.01 is the most downstream reach for Bragg Brook. This reach drains a watershed of 1.21 square miles from the Bragg Brook confluence with Blood Brook, approximately 1,000 feet downstream of the intersection between Bragg Hill and Beaver Meadow Rds., and continuing upstream for 2070 feet to a series of grade controls in a steeper and more confined valley (Fig. 23). The reach was divided into two segments of 1,121 and 959 feet. The lower segment was typed as Rosgen E gravel planebed, based on cross section and pebble count data, while segment B was assessed as a C gravel planebed stream. Both of these were in contrast to Phase 1 preliminary typing as a B type stream, an assessment that may have been related to the artificial confinement created by a long berm in the downstream segment. The Phase 1 data was updated to reflect a C typing based on the Phase 2 fieldwork.

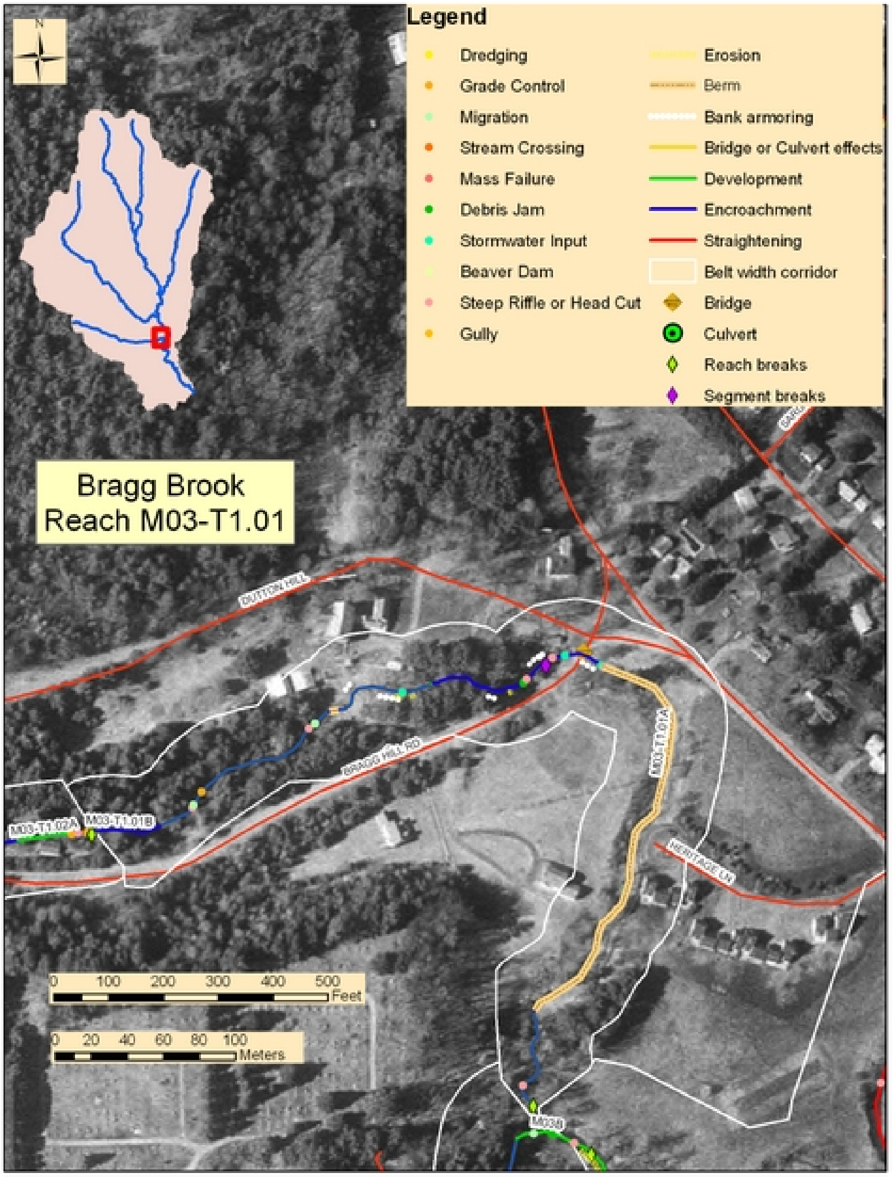

Figure 23. Reach map for M03-T1.01.

The lower segment (M03-T1.01A) was characterized by significant human manipulation and development, particularly on the left bank where a 790 foot berm prevents the stream from reaching its floodplain even in very high water (Fig. 24). A small housing development was located approximately mid-segment on this left bank. The right bank was characterized by steep slopes with a couple houses that only slightly impact the stream belt-width corridor.

Figure 24. Berm on left bank of segment M03-T1.01A prevents stream from accessing the floodplain.

Head cuts were noted in this segment, indicating that the stream is degrading. The top section of this segment had a buffer only 5-25 feet in width, and sometimes less, on the left bank. The most downstream section of this segment was less developed and had a forested buffer exceeding 100 feet on both sides. Straightening of the stream channel in M03-T1.01A contributed to the breakdown of reference streambed features, with most of the segment characterized by plane bed features and diminished aquatic habitat.

The upper segment of this reach (M03-T1.01B) showed less evidence of degradation and streambed disruption, with some riffle-pool structure evident. There was road encroachment along the right bank of this segment and a small amount of development along the left bank, with one bridge in this segment. The width of the bridge in this segment was adequately sized, but the stream takes a sharp turn here and alignment with the stream channel was not ideal.

Potential project identification – Reach M03-T1.01: Potential exists for removal of portions of the berm in the lower segment's forested area to regain some floodplain access. This is well below the housing development and would not have an impact on town infrastructure. As part of a stream corridor protection plan (see Section 7 – Recommendations within the main body of this Blood Brook Watershed Phase 2 report), this project could offer floodplain access above reach M03.

6.9 Bragg Brook – Reach M03-T1.02

M03-T1.02 lies upstream of M03-T1.01 and extends just past a new bridge put in upstream of 369 Bragg Hill Rd. during mid-October, 2006 (Fig. 25). It drains 1.17 square miles and has a channel length of 5,210 feet. The reach was typed as a B-channel with cobble dominated substrates, differing from the Phase 1 preliminary characterization as an A cobble system, and was divided into two segments of 1,348 and 3,852 feet.

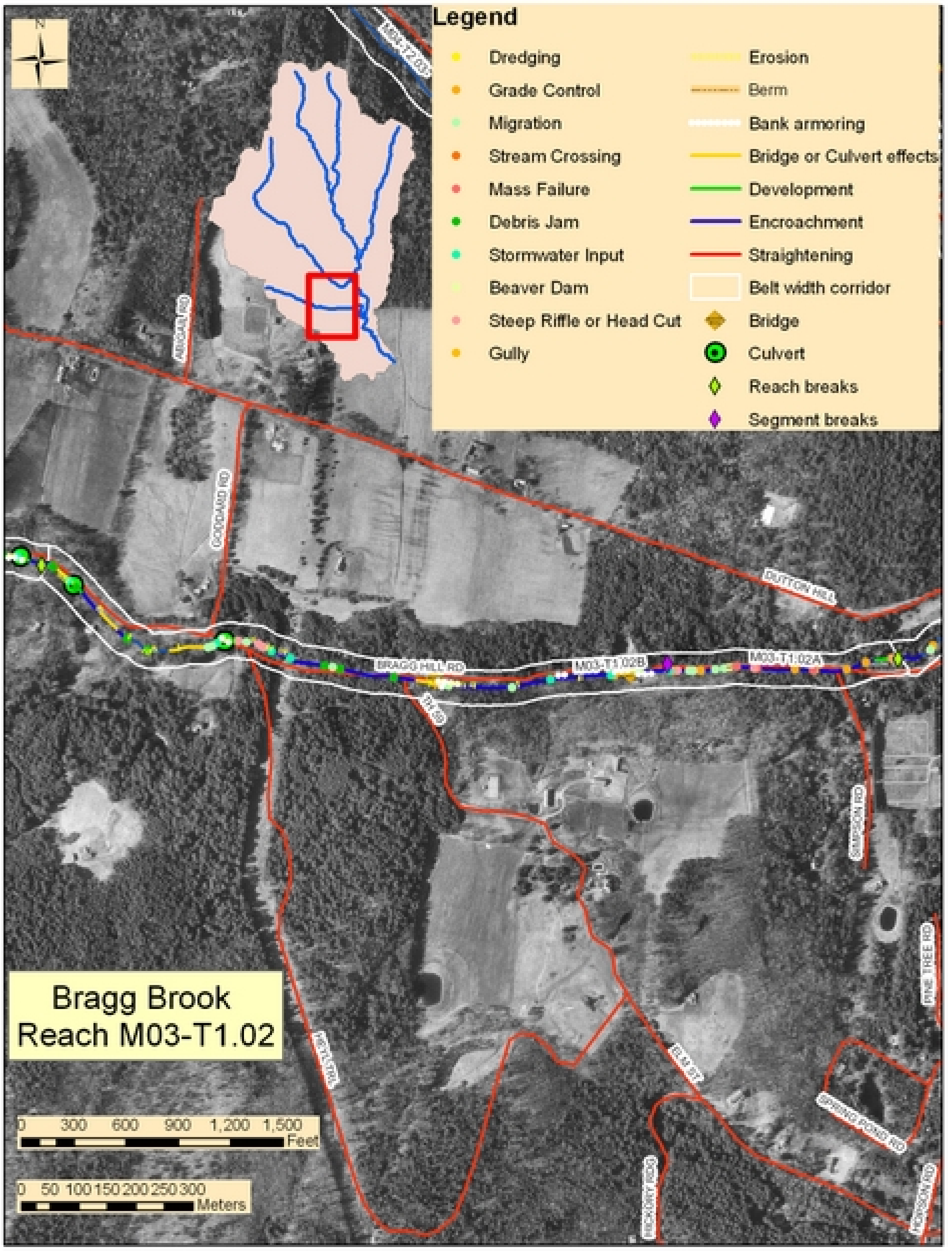

Figure 25. Reach map for M03-T1.02. This reach is recommended for further assessment of bankfull discharge due to significant impacts on stream dynamics.

The lower segment (M03-T1.02 A) was dominated by ledge grade control and was largely in reference condition except for sediment inputs from mass failures on its steep left corridor. These mass failures appear related to a one-time break in a water line leading from town wells near the Connecticut River to a 3 million gallon holding tank on Dutton Hill Road, upslope of this reach, in the late 1970s (pers. comms., Andy Hodgdon, Norwich Road Foreman, December 2006 and January 2007). This area of erosion could also be termed a gully. It extended upslope 70 feet, and was approximately 15-20 feet deep (Fig. 26).

Figure 26. Mass failure/gully in M03-T1.02A appears related to a one-time break in a water line upslope of the stream near Dutton Hill Road.

The upstream segment (M03-T1.02 B) had a high incision ratio (2.0). This is likely related to adjustment processes occurring in response to the water line break downstream; the downcutting is migrating upstream as the stream tries to match the lowered elevation of the streambed downstream. The physical condition of this segment was also affected by human activities; it was frequently encroached upon by Bragg Hill Road and had three culverts and 2 bridges to pass through. The bridges were both new; one represented a channel constriction, while the other was well sized at nearly 1.2 times the channel width. The culverts were all channel constrictions showing deposition and scour.

Potential project identification – Reach M03-T1.02: Although the slopes above this reach have largely stabilized, the large flow increase and sediment inputs related to the water line rupture appear to be impacting Bragg Brook significantly, with subsequent adjustment processes deepening and widening channel dimensions. Bankfull elevations should be measured downstream of these inputs at high flow events to help more accurately assess potential impacts to infrastructure and channel evolution processes.

Throughout the reach, road encroachment comes right to the streambank in several areas and is of concern with incision and lateral migration processes active in the reach; please refer to the general discussions of infrastructure protection and development of a stream corridor protection plan included in Section 7 within the main body of this Report for further discussion of these issues. In addition, the road crew is trying to obtain funding to replace cribbing underlying Dutton Hill Rd just above one of the culverts, near the

Highlander Farm sugarhouse (pers. comm., Andy Hodgdon, Norwich Road Foreman, December 2006). The active adjustment processes in M03-T1.02 B, along with the fact that the one-time impacts of the water line break have largely stabilized, would lend weight to a priority for this project in conjunction with replacement of a perched culvert at this location, but also highlight the dilemmas presented by development within the stream corridor and the importance of limiting any further encroachment in areas of the watershed where this is still possible. The stream has very little room to move in this area, and the same is true of the road. The physical dictates of a dynamic stream system trying to reestablish equilibrium will eventually entail widening as part of the channel evolution process, and efforts to maintain the stream in one location will require escalating costs for maintenance and difficult choices concerning where and how the stream is eventually allowed to access the floodplain it needs to reestablish equilibrium.

6.10 Bragg Brook – Reach M03-T1.03

M03-T1.03 begins where M03-T1.02 leaves off and continues to the head of the Bragg Brook watershed (Fig. 27). The reach is 5,780 feet long and drains a watershed of 0.59 square miles; it was broken into three segments of 1,868, 2,714 and 1,198 feet. The lowest segment (M03-T1.03 A) was characterized by human development and inadequate buffers and is highly recommended for river corridor protection planning and limitation of further encroachment. This segment was a highly sinuous C-channel in some places, though primarily a B type. The middle segment (M03-T1.03 B) had a more natural setting with frequent ledge and waterfall grade controls. This segment alternated between an A-type and B-type channel. The upper segment (M03-T1.03 C) was dominated by impoundments and was not further evaluated, in accordance with Phase 2 protocols (VTANR 2006).

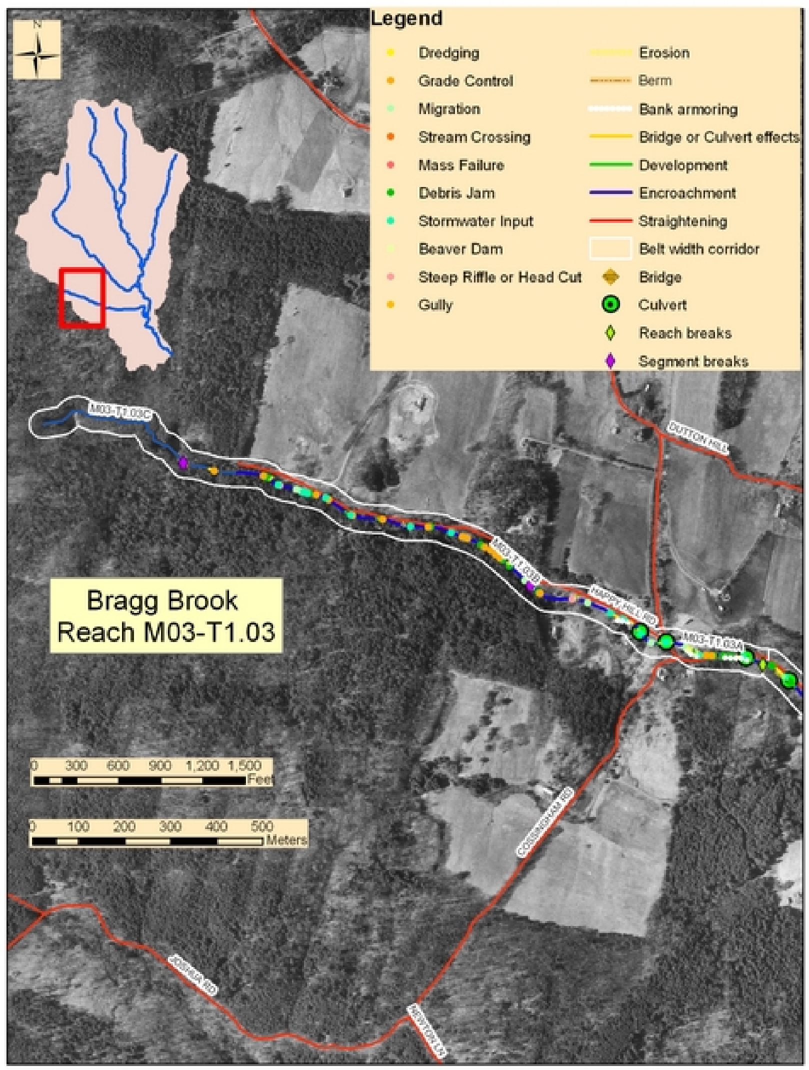

Figure 27. Reach M03-T1.03 was divided into three segments.

The entire reach had a B-type channel overall, but the lower segment (M03-T1.03 A) was dominated by gravel substrates in a riffle-pool setting, while the middle segment was dominated by cobble substrates in a step-pool setting. For these reasons, M03-T1.03 A was designated a subreach. Both segments contained channel restrictions in the form of culverts and bridges. The bridge in the lower segment had been recently replaced; alignment was good and sizing was roughly 75% of bankfull width .

Potential project identification – Reach M03-T1.03: Potential projects for this reach are concentrated on the lower segment. A river corridor protection strategy that would allow vegetation to re-establish boundary conditions that can create resistance to stream power, particularly in areas where buffers are inadequate, is highly recommended. Road encroachment was an issue in several areas of the reach (Fig. 28), and the reader is again referred to the general discussion of infrastructure protection and development of a stream corridor protection plan included in Section 7 – Recommendations within the main body of this Blood Brook Watershed Phase 2 report.

Figure 28. M03-T1.03A, similar to many of the reaches assessed in the Phase 2 study of the Blood Brook watershed, was characterized by human development and frequent road encroachment.

6.11 Charles Brown Brook – Reach M04-T2.01

M04-T2.01 is the most downstream section of Charles Brown Brook, beginning at its confluence with Blood Brook and continuing upstream to the dam below the Norwich Pool. This short reach drains 5.64 square miles. It is only 1,760 feet long, but was segmented into two subreaches of 1,042 and 718 feet because of reference stream type differences (Fig. 29). The segments also differed in corridor encroachment and grade control characteristics.

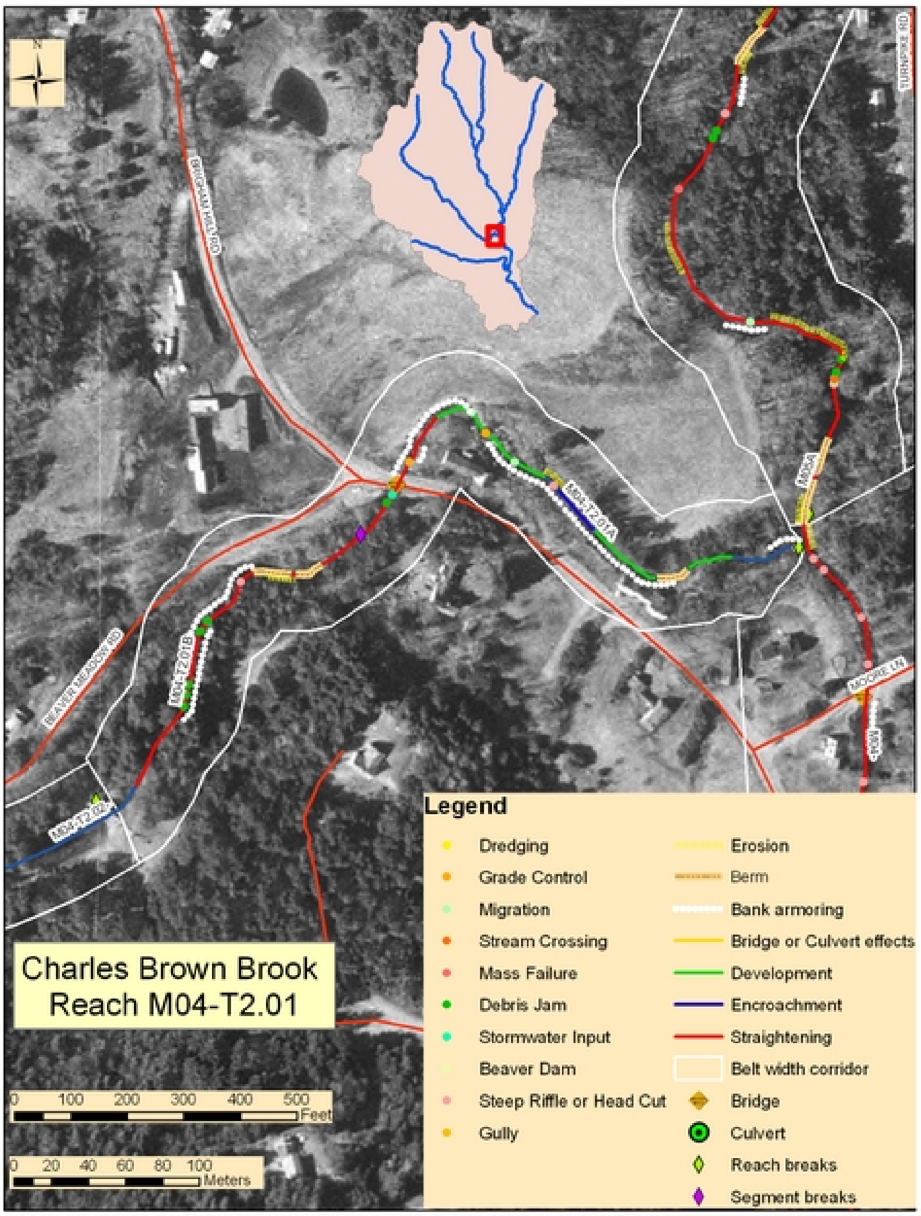

Figure 29. Reach map for Charles Brown Brook Reach M04-T2.01.

The lower subreach (M04-T2.01A) was characterized by somewhat extreme corridor encroachment and a dramatic waterfall grade control (Fig. 30). It was typed as a Rosgen Bc channel dominated by cobble substrates in a plane bed channel structure, in contrast to the preliminary Phase 1 B cobble step-pool typing. The waterfalls account for the large majority of elevation change in this segment, and the rest of the segment is a c subslope (<2 %). An old mill foundation and significant walling of the channel below this indicate that the artificial valley created by this confinement is of a long-standing historical nature, and the segment was designated a subreach with a modified Bc cobble riffle-pool reference type. The plane bed structure is related to adjustment processes in relation to bulldozing both above the waterfalls and below this segment (on the Blood Brook mainstem) following the 1973 flood.

The upper segment (M04-T2.01B) had better buffers, but evidenced road encroachment, store and release damming of the “Norwich Pool” upstream, lack of natural grade controls (Fig. 31). This segment was bulldozed following the 1973 flood (pers. comms., former selectboard member Linda Cook, August 2006 and Town Road Foreman Andy Hodgdon, December 2006). It was deemed a C channel dominated by cobble substrates, also in a plane bed channel structure. There was one bridge in this reach, located in the downstream segment.

Figure 30. Segment M04-T2.01A was marked by corridor encroachment and waterfall, ledge and bedrock grade control that contributes to limiting bed degradation.

Figure 31. Segment M04-T2.01B had better buffers but lacked the bedrock grade controls present downstream in this reach. The check dam in this photo may have been installed to limit upstream migration of headcuts and bed degradation.

6.12 New Boston Brook – Reach M05-T3.01

This reach extends from the confluence of New Boston Brook and Blood Brook and continues upstream to the top of what is known as the "crooked half mile" on New Boston Road (Fig. A-32). At the top of the reach, the landscape broadens into a wide valley. This reach drains 2.79 square miles, is 3302 feet in length, and was left unsegmented. It is characterized by a narrow valley, and the stream was moderately to severely encroached upon by New Boston Road. There were many road crossings within the reach, including one bridge and three culverts. They all represented some channel constriction. An old abutment within the reach was a significant channel constriction but not a floodprone constriction, as it would flood during major flood events.

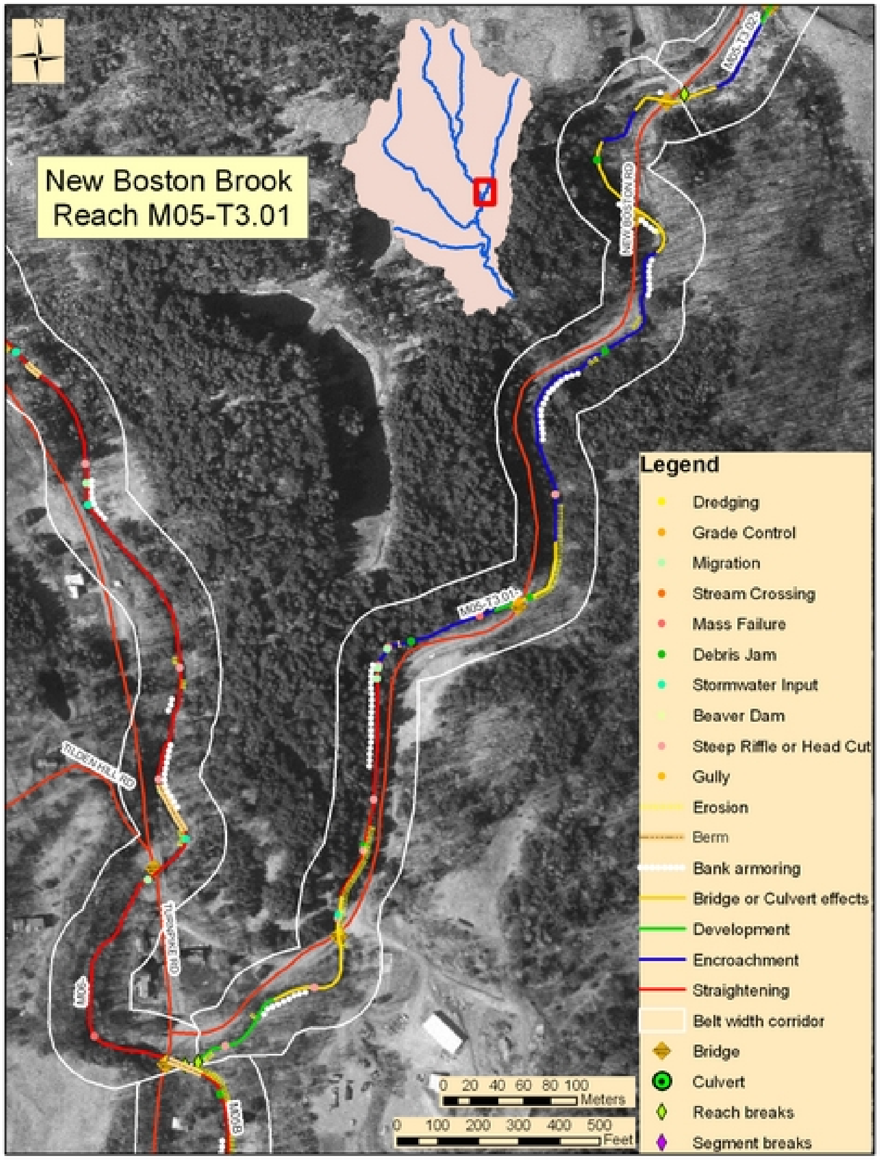

Figure 32. Reach M05-T3.01 is known locally as "the crooked half-mile".

Potential project identification – Reach M05-T3.01: General discussions of infrastructure protection and development of a stream corridor protection plan included in Section 7 – Recommendations within the main body of this Blood Brook Watershed Phase 2 report are highly relevant in this area. Flood prone height is above the grade of the road in many places within this reach. The valley has been somewhat broadened by road construction, a fact that might help alleviate some damage during flooding. At one midreach location, the stream takes a hard turn against the road bed and very large boulders had been installed to protect the road; the stream had eroded behind them. Numerous comments from local residents noted that due to high clay content of the banks in this area the reach has remained remarkably stable over time. The existence of a flood chute shortly upstream evidenced the resistance of those boundary materials, but highlights the potential for channel avulsions in less resistant areas of this narrow valley.

There was also a section of erosion just after the most downstream crossing of this reach on New Boston road where surface water runoff was causing bank erosion and a head cut was forming in the stream (Fig. 33). Attention to this surface water culvert might help arrest this headcut, which would help stream processes move toward equilibrium and minimize further adjustment processes upstream.

Figure 33. Norwich Conservation Commission volunteer Jonathan Frishtick extends a measuring rod near bank erosion located just above a headcut in the stream.

6.13. New Boston Brook - Reach M05-T3.02

Reach M05-T3.02 begins close to New Boston Rd. just upstream of a bridge near 177 and 190 New Boston Rds. and diverges from the road soon thereafter, extending along the bottom of a broad valley to the downstream end of an impoundment close to 688 New Boston Rd. (Fig. 34). This reach consists largely of shrub wetlands varying from 100-300 ft. in width and showed evidence of beaver activity; this activity presents challenges for maintenance of the bridge at the lower end of the reach in particular. Due to the extensive influence of the wetlands the reach was documented with photos but not further assessed.

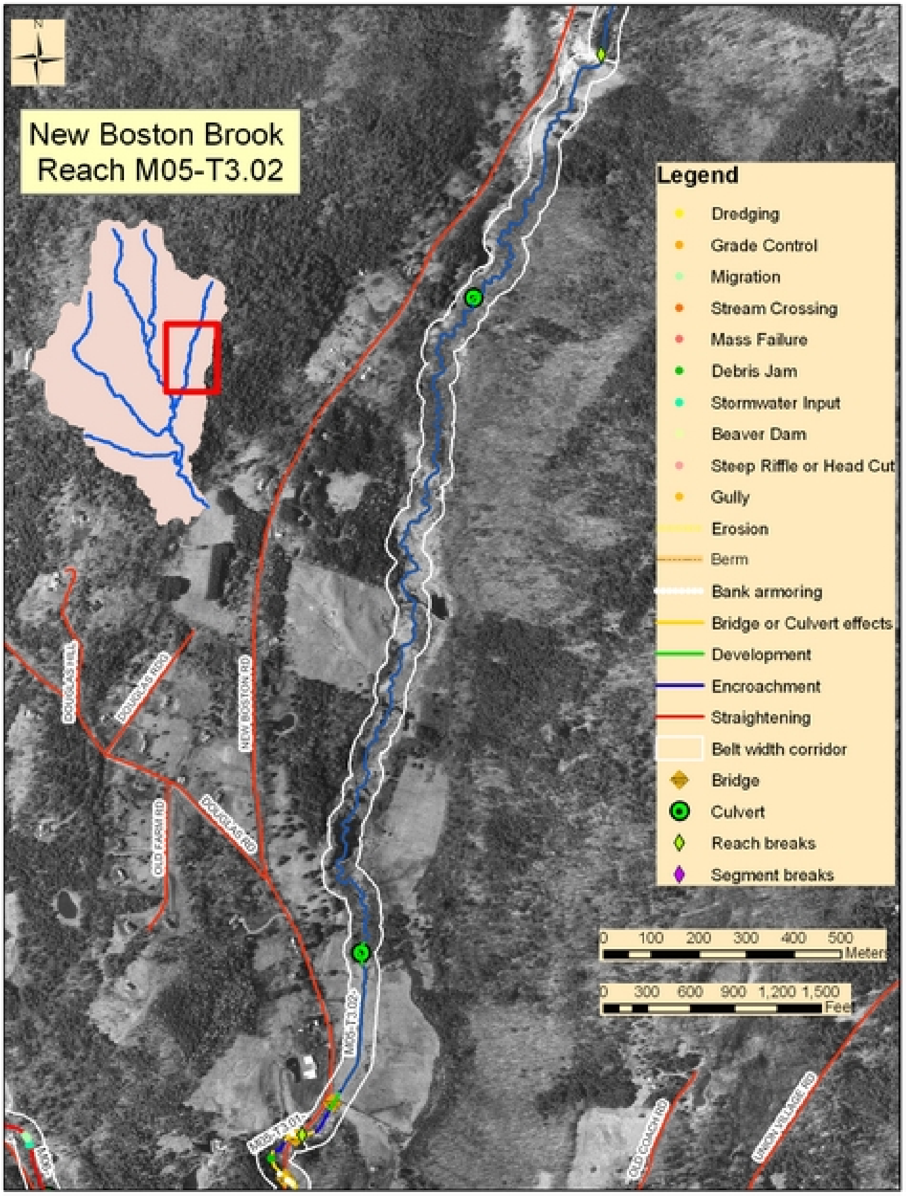

Figure 34. Reach M05-T3.02 on New Boston Brook.

6.14. New Boston Brook – Reach M05-T3.04

M05-T3.04 extends from the upstream end of an impoundment near 734 New Boston Rd. to just below Meetinghouse Rd.; it is a reach heavily influenced by four impoundments (Fig. 35). One of these is a beaver impoundment, and beavers remain active within the reach. The other three are constructs that appear to be largely human-maintained at this point but may have capitalized on previous beaver efforts, as the reach is located in a broad valley with extensive wetlands. Due to the influence of these impoundments and wetlands, the reach was mapped and documented with photographs but not further assessed.

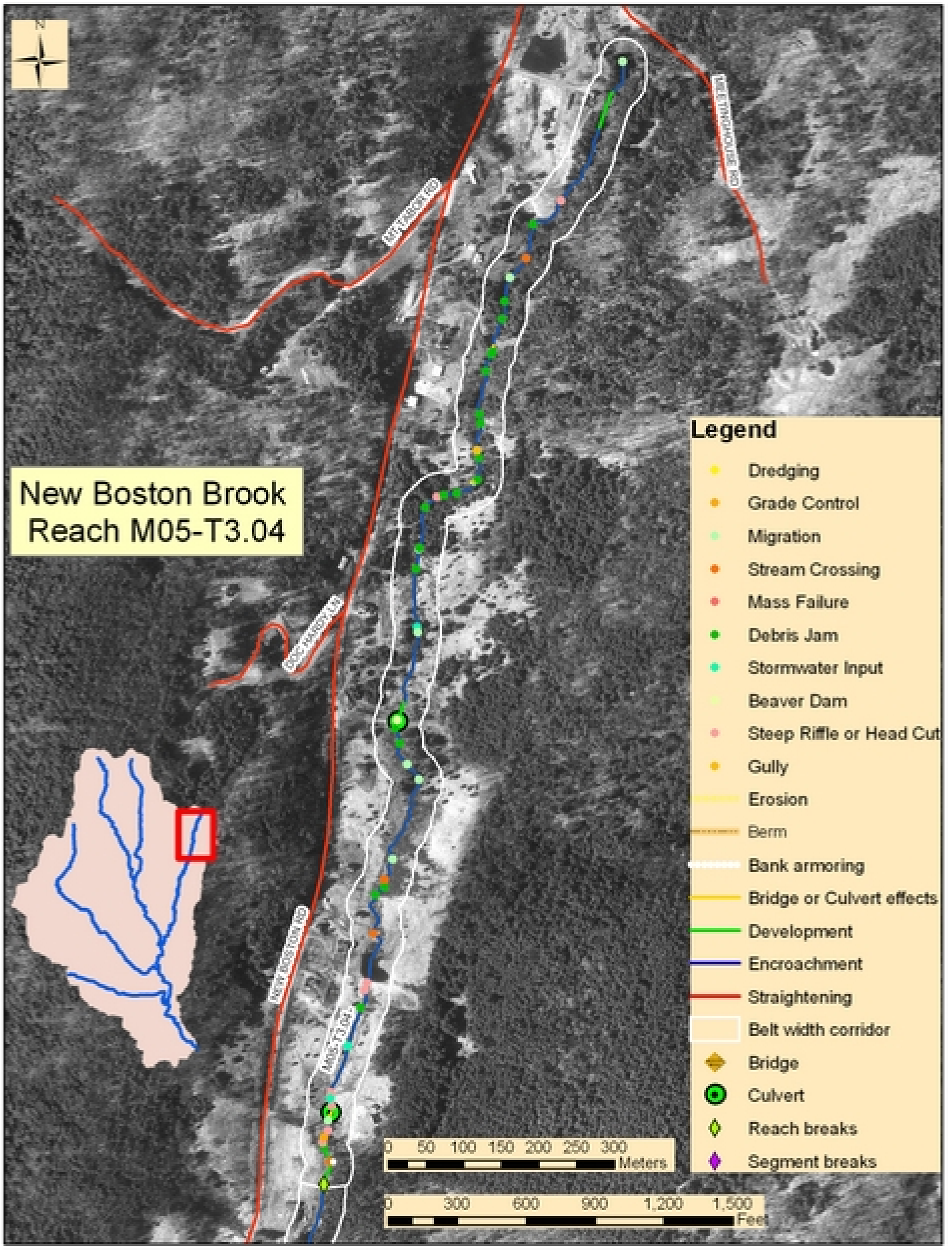

Figure 35. Reach M05-T3.04, like much of New Boston Brook, has extensive areas of shrub wetlands and numerous impoundments maintained by both humans and beavers.

It should be noted that there is extensive development throughout the New Boston Brook valley located, for the most part, well above the stream. Several stormwater outlets were noted above highly erodible soils (Fig. 36). Three culverts under driveways and roads were also documented in this reach, one of which was under a logging road (well away from the main road) and had not been previously identified during the Bridge and Culvert

Assessment performed by TRORC. All of these structures presented channel constrictions and geomorphic incompatibilities evidenced by sedimentation and scouring. The broad valley and extensive wetlands surrounding the stream would mean that primary damage in high water flows would be to the immediate area surrounding these structures, with impacts to the stream related to the extent of adjustment responses.

Figure 36. Highly erodible soils on sideslopes above Reach M05-T3.04, like many sedimentary deposits in the Blood Brook watershed, are sensitive to increased stormwater inputs.

7.0 BRIDGES AND CULVERTS

The Bridge and Culvert Assessment conducted by TRORC personnel assessed 43 structures (16 bridges, 27 culverts, and 2 arches) within the Blood Brook Watershed using VTANR protocols (VTANR 2006, Appendix G). Thirty-eight of those structures were located in reaches included in the Phase 2 study, as well as 2 additional culverts on Blood Brook and 4 culverts on New Boston Brook not assessed in the TRORC study.

Results of the Bridge and Culvert Assessment conducted by TRORC indicated that 40 of 43 structures were flagged in the VT ANR SGA database Failure Modes Report for geomorphic incompatibility that might indicate potential for failure due to deposition, scour, or alignment problems in relationship to the stream (TRORC 2006; (https://anrnode.anr.state.vt.us/ssl/sga/security/frmLogin.cfm; after login, datasets/structures/Upper Connecticut/Blood Brook/reports). All 38 of the structures in the Phase 2 reaches were included in that list of 40 flagged structures, and were reconfirmed by Redstart as showing geomorphic incompatibility evidenced by at least one of these indicators. The four culverts in Reach M05-T3.04 were also undersized and flagged for potential failure. These structures were far from town roads and in an area of extensive wetlands, however, and the primary threat would be to the private roads over these structures, with impacts to the stream tied to the extent of these changes. Some consideration, however, should be given to the potential downstream impacts of concurrent multiple failures of the impoundments in this reach at higher stage flows.

The Blood Brook Phase 1 report from TRORC (TRORC 2006) proposed a classification scheme to help Norwich prioritize Town-maintained structures for replacement. Using bankfull width measurements from the Bridge and Culvert Assessment, that scheme used the bridge span or culvert width expressed as a percentage of the stream bankfull width as a useful metric to help prioritization. Eight town-maintained structures were identified with structure widths of less than 50% of bankfull width. These were divided into Category I structures with highest priority for replacement (structure width <40% of channel width) and Category II structures (structure width 40-49% of channel width). Category II structures, while lower priority for replacement, still present significant potential geomorphic conflicts, particularly in terms of being able to transport sediment in addition to water at high flows.

Based on TRORC measurements of bankfull widths, the eight town-maintained structures (all culverts) prioritized were split into three Category I and five Category II structures. Two of these culverts (both Category I) were on reaches not assessed in Phase 2. Phase 2 indicated that just 3 structures that were assessed, all recent replacements, were sized at bankfull width or above, clarifying both the need to address channel constrictions and the utility of a prioritization method. In addition, Phase 2 channel dimension measurements were quite high in several reaches, and with a concentration of structures in those reaches, 14 town-maintained structures (12 culverts and 2 bridges) would be identified with a width of less than 50% of the reported bankfull width in the Phase 2 assessment. Using the TRORC suggested guidelines, 8 culverts would be classed as Category I; 2 bridges and 4 other culverts would fall into Category II (Table 5).

There is a high density of culverts and bridges in the Bragg Brook and upper Blood Brook mainstem reaches in particular, along with the occurrence of active channel adjustment processes. In addition to the town-maintained structures discussed above, it should be noted that there were nine private culverts in these same segments (two - a failed structure and its replacement that was still under construction - were not assessed in either the Bridge and Culvert Assessment or Phase 2 due to the construction).

Norwich Road Foreman Andy Hodgdon indicated in December of 2006 that, in fact, the structures along Bragg Brook have been a primary focus for Town construction and replacement projects over the last several years. The most recent installation on Bragg Brook was a stepped box culvert that measured 115% of the predicted Phase 1 bankfull width and 120% of the Phase 2 field-measured bankfull width. If adequate funding is found to replace cribbing on Bragg Brook segment M03-T1.02B in conjunction with scheduled culvert replacements, structural projects along Turnpike Rd (Blood Brook mainstem) move toward the top of the list of priorities.

Norwich has developed a culvert and bridge inventory designed to be updated every four years to assist in maintenance and prioritization efforts (Pers. comm., Andy Hodgdon, Dec. 2006). Recommendations for adequate sizing of structures, ideally at 120 – 150% of bankfull width to accommodate both water and sediment transport at higher stage flows, are currently in preparation by the VT ANR (Pers. comm., Kari Dolan, VT ANR River scientist, Feb. 2006). These guidelines will also contain recommendations for providing adequate passage for aquatic organisms, such as at-grade and open-bottom installation designs. Recent installations surveyed in Phase 2 in Norwich have used such designs, and several retrofits on older structures designed in conjunction with Vermont Fish & Wildlife biologists were noted in Phase 2 reaches. With channel constrictions at stream crossings representing a predominant issue in the Blood Brook watershed, recommendations are made to encourage continued support of such efforts at a town level, as well as to encourage private installations to address channel constriction issues (with similar sizing guidelines) in particular.

Table 5. Phase 2 assessment of Norwich town-maintained Category I and II bridges and culverts based on TRORC (2006) suggested replacement prioritization guidelines. All width measurements in ft.

Stream	Road	Structure	Type	Structure Width	TRORC B&C category	Predicted BKFW[1]	TRORC B&C %BKFW[2]	Phase 2 BKFW	Phase 2 %BKFW[3]	Phase 2 Segment ID
Category I (Phase 2 assessment)										
Blood	Turnpike	401411003814111	Culvert	5.5	II	16.2	42%	24.2	23%	M09A
Blood	Turnpike	401411003714111	Box Culvert Stepped	8.0	none	13.5	59%	24.2	33%	M09A
Blood	Turnpike	401411006714111	Squished Culvert	9.5	none	15.6	56%	24.2	39%	M09A
Blood	Turnpike	401411006814111	Squished Culvert	9.5	none	15.3	59%	24.2	39%	M09A
Bragg	Bragg Hill	401411001714111	Culvert	6.0	II	12.9	48%	25.2	24%	M03-T1.02B
Bragg	Bragg Hill	401411004814111	Culvert	6.0	II	13.5	40%	25.2	24%	M03-T1.02B
Bragg	Bragg Hill	100052000514111	Culvert	4.0	none	10.2	62%	13.3	30%	M03-T1.03A
Bragg	Bragg Hill	100052000614111	Culvert	4.0	I	10.4	38%	13.3	30%	M03-T1.03A
Category II (Phase 2 assessment)										
Blood	Upper Tpke	100019000114111	Squished Culvert	11.0	none	19.4	65%	25.6	43%	M08A
Blood	Turnpike	401411003214111	Bridge	11.4	none	19.2	67%	27.2	42%	M08B
Blood	Turnpike	401411001914111	Squished Culvert	9.6	none	15.8	61%	24.2	40%	M09A
New Boston	New Boston	401411000414111	Squished Culvert	10.0	II	20.6	49%	23.4	43%	M05-T3.01
New Boston	New Boston	401411000614111	Box Culvert	10.0	II	20.4	49%	23.4	43%	M05-T3.01
New Boston	New Boston	401411005014111	Bridge	11.0	none	20.4	69%	23.4	47%	M05-T3.01
Not assessed in Phase 2										
Needham	Upper Tpke	401411001414111	Culvert	6.0	I	17.2	35%	na		
Needham	Needham	401411003614111	Culvert	4.5	I	16.8	27%	na		

[1]Bankfull channel width predicted from Regional Hydraulic Geometry Curves (VTANR 2006, Appendix J), which are based on reference stream type and contributing watershed area
[2]Structure width as percent of bankfull width from TRORC Bridge and Culvert (B&C) Assessment. Per ANR protocols, bankfull width was field measured for stream types not well represented by the Regional Hydraulic Geometry Curves
[3]Structure width as percent of bankfull width from Phase 2, in which bankfull width was field measured at representative cross sections

8.0 RECOMMENDATIONS

- Current adjustment processes in much of the watershed include channel widening, lateral migration, and planform adjustment. Thus, Redstart highly recommends the development of a Stream Corridor Management Plan as a starting point. This plan can be used to identify protection and restoration projects, including opportunities to protect the river corridor, restore buffers, arrest headcuts, and restore floodplain access as a means to dissipating stream velocity and power. Through this planning process, the Norwich Conservation and Planning Commissions can also identify willing landowners and potential partners (such as the Upper Valley Land Trust) to develop this plan. The Norwich Conservation and Planning Commissions, in conjunction with their partners at TRORC, could support the development of this river corridor protection strategy by applying for funding from the Vermont Department of Environmental Conservation's River Management Program.

- A Stream Corridor Management Plan should incorporate an analysis of potential erosion hazards caused by stream instability and consider development planning in these areas to prevent further encroachment that would lead to future conflicts and economic losses from flood damages. A "belt-width corridor" of roughly three times the bankfull width, on either side of the stream (total belt-width equal to six times the bankfull width) is recommended as the basis for this planning. The width of this corridor is based on over 30 years of research and data collected from hundreds of streams around the world, and approximates the extent of lateral adjustments likely to occur over time in a meandering stream type (VTANR 2006c, Appendix H). "Human investments within the belt width inevitably result in structural constraints placed on the channel adjustment process to protect those investments and address associated threats to public safety. These threats will be largely avoided by recognizing the hazards created by development, incompatible with channel adjustments, within the critical belt width" (VTANR 2006b, p.17).

- In many areas of the Blood Brook watershed included in the Phase 2 assessment, road and development encroachment and channel constrictions (associated with culvert installations in particular) are a common issue. With channel evolution processes moving toward Stage III in many reaches, lateral migration and erosion are likely to continue, aggravating problems with road undercutting and bank instability. In fact, these processes may increasingly occur at elevated levels as incision continues in many of the reaches and the velocity and erosive power of these streams are increased due to increasing containment of higher stages of stream flow within the channel. Traditional methods of riprap and berms, while appearing to offer a temporary solution in the immediate area of problem spots, frequently transfer problems up or downstream without addressing the underlying stressors and providing opportunities for the stream to move toward equilibrium. These practices can further increase stream velocity and power, and careful consideration needs to be given to the overall processes of channel evolution within the watershed. Depending on the site of installation, hard armoring of banks may aggravate downcutting processes, undermining these installations, and/or may be prone to failure and contribute to propagation of adjustment processes up or downstream. Norwich Road Foreman Andy Hodgdon has been working with innovative methods employing heavy rubber linings behind such installations to address erosion and structural limitations, but this will require greater attention on a town-wide basis to identifying areas where the stream can diffuse the energy contained by protecting critical infrastructure. Hence:

- General recommendations concerning encroachment and infrastructure would include: a) identifying where incision processes can be addressed by identifying and arresting headcuts; b) identifying areas to restore floodplain access; c) identifying opportunities to replace channel constrictions; d) identifying opportunities to prevent further encroachment; e) considering site-specific application of active channel management to treat erosion caused by incision at or near road and bridge infrastructure; and f) considering moving infrastructure away from waterways in the future when opportunities arise.

- In many sections of the Blood Brook watershed the streams have lost access to portions of their floodplain through incision. Restoring floodplains and vegetative buffers to help prevent erosion should be priorities in restoration planning and design work, and the best opportunities for this work in the Blood Brook watershed generally exist in unconfined, C type streams. Possibilities for floodplain restoration through berm removal, with minimal impacts on agricultural or developed lands, exist in segments M03-T1.01 (downstream end of Bragg Brook), M05A above the confluence with Charles Brown Brook, and M07B.

- Stream crossings are a frequent issue in Norwich. The Town of Norwich should continue to support the efforts of the road crew in efforts to install culverts adequately sized to transport sediment in addition to water at high flows, with installations designed to accommodate aquatic organism passage, and encourage landowners to do the same for privately installed culverts. Research has indicated that a structure width of 1.2 to 1.5 times the bankfull width of the stream is required to adequately accommodate both sediment and water transfer.

- Soils within the Blood Brook watershed are frequently highly erodible sedimentary deposits. Increasing development in some of the more rural areas will likely increase the extent of impervious surfaces such as roads, driveways, and parking areas, and increase the number of focused stormwater inputs. Careful attention should be given to stormwater management practices including directing these concentrated flows properly into vegetation to reduce erosion and sedimentation.

LITERATURE CITED

NCC 2004. Open Space Priorities Informal Plan. Norwich Conservation Commission and Norwich Special Places.
http://www.taedge.com/norwich/NorwichConservationCommission/OPEN%20SPACE%20PRIORITIES.final.pdf
http://www.taedge.com/norwich/NorwichConservationCommission/OPEN%20SPACE%20PRIORITIES.final.2.pdf

Schumm, S.A. 1977. The fluvial system. John Wiley and Sons, New York.

Schumm, S.A. 1984. Incised Channels: Morphology, Dynamics and Control. Water Resources Publication (ISBN-0918334-53-5), Littleton, CO.

TRORC 2006. Blood Brook Watershed Phase 1 Final Report, Two Rivers Ottauquechee Regional Commission, Woodstock VT.

VTANR 2006a. Vermont Agency of Natural Resources Protocol Handbooks. Vermont Agency of Natural Resources.
http://www.anr.state.vt.us/dec/waterq/rivers/htm/rv_geoassesspro.htm

VTANR 2006b. Vermont Stream Geomorphic Assessment Phase 2 Handbook: Field Protocols. Vermont Stream Geomorphic Assessment Protocol Handbooks. Vermont Agency of Natural Resources, Waterbury, VT, 83 pp. plus Appendices
http://www.anr.state.vt.us/dec/waterq/rivers/docs/assessmenthandbooks/rv_weblinkpgphase2.pdf

VTANR 2006c. Vermont Stream Geomorphic Assessment Handbook Appendices. Vermont Stream Geomorphic Assessment Protocol Handbooks. Vermont Agency of Natural Resources, Waterbury, VT.
http://www.anr.state.vt.us/dec/waterq/rivers/docs/assessmenthandbooks/rv_weblinkpgappendixs.pdf

Appendix A. Photo log for Blood Brook Phase 2 study

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M03pics\	IMG_0137.JPG	M03	137	Downstream	Debris jam at debris catcher below Rte 5 S
BloodBrook\pix_bbw\M03pics\	IMG_0138.JPG	M03	138	Upstream	Upstream from debris catcher below Rte 5 S
BloodBrook\pix_bbw\M03pics\	IMG_0139.JPG	M03	139	Upstream	Beaver dam
BloodBrook\pix_bbw\M03pics\	IMG_0140.JPG	M03	140	Downstream	From vegetated point bar
BloodBrook\pix_bbw\M03pics\	IMG_0141.JPG	M03	141	Left Bank	From vegetated point bar
BloodBrook\pix_bbw\M03pics\	IMG_0142.JPG	M03	142	Upstream	From vegetated point bar
BloodBrook\pix_bbw\M03pics\	IMG_0143.JPG	M03	143	Downstream	Looking at left bank_debris jam
BloodBrook\pix_bbw\M03pics\	IMG_0144.JPG	M03	144	LB_Up	Steep riffle
BloodBrook\pix_bbw\M03pics\	IMG_0145.JPG	M03	145	Upstream	Upstream from steep riffle
BloodBrook\pix_bbw\M03pics\	IMG_0146.JPG	M03	146	Upstream	Flood chute above big dog leg
BloodBrook\pix_bbw\M03pics\	IMG_0147.JPG	M03	147	Downstream	Flood chute above big dog leg
BloodBrook\pix_bbw\M03pics\	IMG_0148.JPG	M03	148	Downstream	big point bar at field with erosion and LWD
BloodBrook\pix_bbw\M03pics\	IMG_0149.JPG	M03	149	Right bank	Field edge with steep bank erosion
BloodBrook\pix_bbw\M03pics\	IMG_0150.JPG	M03	150	Upstream	From field edge and point bar
BloodBrook\pix_bbw\M03pics\	IMG_0151.JPG	M03	151	Downstream	From steep riffle_trib on RB
BloodBrook\pix_bbw\M03pics\	IMG_0152.JPG	M03	152	Upstream	Steep riffle above trib
BloodBrook\pix_bbw\M03pics\	IMG_0153.JPG	M03	153	Upstream	Mid channel bar_flood chute
BloodBrook\pix_bbw\M03pics\	IMG_0154.JPG	M03	154	Downstream	Below Elm St falls at flood chute_on flood chute
BloodBrook\pix_bbw\M03pics\	IMG_0155.JPG	M03	155	Upstream	Below Elm St falls at flood chute_top of flood chute
BloodBrook\pix_bbw\M03pics\	IMG_0156.JPG	M03	156	Upstream	Directly below Elm St falls

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M03pics\	IMG_0157.JPG	M03	157	RB_down	New scour under cottonwood reported by resident
BloodBrook\pix_bbw\M03pics\	IMG_0158.JPG	M03	158	Downstream	Grade control mid channel
BloodBrook\pix_bbw\M03pics\	IMG_0159.JPG	M03	159	Upstream	Top of grade control at Elm St water level
BloodBrook\pix_bbw\M03pics\	IMG_0160.JPG	M03	160	Downstream	Bottom of grade control at Elm St water level
BloodBrook\pix_bbw\M03pics\	IMG_0161.JPG	M03	161	Upstream	Under Elm St bridge
BloodBrook\pix_bbw\M03pics\	IMG_0162.JPG	M03	162	Upstream	At 3rd grade control at Elm St
BloodBrook\pix_bbw\M03pics\	IMG_0163.JPG	M03	163	LB_Down	At 3rd grade control at Elm St
BloodBrook\pix_bbw\M03pics\	IMG_0164.JPG	M03	164	Downstream	At 3rd grade control at Elm St
BloodBrook\pix_bbw\M03pics\	IMG_0165.JPG	M03	165	Downstream	Below 4th grade control_long diagonal bar
BloodBrook\pix_bbw\M03pics\	IMG_0166.JPG	M03	166	LB_Down	At GC4
BloodBrook\pix_bbw\M03pics\	IMG_0167.JPG	M03	167	Upstream	Above GC4_side bar and bedrock channel
BloodBrook\pix_bbw\M03pics\	IMG_0168.JPG	M03	168	Right bank	old bank undercutting
BloodBrook\pix_bbw\M03pics\	IMG_0169.JPG	M03	169	Left Bank	old floodplain below fields
BloodBrook\pix_bbw\M03pics\	IMG_0170.JPG	M03	170	Downstream	Below fields at Hopson_abandoned floodplain area
BloodBrook\pix_bbw\M03pics\	IMG_0171.JPG	M03	171	Upstream	from just below fields
BloodBrook\pix_bbw\M03pics\	IMG_0172.JPG	M03	172	Upstream	Steep riffle by fields
BloodBrook\pix_bbw\M03pics\	IMG_0173.JPG	M03	173	Upstream	Steep riffle by Brookside Dr
BloodBrook\pix_bbw\M03pics\	IMG_0174.JPG	M03	174	Downstream	Steep riffle by Brookside Dr
BloodBrook\pix_bbw\M03pics\	IMG_0175.JPG	M03	175	Upstream	Steep riffle by Brookside Dr
BloodBrook\pix_bbw\M03pics\	IMG_0176.JPG	M03	176	Upstream	Below Hopson bridge ledge
BloodBrook\pix_bbw\M03pics\	IMG_0177.JPG	M03	177	Upstream	Below Hopson bridge ledge

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M03pics\	IMG_0178.JPG	M03	178	Downstream	0 height grade control just above Hopson bridge
BloodBrook\pix_bbw\M03pics\	IMG_0179.JPG	M03	179	Upstream	looking up at big GC above Hopson
BloodBrook\pix_bbw\M03pics\	IMG_0180.JPG	M03	180	Downstream	RB and pool below GC above Hopson
BloodBrook\pix_bbw\M03pics\	IMG_0181.JPG	M03	181	Right bank	at GC above Hopson (big)
BloodBrook\pix_bbw\M03pics\	IMG_0182.JPG	M03	182	Upstream	at GC above Hopson (big)
BloodBrook\pix_bbw\M03pics\	IMG_0183.JPG	M03	183	Upstream	at Xsect_flood chute or old channel
BloodBrook\pix_bbw\M03pics\	IMG_0184.JPG	M03	184	Downstream	at Xsect_flood chute or old channel
BloodBrook\pix_bbw\M03pics\	IMG_0185.JPG	M03	185	Left Bank	X section below Bragg above GC
BloodBrook\pix_bbw\M03pics\	IMG_0186.JPG	M03	186	Right bank	X section below Bragg above GC
BloodBrook\pix_bbw\M03pics\	IMG_0187.JPG	M03	187	Upstream	X section below Bragg above GC
BloodBrook\pix_bbw\M03pics\	IMG_0188.JPG	M03	188	Downstream	X section below Bragg above GC
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0001.JPG	M03	1	Downstream	X section above bend before Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0002.JPG	M03	2	Right bank	X section above bend before Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0003.JPG	M03	3	Upstream	X section above bend before Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0004.JPG	M03	4	Left Bank	X section above bend before Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0005.JPG	M03	5	Downstream	X section below Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0006.JPG	M03	6	Right bank	X section below Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0007.JPG	M03	7	Upstream	X section below Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0008.JPG	M03	8	Left Bank	X section below Elm St falls
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0009.JPG	M03	9	Downstream	X section_field edge just upstream of major

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
					dogleg
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0010.JPG	M03	10	Right bank	X section_field edge just upstream of major dogleg
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0011.JPG	M03	11	Upstream	X section_field edge just upstream of major dogleg
BloodBrook\pix_bbw\M03pics\2006_09_27_M03xsecs\	100_0012.JPG	M03	12	Left Bank	X section_field edge just upstream of major dogleg
BloodBrook\pix_bbw\M03pics\steepriffle_M03\	DSCN0074.JPG	M03	74	Downstream	steep riffle
BloodBrook\pix_bbw\M03pics\steepriffle_M03\	IMG_0172.JPG	M03	172	Upstream	steep riffle
BloodBrook\pix_bbw\M03pics\steepriffle_M03\	IMG_0174.JPG	M03	174	Downstream	steep riffle
BloodBrook\pix_bbw\M03pics\steepriffle_M03\	IMG_0175.JPG	M03	175	Upstream	steep riffle
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-086.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegA-berm-068.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegA-dwnst-079.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegA-planebed.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegA-RB-078.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segA-upst-080.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segB-070.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segB-071.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segB-bar-072.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegB-dwnst-084.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegB-GC-073.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segB-headcut-069.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segB-LB-081.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-segB-RB-082.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01-SegB-upst-083.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.01pics\	M03-T1.01SegA-LB-077.JPG	M03-T1.01			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-private culvert-100.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-SegA-092.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-DJ-091.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-SegA-DJ-096.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-dwnst-127.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-GC-089.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-GC-090.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-healingMF-095.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-LB-123.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-MF-gully-093.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-RB-0124.JPG	M03-T1.02			

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-samefromSWrunoff-094.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-upstr-0125.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-SegA-waterfall and SW-097.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segA-waterfall-098.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-erosion and till-099.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs1-dwnstr-133.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs1-LB-0129.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs1-LB-128.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs1-RB-131.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs1-upstr-0130.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs1-upstr-132.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs2-dwnst-137.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs2-LB-0134.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs2-RB-135.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.02pics\	M03-T1.02-segB-xs2-upst-136.JPG	M03-T1.02			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAlowersegroadencroach.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAnaturalvalley.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAprivateculvert.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAroadenchroachandSW.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segArockculvert.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAtribinput.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAupperseg.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs1dwnst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs1LB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs1RB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs1upst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs2dwnst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs2LB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs2RB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segAxs2upst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBaluvfan.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBavalley.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBbvalley.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBcascade.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBGC.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBprivateculvert.jpg	M03-T1.03			

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBrockwallfall.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBupsttrailencroach.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBwaterfallandsw.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs1dwnst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs1LB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs1RB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs1upst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs2LB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs2RB.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxs2upst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03segBxsect2dwnst.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03upperreachaluvfanarea.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03upperreachempound.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03upperreachheadcut.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03upperreachpond.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03upreachbetween empoundments.jpg	M03-T1.03			
BloodBrook\pix_bbw\M03-T1.03pics\	M03-T1.03upreachempound.jpg	M03-T1.03			
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0010.JPG	M04	10	Downstream	Ledge constriction_debris jam_2 point bars
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0011.JPG	M04	11	Upstream	Long rip-rap_development above_above ledge in 010
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0012.JPG	M04	12	Downstream	LWD_erosion
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0013.JPG	M04	13	Downstream	Upper section of erosion
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0014.JPG	M04	14	Downstream	5m rip-rap_erosion to big rip-rap
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0015.JPG	M04	15	Downstream	below Beaver Meadow bridge
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0016.JPG	M04	16	Upstream	below Beaver Meadow bridge
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0017.JPG	M04	17	Upstream	at steep riffle_barns by Assissi church
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0018.JPG	M04	18	Downstream	just bellow steep riffle in 017_side bar_widening
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0019.JPG	M04	19	Right bank	old backwater by Huntley St

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0020.JPG	M04	20	Left Bank	From flood chute area
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0021.JPG	M04	21	Left Bank	Flood chute UP
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0022.JPG	M04	22	Left Bank	Flood chute DOWN
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0023.JPG	M04	23	Left Bank	Flood chute DOWN
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0024.JPG	M04	24	Downstream	Start of Rec fields
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0025.JPG	M04	25	Left Bank	Erosion at rec fields_LB
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0026.JPG	M04	26	Downstream	Instream constructed meanders
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0027.JPG	M04	27	Downstream	Instream constructed meanders
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0028.JPG	M04	28	Downstream	Flood chute at rec fields
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0029.JPG	M04	29	Upstream	Flood chute at rec fields
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0030.JPG	M04	30	Upstream	Point bar_debris jam
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0031.JPG	M04	31	Downstream	Point bar_debris jam
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0032.JPG	M04	32	Downstream	Mid channel bar_flood chute
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0033.JPG	M04	33	Upstream	Point bar and erosion by VFW
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0034.JPG	M04	34	Downstream	Point bar at tennis courts
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0035.JPG	M04	35	Upstream	Point bar and erosion at tennis courts
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0036.JPG	M04	36	Downstream	at footbridge
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0037.JPG	M04	37	Upstream	at fotbridge_steep riffle
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0038.JPG	M04	38	Upstream	old channel below Moore Ln bridge
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0039.JPG	M04	39	Downstream	old channel below Moore Ln bridge
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0040.JPG	M04	40	Left Bank	old channel below Moore Ln bridge
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0041.JPG	M04	41	Upstream	Confluence of Charles Brown and Blood_Blood
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0042.JPG	M04	42	Upstream	Confluence of Charles Brown and Blood_Charles Brown
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0043.JPG	M04	43	Downstream	Confluence of Charles

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
					Brown and Blood_Charles Brown
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0044.JPG	M04	44	Downstream	bottom end Old flood chute that starts on M05_plugged
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0045.JPG	M04	45	Upstream	Old flood chute
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0046.JPG	M04	46	Upstream	Berm at head of flood chute
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0047.JPG	M04	47	Downstream	Berm at head of flood chute
BloodBrook\pix_bbw\M04pics\2006_09_21_M04\	100_0048.JPG	M04	48	Downstream	Berm along top of reach M04
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0011.JPG	M04-T2.01	11	Upstream	Head cut and trib rejuv_mouth of Charles Brown Brook
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0012.JPG	M04-T2.01	12	Upstream	House encroachment RB
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0013.JPG	M04-T2.01	13	Upstream	House encroachment RB
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0014.JPG	M04-T2.01	14	Right bank	Riprap above house
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0015.JPG	M04-T2.01	15	Left Bank	Lodgement till
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0016.JPG	M04-T2.01	16	Right bank	Old foundation_may be mill
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0017.JPG	M04-T2.01	17	Upstream	Waterfall_grade control
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0018.JPG	M04-T2.01	18	Upstream	Height at grade control 12.2 ft_length 72 ft
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0019.JPG	M04-T2.01	19	Upstream	RB house near falls
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0020.JPG	M04-T2.01	20		Deleted
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0021.JPG	M04-T2.01	21	Upstream	Debris jam just below bridge
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0006.JPG	M04-T2.01	6	Left Bank	X section M04-T2.01B1
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0007.JPG	M04-T2.01	7	Right bank	X section M04-T2.01B1
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0008.JPG	M04-T2.01	8	Upstream	X section M04-T2.01B1

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M04-T2.01pics\2006_09_19_M04-T2.01\	100_0009.JPG	M04-T2.01	9	Downstream	X section M04-T2.01B1
BloodBrook\pix_bbw\M04-T2.01pics\M04-T2.01\	M04-T2.01 downstream xsect-DS 005.jpg	M04-T2.01	5	Downstream	X section M04-T2.01A1
BloodBrook\pix_bbw\M04-T2.01pics\M04-T2.01\	M04-T2.01 downstream xsect-LB 001.jpg	M04-T2.01	1	Left Bank	X section M04-T2.01A1
BloodBrook\pix_bbw\M04-T2.01pics\M04-T2.01\	M04-T2.01 downstream xsect-RB 002.jpg	M04-T2.01	2	Right bank	X section M04-T2.01A1
BloodBrook\pix_bbw\M04-T2.01pics\M04-T2.01\	M04-T2.01 downstream xsect-US 004.jpg	M04-T2.01	4	Upstream	X section M04-T2.01A1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0001.JPG	M05	091106_01	Upstream	Buckthorn foreground_sidebar and debris jam background
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0002.JPG	M05	091106_02	Upstream	rip-rap RB_sidebar LB
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0003.JPG	M05	091106_03	Right bank	Ben at mass failure
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0004.JPG	M05	091106_04	Right bank	Jap knotweed
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0005.JPG	M05	091106_05	Right bank	Jap knotweed
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0006.JPG	M05	091106_06	Right bank	Tii at second mass failure
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0007.JPG	M05	091106_07	Left Bank	knotweed_rudi_berm
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0008.JPG	M05	091106_08	Left Bank	riprap left_rudi_bridge behind_sidebar on right
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0009.JPG	M05	091106_09	Left Bank	culvert from pond overflow
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0010.JPG	M05	091106_10	Right bank	house and bars
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0011.JPG	M05	091106_11	Left Bank	erosion on bank
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0012.JPG	M05	091306_12	Upstream	Riprap and exposed lodgment till
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0013.JPG	M05	091306_13	Left Bank	Erosion
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0014.JPG	M05	091306_14	Upstream	X section B2
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0015.JPG	M05	091306_15	Downstream	X section B2
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0016.JPG	M05	091306_16	Left Bank	X section B2
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0017.JPG	M05	091306_17	Right bank	X section B2
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0001.JPG	M05	091806_01	Upstream	Headcut and exposed lodgement till just upstream of New Boston_Sun Lion bridge
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0002.JPG	M05	091806_02	Upstream	Headcut and exposed

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
					lodgement till just upstream of New Boston_Sun Lion bridge
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0003.JPG	M05	091806_03	Left Bank	X section B1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0004.JPG	M05	091806_04	Right bank	X section B1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0005.JPG	M05	091806_05	Upstream	X section B1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0006.JPG	M05	091806_06	Downstream	X section B1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0007.JPG	M05	091906_07	Right bank	X section A1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0008.JPG	M05	091906_08	Left Bank	X section A1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0009.JPG	M05	091906_09	Downstream	X section A1
BloodBrook\pix_bbw\M05pics\2006_09_11_M05\	100_0010.JPG	M05	091906_10	Upstream	X section A1
BloodBrook\pix_bbw\M05pics\2006_09_20_M05Axsec3\	100_0001.JPG	M05	092006_01	Left Bank	X section A3
BloodBrook\pix_bbw\M05pics\2006_09_20_M05Axsec3\	100_0002.JPG	M05	092006_02	Right bank	X section A3
BloodBrook\pix_bbw\M05pics\2006_09_20_M05Axsec3\	100_0003.JPG	M05	092006_03	Upstream	X section A3
BloodBrook\pix_bbw\M05pics\2006_09_20_M05Axsec3\	100_0004.JPG	M05	092006_04	Downstream	X section A3
BloodBrook\pix_bbw\M05pics\2006_09_20_M05Axsec3\	100_0005.JPG	M05	092006_05	Left Bank	second shot of LB at X section A3
BloodBrook\pix_bbw\M05-T3.01pics\	Erosion from SWinput 010.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	Headcut and Till 007.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	Headcut and till 008.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	log grade control 013.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	old bridge abuttment 012.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	riprap and roadFPH 011.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	riprapandroadencroach 006.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.01pics\	StreamsEarlyandSladeBrookPicture 014.jpg	M05-T3.01			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02beginwetland.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02channelinwetland.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02lowermidreachdwnstream.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02lowermidreachupstream.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02lowerreach.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02uppermidreachdownstream.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02uppermidreachupstream.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02upperreachaccessrdthruwetland.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.02pics\	M05-T3.02upperreachculvertinwetland.jpg	M05-T3.02			
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0066.JPG	M05-T3.04	66	Downstream	Impoundment below reach break

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0067.JPG	M05-T3.04	67	Downstream	Impoundment below reach break
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0068.JPG	M05-T3.04	68	Right bank	Equipment rd and pipe for new house near reach break
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0069.JPG	M05-T3.04	69	Right bank	Equipment rd and pipe below new foundation near reach break
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0070.JPG	M05-T3.04	70	Upstream	Footbridge_debris jam near new foundation
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0071.JPG	M05-T3.04	71	Left Bank	Small instream dam
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0072.JPG	M05-T3.04	72	Upstream	small instream dam_breached_above debris jam and below culvert (background)
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0073.JPG	M05-T3.04	73	Upstream	4.7 ft culvert with deposition below
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0074.JPG	M05-T3.04	74	Downstream	4.7 ft culvert with scour pool above
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0075.JPG	M05-T3.04	75	Upstream	willow jam_riffle common in segment
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0076.JPG	M05-T3.04	76	Downstream	narrow channel regularly spills into broader wetland_willow snags only bed feature other than silted planebed
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0077.JPG	M05-T3.04	77	Upstream	debris jam_channel spanning woven wire fence
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0078.JPG	M05-T3.04	78	Upstream	Midchannel bar marks downstream end of impoundment influence
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0079.JPG	M05-T3.04	79	Upstream	Impoundment
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0080.JPG	M05-T3.04	80	Right bank	Impoundment
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0081.JPG	M05-T3.04	81	Upstream	Above impoundment
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-	100_0082.JPG	M05-T3.04	82	Downstream	end of willow

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
T3.04\					wetland_dogleg before entry to impoundment
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0083.JPG	M05-T3.04	83	Right bank	Stone-filled ford to access hayfield
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0084.JPG	M05-T3.04	84	Upstream	Debris jam_woven wire fence
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0085.JPG	M05-T3.04	85	Left Bank	Stream ford out of cut willows
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0086.JPG	M05-T3.04	86	Upstream	At least 3 channels in this section_braided
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0087.JPG	M05-T3.04	87	Upstream	At least 3 channels in this section_braided
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0088.JPG	M05-T3.04	88	Upstream	Downstreamend of channel still persisting from culvert influence
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0089.JPG	M05-T3.04	89	Upstream	Culvert (background) discharge rapidly braided partly due to CWD
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0090.JPG	M05-T3.04	90	Right bank	Debris jam below culvert
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0091.JPG	M05-T3.04	91	Upstream	Debris jam removed_screen installed to discourage beavers
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0092.JPG	M05-T3.04	92	Upstream	channel is loosely defined in this section
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0093.JPG	M05-T3.04	93	Upstream	Debris jam 11_channel is defined again for a while upstream of here
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0094.JPG	M05-T3.04	94	Right bank	Tributary rejuvenation
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0095.JPG	M05-T3.04	95	Left Bank	Downcutting in woods may be from stormwater input_headcut in stream at base
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0096.JPG	M05-T3.04	96	Upstream	culvert_logging access_probably not IDed in TRORC assessment
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-	100_0097.JPG	M05-T3.04	97	Downstream	rudi foot on down end

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
T3.04\					of culvert
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0098.JPG	M05-T3.04	98	Downstream	rudi foot on down end of culvert
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0099.JPG	M05-T3.04	99	Downstream	Logging culvert upstream end
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	100_0100.JPG	M05-T3.04	100	Upstream	May be old foundation of some sort
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	101_0101.JPG	M05-T3.04	101	Upstream	Footbridge_debris jam near new foundation
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	101_0102.JPG	M05-T3.04	102	Upstream	Old truck body in stream
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	101_0103.JPG	M05-T3.04	103	Upstream	Down end of culvert_stream braids immediately
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	101_0104.JPG	M05-T3.04	104	Upstream	Impoundment above 1.7 ft culvert
BloodBrook\pix_bbw\M05-T3.04pics\2006_11_01_M05-T3.04\	101_0105.JPG	M05-T3.04	105	Right bank	Stormwater input or trib below Doc Hardy Rd_crosses under New Boston and daylights to hillside above stream
BloodBrook\pix_bbw\M06pics\	M06-downstreamxsect-downstream.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-downstreamxsect-LB.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-downstreamxsect-RB.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-downstreamxsect-upstream.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-Jap Knotweed.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-ledgesGC.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-massfailure.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-newbridgeabutt.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-newdredgestraighten.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-old massfailure.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-oldbridge.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-Planebed.JPG	M06			
BloodBrook\pix_bbw\M06pics\	M06-ripraptoosmall.JPG	M06			
BloodBrook\pix_bbw\M07pics\	M07-segA-exposed till-0139.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segA-headcut-140.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segA-headcut-141.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segA-headcut-development-144.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segA-MF-erosion-138.JPG	M07			

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M07pics\	M07-segA-privatebridge-143.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segA-undercutbank-till-142.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segB-erosion-147.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07-segB-tribrejuv-146.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07heron.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07where.jpg	M07			
BloodBrook\pix_bbw\M07pics\	withPete 005.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-dwnstrxsLB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-dwnstrxsRB.JPG	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-dwnstrxsUPSTR.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-dwnstrxsDWNSTR.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-upstrxsLB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-upstrxsRB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-upstrxsUPSTR.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segA-upstrxsDWNSTR.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segB-dwnstrxsLB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segB-dwnstrxsRB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segB-dwnstrxsUPSTR.jpg	M07			
BloodBrook\pix_bbw\M07pics\	M07segB-dwnstrxsDWNSTR.jpg	M07			
BloodBrook\pix_bbw\M07pics\	withPete 020M07segBupstxsLB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	withPete 021M07segBupstrxsRB.jpg	M07			
BloodBrook\pix_bbw\M07pics\	withPete 022M07segBupstrxsupstr.jpg	M07			
BloodBrook\pix_bbw\M07pics\	withPete 023M07segBupstrxsdwnstr.jpg	M07			
BloodBrook\pix_bbw\M08pics\	IMG_0200.jpg	M08	200	Downstream	culvert down in bed_stream dropping sediment above
BloodBrook\pix_bbw\M08pics\	IMG_0202.jpg	M08	202	Left Bank	stormwater input
BloodBrook\pix_bbw\M08pics\	IMG_0203.jpg	M08	203	Upstream	second culvert_pool steep riffle and deposition above
BloodBrook\pix_bbw\M08pics\	IMG_0204.jpg	M08	204	Upstream	scour and pool below culvert
BloodBrook\pix_bbw\M08pics\	IMG_0205.jpg	M08	205	Right bank	bridge abutment depostion and rudi
BloodBrook\pix_bbw\M08pics\	IMG_0206.jpg	M08	206	Left Bank	stormwater input_delta bar at head cut_rudi
BloodBrook\pix_bbw\M08pics\	IMG_0207.jpg	M08	207	Left Bank	flood chute just below culvert to Old Orchard Ln_sealed by berm
BloodBrook\pix_bbw\M08pics\	IMG_0208.jpg	M08	208	Upstream	DEEP pool and scour below_berm on right

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
					seals flood chute
BloodBrook\pix_bbw\M08pics\	IMG_0209.jpg	M08	209	Downstream	front top of flood chute looking down
BloodBrook\pix_bbw\M08pics\	IMG_0210.jpg	M08	210	Downstream	X section M08A1
BloodBrook\pix_bbw\M08pics\	IMG_0211.jpg	M08	211	Right bank	X section M08A1
BloodBrook\pix_bbw\M08pics\	IMG_0212.jpg	M08	212	Upstream	X section M08A1
BloodBrook\pix_bbw\M08pics\	IMG_0213.jpg	M08	213	Left Bank	X section M08A1
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0013.JPG	M08	13	Downstream	Tributary rejuvenation just beyond lower end of M08 in Reach M07
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0014.JPG	M08	14	Upstream	Tributary rejuvenation just beyond lower end of M08 in Reach M08
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0015.JPG	M08	15	Upstream	Scour RB and diagonal bar LB in bridge at Upper Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0016.JPG	M08	16	Downstream	Scour LB and deposition above bridge at Upper Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0017.JPG	M08	17	Right bank	stormwater input and scour pool from under Tpke Rd above Upper Tpke bridge
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0018.JPG	M08	18	Upstream	stormwater input from under Tpke Rd above Upper Tpke bridge
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0019.JPG	M08	19	Upstream	check dam with scour pool below_ above Upper Tpke bridge
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0020.JPG	M08	20	Right bank	Erosion E1 6 ft tall undercutting Tpke Rd
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0021.JPG	M08	21	Right bank	Erosion E1 6 ft tall undercutting Tpke Rd
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0022.JPG	M08	22	Left Bank	Mass failure_rod extended to 13 ft_hairpin turn in stream
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0023.JPG	M08	23	Downstream	brush revetment just above mass failure
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0024.JPG	M08	24	Upstream	vegetated midchannel bar downstream of

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
					Tpke Rd bridge at 914 Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0025.JPG	M08	25	Upstream	Sidebar below Tpke Rd bridge at 914 Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0026.JPG	M08	26	Upstream	stormwater input lower left and scour pool and exposed footings in Tpke Rd bridge at 914 Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0027.JPG	M08	27	Upstream	eroding footings in Tpke Rd bridge at 914 Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0028.JPG	M08	28	Upstream	eroding footings in Tpke Rd bridge at 914 Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0029.JPG	M08	29	Downstream	angle of entry Tpke Rd bridge at 914 Tpke
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0030.JPG	M08	30	Upstream	debris jam and deposition above streamside house_midchannel bar below with pool
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0031.JPG	M08	31	Downstream	debris jam and deposition above streamside house_midchannel bar below with pool
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0032.JPG	M08	32	Upstream	delta bar at inlet of trib or combined seeps coming from recently logged terrace_no obvious source aboveground
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0033.JPG	M08	33	Right bank	Trib rejuvenation above Needham Rd
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0034.JPG	M08	34	Left Bank	Road ditch stormwater outlet upstream of Needham Rd
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0035.JPG	M08	35	Left Bank	Banks slumping over riprap_Tpke just above Needham Rd
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0036.JPG	M08	36	Left Bank	Erosion and exposed

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
					roots_Tpke upstream of Needham
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0037.JPG	M08	37	Right bank	Bank failure at flood chute_ford
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0038.JPG	M08	38	Right bank	flood chute at headcut starting behind log installed for stream ford
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0039.JPG	M08	39	Right bank	headcut starting behind logs installed for stream ford
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0040.JPG	M08	40	Left Bank	closeup of headcut starting behind logs
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0041.JPG	M08	41	Left Bank	rudi standing by top of flood chute by headcut
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0042.JPG	M08	42	Left Bank	Sidebar LB above headcut
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0043.JPG	M08	43	Right bank	Fllod chute looking up above sidebar
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0044.JPG	M08	44	Left Bank	erosion on right bank_flood chute is further to the right
BloodBrook\pix_bbw\M08pics\2006_10_03_M08\	100_0045.JPG	M08	45	Left Bank	stormwater input downstream of first private culvert
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0046.JPG	M08	46	Downstream	X section M08B1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0047.JPG	M08	47	Right bank	X section M08B1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0048.JPG	M08	48	Upstream	X section M08B1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0049.JPG	M08	49	Left Bank	X section M08B1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0050.JPG	M08	50	Downstream	X section M08C1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0051.JPG	M08	51	Right bank	X section M08C1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0052.JPG	M08	52	Upstream	X section M08C1
BloodBrook\pix_bbw\M08pics\2006_10_06_M08xsecsB1C1\	100_0053.JPG	M08	53	Left Bank	X section M08C1
BloodBrook\pix_bbw\M08pics\2006_10_13_M08xsecD1\	100_0062.JPG	M08	62	Downstream	X section M08D1
BloodBrook\pix_bbw\M08pics\2006_10_13_M08xsecD1\	100_0063.JPG	M08	63	Right bank	X section M08D1
BloodBrook\pix_bbw\M08pics\2006_10_13_M08xsecD1\	100_0064.JPG	M08	64	Upstream	X section M08D1
BloodBrook\pix_bbw\M08pics\2006_10_13_M08xsecD1\	100_0065.JPG	M08	65	Left Bank	X section M08D1
BloodBrook\pix_bbw\M09pics\	M09segAchannel.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAchannelaboveculvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAchannelincised.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAculvert andencroachment.jpg	M09			

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M09pics\	M09segAculvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAculverttoosmall.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAdepaboveculvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAencroach.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAerosion below culvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAerosion.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAGC.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAGCaboveculvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAGCagain.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAheadcut.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAMCbar.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAMF.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAmoreGC.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAplanebedchannel.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segApoolbelowculvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segApoolbelowGC.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAPowerlineROW.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAroadencroach.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAroadencroach2.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAtopGCwithpool.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAundercutbank.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs1downstnotape.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs1downstr.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs1LB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09SegAxs1RB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs1RB2.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs1upstm.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs1which.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs2dwnstr.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs2LB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs2RB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segAxs2upst.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBbridgeabut.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBcascades.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBchannel.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBdwnstreamxsLB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBdwnstreamxsRB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBdwnstrmxsdwnstr.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBdwnstrmxsRB.jpg	M09			

PATH	FILENAME	REACH_ID	PHOTO_ID	PHOTOVIEW	DESCRIPTION
BloodBrook\pix_bbw\M09pics\	M09segBdwnstrmxsupstream.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBGCcascade.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBmoreGC.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBoldbeaverwet.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBoldbeaverwetarea.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBoldempoundment.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBrockabutbeforebeaver.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBupperGC.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBupstrxsdwnstr.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBupstrxsRB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBupstrxsupstr.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segBupstxsLB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segC.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCbank.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCbeaverwet.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCdown.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCLB.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCrockabut.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCunassessed.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09segCup.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09steppedboxculvert.jpg	M09			
BloodBrook\pix_bbw\M09pics\	M09streammorenatural.jpg	M09			
BloodBrook\pix_bbw\M09pics\	MISSINGLBm09 037.jpg	M09			

Appendix B. Summary reports for all reaches and segments: Rapid Geomorphic Assessment (RGA) and Stream geometry with RGA and Rapid Habitat Assessment condition