

Little River Corridor Plan

**Stowe, Waterbury, Morristown, Worcester,
Bolton, Underhill and Cambridge, Vermont**
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Prepared by:
Bear Creek Environmental, LLC
297 East Bear Swamp Road
Middlesex, Vermont 05602



Prepared for:
The Lamoille County Planning Commission
632 LaPorte Road
Morrisville, VT 05661

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Bear Creek **Environmental**

297 East Bear Swamp Road, Middlesex, Vermont 05602
Phone: (802) 223-5140 / **Fax:** (802) 229-4410

Little River Corridor Plan Stowe, Waterbury, Morristown, Worcester, Bolton, Underhill and Cambridge, Vermont

I.0 EXECUTIVE SUMMARY

The River Corridor Planning effort is sponsored by the Lamoille County Planning Commission (LCPC) with funding provided through a grant from the Agency of Natural Resources Clean and Clear Program and the Federal Emergency Management Agency (FEMA). The Vermont Department of Environmental Conservation (DEC) River Management Program provided technical expertise and shared quality control/quality assurance responsibilities with Bear Creek Environmental, LLC (BCE). The River Corridor Plan (RCP) followed the Vermont Agency of Natural Resources River Corridor Planning Guide. Information for the RCP came from the DEC, the Vermont Center for Geographic Information (VCGI), and field data collected by BCE and LCPC.

The primary objective of the RCP is to use stream geomorphic assessment data to identify and prioritize river corridor protection and restoration projects within the Little River watershed primarily in the Town of Stowe. The stream geomorphic assessment data can be used by resource managers, community watershed groups, municipalities and others to identify how changes to land use alter the physical processes and habitat of rivers. The Vermont Stream Geomorphic Assessment Protocol includes three phases:

1. Phase 1 - Remote sensing and cursory field assessment;
2. Phase 2 – Rapid habitat and rapid geomorphic assessment to provide field data to characterize the current physical condition of a river; and
3. Phase 3 – Detailed survey information for designing “active” channel management projects.

A Phase 1 Stream Geomorphic Assessment following Agency of Natural Resources Protocols was completed for the Little River watershed by Lamoille County Planning Commission (LCPC) and BCE during 2006, and a Phase 2 Stream Geomorphic Assessment following Agency of Natural Resources Protocols was completed for Little River by BCE during summer 2007. During Phase 1, the Little River watershed was divided into 138 reaches, encompassing roughly 83 miles of river channel. Four of these reaches that were impounded by lakes, ponds or wetlands were excluded from the Phase 1 assessment. Reaches on the West Branch of the Little River were also excluded because this subwatershed was previously assessed using Phase 1 and 2 protocols. A corridor plan for the lower West Branch using the stream geomorphic assessment information was prepared in 2007 by LCPC (Lamoille County Planning Commission 2007). BCE has been retained by the LCPC through funding from the Clean and Clear Program

to prepare a RCP of the upper West Branch watershed. The upper West Branch corridor plan is expected to be completed during summer 2010.

Phase 2 field work was conducted within the Little River watershed in 2007 on the Little River main stem, Gold Brook, Miller Brook and Moss Glen Brook; approximately 21 miles of river were assessed. Bridge and culvert data collected by J Schwartz during August and September 2006 were used in conjunction with data collected by BCE during the Phase 2 assessment to identify structures that have the potential to fail because of channel adjustments, are having a geomorphic impact on the stream, or are impeding aquatic organism passage.

The major problems in the Little River watershed include lack of riparian buffers, channel straightening, and poor floodplain access. The lack of forested riparian buffers has led to extensive bank erosion and invasive species growing on the river banks and within the river corridor. Japanese knotweed is an invasive plant species that is prevalent in both the riparian buffer and the corridor within the Little River mainstem and Miller Brook. The Little River mainstem from the Waterbury Reservoir to above Stowe village has been extensively channelized and straightened with a combination of rock riprap, hard bank armoring, and berms. These activities have contributed to poor floodplain access. A total of 24 berms were mapped as part of the stream geomorphic assessment. Eleven of these berms are on Gold Brook. Gravel extraction and dredging of the lower reaches of the major tributaries and the Little River mainstem has also contributed to channel straightening, removal of woody vegetation and loss of large woody debris. Alteration of stream channels has caused major channel degradation resulting in sediment build up, channel widening and planform adjustment. The channel modification activities, floodplain encroachment, gravel mining, channel straightening, and excessive build up of sediment have all resulted in reduced aquatic habitat.

As the river works toward a more stable equilibrium, the community of Stowe has the opportunity to provide long-term protection to the river corridor and encourage the reestablishment of floodplain vegetation and healthy instream habitat. At the reach and site level, potential restoration and protection projects that would be compatible with geomorphic adjustments and managing the stream toward equilibrium conditions were identified. A list of 42 potential restoration and conservation projects was developed during project identification. Types of projects include: river corridor protection through corridor easements and conservation efforts, replacing undersized structures causing localized channel instability, improving riparian buffers, and alternative analyses for removing dams and streamside berms that are no longer serving a purpose.

2.0 LOCAL PLANNING PROGRAM OVERVIEW

2.1 River Corridor Planning Team

The river corridor planning team for the Little River watershed is comprised of the Lamoille County Planning Commission, the Agency of Natural Resources, Bear Creek Environmental, LLC, local municipalities and landowners. This planning effort is sponsored by the Lamoille County Planning Commission. Funding for the project is provided through a grant from the Clean and Clear Program and FEMA. Gretchen Alexander from the Vermont River Management Section of the Vermont Agency of Natural Resources (VANR) provided technical guidance for this project.

2.2 Goals and Objectives of the Project

The primary objective of the River Corridor Management Plan is to use the Phase I and 2 Stream Geomorphic Assessment data to identify and prioritize river corridor protection and restoration projects within the Little River watershed. The State of Vermont's River Management Program has set out several goals and objectives that are supportive of the local initiative in the Little River watershed. The state management goal is to, "manage toward, protect, and restore the fluvial geomorphic equilibrium condition of Vermont rivers by resolving conflicts between human investments and river dynamics in the most economically and ecologically sustainable manner" (Vermont Agency of Natural Resources, 2007b). The objectives of the Program include fluvial erosion hazard mitigation and sediment and nutrient load reduction, as well as aquatic and riparian habitat protection and restoration. The Program seeks to conduct river corridor planning in an effort to remediate the geomorphic instability that is largely responsible for problems in a majority of Vermont's rivers. Additionally, the Vermont River Management Program has set out to provide funding and technical assistance to facilitate an understanding of river instability and the establishment of well developed and appropriately scaled strategies to protect and restore river equilibrium.

3.0 BACKGROUND WATERSHED INFORMATION

3.1 Geographic Setting

3.1.1 Watershed Description

The Little River has a watershed size of 112 square miles (Figure 3.1). The Phase 2 study focused on stream reaches on the main stem of the Little River and the lowest stream reaches on Miller Brook, Gold Brook and Moss Glen Brook. The combined length of the stream reaches assessed is approximately 21 miles. The Little River begins as Sterling Brook in the headwaters of Mount Mansfield near the boundary of Stowe and Morristown. The Little River heads southeast and then south through the Town of Stowe, where it joins with the West Branch of the Little River see Figure 3.2. Downstream of Stowe, the Little River crosses into Waterbury and enters Washington County. The Little River flows into the Winooski River at approximately 390 feet above sea level, which then drains westerly into Lake Champlain.

3.1.2 Political Jurisdictions

The Little River watershed flows through seven towns (Cambridge, Underhill, Morristown, Stowe, Waterbury, Worcester and Bolton). The Little River watershed is located in Lamoille, Washington and Chittenden Counties (Figure 3.2). The Little River watershed falls under the jurisdiction of the LCPC, the Central Vermont Regional Planning Commission (CVRPC) and the Chittenden County Regional Planning Commission. This project focused on Phase 2 reaches within Lamoille County.

3.1.3 Land Use

Geographic Information System (GIS) data from 1992 was obtained from the Vermont Center for Geographic Information (VCGI) to analyze landuse within the Little River watershed. The majority of the Little River is forested (Figure 3.3). The landuse breakdown for the watershed is 77 percent forest, 9 percent agriculture, 4 percent developed and urban land, 8 percent water and 1 percent wetland. The most concentrated areas of development in the watershed are along the Mountain Road and at the intersection of the Mountain Road and Route 100 in Stowe as well as in downtown Waterbury Center. Agricultural lands are prevalent within the Little River and the West Branch corridor in Stowe. Lands marked as agricultural in the upper part of the West Branch are actually ski trails and not agricultural land.

The Mount Mansfield Natural Area, Mount Mansfield State Forest and CC Putnam State Forest are public lands within the Little River watershed. A description of each of these areas is included under Section 3.5 (Ecological Setting).

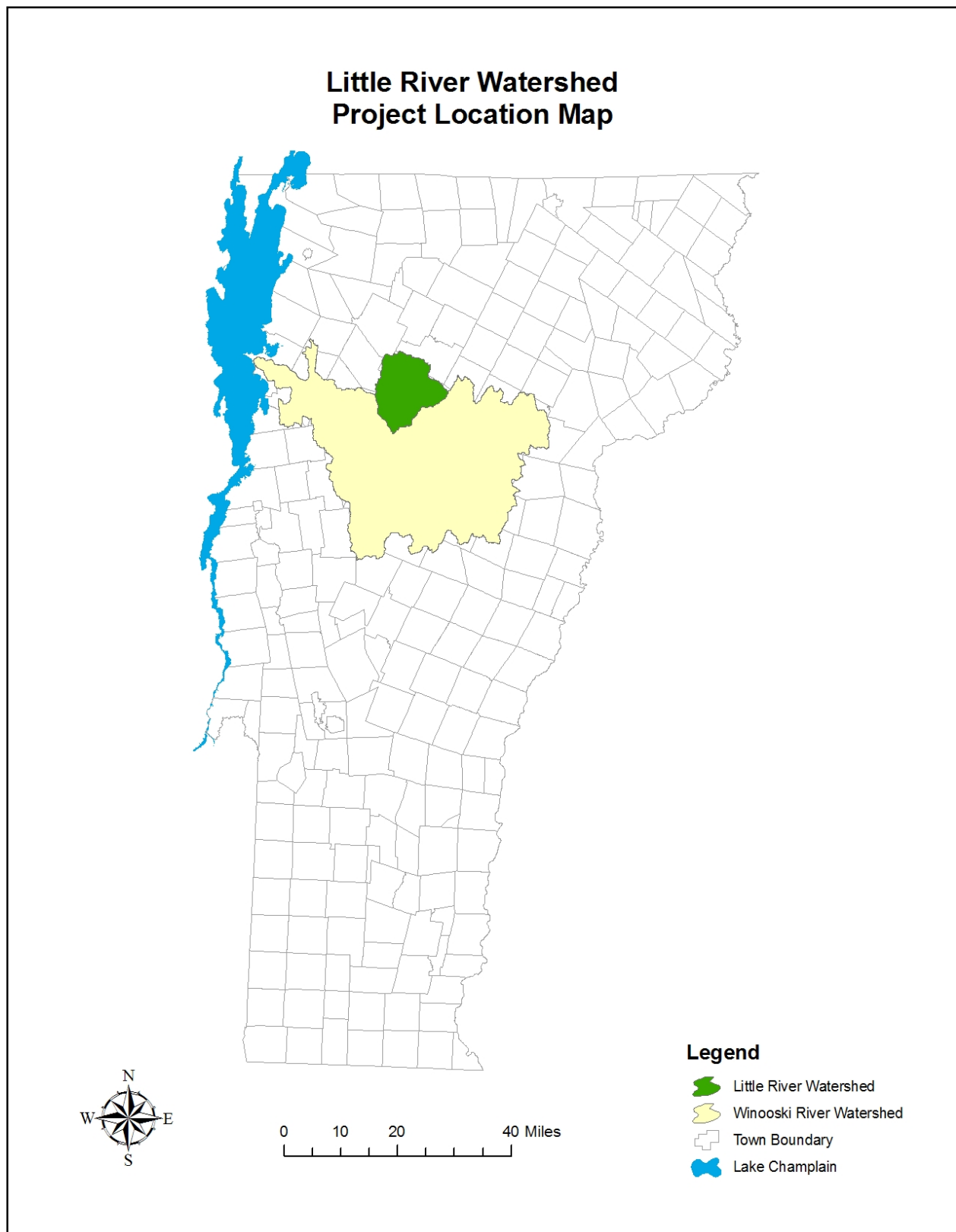


Figure 3.1. Project Location Map for the Little River Watershed

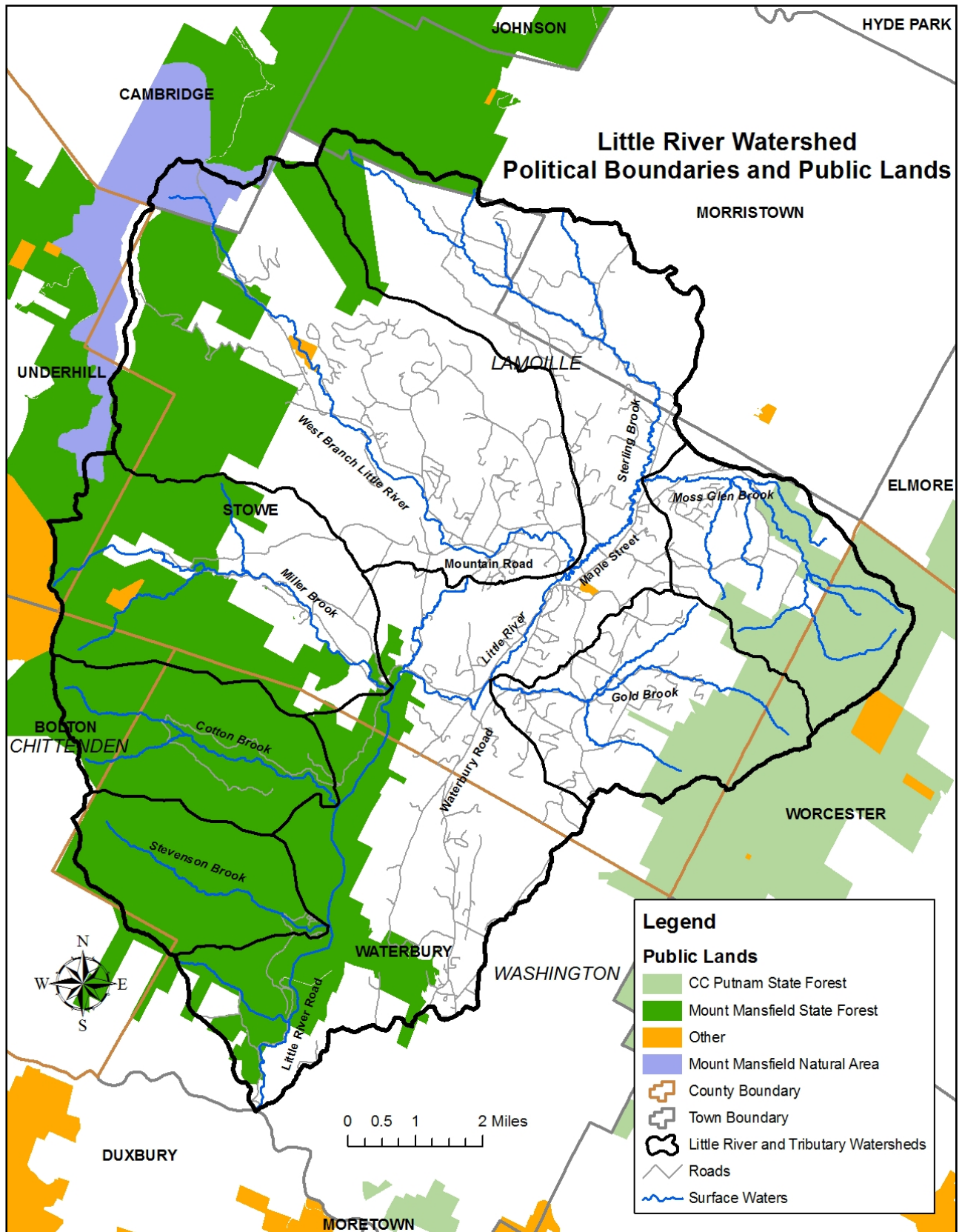


Figure 3.2. Little River Political Boundaries and Public Lands

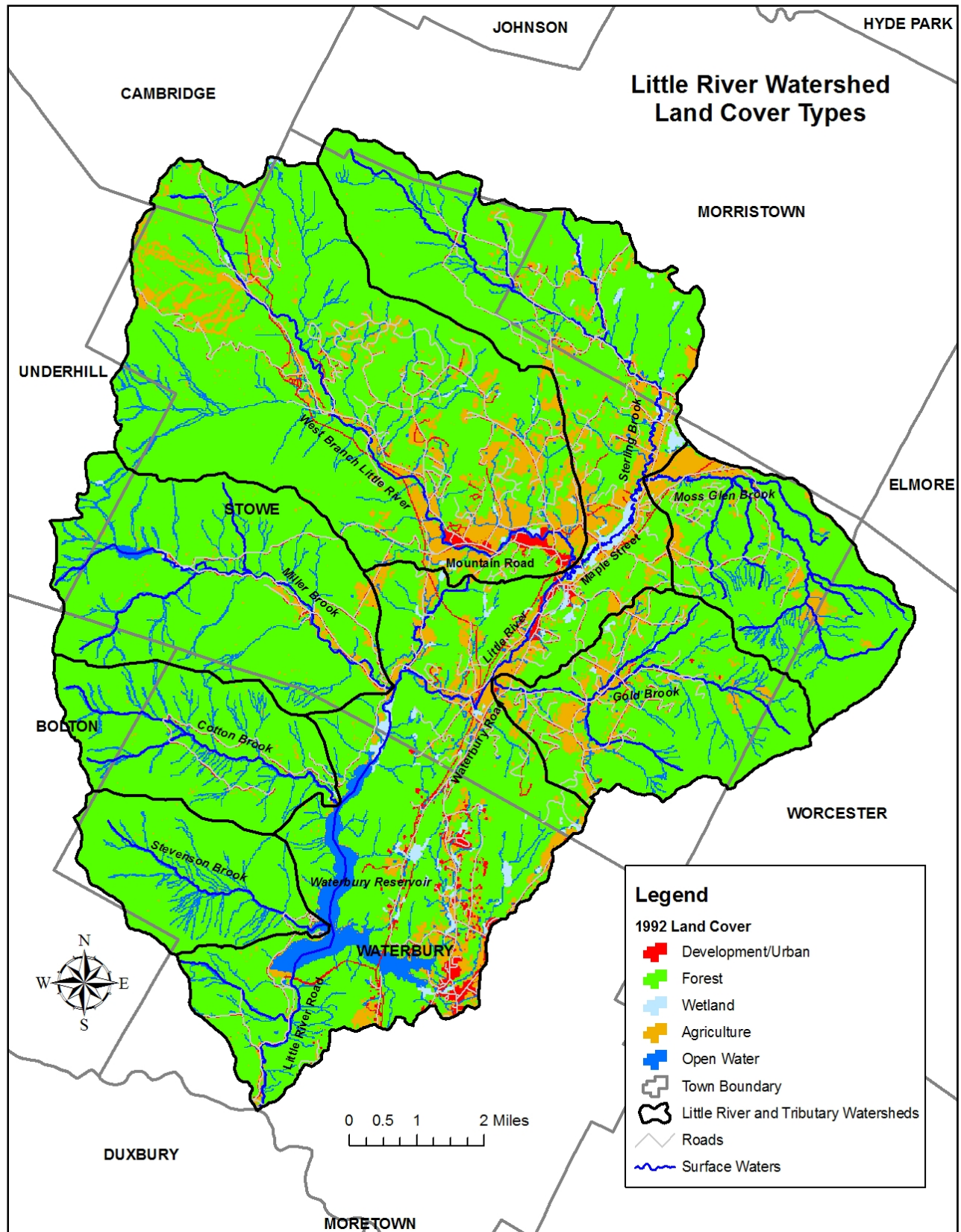


Figure 3.3. Land Cover and Land Use Map for the Little River Watershed

3.2 Geologic Setting

The Little River watershed is located within the Green Mountain Geo-physiographic Province. The Green Mountains were uplifted during the Taconic orogeny about 455 million years ago (Doolan, 1996). The bedrock underlying the Little River watershed primarily consists of the Hazens Notch Formation and the Stowe Formation. The Hazens Notch Formation is comprised of interbedded carbonaceous and noncarbonaceous schist. The Stowe Formation is located in the eastern part of the watershed. The Stowe Formation is comprised of quartz and chlorite phyllite and schist with abundant segregations of granular white quartz. Within the Stowe Formation at this location are also greenstone and amphibolite rocks. The western part of the watershed contains a thin section of the Underhill Formation. The Underhill Formation is comprised of silvery, gray-green schist with many segregations of granular white quartz. Nestled in between the Stowe Formation and the Hazens Notch Formation is the Ottauquechee Formation. The Ottauquechee Formation is comprised of black carbonaceous phyllite or schist with interbeds of quartzite (Doll, 1961).

The Green Mountains and adjacent valleys have been covered with ice during historic glacial periods. The last large ice sheet, the Laurentide Ice Sheet, covered all of New England and advanced up the Winooski River Valley. As the climate warmed, the glacier slowly retreated and glacial lakes were dammed in the Winooski River valley. Following the retreat of the ice sheet, the Winooski River and its tributaries began eroding the glacial and lake sediments that were left behind (Wright, 2003).

Natural Resource Conservation Service (NRCS) soils information for the Little River watershed was acquired from GeologicSoils_So (Vermont Center for Geographic Information, 2008). The dominant surficial geology of the Little River watershed consists of glacial till as shown in Figure 3.4. Outwash (ice-contact deposits), alluvial and lacustrine deposits are subdominant within the watershed. Alluvial deposits, outwash, and lacustrine are dominant within the Little River and the West Branch corridors. The watershed is primarily comprised of highly erodible and potentially highly erodible soils (Figure 3.5). Except for along the Waterbury Reservoir, there are concentrated areas of non-highly erodible soils within the Little River corridor in Waterbury and Stowe and within the West Branch corridor downstream of the Ranch Brook confluence. Non-highly erodible soils are also located within the corridors of Moss Glen Brook and the downstream reaches of Miller Brook.

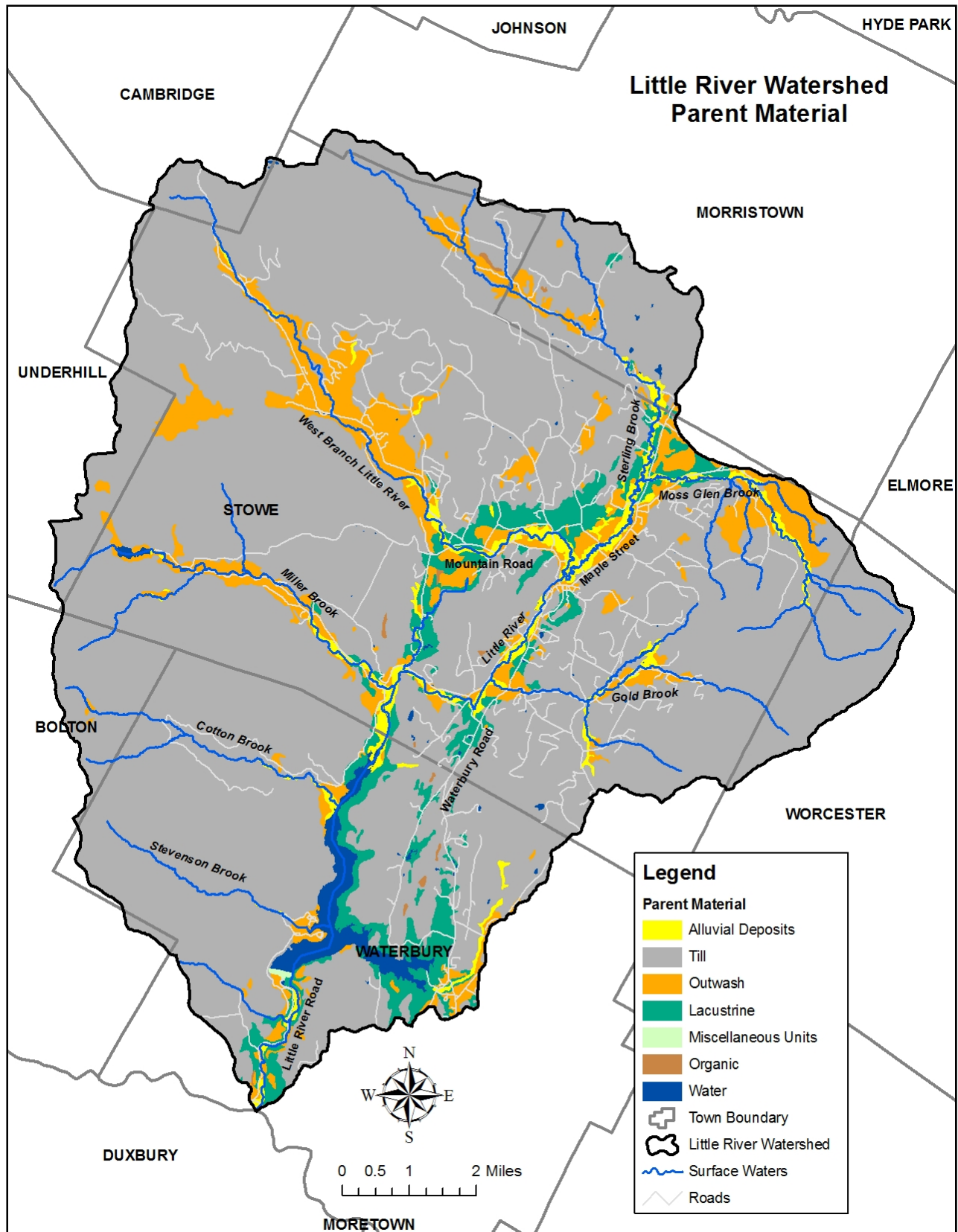


Figure 3.4 Little River Watershed Soil Parent Material

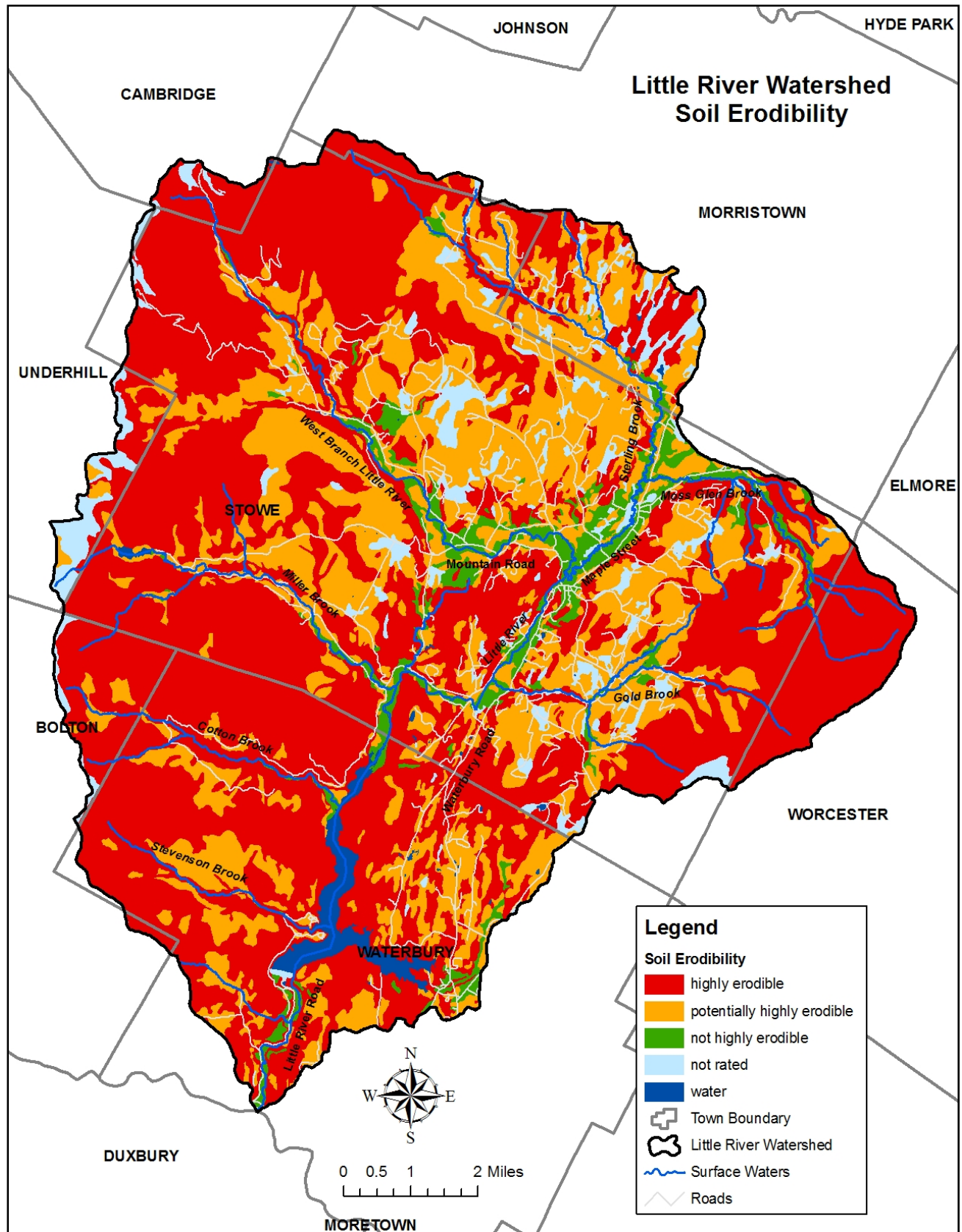


Figure 3.5 Little River Soil Erodibility

3.3 Geomorphic Setting

A Phase 1 Stream Geomorphic Assessment was conducted on 138 reaches of the main stem of the Little River, three major tributaries (Miller Brook, Gold Brook and Moss Glen Brook) and twelve unnamed tributaries. The West Branch of the Little River was excluded from the study since it was assessed under another project. The Cotton Brook and Stevenson Brook watersheds as well as two unnamed tributary watersheds were excluded from the study since they were located in Waterbury and outside the scope of this project (Figure 3.6). The Phase 2 study focused on 16 stream reaches on the main stem of the Little River within the Towns of Stowe and Morristown, five reaches on Miller Brook, seven reaches on Gold Brook and three reaches on Moss Glen Brook. The combined length of the stream reaches assessed during the Phase 2 study is approximately 21 miles (Figure 3.7). Each reach represents a similar section of the stream based on physical attributes such as valley confinement, slope, sinuosity, bed material, dominant bedform, land use, and other hydrologic characteristics. Each point represents the downstream end of the reach.

Reference stream types are based on the valley type, geology and climate of a region and describe what the channel would look like in the absence of human-related changes to the channel, floodplain, and/or watershed. Stream and valley characteristics including valley confinement, and slope were determined from digital USGS topographic maps. The reference reach characteristics were refined during the windshield survey and Phase 2 Assessment. Reference reach typing was based on both the Rosgen (1996) and the Montgomery and Buffington (1997) classification systems. Table 1 shows the typical characteristics used to determine reference stream types (Vermont Agency of Natural Resources, 2007b). Reference stream types for the assessed reaches are listed in Table 2. With the exception of three reaches, which are “B” channels by reference, all the reference stream types on the main stem of the Little River assessed for Phase 2 are “C” channels. Reference “C” channels have unconfined valleys with moderate to gentle valley slopes and moderate to high width to depth ratios and sinuosity. The rest of the reaches on the main stem are either “B” or “A” channels by reference. “B” channels have moderate to steep slopes and have narrower valleys than “C” channels. “A” channels have very steep slopes and are confined or narrowly confined. All Phase 2 assessed reaches on Miller Brook and Moss Glen Brook have a reference stream type of “C”. Gold Brook contains three reaches with a “B” stream type and the remaining reaches are “C” channels by reference (Figure 3.8).

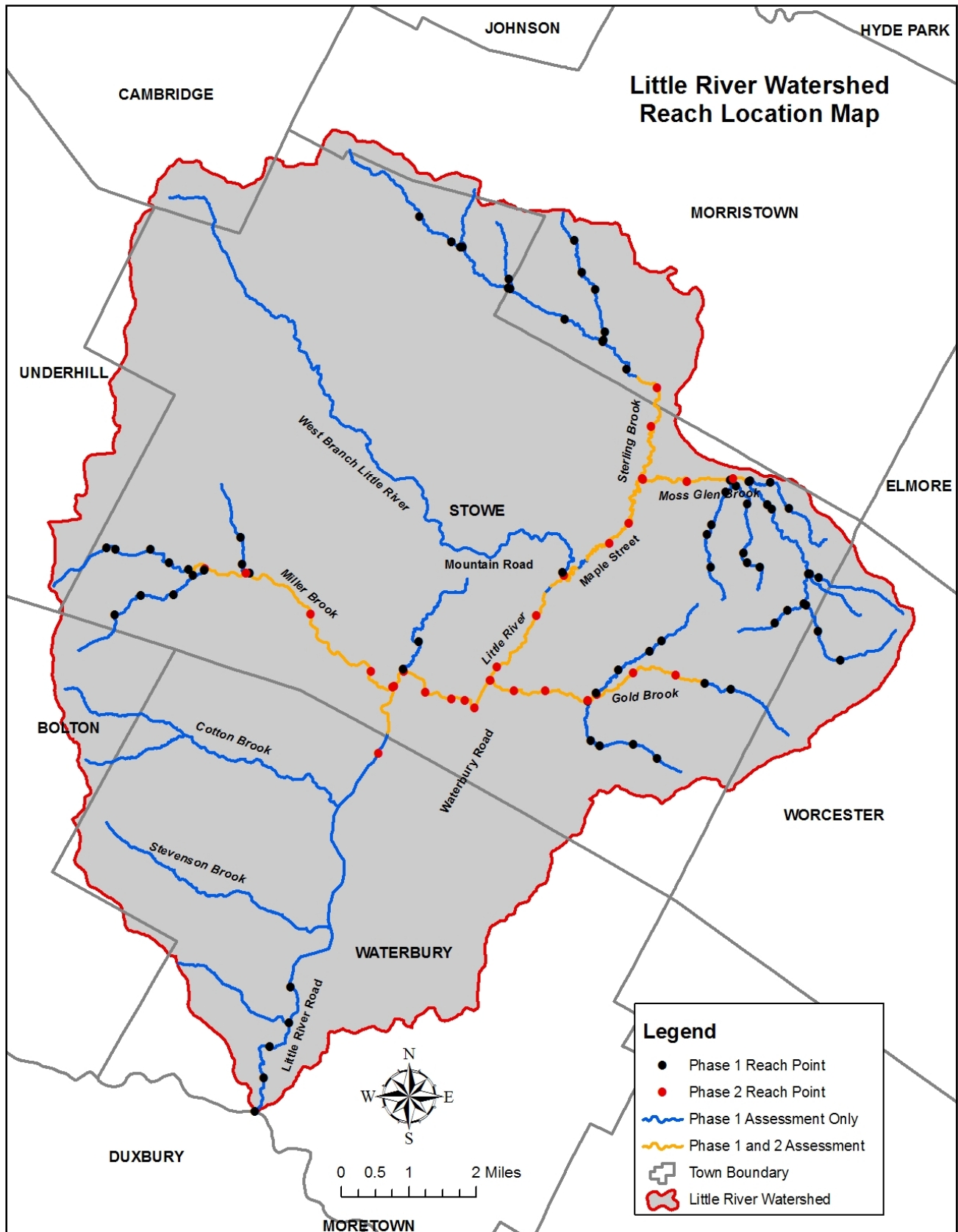


Figure 3.6 Little River Watershed Reach Location Map

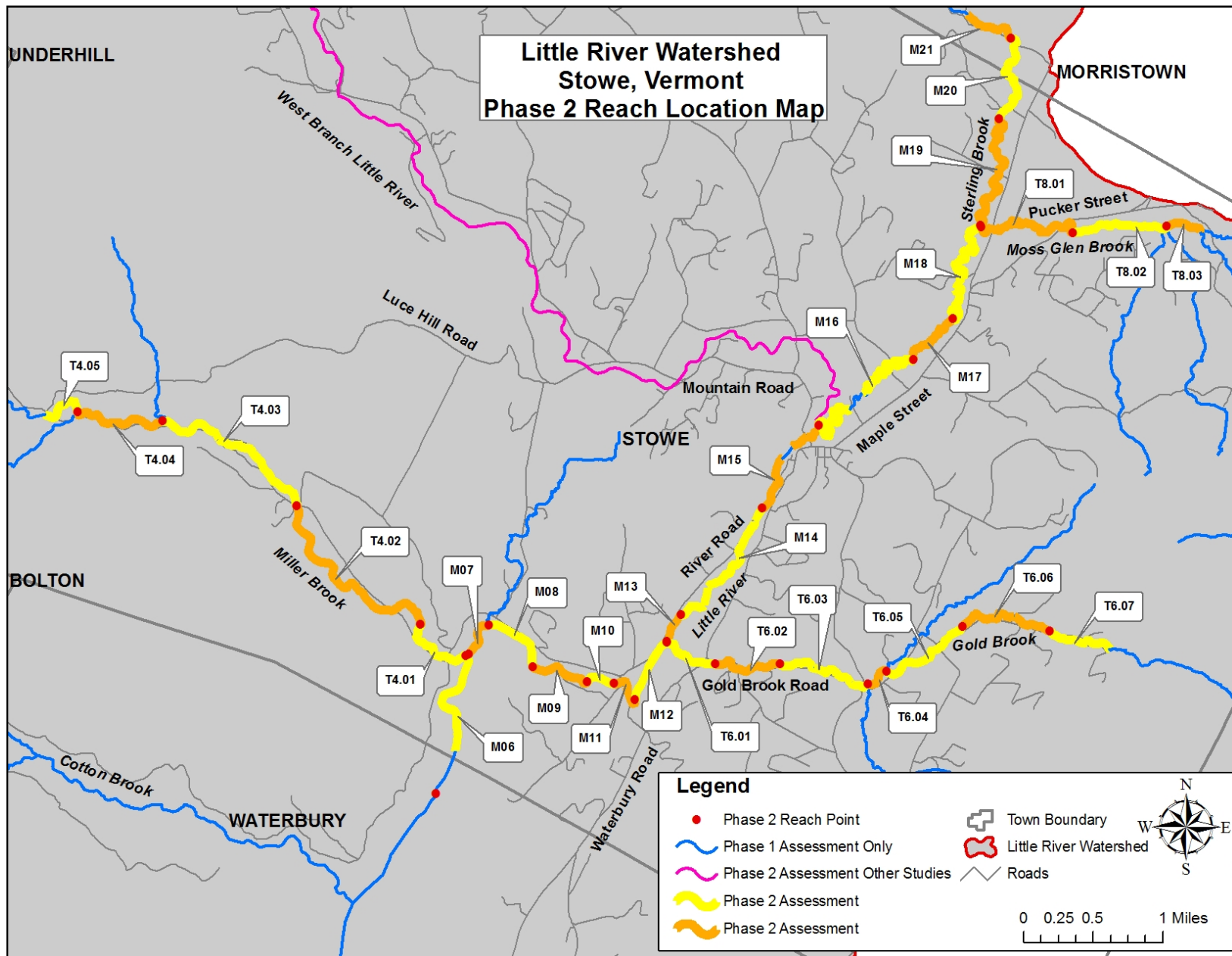


Figure 3.7 Reach location map for Phase 2 Stream Geomorphic Assessments

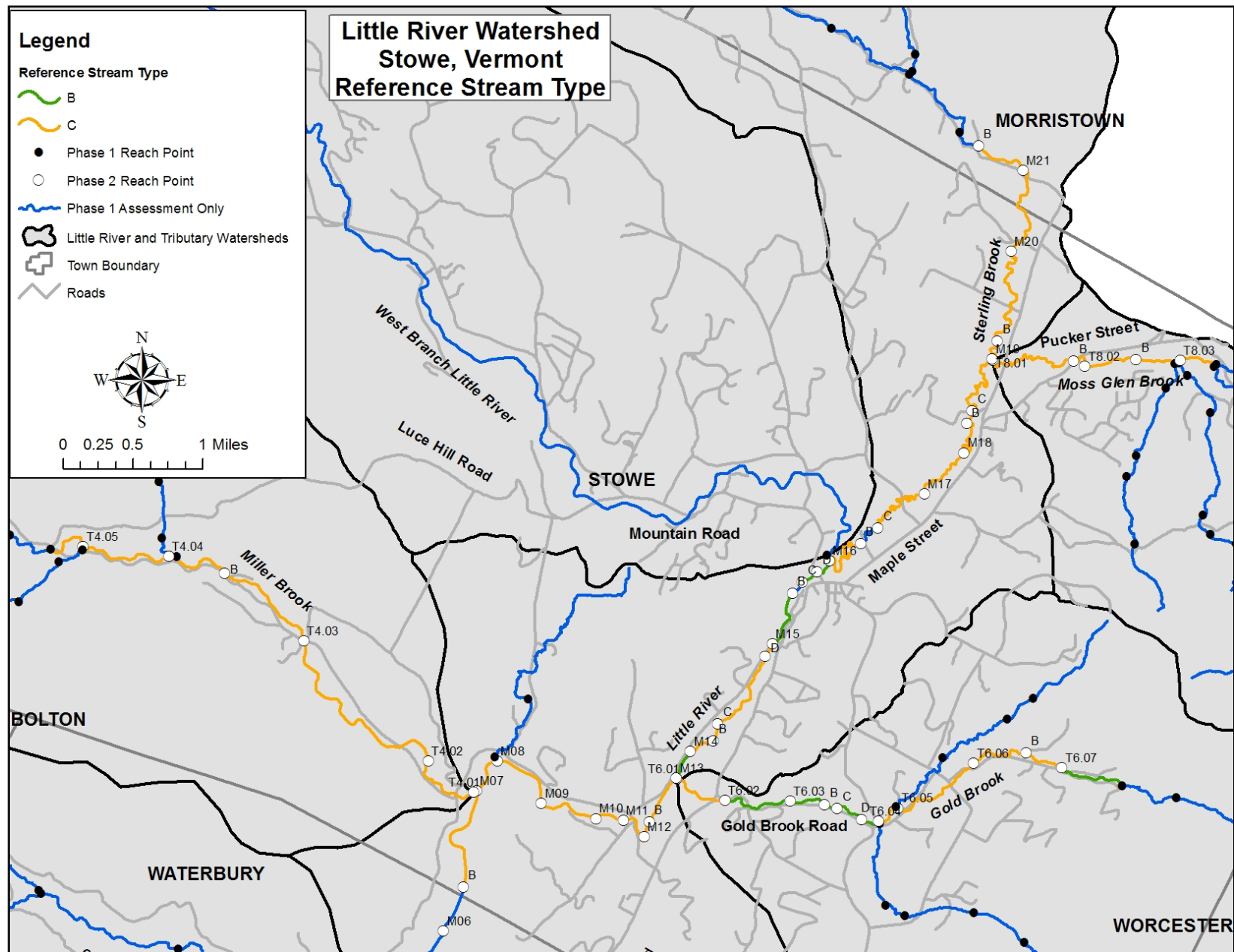


Figure 3.8 Reference Stream Type for Phase 2 Geomorphic Assessments

Table 1: Reference Stream Type			
Stream Type	Confinement	Valley Slope	Bed Form
A	Narrowly Confined	Very steep > 6.5 %	Cascade
A	Confined	Very steep 4.0 - 6.5 %	Step-Pool
B	Confined or Semi-confined	Steep 3.0 – 4.0 %	Step-Pool
B	Confined, Semi-confined or Narrow	Moderate to Steep 2.0 – 3.0 %	Plane Bed
C or E	Unconfined (Narrow, Broad or Very Broad)	Moderate to Gentle <2.0 %	Riffle-Pool or Dune-Ripple
D	Unconfined (Narrow, Broad or Very Broad)	Moderate to Gentle <4.0 %	Braided Channel

Table 2: Geomorphic Setting of Assessed Reaches				
Reach ID	Reference Stream Type	Confinement	Valley Slope	Bedform
M06	C	Very Broad	0.27	Riffle-Pool
M07	C	Broad	0.06	Riffle-Pool
M08	C	Narrow	0.04	Riffle-Pool
M09	C	Broad	0.36	Riffle-Pool
M10	C	Broad	0.78	Riffle-Pool
M11	C	Broad	0.10	Riffle-Pool
M12	C	Very Broad	0.19	Riffle-Pool
M13	B	Semi-Confined	0.43	Riffle-Pool
M14	C	Broad	0.29	Riffle-Pool
M15	B	Semi-Confined	0.98	Riffle-Pool
M16	C	Very Broad	0.32	Riffle-Pool
M17	C	Very Broad	0.21	Riffle-Pool
M18	C	Very Broad	0.16	Riffle-Pool
M19	C	Very Broad	0.54	Riffle-Pool
M20	C	Very Broad	1.02	Riffle-Pool
M21	C	Broad	1.88	Riffle-Pool

Table 2: Geomorphic Setting of Assessed Reaches				
Reach ID	Reference Stream Type	Confinement	Valley Slope	Bedform
T4.01	C	Very Broad	0.56	Riffle-Pool
T4.02	C	Very Broad	1.44	Riffle-Pool
T4.03	C	Very Broad	2.82	Riffle-Pool
T4.04	C	Broad	2.81	Riffle-Pool
T4.05	C	Broad	1.79	Riffle-Pool
T6.01	C	Very Broad	2.12	Riffle-Pool
T6.02	B	Semi-Confined	3.71	Step-Pool
T6.03	B	Broad	2.56	Riffle-Pool
T6.04	C	Very Broad	2.37	Riffle-Pool
T6.05	C	Very Broad	2.32	Riffle-Pool
T6.06	C	Very Broad	4.49	Riffle-Pool
T6.07	B	Narrow	7.05	Step-Pool
T8.01	C	Very Broad	0.82	Riffle-Pool
T8.02	C	Very Broad	0.65	Riffle-Pool
T8.03	C	Very Broad	1.14	Riffle-Pool

3.4 Hydrology

In order to better understand the flood history of the Little River, long term data from the U.S. Department of the Interior, U.S. Geological Survey (USGS) gauge on the Little River in Waterbury, VT were obtained (USGS 2009). Seventy-three years of record (1936-2008) are available for the Little River gauge.

The long term record for the Little River shows that 1936 had the highest flow on record and exceeded the 50 year discharge. The 25 year discharge was exceeded in 1995. The long term record on the Little River gauge shows major flood events also occurred in the years 1937, 1938, 1990, 1996 and 2008. The graph below (Figure 3.9) provides a flood frequency analysis for the Little River gauge. The flow at this gauge is affected by regulation or diversion at the dam for Waterbury Reservoir.

Of all the natural hazards experienced in Vermont, flooding is the most frequent, damaging, and costly. Over the last 50 years, flood recovery has cost Vermonters an average of 14 Million dollars a year. During the period of 1995-1998 alone, flood losses in Vermont totaled nearly \$57 Million. While some flood losses are caused by inundation (i.e. waters rise, fill, and damage low-lying structures), most flood losses in Vermont are caused by “fluvial erosion”. Fluvial erosion is erosion caused by rivers and streams, and can range

from gradual bank erosion to catastrophic changes in river channel location and dimension during flood events (Vermont Agency of Natural Resources 2006).

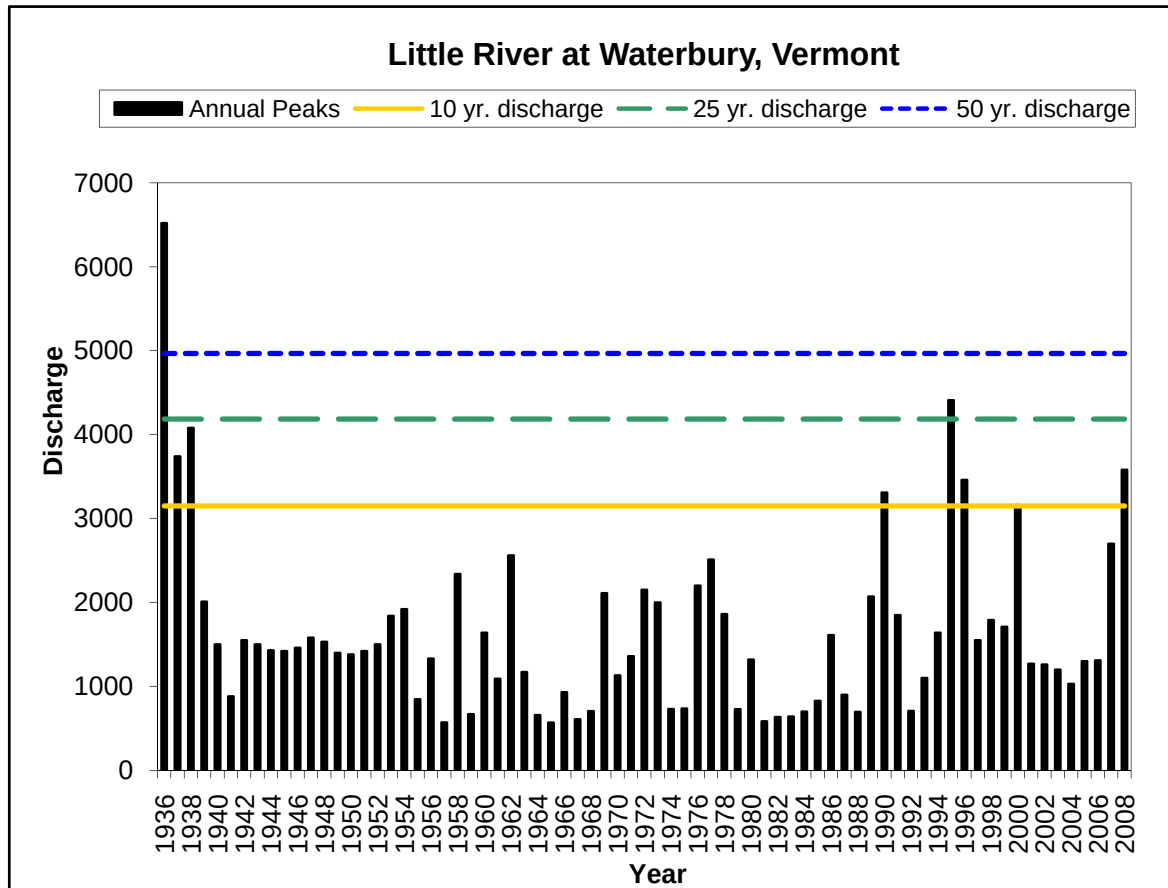


Figure 3.9. Flood frequency analysis for the Little River at Waterbury, VT (affected by regulation and diversion).

Closer study of our rivers and streams reveals that Vermont's erosion hazard problems are largely due to pervasive, human-caused alteration during the past 150 to 200 years of our waterways and landscapes they drain. By end of the nineteenth century, forests had been cleared from many watersheds, resulting in major changes in watershed hydrology and sediment production. Towns and villages, the centers of commerce, grew on the banks of rivers. Benefits of power generation and transportation initially outweighed flood risks. In addition, many watersheds were changed by development, agriculture, log drives, roads and railways. The legacy of this landscape manipulation is rivers, such as the Little River, which are unstable and prone to fluvial erosion (Vermont Agency of Natural Resources 2006). The Waterbury Dam was created in response to local floods that occurred in the early 1900's. Torrential rains on November 3 and 4, 1927 resulted in high water in the Little River, which drove residents to their roofs. A second flood in 1934 was the impetus for creating the Waterbury Dam. The dam was created between 1935 and 1938 by the Civilian Conservation Corps in cooperation with the Corps of Engineers. (Wildernet.com, Accessed March 11, 2010 (a)).

Flooding events are usually correlated with extreme weather patterns. The majority of the twentieth century's largest floods have occurred during the summer months of June through August and are associated with intense cloudbursts, which stay in the mountains producing high rainfall amounts. The remainder is divided quite evenly between fall floods (September through November) which are often associated with hurricanes. Winter/spring floods (January through April) are associated with rain on snow events or snowmelt. Summer and fall floods are associated with greater flood damage than winter snowmelt floods. A flood in July 2004 in Stowe dropped as much as 4 inches of rain in one hour causing almost \$500,000 in flood damage according to the Federal Emergency Management Agency (Barg, 2004).

3.5 Ecological Setting

The Little River watershed lies exclusively within the Northern Green Mountains biophysical region (Figure 3.8). This region is characterized by Thompson and Sorenson (2005) as having high elevations and cool summers. The Green Mountains have a strong influence on the weather resulting in an abundance of precipitation in the form of both rain and snow. Precipitation within the West Branch watershed averages 53 inches annually (USGS, Scott Olson, pers. comm., 2004). On the top of Mount Mansfield annual precipitation averages over 78 inches. Precipitation increases with elevation, at about an inch per 1000 feet of elevation (Wemple, 2002). Mount Mansfield receives more precipitation than most areas in the State. An orographic effect often occurs on Mount Mansfield where convection off of sunny slopes leads to thunderstorms. Since the prevailing winds off of the Green Mountains are from the west, air rising through convection is shifted downwind and therefore increases precipitation onto the opposite (east) slope. The direction from which the air comes affects the outcomes of storms. Air which arrives from the south is usually moisture laden and causes extreme rainfall events, while storms that come from the north or northwest typically have dry air.

Northern hardwood forest is the dominant community in the Northern Green Mountains biophysical region. The Northern Green Mountains provide important habitat for both aquatic and terrestrial animals. According to Thompson and Sorenson (2005), the Green Mountains offer extensive habitat for black bear, white-tailed deer, bob cat, fisher, beaver and red squirrel. Birds such as blackpoll warblers, Swainson's thrush and the rare Bicknell's thrush nest in the high elevation forests.

The Vermont Significant Wetland Inventory GIS layer ("WaterWetland_VSWI") provides important information about the distribution of wetland habitat within the Little River watershed. Wetland habitat is located adjacent to the Little River south of the confluence with Miller Brook as well as along the Little River in the vicinity of Maple Road. Wetland habitat is also common in the southeast portion of the watershed.

Deer wintering areas identified by the Vermont Agency of Natural Resources in the shapefile "EcologicHabitat_DEERWN" last updated May 1, 2006 are common within the watershed as shown in Figure 3.10. Rare, Threatened and Endangered Species & Significant Communities from the shapefile "EcologicOther_RTENATCOM" prepared by the Vermont Fish and Wildlife Department, Nongame and Natural Heritage Program (last updated in 2009) are mapped in Figure 3.10 to better understand the ecological setting of the Little River watershed. The western portion of the Little River watershed has been identified by the Nongame and Natural Heritage Program as a significant terrestrial community. Much of this area identified as significant terrestrial community is part of the Mount Mansfield State Forest (see Figure 3.2). The Mount Mansfield State Forest is 37, 242 acres and is the largest forest in Vermont (Wildernet.com, Accessed March 11, 2010 (a)). The Mount Mansfield Natural Area is also part of the area identified as a significant terrestrial community. Located along the western ridge of the Little River watershed, this important natural area offers a subalpine spruce-fir forest. The CC Putman State Forest, located on the eastern side of the Little River watershed, is a 13,355 acre state forest within the Woodbury Mountain Range. Camping, fishing, hiking and hunting are all recreation opportunities within this State forest. (Wildernet.com, Accessed March 11, 2010 (b)).

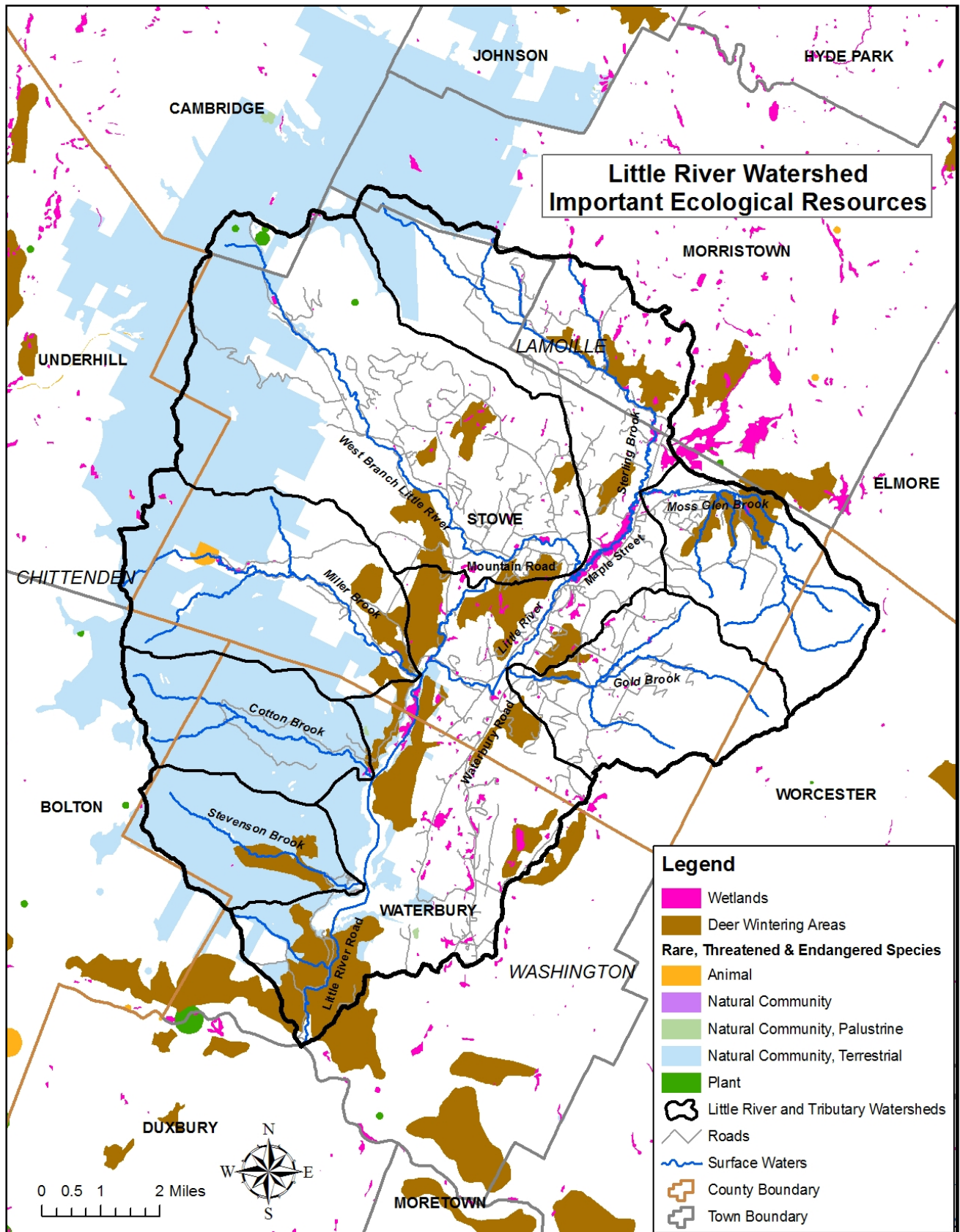


Figure 3.10. Important ecological resources within the Little River watershed

4.0 METHODS

4.1 Phase 1 Methodology

A Stream Geomorphic Assessment process is divided into three phases, based on VANR protocols. Phase I, the remote sensing phase, involves the collection of data from topographic maps and aerial photographs, from existing studies, and from very limited field studies called “windshield surveys” (Vermont Agency of Natural Resources, 2006). The Phase I assessment provides an overview of the general physical nature of the watershed. A Phase I Assessment of the Little River watershed was completed by the Lamoille County Planning Commission in 2006.

4.2 Phase 2 Methodology

The Phase 2 assessment of the Little River watershed followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase 2 (Vermont Agency of Natural Resources, 2007b). All assessment data were recorded on the Agency of Natural Resources Phase 2 data sheets, and were entered in to the VANR Stream Geomorphic Assessment data management system (DMS). The Phase I database was updated using the field data from the Phase 2 assessment in 2007.

The parameters and protocols used for undertaking the Phase 2 assessment are outlined in the Phase 2 Handbook (Vermont Agency of Natural Resources, 2007b). The entire length of each Phase 2 reach was walked to determine segment breaks. Bank erosion, grade control structures, bank revetments, debris jams, depositional features, stormwater inputs, flood chutes, valley walls and other important features were mapped within all segments. BCE used the Stream Geomorphic Assessment Tool (SGAT) version 4.56 to index features that were mapped during the Phase 2 assessment. SGAT is an ArcView extension.

4.3 Bridge and Culvert

Bridge and culvert inventory and assessments were conducted by J Schwartz in August and September 2006 to determine if stream crossings were contributing to localized streambank erosion, sedimentation, and reduced fish passage. Thirty of these structures are located within the Little River Phase 2 study area. The Agency of Natural Resources Bridge and Culvert protocols (Vermont Agency of Natural Resources, 2007b) were followed. The Vermont Culvert Geomorphic Screening Tool (Milone and MacBroom, Inc., 2008a) and the Vermont Culvert Aquatic Organism Passage Screening Tool (Milone and MacBroom, Inc., 2008b) were used to identify culverts within the Little River watershed that are highest priority for replacement/retrofit due to geomorphic incompatibility and/or for being potential barriers to movement and migration of aquatic organisms. The Vermont Culvert Geomorphic Screening Tool was modified for bridges. This modification for bridges includes a score for percent bankfull width, approach angle, erosion and armoring, and sediment continuity. Slope is not included as it is with the evaluation of culverts.

4.4 River Corridor Plan

The Vermont Agency of Natural Resources River Corridor Planning Guide (2007a) and Draft 9 of Chapter 5 of the plan dated October 2, 2007 were followed to generate a series of stressor maps, which are included in Section 6.0. The stressor maps were created using indexed data from the Phase 1 and Phase 2 Stream Geomorphic Assessments along with existing data available from VCGI, including e911 roads, e911 buildings and e911 driveways. The stressor maps were then used to identify potential project locations that have few constraints to channel adjustment.

4.5 Quality Control/Quality Assurance Procedures

To assure a high level of confidence in the Phase 1 and 2 SGA data, strict quality assurance/quality control (QA/QC) procedures were followed by BCE. These procedures involved a thorough in-house review of all data as well as automated and manual QC checks with the DEC River Management Program.

In 2008, BCE completed its own in-house QA review after all the Phase 2 data were entered into the DMS and the Phase 1 data were updated. The Phase 1 DMS and ArcView shapefiles were updated by Colleen Sullivan and Mary Nealon based on the Phase 2 field assessment work during the Phase 2 QA/QC process. The DMS and the ArcView shapefiles for the Little River Phase 2 study were submitted to Gretchen Alexander of the VANR for a Quality Assurance review in spring 2008. Some minor revisions were made by BCE to the DMS following this review and the VANR QA review was completed in October 2008.

5.0 RESULTS

5.1 Phase 2 Results

Rapid Geomorphic Assessment

During the Phase 2 assessment, sixteen reaches on the mainstem of the Little River were broken into 30 segments based on detailed field observations. The reference and existing stream type for each assessed segment is included in Figure 5.1. Detailed segment summary data are provided in Appendix A.

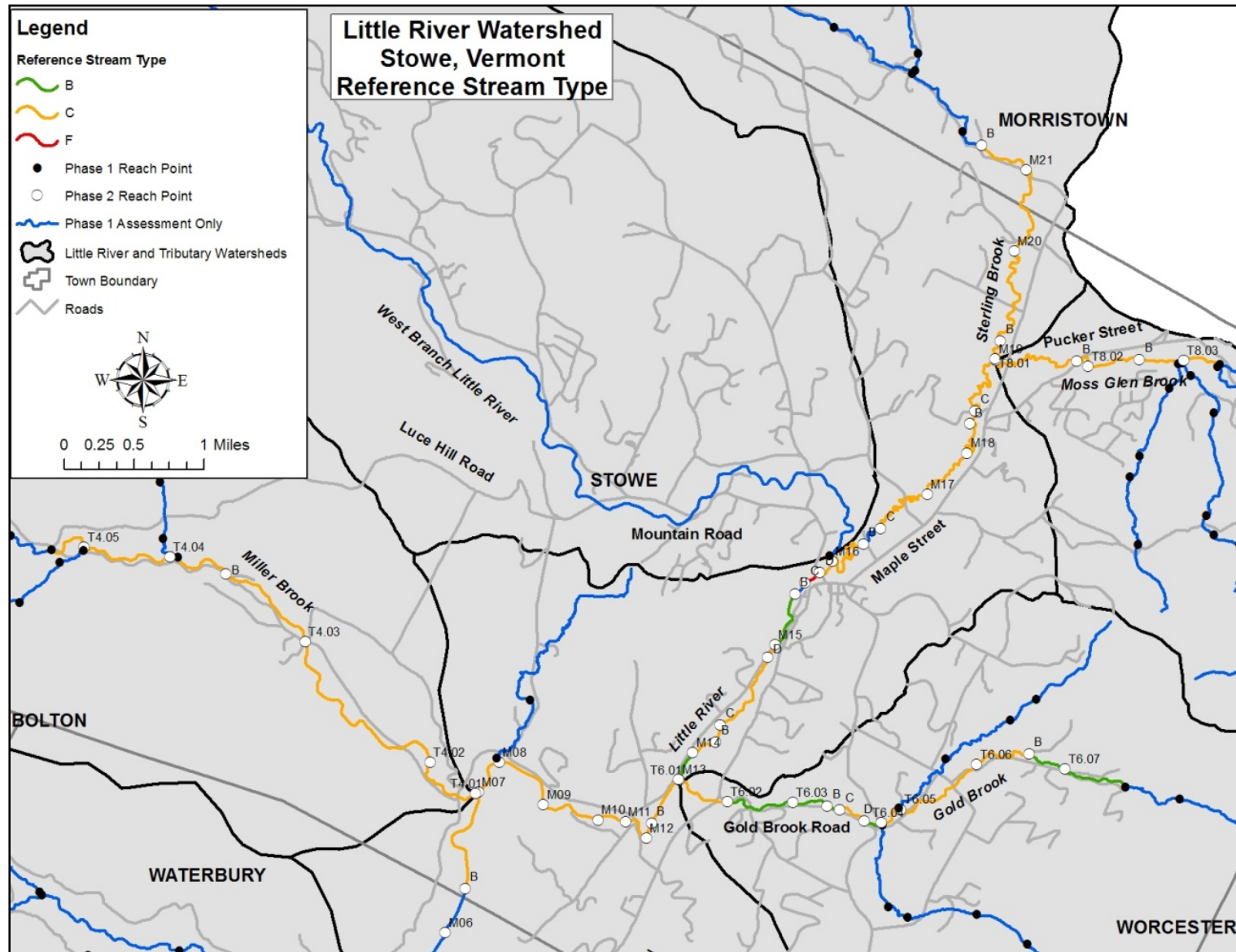


Figure 5.1. Reference stream types for the Little River watershed

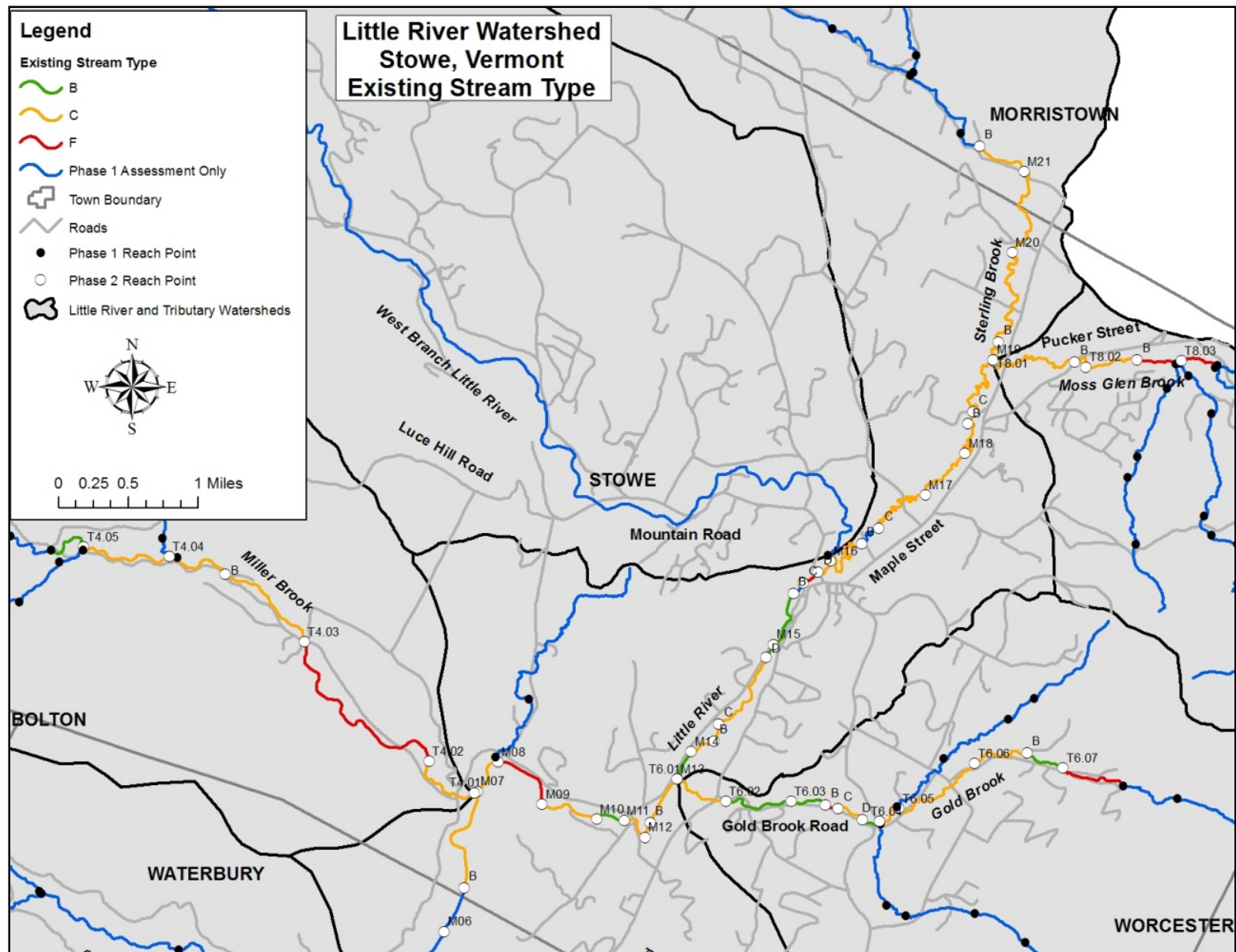


Figure 5.2 Existing stream types of the Little River watershed

All but one of the Phase 2 reaches/segments on the main stem of the Little River within the Phase 2 study area are Rosgen (1996) “C” channels by reference; M13 and M15 are semi-confined “B” channels. All assessed reaches on Miller Brook and Moss Glen Brook are “C” channels by reference. On Gold Brook, all except three reaches are “C” channels by reference. The other three reaches are “B” channels by reference. There are many reaches/segments where the existing stream type differs from the reference stream type or a stream type departure has taken place. A stream type departure occurs when the channel dimensions deviate so far from the reference condition that the existing stream type is no longer the reference stream type. Stream type departures from a reference “C” channel with slight entrenchment to a “Bc” channel with moderate entrenchment have occurred in reaches/segments M10, M14-D and T4.05. A slightly more extreme stream type departure occurred in two reaches/segments on Gold Brook (T6.03-B and T6.07) where moderately entrenched “B” channels have become very entrenched “F” channels. An even more extreme stream type departure from a reference “C” channel with slight entrenchment to an entrenched “F” channel has occurred in reaches/segments M08, T4.02, T8.02-B and T8.03. These stream type departures represent a significant change in floodplain access and stability. Watersheds which have lost attenuation or sediment storage areas due to human related constraints are generally more sensitive to erosion hazards, transport greater quantities of sediment and nutrients to receiving waters, and lack the sediment storage and distribution processes that create and maintain habitat (Vermont Agency of Natural Resources, 2007a).

Functioning floodplains play a crucial role in providing long term stability to a river system. Natural and anthropogenic impacts may alter the equilibrium of sediment and discharge in natural stream systems and set in motion a series of morphological responses (aggradation, degradation, and widening and/or planform adjustment) as the channel tries to reestablish a dynamic equilibrium. Small to moderate changes in slope, discharge, and/or sediment supply can alter the size of transported sediment as well as the geometry of the channel; while large changes can transform reach level channel types (Ryan 2001). Human-induced practices that have contributed to stream instability within the Little River watershed include:

- Forest clearing
- Channelization and bank armoring
- Removal of woody riparian vegetation
- Floodplain encroachments
- Poor road maintenance and installation of infrastructure
- Loss of wetlands

These anthropogenic practices have altered the balance between water and sediment discharges within the Little River watershed. Channel morphologic responses to these practices contribute to channel adjustment that may further create unstable channels. All three adjustment processes, aggradation, widening and planform migration as a result of historic degradation within the channel, were common in the Little River watershed. Degradation is the term used to describe the process whereby the stream bed lowers in elevation through erosion, or scour, of bed material. Aggradation is a term used to describe the raising of the bed elevation through an accumulation of sediment. The planform of a channel is its shape as seen from the air. Planform change can be the result of a straightened course imposed on the river through different channel management activities, or a channel response to other adjustment processes such as aggradation and widening.

Channel widening occurs when stream flows are contained in a channel as a result of degradation or floodplain encroachment or when sediments overwhelm the stream channel and the erosive energy is concentrated into both banks.

The existing geomorphic condition is depicted in Figure 5.3. Geomorphic condition is determined based on the degree (if any) of channel degradation, aggradation, widening and planform adjustment. Except for four reaches/segments, the assessed segments and reaches in the Little River watershed were found to be in “fair” geomorphic condition. The other four assessed reaches were in “good” geomorphic condition. Four segments did not receive a full phase 2 assessment. Segment M06-A was not assessed because it was influenced by backwater from the Waterbury Reservoir. Segment M16-B was not assessed due to influence from beaver dams. Two segments (M15-B and M21-B) were not assessed because they are located in bedrock gorges.

The reach condition ratings of the Little River indicate that most of the reaches are actively, or have historically, undergone a process of minor, major or even extreme geomorphic adjustment. Many of the reaches studied in the Little River watershed are undergoing a channel evolution process in response to large scale changes in its sediment, slope, and/or discharge associated with the human influences on the watershed. Table 3 below summarizes the channel evolution of each study reach and the primary adjustment processes that are occurring.

Both the “D” stage and “F” stage channel evolution model (Vermont Agency of Natural Resources, 2007b) are helpful for explaining the channel adjustment processes underway in the Little River watershed. The “F” stage channel evolution model is used to understand the process that occurs when a stream degrades (incises). The common stages of the “F” channel evolution stage, as depicted in Figure 5.4 include:

- A pre-disturbance period
- Incision – channel degradation
- Aggradation and channel widening
- The gradual formation of a stable channel with access to its floodplain at a lower elevation

The “D-stage” channel evolution model applies to reaches where there may have been some minor historic incision; however, the more dominant active adjustment process is aggradation, which in turn leads to channel widening and planform adjustment. The D-stage adjustment process typically occurs in unconfined, low to moderate gradient valleys where the stream is not entrenched and has access to its floodplain or flood prone area at the 1-2 year flood stage.

When stream channels are altered through straightening, it can set this evolution process into motion and cause adjustment processes to occur. The bed erosion that occurs when a meandering river is straightened in its valley is a problem that translates to other sections of the stream. Localized incision will travel upstream and into tributaries, thereby eroding sediments from otherwise stable streambeds. These bed sediments will move into and clog reaches downstream, leading to lateral scour and erosion of the streambanks. Channel evolution processes may take decades to play out. Even landowners that have maintained wooded areas along their stream and riverbanks may have experienced eroding banks as stream channel slopes adjust to match the valley slopes. It is difficult for streams to attain a new equilibrium where the placement of roads and

other infrastructure has resulted in little or no valley space for the stream to access or to create a floodplain.

Channel equilibrium can be assessed by looking at the regimes of sediment transport within the watershed. The analysis of sediment regimes at the watershed scale is useful for summarizing the stressors affecting the equilibrium condition of river channels. Sediment regime mapping provides a context for understanding the sediment transport and channel evolution processes which govern changes in geometry and planform for river channels in a state of disequilibrium.

In terms of the VANR channel evolution model, the Little River is predominately at stage III of the “F-stage” channel evolution model. In many reaches the channel has undergone historic degradation as evidenced by abandoned terraces. Many of the cross sections on study reaches were found to be incised, with eight segments having severe incision ratios. The incision ratios ranged from 1.0 to 2.85. Along many of the reaches and near the mouths of the tributaries, the system is actively adjusting to this lower bed elevation by moving laterally and widening in order to create a new floodplain at a lower elevation. This widening and planform adjustment is leading to another adjustment process, aggradation. Aggradation in the Little River study area seems to be a combination of endogenous sediment that is created as the stream widens and erodes its banks to reestablish a new floodplain as well as from exogenous sources such as gravel roads and land clearing. Unvegetated mid-channel bars, point bars, side bars, avulsions, flood chutes and impending neck cutoffs confirm the Little River is undergoing extensive lateral migration. Three segments in the study area (M15-C, T6.03-A and T6.03-D) were found to be in stage I of the “F-stage” channel evolution model, wherein the channel has not yet incised and no major adjustment processes are occurring.

Four segments within the Little River study area (M20, M21-A, T6.02 and T6.03-C) fall into the “D-stage” evolution model, where the more dominant active adjustment process is aggradation. This build up of sediment leads to channel widening and planform adjustment. Some of these segments have undergone some minor historic incision; however, the more dominant active adjustment process is aggradation. Segment T6.03-C on Gold Brook (D-IIId stage) is undergoing extreme aggradation. This has led to major channel widening and planform adjustment. Reach T6.02 on Gold Brook falls into the D-IIb stage. Channel incision has not occurred in reach T6.02 due to the resistance of bedrock grade controls on the streambed. The dominant process in this reach is aggradation. The stream is a very entrenched “B” stream type.

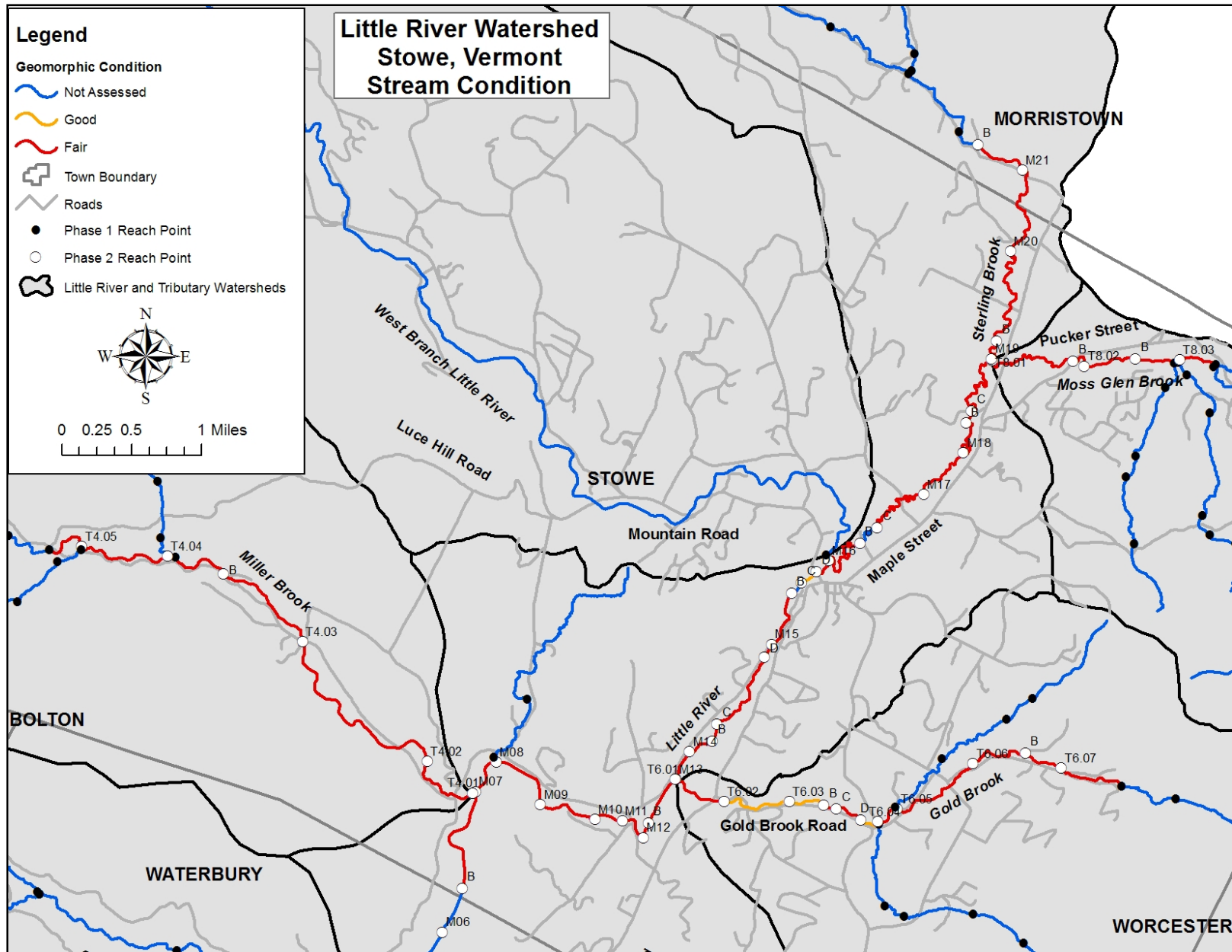


Figure 5.3. Phase 2 Geomorphic Condition of the Little River Watershed

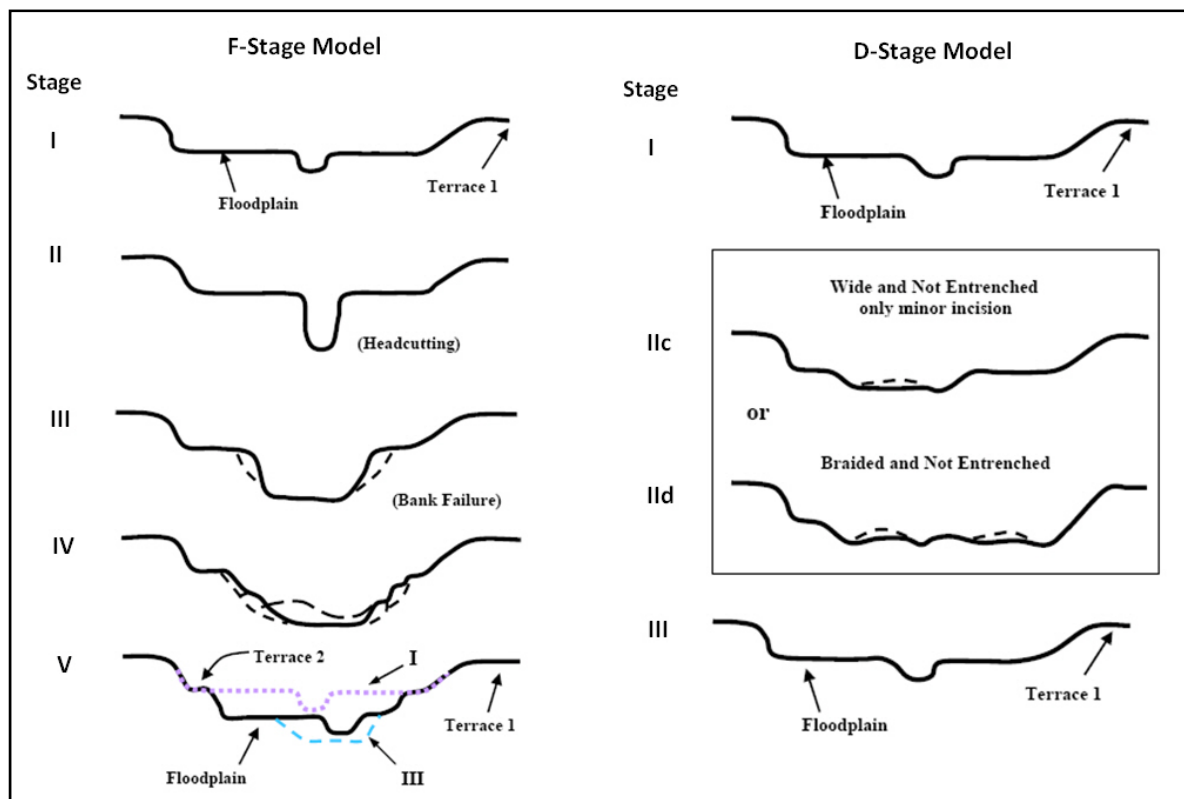


Figure 5.4 Typical channel evolution model for F-Stage and D-Stage (Vermont Agency of Natural Resources, 2007b)

Table 3. Stream Type and Channel Evolution Stage							
Segment Number	Entrenchment Ratio	Width to Depth Ratio	Reference Stream Type	Incision Ratio	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
M06-B	2.95	41.4	C4	1.95	C4	F-III	Aggradation Widening Planform
M07	2.39	38.7	C4	2.08	C4	F-IV	Aggradation Widening Planform
M08	1.23	24.6	C4	1.95	F4	F-III	Aggradation Widening Planform
M09	3.27	23.1	C4	1.98	C4	F-III	Aggradation Widening Planform
M10	1.38	31.0	C4	2.26	B4c	F-III	Aggradation Widening Planform
M11	4.83	38.4	C4	1.28	C4	F-III	Aggradation Widening Planform

Table 3. Stream Type and Channel Evolution Stage							
Segment Number	Entrenchment Ratio	Width to Depth Ratio	Reference Stream Type	Incision Ratio	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
MI2-A	10.91	18.2	C4	1.47	C4	F-III	Aggradation Widening Planform
MI2-B	12.82	27.5	C4	1.30	C4	F-III	Aggradation Widening Planform
MI3	2.07	23.2	B5c	1.51	B5c	F-III	Aggradation Widening Planform
MI4-A	2.18	21.8	C4	1.62	C4	F-III	Aggradation Widening Planform
MI4-B	8.77	16.8	C4	1.47	C4	F-II	Aggradation Widening Planform
MI4-C	5.73	23.3	C4	1.71	C4	F-III	Aggradation Widening Planform
MI4-D	1.45	22.2	C4	1.87	B4c	F-II	Aggradation Widening Planform
MI5-A	1.45	22.2	B4c	1.87	B4c	F-II	Aggradation Widening Planform
MI5-C	1.21	18.2	F3	1.00	F3	F-I	Widening
MI5-D	2.84	25.1	C4	1.45	C4	F-III	Aggradation Widening Planform
MI6-A	15.50	22.5	C5	1.31	C5	F-III	Aggradation Widening Planform
MI6-C	23.81	11.5	C4	1.53	C4	F-III	Aggradation Widening Planform
MI7	9.70	21.5	C4	1.63	C4	F-III	Aggradation Widening Planform
MI8-A	17.48	12.0	C4	1.49	C4	F-III	Aggradation Widening Planform
MI8-B	17.05	11.4	C4	1.74	C4	F-III	Aggradation Widening Planform
MI8-C	17.48	12.0	C4	1.49	C4	F-III	Aggradation Widening Planform

Table 3. Stream Type and Channel Evolution Stage

Segment Number	Entrenchment Ratio	Width to Depth Ratio	Reference Stream Type	Incision Ratio	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
M19-A	37.54	22.7	C4	1.69	C4	F-III	Aggradation Widening Planform
M19-B	9.90	20.2	C4	1.47	C4	F-III	Aggradation Widening Planform
M20	19.06	10.9	C4	1.00	C4	D-IIc	Aggradation Widening Planform
M21-A	8.56	20.8	C4	1.00	C4	D-IIc	Aggradation Widening Planform
T4.01	2.30	50.4	C4	1.52	C4	F-III	Aggradation Widening Planform
T4.02	1.20	30.5	C4	2.00	F4	F-III	Aggradation Widening Planform
T4.03-A	2.29	21.9	C3b	1.37	C3b	F-III	Aggradation Widening Planform
T4.03-B	2.57	19.5	C3b	1.90	C3b	F-III	Aggradation Widening Planform
T4.04	2.88	23.5	C4b	1.86	C4b	F-III	Aggradation Widening Planform
T4.05	1.33	25.7	C3	2.00	B3c	F-II	Aggradation Widening Planform
T6.01	5.86	23.9	C4	1.77	C4	F-III	Aggradation Widening Planform
T6.02	1.33	24.7	B4	1.00	B4	D-IIb	Aggradation Widening Planform
T6.03-A	1.89	23.3	B3	1.00	B3	F-I	Widening
T6.03-B	1.28	21.0	B3	2.85	F4b	F-II	Aggradation Widening Planform
T6.03-C	2.78	29.2	C4b	1.20	C4b	D-IIId	Aggradation Widening Planform
T6.03-D	1.50	22.3	B3	1.00	B4	F-I	Widening
T6.04	5.82	13.8	C4b	1.43	C4b	F-III	Aggradation Widening Planform

Table 3. Stream Type and Channel Evolution Stage							
Segment Number	Entrenchment Ratio	Width to Depth Ratio	Reference Stream Type	Incision Ratio	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
T6.05	5.69	13.6	C4b	1.39	C4b	F-III	Aggradation Widening Planform
T6.06-A	3.42	15.8	C3b	1.36	C3b	F-III	Aggradation Widening Planform
T6.06-B	1.60	21.8	B4a	1.76	B4a	F-II	Aggradation Widening Planform
T6.07	1.15	24.5	B3a	2.41	F4a	F-II	Aggradation Widening Planform
T8.01-A	2.01	13.8	C4	1.62	C4	F-III	Aggradation Widening Planform
T8.01-B	11.43	39.5	C4	1.86	C4	F-IV	Aggradation Widening Planform
T8.02-A	9.06	43.1	C4	1.00	C4	F-IV	Aggradation Widening Planform
T8.02-B	1.15	21.6	C4	2.79	F4	F-III	Aggradation Widening Planform
T8.03	1.26	26.2	C4	2.37	F4	F-III	Aggradation Widening Planform
	Bold Red lettering – denotes extreme adjustment process Bold Black lettering – denotes major adjustment process Black lettering (no bold) – denotes minor adjustment process Pink denotes high width to depth ratio Red denotes severe incision ratio Blue denotes moderate incision ratio Green denotes a stream type departure						

Two segments on the main stem (M20 and M21-A) fall into the D-IIc stage. The stream channel has not incised in segment M20 and has only slightly incised in M21-A. In the D-IIc stage, a steeper gradient may have been imposed through activities such as channelization, but due to the resistance of the bed material, or a downstream grade control, the stream has not incised or lost access to its floodplain (remaining a “C” Stream Type). There is some minor widening and major planform adjustment as the channel migrates laterally through bank erosion caused by the increased stream power. The balance between stream power and boundary materials is re-established when the slope flattens after a process of channel lengthening and increased sinuosity. The stream bed in these channels may be a combination of poorly defined riffle-pool features and plane bed features.

Nine reaches have experienced stream type departures. Four reaches with “C” reference stream types (M08, T4.02, T8.02-B and T8.03) have become “F” channels. Two segments (T6.03-B and T6.07) have evolved from “B” channels to “F” channels. Three segments (M10, M14-D and T4.05), which were once “C” channels, are now “B” channels. Most of these stream type departures are likely due to channel alteration and/or encroachment within the river corridor thereby resulting in extreme incision. Reach T4.05 is located just downstream of an on-stream dam and has been starved of sediment, resulting in extreme incision and a change in stream type.

HABITAT EVALUATION

Table 4 below shows a comparison of the habitat condition based on the Rapid Habitat Assessment (RHA) and the geomorphic condition based on the Rapid Geomorphic Assessment (RGA). For 30 of the 48 assessed segments, both the RHA and the RGA resulted in a “fair” rating. Three segments (T6.02, T6.03-A and T6.03-D) had a rating of “good” for both the RHA and the RGA. One segment (M15-C) had a rating of “fair” for habitat but “good” for geomorphic condition, and fourteen segments had a rating of “good” for habitat but “fair” for geomorphic condition. Many of the reaches that had been straightened or had floodplain alterations lacked a strong riffle-pool bedform and the diversity of habitat features that this brings. Numerous reaches had major intrusion into their river corridor from roads, and many reaches had inadequate riparian buffers due to historic and /or recent land clearing. Overall, the RHA score was similar to the RGA score, implying that the ecological health of the Little River is closely related to the geomorphic condition of the stream.

Table 4. Comparison of RHA and RGA for Phase 2 Reaches				
Segment Number	Score RHA	Score RGA	Rating RHA	Rating RGA
M06-A	Impounded - Not Assessed			
M06-B	0.60	0.44	Fair	Fair
M07	0.60	0.39	Fair	Fair
M08	0.54	0.45	Fair	Fair
M09	0.56	0.45	Fair	Fair
M10	0.58	0.49	Fair	Fair
M11	0.58	0.54	Fair	Fair
M12-A	0.46	0.55	Fair	Fair
M12-B	0.59	0.58	Fair	Fair
M13	0.50	0.49	Fair	Fair
M14-A	0.60	0.54	Fair	Fair
M14-B	0.48	0.59	Fair	Fair
M14-C	0.55	0.40	Fair	Fair
M14-D	0.55	0.53	Fair	Fair
M15-A	0.53	0.53	Fair	Fair

Table 4. Comparison of RHA and RGA for Phase 2 Reaches				
Segment Number	Score RHA	Score RGA	Rating RHA	Rating RGA
M15-B	Bedrock Gorge – Not Assessed			
M15-C	0.64	0.76	Fair	Good
M15-D	0.61	0.61	Fair	Fair
M16-A	0.59	0.48	Fair	Fair
M16-B	Beaver Dam Influence – Not Assessed			
M16-C	0.57	0.46	Fair	Fair
M17	0.66	0.44	Good	Fair
M18-A	0.58	0.46	Fair	Fair
M18-B	0.57	0.58	Fair	Fair
M18-C	0.60	0.46	Fair	Fair
M19-A	0.57	0.44	Fair	Fair
M19-B	0.63	0.44	Fair	Fair
M20	0.68	0.60	Good	Fair
M21-A	0.68	0.58	Good	Fair
M21-B	Bedrock Gorge – Not Assessed			
T4.01	0.65	0.41	Good	Fair
T4.02	0.62	0.38	Fair	Fair
T4.03-A	0.60	0.50	Fair	Fair
T4.03-B	0.71	0.53	Good	Fair
T4.04	0.68	0.49	Good	Fair
T4.05	0.81	0.56	Good	Fair
T6.01	0.47	0.51	Fair	Fair
T6.02	0.76	0.69	Good	Good
T6.03-A	0.70	0.80	Good	Good
T6.03-B	0.64	0.53	Fair	Fair
T6.03-C	0.66	0.53	Good	Fair
T6.03-D	0.73	0.78	Good	Good
T6.04	0.68	0.61	Good	Fair
T6.05	0.71	0.59	Good	Fair
T6.06-A	0.65	0.54	Good	Fair
T6.06-B	0.71	0.55	Good	Fair
T6.07	0.66	0.54	Good	Fair
T8.01-A	0.55	0.56	Fair	Fair
T8.01-B	0.45	0.44	Fair	Fair
T8.02-A	0.58	0.51	Fair	Fair
T8.02-B	0.55	0.53	Fair	Fair
T8.03	0.68	0.41	Good	Fair

5.2 Bridge and Culvert Assessment

A total of 30 structures (26 bridges and 4 culverts) are located within the Phase 2 Little River study area (Figure 5.5). Twenty-five of these stream crossings are on public roads. A bridge and culvert assessment using the VANR protocol was conducted of 19 of these structures by J Schwartz during August and September 2006. Bear Creek Environmental, LLC used the VANR bridge and culvert protocol to assess the Waterbury Road crossing during summer 2007. The geomorphic compatibility and AOP screening tools, photographs and Phase 2 constriction notes were used to prioritize structures for replacement/retrofit. A list of resources for towns regarding funding, planning and design for replacement and retrofit of stream crossings is available on the Vermont River Management and the Vermont Department of Fish and Wildlife's web sites:

http://www.vtwaterquality.org/rivers/htm/rv_EducationalResources.htm
http://www.vtfishandwildlife.com/library.cfm?libbase_ =Reports_and_Documents).

Table 5 summarizes the data collected for the twenty-four structures that cross public roads within the Phase 2 study reach. The final column of Table 5 includes a prioritization of structures for replacement or retrofit based on three criteria: structure width in relation to bankfull channel width, aquatic organism passage (AOP) and geomorphic compatibility, and notes from the Phase 2 study. One of four priorities for replacement was assigned (NR- not recommended for replacement at this time, low, moderate or high).

Six structures are not recommended for replacement at this time. These structures are all bridges that have structure spans that are at least 100 percent of the bankfull channel width. No significant sediment transport issues were noted at the structures, which were assigned NR. Seven structures were assigned a low priority for replacement/retrofit. The low priority structures are bridges with only minor sediment transport issues. Ten structures were identified as moderate priority for replacement/retrofit. The bridges in the moderate priority category fall within the partially compatible or mostly incompatible category using the geomorphic screening tool. Two culvert crossings on Gold Brook (Bryan Road and North Hollow Road) were placed in the moderate priority category because the structures are undersized and do not have sediment throughout the structure, resulting in reduced aquatic organism passage. Two stream crossings (Upper Hollow Road and Stagecoach Road) were assigned a high priority for replacement. The culvert on Gold Brook that crosses Upper Hollow Road is freefall and has no AOP except for adult salmonids. The twin culverts on Moss Glen Brook at the Stagecoach Road crossing were found to be mostly incompatible using the geomorphic screening tool and have reduced AOP. A summary of the moderate and high priority structures is provided in Appendix B.

Table 5
Little River Watershed
Evaluation using VANR Geomorphic Compatibility and AOP Screening Tools

Stream Name	Reach/ Segment Number	Road Name	Structure Type	Percent Bankfull Channel Width ¹	Aquatic Organism Passage (AOP)	Geomorphic Compatibility	Phase 2 Constriction Notes	Priority for Replacement or Retrofit
Little River Mainstem	M11	Moscow Road	Bridge	89% ²	NA	Partially Compatible	Scour above, scour below, Alignment	Moderate
	M15-A	River Road	Bridge	85% ²	NA	Mostly Compatible	Deposition above (mid-channel bar > ½ bankfull)	Low
	M15-D	Mountain Road	Bridge	120% ²	NA	Mostly Compatible	Deposition above and scour below	Low
	M16-B	Cemetery Road	Bridge	100% ²	NA	Fully Compatible	None	NR ⁵
	M16-C	West Hill Road	Bridge	113% ²	NA	No assessment data available	Deposition above, deposition below, scour above, alignment	Low
	M18-B	Little River Farm Road	Bridge	65% ⁴	NA	Partially Compatible	Scour above; rip-rap within structure acting as channel constriction	Moderate
Sterling Brook	M19-B	Tansy Hill Road	Bridge	79% ²	NA	Fully Compatible	Deposition below	Low
	M20	Moulton Lane	Bridge	100% ⁴	NA	Mostly Compatible	Deposition above	NR
	M20	Sterling Valley Road	Bridge	Not available	NA	No assessment data available	Deposition above, deposition below	Low
	M21-B	Dr Neel Road	Bridge	67% ³	NA	No assessment data available	Scour below	Low
Miller Brook	T4.01	Moscow Road	Bridge	56% ²	NA	Partially Compatible	Deposition above and below; scour above and below	Moderate
	T4.02	Nebraska Valley Road	Bridge	79% ²	NA	Partially Compatible	Deposition above, scour above and below, alignment (bridge appears to be in poor condition)	Moderate
	T4.03-A	Nebraska Valley Road	Bridge	88% ²	NA	Partially Compatible	Deposition above and below, scour above, alignment	Moderate

Table 5
Little River Watershed
Evaluation using VANR Geomorphic Compatibility and AOP Screening Tools

Stream Name	Reach/ Segment Number	Road Name	Structure Type	Percent Bankfull Channel Width ¹	Aquatic Organism Passage (AOP)	Geomorphic Compatibility	Phase 2 Constriction Notes	Priority for Replacement or Retrofit
	T4.03-A	Miller Brook Road	Bridge	110% ²	NA	No assessment data available	Deposition above	NR
	T4.05	Nebraska Valley Road	Bridge	46% ²	NA	Partially Compatible	Deposition below and scour above	Moderate
Gold Brook	T6.01	Waterbury Road	Bridge	91% ⁴	NA	Partially Compatible	Deposition below; top of structure deteriorated	Moderate
	T6.02	Gold Brook Road	Bridge	186% ⁴	NA	Mostly Compatible	Bridge is 50 feet high	NR
	T6.03-D	Covered Bridge Road	Bridge	108% ²	NA	Mostly Compatible	None	NR
	T6.05	Stowe Hollow Road	Bridge	135% ²	NA	Mostly Compatible	Deposition above, deposition below, alignment	Low
	T6.05	Upper Hollow Road	Culvert	65% ²	No AOP except adult salmonids	Fully Compatible	Deposition above and below, scour below	High
	T6.05	N Hollow Road	Bridge	69% ²	NA	Mostly Incompatible	Deposition above, deposition below, scour below	Moderate
	T6.06-A	Bryan Road	Culvert	37% ²	Reduced	Mostly Compatible	Deposition above, deposition below, scour below (steep riffle and undersized)	Moderate
	T6.07	N Hollow Road	Culvert	42% ²	Reduced	Mostly Compatible	Deposition above, deposition below, scour below; possible fish passage issue	Moderate
Moss Glen Brook	T8.01-A	Stagecoach Road	Twin Culverts	56% ⁴	Reduced	Mostly Incompatible	Deposition above and below, scour below	High
	T8.01-A	Pucker Street	Bridge	175% ²	NA	No assessment data available	Deposition above	NR

¹Shaded for bankfull width percentage less than 50%, ²Percent bankfull width measured in the field during Phase 2 Assessment, ³Percent bankfull width based on Vermont Hydraulic Geometry Curves, ⁴Structure width from VANR Bridge and Culvert Assessment, ⁵NR- not recommended for replacement or retrofit at this time

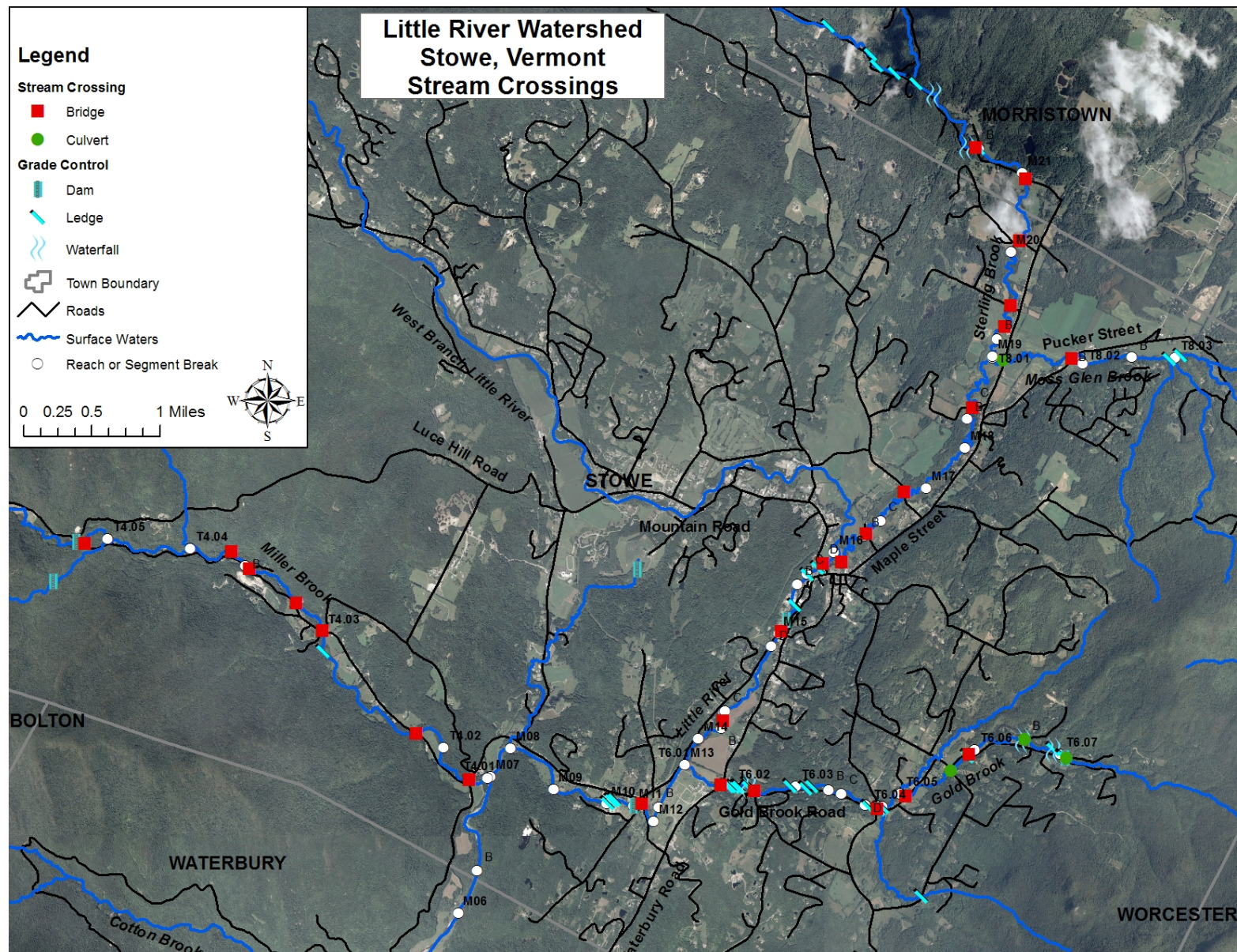


Figure 5.5. Stream Crossings within the Little River Watershed

6.0 Stressor, Departure and Sensitivity Analysis

Stressor, departure and sensitivity maps are presented here as a means of displaying the effects of all significant physical processes occurring within the Little River watershed that were observed during the Phase 1 and Phase 2 Stream Geomorphic Assessments. These maps also provide an indication of the degree to which the channel adjustment processes within the watershed have been altered, at both the watershed scale and the reach scale. The analysis of existing and historic departures from equilibrium conditions along a stream network allows for the prediction of future alterations within the watershed. This is helpful in developing and prioritizing potential protection and restoration projects.

6.1 Stressor Identification

6.1.1 Hydrologic Regime Stressors

The hydrologic regime is the timing, volume, and duration of flow events throughout the year and over time and is characterized by the input and manipulation of water at the watershed scale. When the hydrologic regime has been significantly changed, stream channels will respond by undergoing a series of channel adjustments. The land use within the watershed plays a role in the hydrology of the receiving waters. The percentage of urban and cropland development within the watershed are factors which change a watershed's response to precipitation. The most common effects of urban and cropland development is increasing peak discharges and runoff by reducing infiltration and travel time (United States Department of Agriculture 1986).

The dominant watershed land cover/land use within the Little River watershed is forest. The two most downstream reaches on Gold Brook were the only Phase 2 reaches which resulted in a watershed land cover/land use impact rating of high (10% or more is crop and/or urban). Analysis of hydric soils located where current land uses are agricultural or urban indicates some loss of wetland attenuation (Figure 6.1). Historical deforestation in the Little River watershed may also have contributed to wetland loss.

The Little River watershed has a moderate network of roads as shown in Figure 6.1. Extensive road networks can contribute significantly to increased flows within a river resulting both from increased runoff and stormwater ditching. According to Foreman and Alexander (1998), increased peak flows in streams may be evident at road densities of 3.2 miles/ square mile. Subwatersheds with road densities of greater than 3.2 miles/ square mile account for about 13 percent of the Little River watershed. The highest road densities within the watershed are along the lower end of Stevenson Brook, Gold Brook and along Moss Glen Brook.

6.1.2 Sediment Regime Stressors

The sediment regime is the quantity, size, transport, sorting and distribution of sediments. The sediment regime may be influenced by the proximity of sediment

sources, the hydrologic regime, and the specific morphology of the valley, floodplain, and stream. The Sediment Load Indicators Map (Figure 6.2) shows the distribution of sediment load indicators in the study area. Figure 6.2 also shows the cumulative percentage of agricultural land (based on the percentage of cropland) for each subwatershed. As discussed in Section 3.1.3. Land Use, the Little River watershed is 77 percent forest, 9 percent agriculture, 4 percent developed and urban, 8 percent water and 1 percent wetland.

Bank erosion and mass failures contribute significant sediment inputs within the Little River watershed. Bank erosion is defined as “an area of raw and barren soils where the vegetation does not have the ability to hold the soil and/or the soil has slumped or fallen into the channel”. Mass failures can occur when “a perennial stream erodes into or undercuts a high erodible landform, such as glacial lacustrine terrace” (Vermont Agency of Natural Resources, 2007b). Bank erosion mapped during the Phase 2 study totals approximately 27 percent on both the east and west banks of the 48 reaches assessed. Nineteen mass wasting sites were mapped during the Phase 2 assessment. The total length of mass failures on the Little River Phase 2 reaches is about 1,200 feet. Mass failures are most prevalent on Gold Brook. The Gold Brook reaches account for about 15 percent of the mass failures by length of the Phase 2 study area.

Depositional features per mile are mapped to show areas of deposition and planform adjustment. Steep riffles, mid-channel bars, delta bars, flood chutes, avulsions and braiding are parameters included in the depositional features’ map layer. This layer does not necessarily explain the sources of sediment, but these depositional and channel bifurcation features are common in areas where the sediment transport capacity of the channel has been exceeded (VANR, 2007a). Channel migration features (avulsions and flood chutes) are included on the map to show areas of significant planform adjustment. Over 80 percent of the Phase 2 segments assessed have a high number (greater than 5) of depositional features per mile. The most downstream segment assessed for Phase 2 (M06-B) is the only reach with a moderate (between 2 and 5) number of depositional features per mile. Eight segments have a low (less than 2) number of depositional features per mile.

The high bank erosion and the prevalence of mass failures illustrate the Little River has a high source of sediment input. This is resulting in the channel being overwhelmed by sediment and exceeding the sediment transport capability as observed by the numerous depositional features per mile. The high level of aggradation is especially evident in T6.03-B on Gold Brook where there are multiple depositional features and a channel evolution stage of D-IIId.

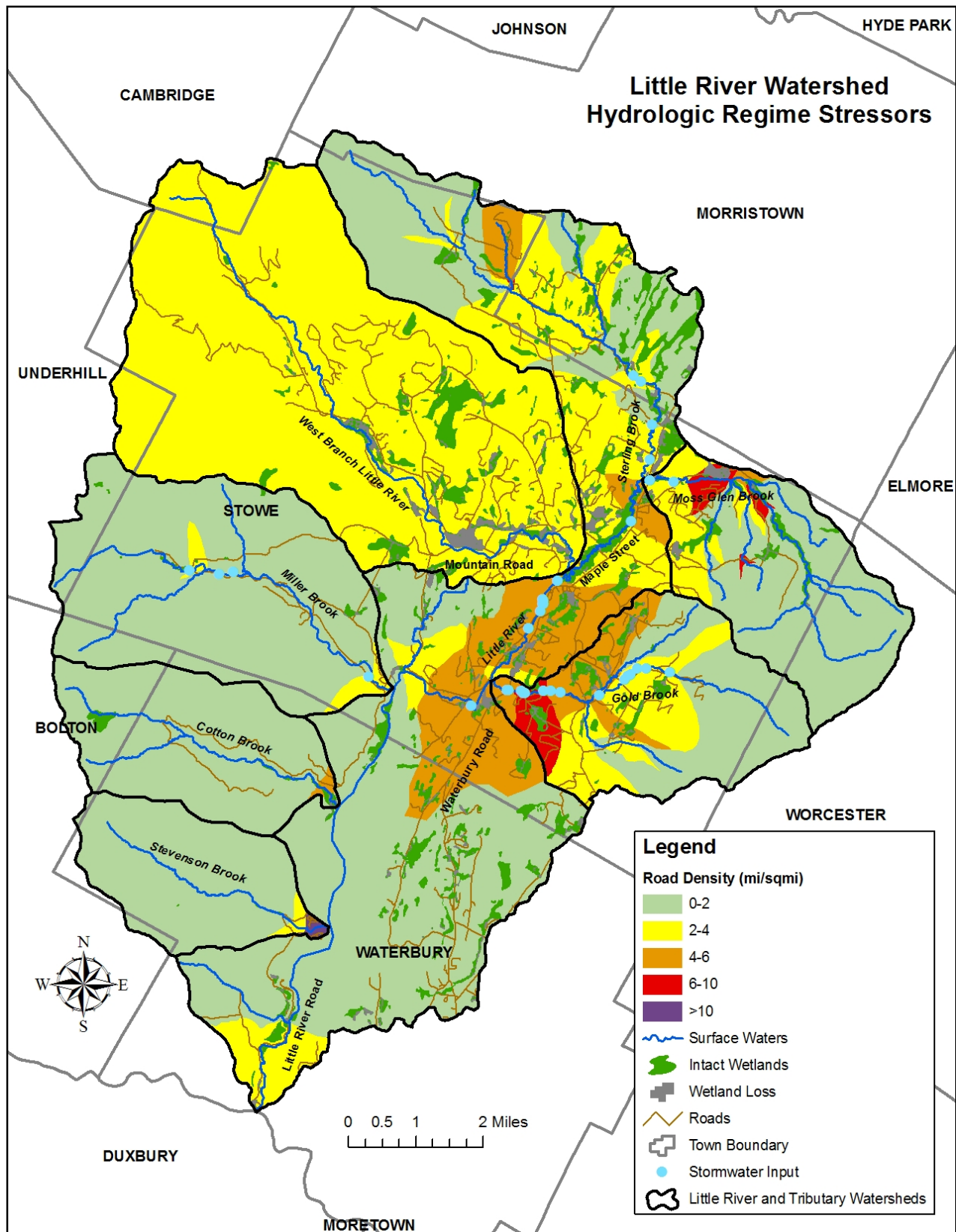


Figure 6.1 Hydrologic Regime Stressors in the Little River watershed.

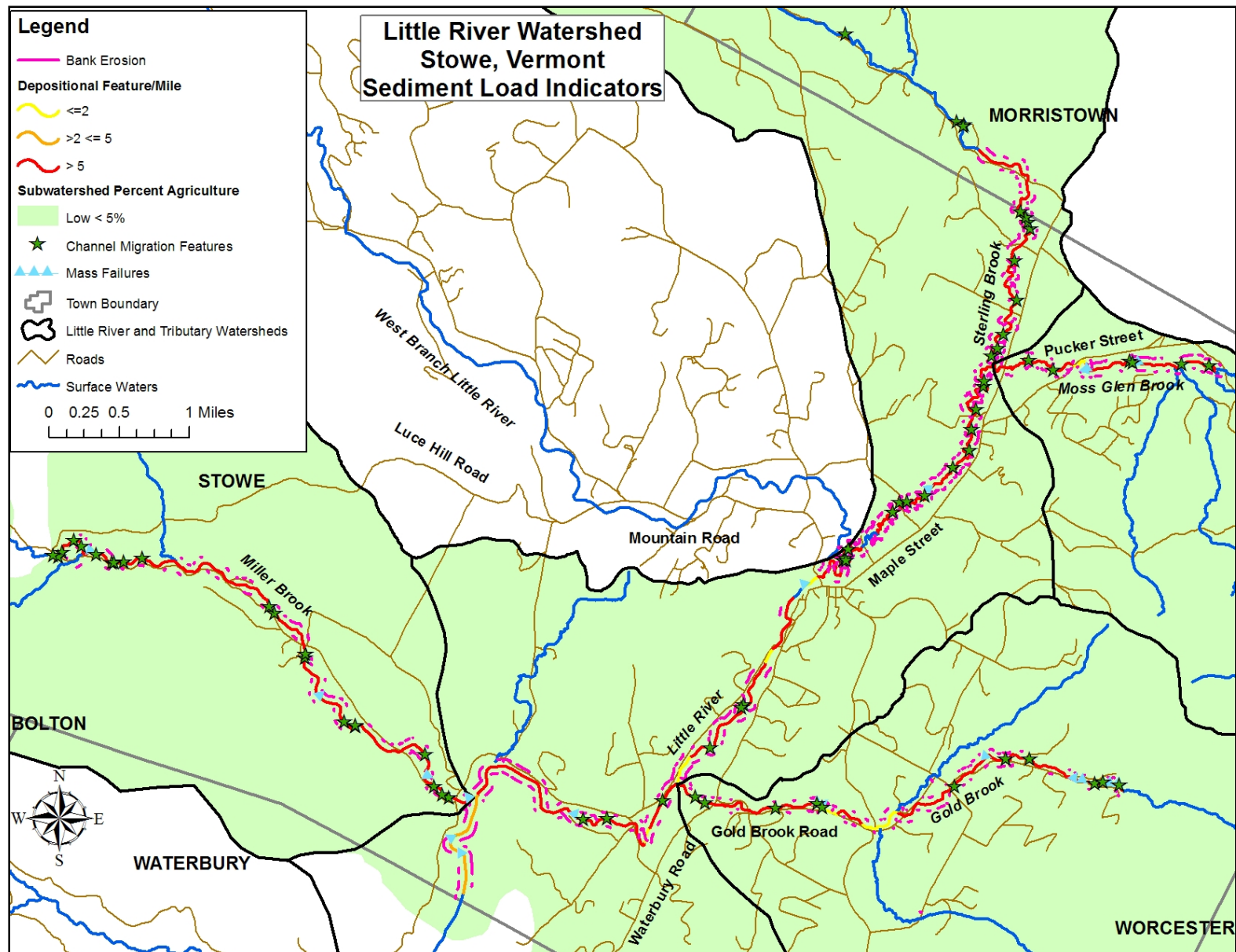


Figure 6.2. Sediment load indicators map for the Little River in Stowe.

6.1.3 Channel Modifiers

Channel straightening, floodplain encroachment, and berms and roads can increase the slope of a channel resulting in increased stream power. Increases in stream power (shown in red or orange in Figures 6.3 and 6.4) can initiate streambed erosion resulting in incision. The most extensive areas of channel straightening and floodplain encroachment (both development and adjacent berms and roads) are in the middle of the watershed between reaches M08 and M15 (Figures 6.3 and 6.4). The Little River within these reaches runs predominantly along Moscow Road and River Road. The majority of the channel straightening within the Little River watershed is associated with roads that run parallel to the stream. The extensive areas with increases in stream power explain the high degree of channel adjustment that is occurring within the watershed.

Grade controls (waterfalls and ledge) and natural and manmade dams and constrictions (such bridges and culverts) constrict flows or raise the bed elevation. Backwater conditions and sediment deposition typically reduce channel slope and stream power (Vermont Agency of Natural Resources, 2007a). Localized areas where slope decreases are expected in the Little River watershed are shown in blue and green in Figures 6.3 and 6.4.

6.1.4 Boundary Conditions and Riparian Modifiers

The resistance of the channel boundary materials is important for understanding the sensitivity of a channel and for predicting when a channel will undergo adjustment from stressors in the watershed. There are a number of factors that can result in decreased boundary condition. One of the most important factors is the quality of the riparian buffer. Riparian buffers provide many benefits. Some of these benefits are protecting and enhancing water quality, providing fish and wildlife habitat, providing streamside shading, and providing root structure to prevent bank erosion. Woody vegetation is essential for holding the bank soils to provide resistance to streambank erosion. There are many locations along the Little River mainstem, Gold Brook and Miller Brook where there is little or no buffer as defined by buffers less than 25 feet in width (Figures 6.5 and 6.6). These stream reaches which lack a high quality riparian buffer are at a significantly higher risk of experiencing high rates of lateral erosion.

Parameters which are indicative of a decrease in boundary condition are shown in red and orange in Figures 6.5 and 6.6. While bank armoring may temporarily increase the boundary condition, it is indicative of where the stream power has resulted in bank erosion or widening of the channel. Extensive bank erosion may increase the stream power, resulting in downstream bank erosion. Areas where woody debris, bed substrate and plant material were removed from the channel also result in decreased stream power. Gravel mining is a practice that can significantly decrease the boundary resistance. General areas where gravel mining has taken place were mapped by the LCPC during the Phase I portion of the study based on information provided by Vermont Agency of Natural Resources.

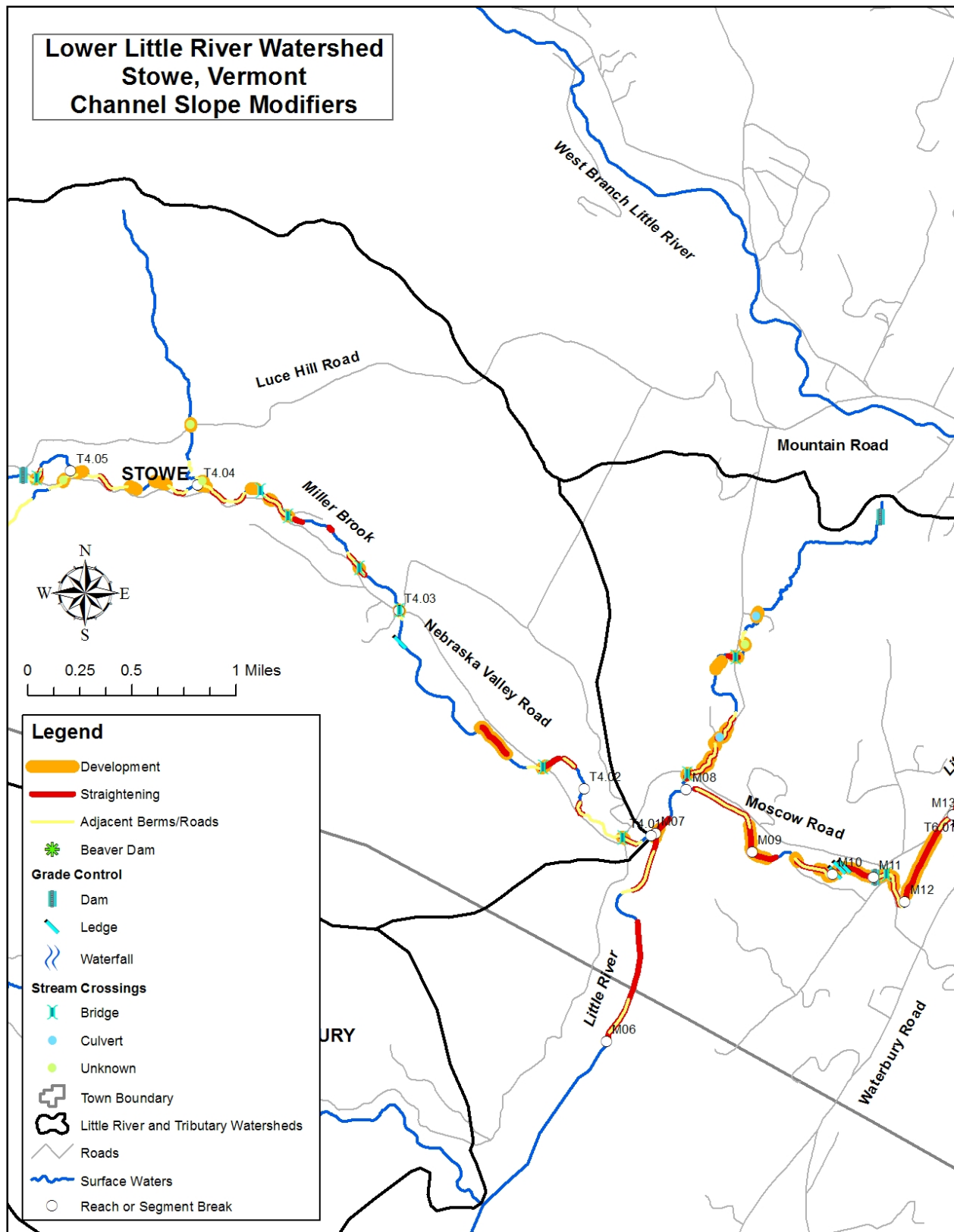
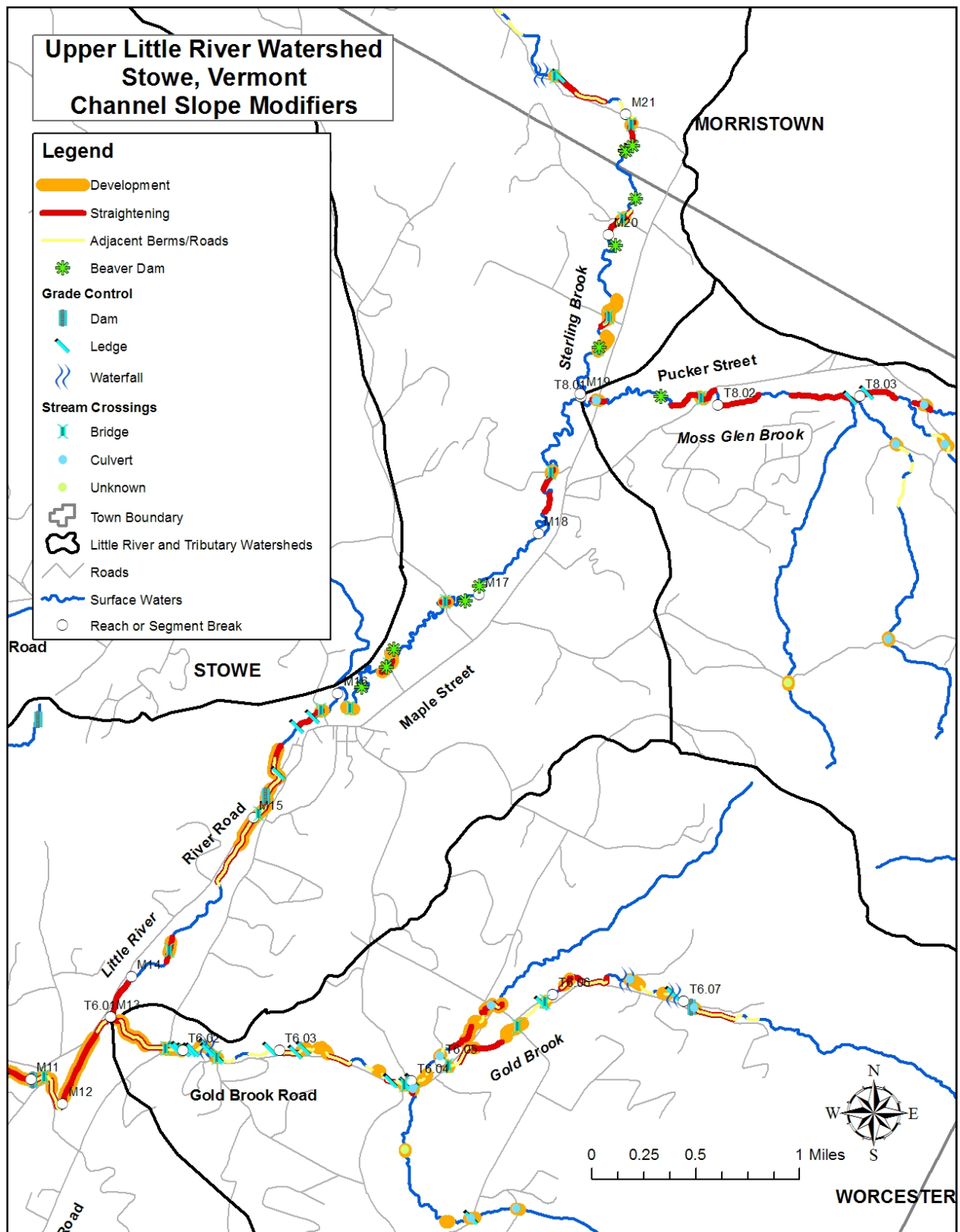


Figure 6.3. Channel slope modifiers map for lower Stowe showing parameters contributing to increases (red and orange) or decreases (blue and green) in slope.



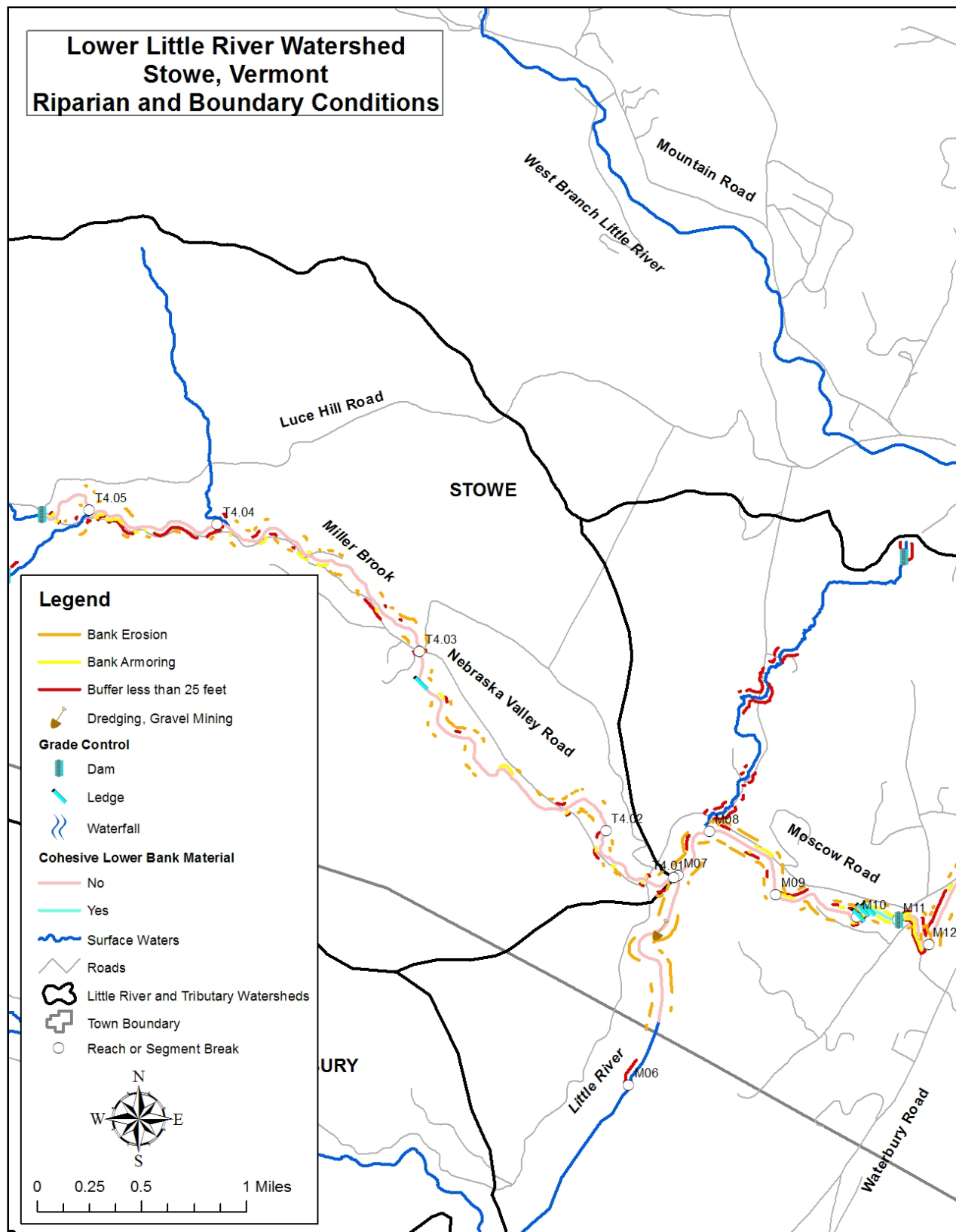


Figure 6.5. Boundary conditions and riparian modifications map for lower Stowe showing areas of decreased boundary condition (red and orange) and increased boundary condition (aqua).

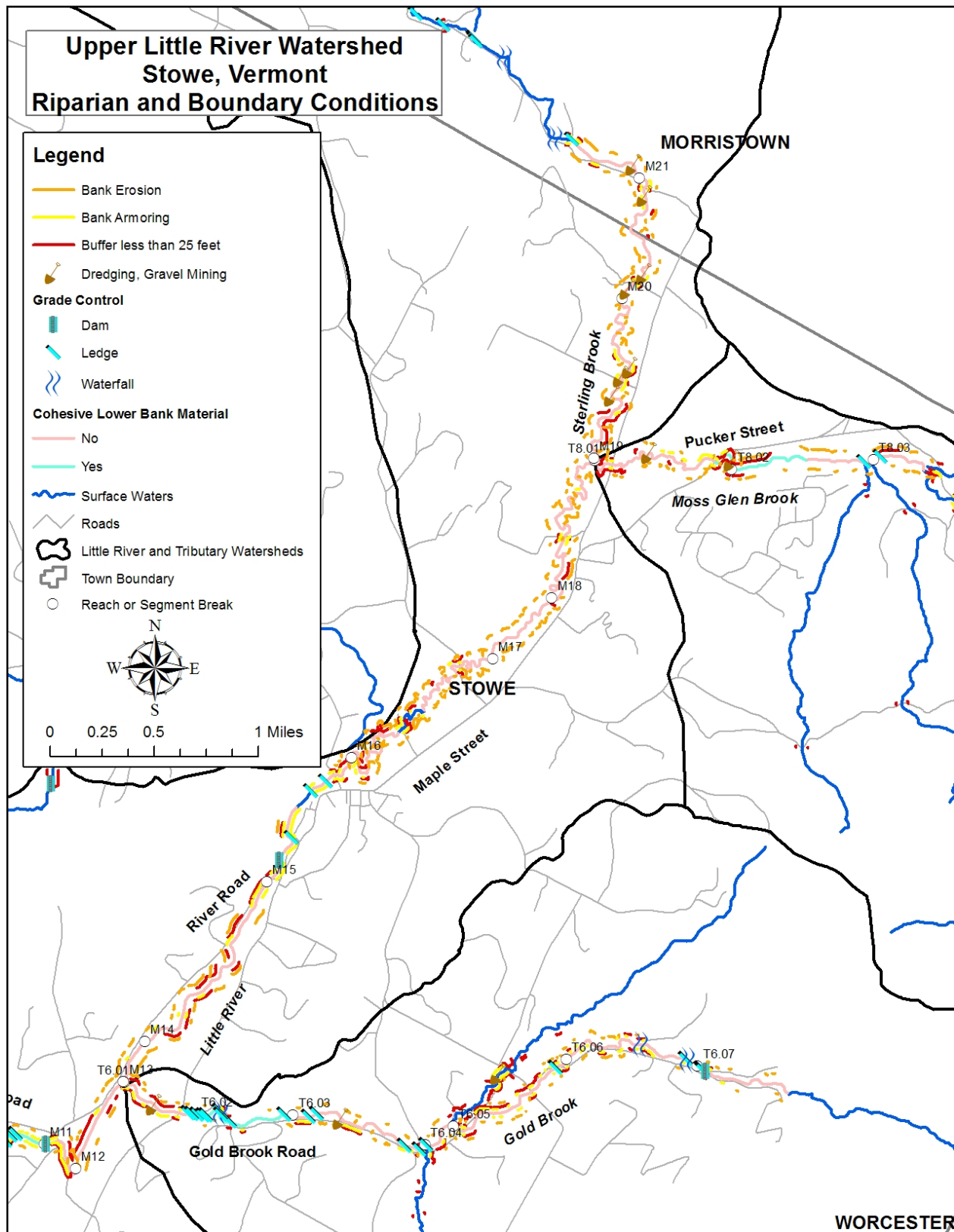


Figure 6.6. Boundary conditions and riparian modifications map for upper Stowe showing areas of decreased boundary condition (red and orange) and increased boundary condition (aqua).

Important factors that result in an increase in boundary condition are included in Figures 6.5 and 6.6 with aqua colored symbols. Natural and man-made grade controls increase the resistance of the bed to erosion. There were several locations where natural grade controls (ledge) were mapped based on the Phase 2 fieldwork including Miller Brook, mainstem of the Little River, Gold Brook and Moss Glen Brook. The cohesiveness of the lower bank materials is another factor that was considered in evaluating boundary resistance. Cohesive bank material can increase the boundary condition. The following areas had cohesive lower banks: middle section of the Little River main stem (M10), lower Gold Brook upstream of the Waterbury Road crossing (T6.02), and lower Moss Glen Brook above Pucker Street (T8.01-B and T8.02-A).

6.2 Departure Analysis

Successful river corridor restoration and protection projects depend on a thorough understanding of the sources, volumes, and attenuation of flood flows and sediment loads within the stream network. If increased loads are transported through the network to a sensitive reach, where conflicts with human investments are creating a management expectation, little success can be expected unless the restoration design accommodates the increased load or finds a way to attenuate the loads upstream (Vermont Agency of Natural Resources, 2007a).

Within a reach, the principles of stream equilibrium dictate that stream power and sediment will tend to distribute evenly over time (Leopold, 1994). Changes or modifications to watershed inputs and hydraulic geometry create disequilibrium and lead to an uneven distribution of power and sediment. Large channel adjustments observed as dramatic erosional and depositional features may be the result of this uneven distribution of power and sediment, and these adjustments may continue until a state of equilibrium is reached.

The analysis of sediment regimes at the watershed scale is useful for summarizing the stressors affecting the equilibrium condition of river channels. Sediment regime mapping provides a context for understanding the sediment transport and channel evolution processes which govern changes in geometry and planform for river channels in a state of disequilibrium. Sediment Regime Maps have been prepared to show departure from reference conditions due to human alterations.

The reference sediment regime map (Figure 6.7) shows the Phase I reference stream sediment conditions for each reach within the stream network. In the reference condition, streams use available floodplain access as a means to store sediment within the watershed. With one exception, all segments of the Phase 2 study area have a reference sediment regime of Coarse Equilibrium & Fine Deposition (*Equilibrium*) or Transport. The majority of the stream network has a reference sediment regime of *Equilibrium*. *Equilibrium* channels are unconfined on at least one side, and they transport and deposit sediment in equilibrium, wherein the stream power is balanced by the sediment load, sediment size, and channel boundary resistance. *Transport* channels, on the other hand, are steep, dominated by bedrock and boulder/cobble substrates, and are typically in confined valleys. Transport

channels do not supply appreciable quantities of sediments to downstream reaches (Vermont Agency of Natural Resources, 2007a). Reach M13 has a reference regime of *Confined Source and Transport*. These channels have confining valleys walls with limited sediment storage capacity due to both channel slope and entrenchment (Vermont Agency of Natural Resources, 2007a).

Changes in hydrology (such as development and agriculture within the riparian corridor) and sediment storage within the watershed have altered the reference sediment regime types for some reach segments. All departures were derived from the DMS according to the sediment regime criteria established by the Vermont Agency of Natural Resources (2007a). Existing sediment regimes have not been established for reaches that were not assessed during the phase 2 stream geomorphic assessment. Many segments that were *Coarse Equilibrium (in=out)* & *Fine Deposition* type segments by reference have been converted to *Fine Source and Transport* & *Coarse Deposition* sediment regimes based on the Phase 2 Stream Geomorphic Assessment data (Figure 6.8). This means that most fine sediment entering the stream is transported through without being deposited as a result of channel incision and reduced floodplain access. Additionally, coarse sediment storage is increased due to increased load along with lower transport capacity.

The existing sediment regime for the Little River watershed includes reduced floodplain access, increased stream power, reduced boundary resistance, and lateral constraints, such as roads, at various locations throughout the stream network. Watersheds which have lost attenuation or sediment storage areas, due to human related constraints, are generally more sensitive to erosion hazards, transport greater quantities of sediment and nutrients to receiving waters, and lack the sediment storage and distribution processes that create and maintain habitat (Vermont Agency of Natural Resources, 2007a).

6.3 Sensitivity Analysis

Stream sensitivity refers to the likelihood that a stream will respond to a watershed or local disturbance or stressor, such as: floodplain encroachment, channel straightening or armoring, changes in sediment or flow inputs, and/or disturbance of riparian vegetation (Vermont Agency of Natural Resources, 2007b).

Assigning a sensitivity rating to a stream is done with the assumption that some streams, due to their setting and location within the watershed, are more likely to be in an episodic, rapid, and/or measurable state of change or adjustment. A stream's inherent sensitivity may be heightened when human activities alter the characteristics that influence a stream's natural adjustment rate including: boundary conditions; sediment and flow regimes; and the degree of confinement within the valley. Streams that are currently in adjustment, especially those undergoing degradation or aggradation, may become acutely sensitive (Vermont Agency of Natural Resources, 2007b). Stream sensitivity is assigned based on the existing stream type and condition. For a particular stream type, a segment in "reference" or "good" condition has a lower sensitivity than a reach in "fair" condition. The highest sensitivity is assigned for segments in "poor" condition and reaches which have undergone a stream type departure.

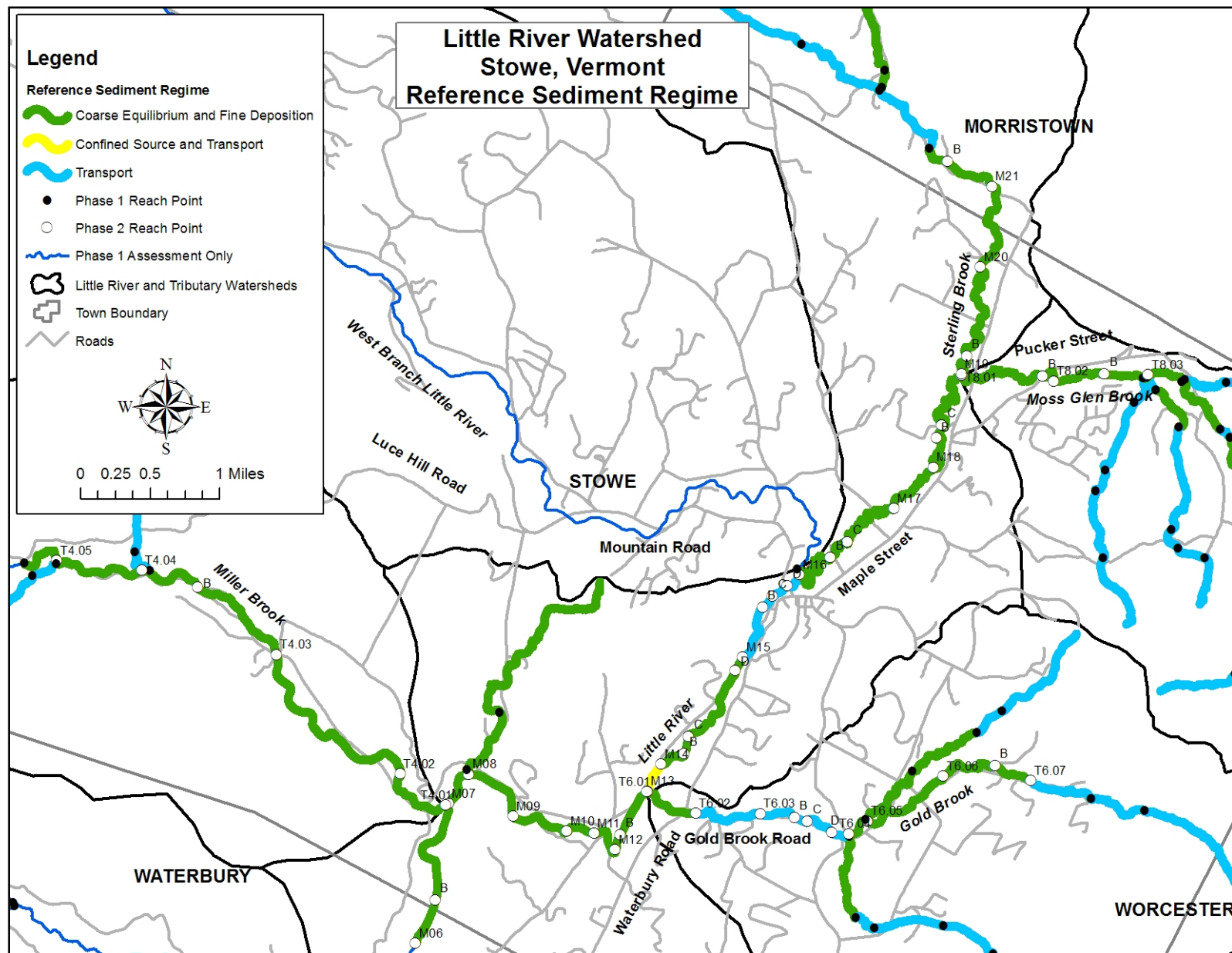


Figure 6.7. Reference Sediment Regime Departure Map showing areas of coarse equilibrium and fine deposition, confined source and transport, and transport reaches.

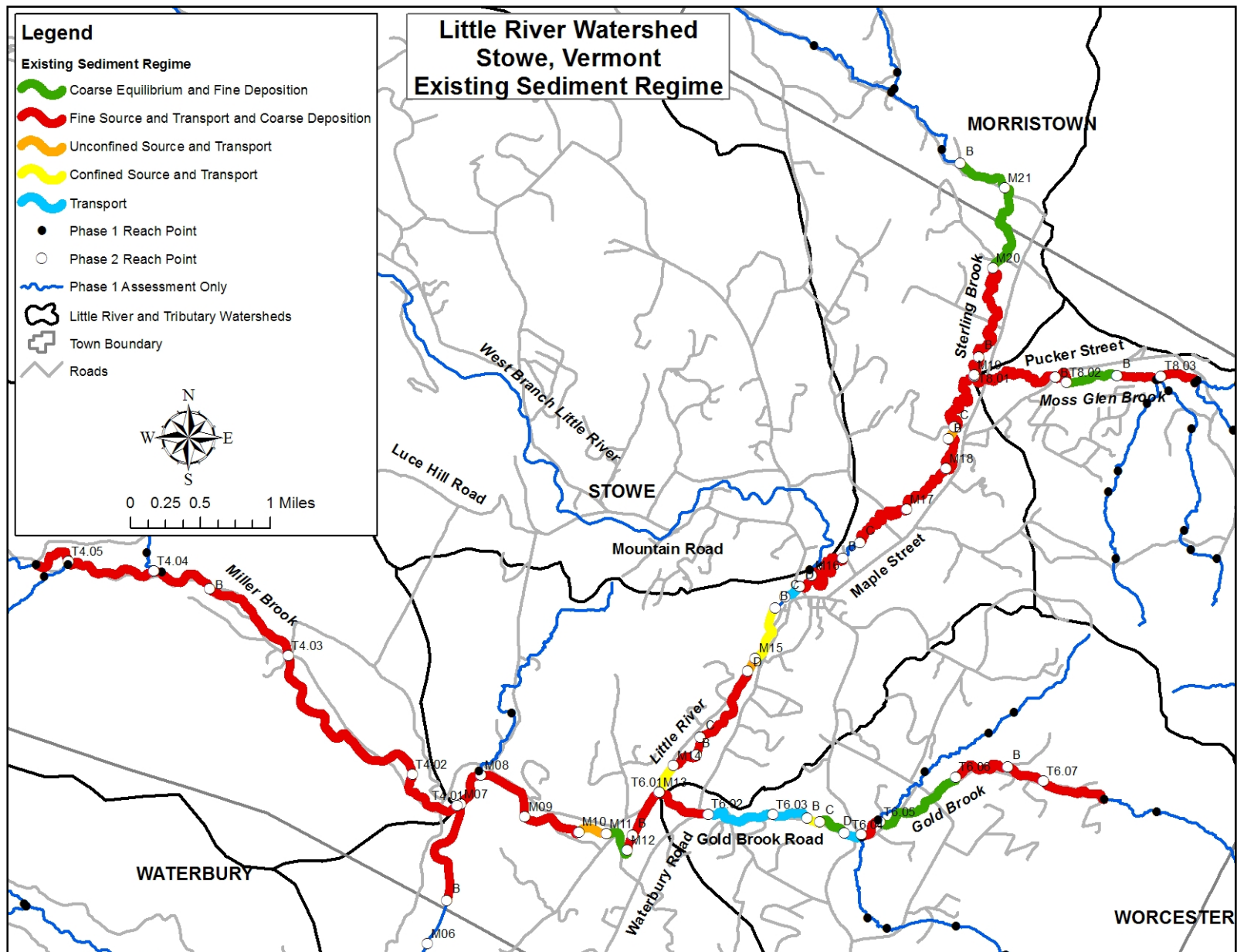


Figure 6.8. Existing Sediment Regime Departure Map showing predominantly areas of fine source and transport and coarse deposition reaches.

There are many variables that are contributing to the sensitivity of the reaches in the Little River watershed. The lack of bedrock and cohesive lower banks decrease the resistance to lateral and vertical adjustments; thereby, making the channel more sensitive. Additionally, bank vegetation and roots which hold the soil are lacking especially in the middle section of the Little River main stem and along Gold Brook and Miller Brook. Reaches that are lacking high quality riparian vegetation are more sensitive to channel adjustment.

The location and slope of a stream also affects its morphology and sensitivity. Streams that are transporting sediment through the channel are less sensitive than streams that are storing and responding to sediment. Low gradient streams, like the Little River, with high sediment supplies are very sensitive and may undergo adjustment following minor changes in channel geometry or boundary condition. Additionally, flow regime and floodplain constrictions may be affecting the sensitivity of the Little River watershed. Changes in land use and land cover that increase impervious cover, peak discharges, and/or the frequency of high flows will heighten a stream's sensitivity to change and adjustment. Confinement becomes a significant sensitivity concern when structures such as roads, railroads, and berms significantly change the confinement ratio, reduce or restrict a stream's access to floodplain, and result in higher stream power during flood stage.

Figure 6.9 is a map presenting the stream sensitivity, generalized according to stream type and condition as per the VANR protocol, and current adjustments for each reach segment in the Little River watershed. Sensitivity ratings have not been assigned for bedrock dominated segments and impounded segments that were not assessed. Segments M08 (lower Little River mainstem), T4.02 (lower Miller Brook), T8.02-B, and T8.03 (lower Moss Glenn Brook) are gravel dominated segments that have undergone a stream type departure from a reference "C" channel to an "F" channel. This has resulted in a change in sensitivity from high to extreme (Figure 6.9). Segments T6.03-B and T6.07 (on central and upper Gold Brook, respectively), are gravel dominated segments that have also undergone a sensitivity change (moderate to extreme) because of a stream type departure from a "B" channel to an "F" channel. These stream type departures are attributed to historic incision. Major aggradation adjustment processes are displayed on the corridor where they were found to be actively occurring and not evaluated as historic. Aggradation is a current major active process for many Little River main stem reaches, the three most downstream reaches on Miller Brook, most reaches on Moss Glen Brook, and one reach on Gold Brook. This information is useful in prioritizing the implementation of the projects identified in Section 7 of this report, as certain management actions may be influenced by these active adjustment processes.

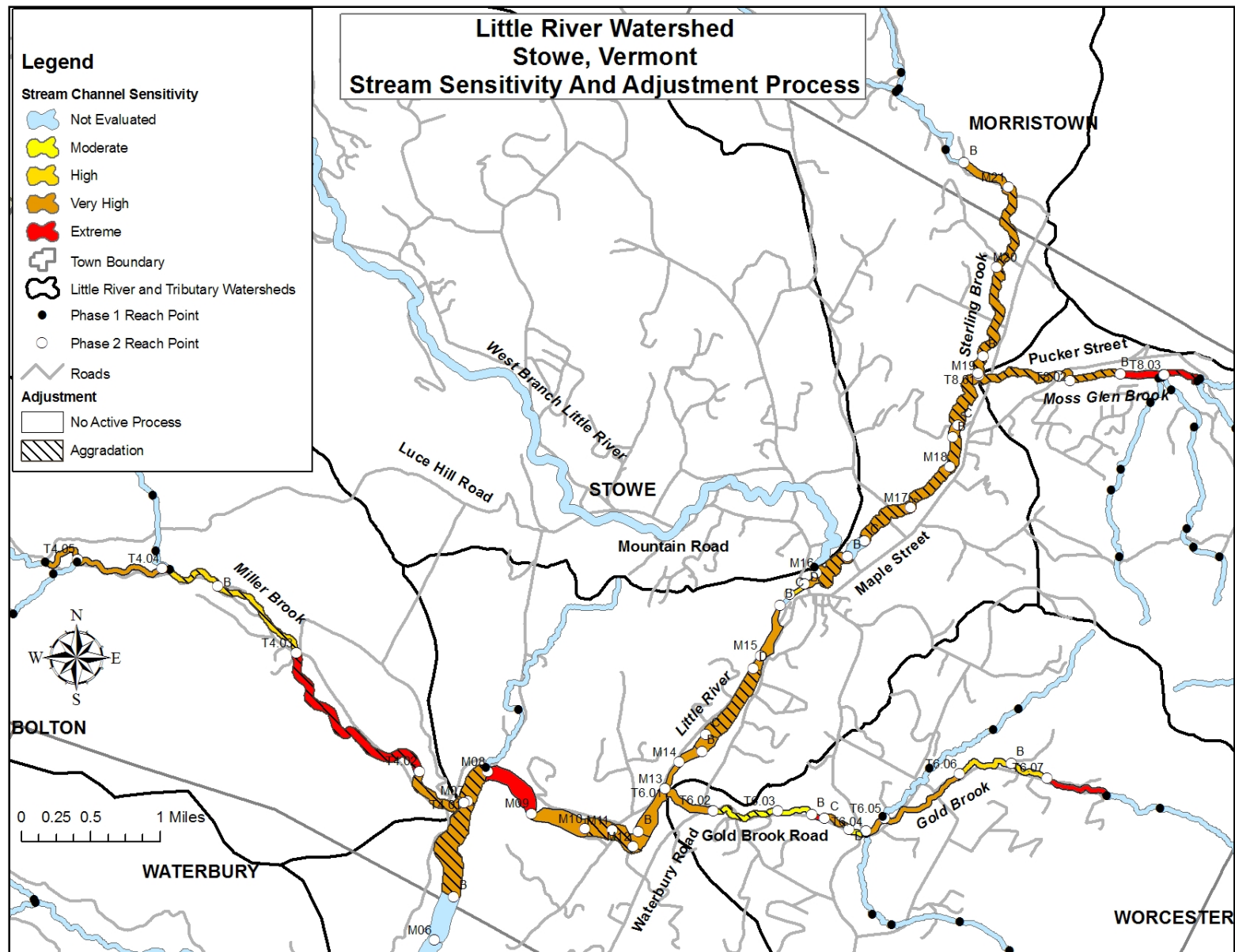


Figure 6.9. Stream sensitivity and current adjustment of the Little River

7.0 PRELIMINARY PROJECT IDENTIFICATION AND PRIORITIZATION

The departure and sensitivity analyses presented in Section 6.0 of this report provide beneficial background for selecting potential projects that will effectively help the channel return to equilibrium conditions by assessing limiting factors and by identifying underlying causes of channel instability. The stream reaches evaluated in this study present a variety of planning and management strategies which can be classified under one of the following categories: Active Geomorphic Restoration, Passive Geomorphic Restoration, and Conservation.

Active Geomorphic Restoration implies the management of rivers to a state of geomorphic equilibrium through active, physical alteration of the channel and/or floodplain. Often this approach involves the removal or reduction of human constructed constraints or the construction of meanders, floodplains or stable banks. Active riparian buffer revegetation and long-term protection of a river corridor is essential to this alternative.

Passive Geomorphic Restoration allows rivers to return to a state of geomorphic equilibrium by removing factors adversely impacting the river and subsequently using the river's own energy and watershed inputs to re-establish its meanders, floodplains and equilibrium conditions. In many cases, passive restoration projects may require varying degrees of active measures to achieve the ideal results. Active riparian buffer revegetation and long-term protection of a river corridor is also essential to this alternative.

Conservation is an option to consider when stream conditions are generally good and nearing a state of dynamic equilibrium. Typically, conservation is applied to minimally disturbed stream reaches where river structure and function and vegetation associations are relatively intact.

There are a number of voluntary programs available for river protection. Two of the primary programs are the Conservation Reserve Enhancement Program (CREP) and the River Corridor Easement (RCE). CREP is a program that helps protect environmentally sensitive land, decrease erosion, and restore wildlife habitat by taking land out of agricultural production. An overview of the Conservation Reserve Enhancement Program is found at <http://www.fsa.usda.gov/FSA/webapp?area=home&subject=lown&topic=cep>. The River Corridor Easement is designed to promote the long term physical stability of the river by allowing the river to achieve a state of equilibrium (where sediment and water loads are in balance). River corridor easements are vital for a passive geomorphic restoration approach and can also be used for conserving rivers that are in good condition (equilibrium). Rivers that are in equilibrium have access to their floodplains and therefore experience less erosion and negative impacts from flooding events. A description of each of the programs prepared by the Vermont River Management Program is provided below.

Conservation Reserve Enhancement Program

- CREP can be either a 15 or 30 year contract to plant trees.
- 90% of the practice costs are covered with the remaining 10% either resting with the participants or could be paid by the US Partners for Fish and Wildlife. Examples of the

practice costs include fencing, watering facilities, and trees. There are some costs that are capped, but generally all the practice costs can be paid through the program.

- To provide additional incentives to enroll in CREP, the program offers upfront and annual rental payments for the land where agricultural production is lost during the contract period.

River Corridor Easement (RCE)

- Easements are in perpetuity, meaning the agreement stays with the land forever.
- A onetime payment is received by the landowner for transferal of channel management rights to a second party (a land trust).
- Transferal of channel management rights means that the landowner would no longer be able to rock line river banks or remove gravel for personal use.
- A RCE requires a minimum 50 foot buffer that floats with the river. No active land use is allowed within the buffer. The buffer can be actively planted or allowed to revegetate passively.
- The easement does not take away the agricultural land use rights, so the landowner could continue to crop or pasture the farm land mapped outside of the buffer, yet within the corridor, for as long as the river allows.

7.1 Watershed-Level Opportunities

Fluvial Erosion Hazard Zones

Of all types of natural hazards experienced in Vermont, flash flooding represents the most frequent disaster mode and has resulted in by far the greatest magnitude of damage suffered by private property and public infrastructure. While inundation-related flood loss is a significant component of flood disasters, the predominant mode of damage is associated with the dynamic, and oftentimes catastrophic, physical adjustment of stream channel dimensions and location during storm events due to bed and bank erosion, debris and ice jams, structural failures, flow diversion, or flow modification by man-made structures. These channel adjustments and their devastating consequences have frequently been documented wherein such adjustments are related to historic channel management activities, floodplain encroachments, adjacent land use practices and/or changes to watershed hydrology associated with land use and drainage.

The purpose of defining Fluvial Erosion Hazard Zones is to prevent increases in fluvial erosion resulting from uncontrolled development in identified fluvial erosion hazard areas; minimize property loss and damage due to fluvial erosion; prohibit land uses and development in fluvial erosion hazard areas that pose a danger to health and safety; and discourage the acquisition of property that is unsuited for the intended purposes due to fluvial erosion hazards. The basis of a Fluvial Erosion Hazard Zone is a defined river corridor which includes the course of a river and its adjacent lands. The width of the corridor is defined by the lateral extent of the river meanders, called the meander belt width, which is governed by valley landforms, surficial geology, and the length and slope requirements of the river channel. The width of the corridor is also governed by the stream type and sensitivity of the stream. River corridors, as defined by the Vermont

Agency of Natural Resources (2008), are intended to provide landowners, land use planners, and river managers with a meander belt width which would accommodate the meanders and slope of a balanced or equilibrium channel, which when achieved, would serve to maximize channel stability and minimize fluvial erosion hazards. Information collected during the Phase 2 Assessment including reach sensitivity, reach condition, and stream type is used to develop these zones. Towns have the opportunity to work with the Vermont River Management Program to develop fluvial erosion hazard zones to reduce conflicts within the river corridor.

STORMWATER

Stormwater runoff rates are of particular concern in urbanized and agricultural watersheds because stormwater runs off from impervious surfaces rather than naturally infiltrating the soil. The cumulative effect of the increased frequency, volume, and rate of stormwater runoff results in increases in wash-off pollutant loading to streams and destabilization of stream channels. All potential restoration projects within the Little River watershed should be evaluated in terms of their effects on stormwater.

7.2 Reach-Level Opportunities

A description of each reach/segment is provided in this section along with general recommendations for restoration and protection strategies. The reaches are listed from downstream to upstream. Further details about project types for each reach will be discussed in Section 7.3. The reaches are broken into sections based on the stream they are located in: Little River, Miller Brook, Gold Brook, and Moss Glen Brook.

Little River Section A: The Little River mainstem has three distinct sections. The lower 2.9 miles (M06 to M11) in general have channels with a very high width to depth ratio and moderate to severe incision. These reaches are predominantly located in a *Fine Source and Transport and Coarse Deposition* regime and are in stage F-III or F-IV of the channel evolution model. All of these reaches are gravel dominated “C” reaches by reference.

Reach M06

Little River reach M06 is 6,242 feet in length and begins just 1,800 feet downstream of the Stowe/Waterbury boundary. The river corridor of reach M06 lies completely within the Mount Mansfield State Forest. The lower section M06-A was not assessed since it was influenced by the downstream Waterbury Reservoir. Segment M06-B begins at the Stowe/Waterbury boundary and continues north 4,418 feet until the confluence with Miller Brook. M06-B has a very broad valley and a very high width to depth ratio. As shown in Figures 7.1 and 7.2, Segment M06-B has a wide depositional channel as shown by large side bars. Erosion is common along both banks, especially on meander bends, and there are two mass failures within Segment M06-B (Figure 7.1). Forest is the dominant land use on both sides of the corridor and hay is the sub-dominant land use within the west corridor. There are areas that have been mined for gravel on the large side bars (Figure 7.2). The channel has been extensively straightened for agriculture, which most likely led to its incision and

subsequent widening. There is a minor change in channel confinement in this segment from nearby Cottonbrook Road, but no change in valley type.



Figure 7.1. Large side bar and mass failure in Segment M06-B



Figure 7.2. Another large side bar in Segment M06-B

Segment M06-B is a “C” gravel dominated segment. The rapid geomorphic assessment (RGA) scored in the “fair” category due to the major historic degradation, major widening and aggradation, and minor planform adjustment. The reference channel width is 92 feet, but the bankfull width in the cross section was measured as 133 feet (Figure 7.3) indicating that the segment is over widened. The large depositional features are a result of the over widened channel. The rapid habitat assessment (RHA) rated in the “fair” category mostly due to deposition in the channel, channel straightening, and bank erosion.



Figure 7.3. Typical wide cross section in M06-B

Reach M07 **Streamside Plantings**

M07 begins at the confluence with Miller Brook and extends upstream for 1,580 feet. With the exception of the upper end of reach M07, the river corridor includes and is surrounded by the Mount Mansfield State Forest. Forest is the dominant land use within the east corridor and the dominant land use within the west corridor is hay. The valley is slightly narrower than in M06 with a broad confinement. Like M06-B, M07 has a very high width to depth ratio. Reach M07 is severely incised and is in stage F-IV for channel evolution. About one-third of the channel length has been historically straightened for agriculture, which most likely led to its incision and subsequent widening and planform adjustment. There is a slight human caused change in valley confinement for this reach from Moscow Road, but no change in valley type.

The presence of a mid-channel bar, point bars and large side bars indicates that M07 is also depositional (Figure 7.4). Erosion is also common along both banks. The dominant buffer width on both sides of the channel is greater than 100 feet in width; however, about one-quarter of the west bank has buffers less than 25 feet (Figure 7.5). These areas of minimal buffer are associated with hay fields. Streamside plantings are recommended to augment current planting efforts on lands within the Mount Mansfield State Forest.



Figure 7.4. Depositional features and wide channel in M07



Figure 7.5. Reach M07 has a significant lack of buffer contributing to bank failure.

The channel width in this gravel dominated “C” reach has deviated from its reference of 84 feet to 111 feet indicating major widening, which explains the deposition within the segment. The RGA rated in the “fair” category due to extreme historic degradation, and major aggradation, widening, and planform adjustment. Disturbance of natural conditions has impacted the habitat in this M07 resulting in a “fair” score for the RHA. The lack of vegetation on the western bank and within the riparian buffer, as well as bank erosion, contributed to the habitat condition. The east bank along reach M07 is providing higher quality habitat along than the west bank due to its well vegetated riparian buffer and protected banks.

Reach M08

Streamside Plantings

The total length of Reach M08 is 2,648 feet. The lower end of the reach begins at the confluence of Barrows Brook where the Little River turns to the east. The Stowe Land Trust owns close to a 50 acre parcel at the corner of Moscow Road and Barrows Road, called the Dumont property. The Dumont property abuts the Mt. Mansfield State Forest and a parcel owned by the Town of Stowe. In addition to providing opportunities for non-motorized outdoor recreation and wildlife habitat, the Dumont property affords additional protection to the Little River and Waterbury Reservoir watersheds. (Stowe Land Trust, 2008a). According to Tom Jackman, Director of Planning for the Town of Stowe (personal communication, 2010), a Japanese knotweed eradication project is being considered for the Dumont property. Japanese knotweed is an ornamental that was introduced for erosion control. This invasive plant spreads quickly to form dense thickets that exclude native plant species and the plant is of little value to wildlife (Van Driesche, R., et al., 2002). Japanese knotweed has inferior root structure compared with native plant species such as willows, dogwood and alders. Streamside plantings using native vegetation are recommended as part of the knotweed eradication project.

M08 has a narrow valley with no human-caused change in valley confinement. There is significant erosion on both banks of M08. Where Moscow Road comes close to the stream, rip-rap for bank stabilization is found along the north bank. Approximately one-quarter of the southern bank and even less of the northern bank has a buffer width less than 25 feet. The majority of the reach has been straightened and is encroached by Moscow Road on the north side.

Reach M08 has experienced a stream type departure from a gravel dominated “C” stream to an “F” stream type due to the extreme historic incision. The RGA rated in the “fair” category due to major widening and minor aggradation and planform adjustment. There are three steep riffles, some mid-channel bars and many side bars in M08 indicating that it is depositional. Pools have been filled in with sediment with the bed profile dominated by runs (Figure 7.6). The RHA also scored in the “fair” category as a result of extensive channel straightening, embedded bed substrate, unstable banks, and reduced riparian buffer. This reach would benefit from buffer restoration.



Figure 7.6. Long run in Reach M08

Reach M09 **Streamside Plantings**

Reach M09 starts on meander bend where Moscow Road is farther away from the channel and extends upstream 2,399 feet to the start of bedrock grade controls. The Dumont parcel owned by the Stowe Land Trust and town-owned property (stump dump) encompass much of the southern river corridor of the Little River in reach M09. The Moscow Recreation Field is part of the northern river corridor and includes 600 feet of frontage on the Little River. This 4.7 acre parcel is an open space used for activities such as baseball, swimming and picnicking. The Stowe Land Trust and the Vermont Housing and Conservation Board hold a conservation easement on the property with the Town of Stowe holding the title. (Stowe Land Trust, 2008b). Streamside plantings at the Moscow Recreation Field are recommended to increase the buffer width along the Little River. The buffer width could also be increased by discontinuing mowing close to the river edge.

Reach M09 runs along Moscow Road with development occurring within the river corridor on the north side. The valley confinement is broad and there is no human-caused change in valley width. Residential land use adjacent to Moscow Road dominates the riparian corridor on the north side, while forest dominates the corridor on the south. On the upstream end of the corridor on the south side, there is commercial land use.

Approximately half of the north bank has a buffer less than 25 feet in width, while the south bank has a dominant buffer width of greater than 100 feet. There is considerable bank erosion with approximately 30 percent erosion on each bank (Figure 7.7). A knotweed eradication project is currently underway at the Moscow Recreation Field (personal communication with Tom Jackman, 2010). There is a mass failure (12' high x 180' wide) on the upstream end of the reach on the south bank. The reach has been armored with rip-rap in some locations where there is no buffer and the reach has been straightened.

Many side bars, one mid-channel bar, two point bars, one diagonal bar, and one steep riffle were noted in the reach indicating that this reach is depositional (Figure 7.8). Reach M09 is a gravel dominated "C" channel in the F-III stage of channel evolution. The RGA scored "fair" due to extreme historic degradation and major widening and aggradation. Planform adjustment is a minor process. Channelization along Moscow Road, exposed substrates, deposition, bank erosion, and a narrow buffer width on the north bank are all factors that contributed to a RHA score of "fair".



Figure 7.7. Bank erosion along M09



Figure 7.8. Side bars in Reach M09

Reach M10

Reach M10 begins on the downstream end where there are bedrock grade controls (Figure 7.9) and commercial development within the corridor. The reach is 1,180 feet in length. The valley confinement is broad and there is no human-caused change in valley confinement. The corridor of reach M10 has considerable development along it with 60 percent of the north side developed and approximately 40 percent development on the south side. Straightening has occurred along approximately three-quarters of the reach and the reach has been armored for about half its length with rip-rap along both banks.



Figure 7.9. Bedrock grade control in Reach M10

The dominant buffer width on both sides is 26 to 50 feet with a subdominant width of 0 to 25 feet. Residential land use is the dominant land use within both corridors. Low to moderate bank erosion was noted within the reach.

Multiple mid-channel bars, a diagonal bar and a steep riffle are present within the reach as well as some channel migration evident from a large flood chute. The geomorphic condition of the channel is “fair” based on the RGA. Reach M10 has experienced a stream type departure from a “C” channel to a “Bc” channel due to extreme historic incision. The Moscow Mills dam is located just upstream of reach M10 has most likely contributed to channel degradation (Figure 7.10). Aggradation is a major process in this reach and widening and planform adjustment are minor processes. The stream condition rating for both geomorphic condition and habitat is “fair”. Channelization and narrow riparian buffers (26-50 feet on both banks) are all contributing to the fair habitat condition.



Figure 7.10. Moscow Mills Dam

Reach M11 **Bridge Replacement**

Reach M11 begins at the dam approximately 300 feet downstream of the bridge at Moscow Road (Figures 7.11 and 7.12) and continues 1,515 feet until just upstream of where the river bends away from Moscow Road. At this bend, a planned unit development (PUD) located on the south side of the Little River on the Salvias property has been approved with about 10 acres along the river as permanent open space (Personal communication with Tom Jackman, 2010). The Salvias property abuts the Nichols field, located in reach M12. The Stowe Land Trust has held a conservation easement on this field since 2004 (Stowe Land Trust, 2008c).



Figure 7.11. Bridge at Moscow Road in Reach M11

The west side of reach M11 has a buffer that is less than 25 feet for approximately three-quarters of the reach and the other side has a buffer less than 25 feet for about half of its length. The subdominant buffer width is 26 to 50 feet. Residential land use is the dominant land use within the west corridor and pasture within the east corridor. There is limited bank erosion on the west bank due to the extensive bank armoring, but on the east bank there is approximately 30 percent bank erosion.

There is a human-caused change in valley confinement from broad to narrow due to the close encroachment of Moscow Road and Adams Mill Road along 1,345 feet of the west bank. Reach M11 has been extensively straightened. The west bank has been heavily

armored with rip-rap along 70 percent of its length where it is very close to Moscow Road, while the east bank has rip-rap along 20 percent of its length.

The Moscow Mills dam is located within reach M11 about 300 feet downstream of the Moscow Road crossing. According to Tom Jackman, the dam is listed in the National Register of historic places and is Stowe's only functioning hydro plant. The dam is about 20 feet high and is built on bedrock. The natural flow regime of the Little River is modified by the hydroelectric operations, and the dam is an issue in terms of aquatic organism passage and sediment transport. Sediment is retained above the dam (Figure 7.12) and the downstream reach, M10, has historically incised in response to the channel being sediment starved.



Figure 7.12. Moscow Mills Dam in Reach M11

Reach M11 contains many depositional features for its short length: three mid-channel bars, two side bars, one delta bar, one diagonal bar, and one steep riffle. Two islands indicate that the channel planform has been adjusting. The width to depth ratio is very high in M11 and the RGA was scored as "fair" due to its major aggradation and widening. Degradation and planform adjustment are minor in this reach. As a result of channel straightening, bank erosion, lack of riparian buffers and the decreased quality of channel substrate, the habitat has been affected with a RHA score of "fair".

Little River Section B: Section B includes segments M12-A through M15-D, where the channel is moderately incised and the existing stream type is the same as the reference stream type, with the exception of one segment. This 7.3 mile long section is a transition point between the severely incised downstream reaches and the upper depositional reaches. In general, section B is best characterized as stage II or III of the F channel evolution model with moderate historic incision and current minor aggradation, widening and planform adjustment in most downstream reaches. The processes in the upstream end include major aggradation and planform adjustment with minor to major widening. In many of the downstream reaches, the cross sections show that there is an old terrace at a higher elevation than the top of the bank.

Reach M12 **Streamside Plantings**

Reach M12 was broken into two segments due to depositional features and bedform. M12-B contains more depositional features than M12-A. M12-A has a plane bed bedform (Figure 7.13), while M12-B is predominantly riffle-pool.

Segment M12-A begins at the sharp meander bend where Moscow Road is very close to the stream and continues past Gold Brook Campground upstream 598 feet where the valley width opens up. The valley confinement is broad and there is a human-caused change in channel confinement from River Road. It appears that the entire channel length was historically straightened.



Figure 7.13 Lack of bedform features in Segment M12-A

The dominant buffer width of the east side is 26 to 50 feet, and over half of the west buffer is less than 25 feet in width. The west river corridor is mostly residential. Moderate to high scour and erosion was noted at the base of both banks, with more than half of the east bank eroded. Invasive vegetation covers both banks making M12-A vulnerable to erosion (Figure 7.14).

The dominant land use for the east river corridor is hay. The Nichols field abuts the river corridor at the southern end of the reach M12 on the east side, and has about 1000 feet of river frontage. Vermont Electric Power Company (VELCO) is implementing a riparian planting plan for Nichols field (Personal communication with Tom Jackman, 2010). The Gold Brook Campground also lies within the eastern corridor.

Segment M12-A is a gravel dominated “C” channel in stage III of the F evolution model. There is a lack of riffle-pool features (Figure 7.14). Extensive historic straightening has resulted in the downcutting of the bed leading to major historic degradation and plane bed features.

The current geomorphic processes in segment M12-A include minor widening, aggradation and planform adjustment. No depositional features were mapped in this segment. Both the RGA and RHA were rated as “fair condition”. Extensive channel alteration, poor habitat diversity, unstable banks, and lack of riparian buffers contribute to the “fair” RGA score.



Figure 7.14. Invasive vegetation on the banks of Segment M12-A

Segment M12-B is 1,969 feet in length and ends at the confluence with Gold Brook (T6.01). The segment is “C” gravel dominated, riffle-pool channel. There is a slight human-caused change in channel confinement but no change in valley type. The entire length has been

straightened with armoring in a couple of short locations on each bank (Figure 7.15). Development occurs along 50 percent of one bank and 15 percent of both banks.

The dominant buffer width on the east bank is 26 to 50 feet and the dominant buffer width on the west bank is 51 to 100 feet. Both banks have a subdominant buffer width less than 25 feet. On the east bank the narrow buffer is due to the nearby campground and agricultural field, while the lack of buffer on the west bank is from residential lawns. Both corridors are mostly residential. Segment M12-B has minimal to moderate scour and erosion along both banks, with erosion along one-third of the west bank.



Figure 7.15. Typical straightened channel in M12-B

Depositional features are common within reach M12-B. Two steep riffles and one large flood chute was observed. As in M12-A, there is no major adjustment process in M12-B. The segment has experienced minor historic degradation with an incision ratio of 1.3. Both the geomorphic and habitat conditions were rated as “fair”. Given the abundant channel straightening, depositional features, bank erosion (west bank) and limited riparian buffer (east side); the RHA was scored as “fair”.

Reach M13 **River Corridor Protection**

Gold Brook (T6.01) enters the Little River just downstream of the reach break for M13. Reach M13 continues 1,195 feet along River Road and is straightened for the majority of the reach. River Road runs parallel to the river, but it is highly elevated above the valley wall and therefore does not encroach upon the corridor nor has there been a human caused change in channel confinement from the road (Figure 7.16). Reach M13 has a different reference stream type than reaches upstream and downstream from it. The reference and existing stream type is a semi-confined “B” riffle-pool channel that is sand dominated. This channel is also in stage III of the F channel evolution model.



Figure 7.16. Elevated River Road along Reach M13

Most of the west bank within M13 has a riparian buffer width of 26 to 50 feet. On the east side of the river, the buffer width is predominantly 51 to 100 feet. Invasive vegetation is very common along banks and dominant within both buffers (Figure 7.17). Erosion is prevalent on both banks (about 50 percent on both sides) as a result of the poor root structure offered by the invasive vegetation. The dominant and subdominant land use within the west corridor is shrub/sapling and forest, respectively. The eastern corridor is dominated by crops and also contains forest.



Figure 7.17. Invasive vegetation within both buffers in M13

The channel in reach M13 is moderately incised. The RGA scored “fair” with major historic degradation, widening and planform adjustment and minor aggradation. Reach M13 is overwide with moderate to high scour and erosion at the base of both banks. Moderate to high lateral bank erosion on most outside bends is also prevalent. The RHA also scored in the “fair” range due to a number of factors including the extensive channel straightening, sediment deposition within the channel, poor habitat diversity, bank erosion and lack of native vegetation on the banks.

Reach M14

River Corridor Protection CREP

Reach M14 was broken up into four segments due to differences in depositional features, channel alteration, and valley width. Segment M14-A has not been straightened, while segment M14-B has undergone extensive channel modifications. Segment M14-C contains more large depositional features than the other segments. Differences in valley width and stream type resulted in the segmentation of M14-D. This most upstream segment has experienced a stream type departure from a “C” to a “Bc” channel as a result of encroachment of River Road into the river corridor, causing a change in valley width.

The lowest segment, M14-A, is a gravel dominated “C” stream that is in stage III of an F type evolution. This 1,065 foot long segment begins where the Little River starts to meander again and then migrates away from River Road. In contrast to the adjacent segments, M14-A does not appear to have been historically straightened (Figure 7.18).



Figure 7.18. Typical channel in M14-A

Herbaceous vegetation dominates the eastern buffer and deciduous trees are subdominant. The west side contains deciduous trees primarily, but there are also many invasive plants within the buffer. Dominant buffer widths for the east and west banks are less than 25 feet and greater than 100 feet, respectively. Land use within the eastern corridor is characterized mostly by hay fields with some forested areas. The west corridor is dominated by forest and shrub sapling is subdominant. The Stowe Land Trust holds a river corridor conservation easement in Stowe's lower village within reach M14. The project was funded through the State of Vermont River Management Program and the Stowe Conservation Commission. The corridor easement includes 2,000 feet of river frontage including floodplain and agricultural fields. (Stowe Land Trust, 2008d) Because of the major planform adjustment that is occurring within Reach M14, the acquisition of additional river corridor easements within this reach is recommended. Mary Nealon (2003) evaluated options for a restoration project using natural channel design principals on a section of river immediately upstream of the corridor easement referenced above. The Lamoille County Natural Resources Conservation District was responsible for acquiring funding for the project design work.

The channel is deep within M14-A. There is a very large point bar with a flood chute located in the upstream section. The historic incision along the Little River has also occurred within M14-A. The RGA scored "fair" due to major degradation and planform adjustment. Aggradation and widening are minor processes. The RHA was rated as "fair" due to the lack of areas for fish cover, increased substrate embeddedness, unstable banks, lack of vegetation, and a poor riparian buffer zone on the east bank.

Segment 14-B begins where the river channel has been historically straightened again for 675 feet. All of segment M14-B has been straightened for agricultural purposes. As with other segments in M14, M14-B is a gravel dominated "C" stream in stage F-III channel evolution, but unlike other segments, it has a plane bed bedform (Figure 7.19). The valley confinement is broad and there is no human caused change in channel confinement.



Figure 7.19. Typical channel in M14-B

Buffer vegetation within the east buffer is mostly invasive vegetation with deciduous trees subdominant. The western side contains primarily mixed trees with herbaceous vegetation. The dominant buffer width for the east side is less than 25 feet and on the west side it is primarily 26 to 50 feet wide and greater than 100 feet wide in some places. Land use within both corridors is predominantly hay and on the west side residential land use is subdominant. The areas of minimal buffer are associated with the hay fields. The water quality in the river could be improved by increasing the buffer widths along the hay fields through a program such as CREP. Due to active planform adjustment, streamside plantings are not recommended near the bank. There is erosion along both banks, but erosion is more prevalent on the east bank due to the lack of buffer and presence of invasive species. Approximately 20 percent of the east bank is armored with rip-rap.

The RGA was rated as “fair” due to the degradation and minor aggradation, widening and planform change. Segment M14-B has experienced major historic degradation leading to a weak riffle-pool channel with a bed profile that is dominated by runs. This lack of deep pools carries over to the habitat assessment as the RHA also rated as “fair”. The widespread channel straightening, unstable banks on the east side, and lack of riparian buffer also contribute to the “fair” habitat condition. Other factors influencing aquatic habitat in the segment are reduced fish cover and substrates for epifaunal colonization and excess sediment causing the substrate to be embedded.

Segment M14-C is another “C” stream and is the longest segment in reach M14 with a length of 3,466 feet. The segment begins where the river develops a meander pattern again and continues approximately 700 feet downstream of the River Road Bridge. Straightening has occurred along 39 percent of M14-C, mostly in the upstream part of the segment. For 41 percent of the segment, River Road encroaches upon the western corridor, which has led to a human caused change in channel confinement, but did not change the broad valley type.

Erosion is present on both the east and west banks with 30 percent and 51 percent, respectively. Armoring in the form of rip-rap has been placed along 11 percent of the west bank and 5 percent of the east bank. Buffer widths are impacted in this segment from

agricultural fields and the encroachment of River Road with about half of the west side having a buffer of less than 25 feet. The subdominant buffer width is 26 to 50 feet. Approximately one-quarter of the east side has a buffer less than 25 percent, making it the subdominant buffer width. The dominant buffer width on this side is 26 to 50 feet. Land use within the riparian corridor consists of hay fields, residential homes and lawns, and roads. Protection programs, such as CREP and river corridor easements, could be extended to Segment M14-C.

Deposition along Segment M14-C is much more pervasive than in other segments in M14 (Figure 7.20). This deposition has affected the reach enough to cause diagonal bars and steep riffles to form. There are also eight large point bars and four side bars. Channel planform has changed in M14-C as shown by the presence of an island, flood chute and a channel avulsion. Both the RGA and the RHA scored in the “fair” category. The RGA was fair as a result of major historic degradation, aggradation, widening, and planform adjustment. Numerous depositional features, exposed substrate, unstable banks, lack of bank vegetation and riparian buffer, and channel straightening resulted in the decreased quality of habitat in segment M14-C.



Figure 7.20. Large point bars, bank erosion and lack of buffer in segment M14-C

Segment M14-D has experienced a stream type departure from its reference “C” to a stream type of “Bc” that is more entrenched and in stage II of the F channel evolution model. This segment is very incised (1.87 incision ratio) and has lost access to its historic floodplain. The length of M14-D is 590 feet and begins about 740 feet downstream of the River Road Bridge. River Road runs parallel to the Little River along the west side and has caused a change in confinement. The entire length of the segment has been straightened (Figure 7.21) and armored with rip-rap on the west bank, thereby increasing its stream power and degrading the channel bed. On the east bank, 40 percent of the bank has been armored with rip-rap. The rip-rap along the banks is preventing the stream from widening.

The entire length of the west side has a buffer width of less than 25 feet and the east side’s buffer is 26 to 50 feet wide. Invasive vegetation is dominant on both stream banks and subdominant in both buffers. Dominant buffer vegetation on both sides is comprised of deciduous trees. The land use in the corridor is predominantly residential within both corridors.



Figure 7.21. Straightened section of segment M14-D

The RGA was rated as “fair” for M14-D primarily due to extreme historic incision. Minor aggradation, widening, and planform adjustment are other processes identified in M14-D. Habitat condition is consistent with other segments in M14 rating as “fair”. The “fair” condition was mostly from channel straightening and lack of riparian buffer, cover for fish, and substrates for epifaunal colonization.

Reach M15

Streamside Plantings

Stormwater Improvements

Buffer Restoration

River Corridor Protection

Berm Removal

Dam Removal

Reach M15 was divided into four segments. The four segments vary in valley width, substrate size, and channel dimensions. The most downstream segment, M15-A, contains more depositional features and is a “Bc” type stream. M15-B is a bedrock gorge in the center of the reach. The narrow confinement in the bedrock gorge continues into M15-C making it an “F” type stream upstream of the gorge. Both M15-B and M15-C are “F” channels by reference. The last segment, M15-D, has a much wider valley than downstream and is a “C” channel.

M15-A is the most impacted segment within M15. The downstream end of Segment M15-A starts about 150 feet downstream of the River Road Bridge and continues for 2,326 feet until just after the western corridor becomes forested and the stream becomes a bedrock gorge. South Main Street and Palisades Road run parallel to the Little River for the entire segment length. These roads, along with driveways for industrial and commercial development on the western bank, have resulted in a significant human-caused change in channel confinement but no change in valley type from semi-confined. The channel is a “Bc” stream type in stage II of the F channel evolution model.

There is a bedrock grade control and an old dam (Figure 7.22) acting as a grade control in segment 15-A. The old dam is acting as a channel constriction and causing fine sediment to settle out upstream. The municipal sand storage is located on the western bank and there is significant bank erosion in the vicinity of this facility (Figure 7.23). The relocation of sand stockpiles and stormwater improvements are recommended at this site. A berm adjacent to the river could be removed as part of regrading of the parking lot; however, this berm is located above the floodprone elevation and removal will not result in improved floodplain access. A second parcel of land owned by the Town of Stowe, the wastewater treatment facility, abuts the northern bank of the Little River in segment M15-A and B.



Figure 7.22. Old dam grade control is constricting channel and causing sediment deposition upstream in M15-A.



Figure 7.23. Bank erosion and lack of woody vegetation in the vicinity of the municipal sand storage facility

There are several stormwater inputs including four road ditches and one field ditch. Most of Segment M15-A has been straightened and armored to protect development. Woody vegetation to help reduce bank erosion is lacking on both banks due to the presence of rip-rap and invasive bank vegetation. Buffers of less than 25 feet are present along the west bank (about 20 percent), but the dominant buffer width is 51 to 100 feet. The east side has a dominant buffer width of 26 to 50 feet. Residential is the dominant corridor land use on the east side, while industrial is dominant adjacent to the west bank.

The RGA scored in the “fair” category for M15-A. In response to major historic degradation, segment M15-A is now undergoing minor planform adjustment, aggradation and widening. The channel is responding to a major alteration of channel planform from channel straightening and the reduction in the width of the floodprone area from floodplain encroachments. The extensive rip-rap in the channel is preventing widening and planform adjustment. The RHA was rated as “fair”. Fair fish cover, embeddedness, moderate sediment deposition, bank stability (west bank), riparian zones, and over 80 percent channel alteration are all contributing factors to the “fair” habitat conditions.

Segment M15-B is 559 feet long and is contained within a bedrock gorge (Figure 7.24). Due to the bedrock grade controls, Segment M15-B was not fully assessed. Since Segment M15-B is in a narrowly confined bedrock gorge with decent riparian buffers, it is presumed to be in reference condition. The western corridor is well forested, but the eastern corridor contains residential and commercial land use outside the valley wall.

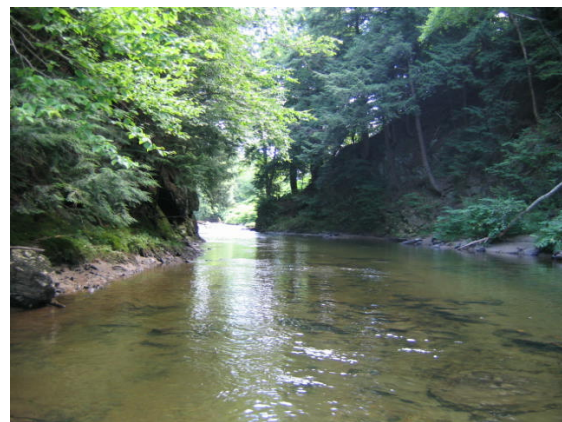


Figure 7.24. Reference condition of bedrock gorge in Segment M15-B

Segment M15-C begins at the top of the bedrock and continues until the Route 108 bridge crossing. This segment is 717 feet in length. It has an “F” stream type due to its entrenchment. The channel has predominantly plane bed features, but there are some deep pools and riffle like characteristics. One hundred percent of M15-C has been straightened and there is old rip-rap along most of the east bank. Buffer widths were generally wider in M15-C than in M15-A, especially on the west side. The dominant buffer width on the west side is greater than 100 feet and 51 to 100 feet on the east side. The west corridor is primarily forested, while the dominant land use of the east corridor is commercial land.

Segment M15-C is the first segment on the Little River mainstem that is not incised. There has been some minor historic widening on the west bank due to the influence of rip-rap on the east bank. The RGA was scored as “good”, but the RHA was scored in the higher end of “fair” due lack of slow velocity patterns, exposure of substrates in the channel, poor vegetative protection, and decreased riparian buffer on the east side.

Segment M15-D begins where the Route 108 Bridge crosses (Figure 7.25). The valley opens up and the channel is less entrenched making it a gravel dominated “C” stream in stage III of the F channel evolution model. The presence of three large point bars, one side bar, and one mid-channel bar indicates M15-D is more depositional than the downstream segments in M15 (Figure 7.26). The west side of the river has a buffer less than 25 feet along 80 percent of its length from the presence of mowed lawn for commercial purposes. Erosion is minimal to moderate due to the presence of rip-rap on both banks.



Figure 7.25. Route 108 bridge at downstream end of Segment M15-D



Figure 7.26. Large point bars within Segment M15-D

As in segments located downstream from the bedrock gorge, Segment M15-D has experienced major historic incision. The geomorphic processes that Segment M15-D is undergoing include minor aggradation, widening, and planform adjustment. Both the RGA and the RHA were rated in the higher end of the “fair” range. The “fair” rating for the RHA reflects the lack of vegetative protection on the banks from the rip-rap and presence of invasive vegetation, the riparian buffer condition and the embedded substrate (50-75%).

Little River Section C: Section C includes reaches M16 through M19, where the channel is moderately incised and the existing stream type is the same as the reference stream type. All reaches in this section are “C” channels that are in stage III of the F channel evolution model, i.e. they have incised, widened, and are generally undergoing major aggradation and planform change. A few reaches are also undergoing major widening. In general, the main difference between this 4.6 mile long section and section B is that section C is currently experiencing much greater aggradation and planform adjustment.

Reach M16 **River Corridor Protection** **Buffer Restoration**

Reach M16 was separated into three segments to capture the characteristics of a beaver dam influenced sub-reach, M16-B. Differences in substrate size and depositional features were also factors in segmenting the reach. All three segments have beaver dams (Figure 7.27), but M16-B is most affected by the beaver dams.



Figure 7.27. Beaver dam and deposition in M16-A

The confluence of the West Branch and the Little River is located just downstream of the start of M16-A. The segment continues about three-quarters of a mile to just downstream of the Cemetery Road Bridge. Two properties owned by the Town of Stowe provide river frontage in segment M16-A. A 15.6 acre parcel off of Cemetery Road (Hayes land) abuts the Little River on the south side. The Hayes parcel is included in the Vermont Significant Wetland Inventory. A VAST trail goes through this property and is used for winter recreation (Tom Jackson, 2010 personal communication). The Mayo Farm, a 235 acre farm, is located on the north side of the river. The Stowe Land Trust holds a conservation easement on the Mayo Farm (Stowe Land Trust, 2008e).

The lower segment (M16-A) and the most upstream segment (M16-C) are much more depositional and have experienced more planform adjustment than the middle segment (Figures 7.28 and 7.29). Numerous point bars, mid-channel bars and side bars in M16-A and M16-C show that the stream is currently aggrading. The presence of flood chutes, channel avulsions and neck cutoffs are evidence of planform adjustment within Segments M16-A and M16-C. Both segments are sinuous “C” channels in stage III of the F channel evolution model.

The dominant buffer width on the east side is greater than 100 feet in segment M16-A, but over one-third of the west side has a buffer less than 25 feet in width. The dominant buffer width on the west side is 51-100 feet. The west corridor is primarily residential, while the east side has a dominant corridor land use of shrub/sapling. Both banks in M16-A are sandy banks with active erosion on about half their length, indicating that the channel is currently widening.



Figure 7.28. The large sand point bar reflects the major aggradation in M16-C.

Segment M16-A has undergone minor historic incision. The channel has an abandoned terrace and is developing a new floodplain. Active adjustment processes include major aggradation, widening and planform adjustment. The RGA and the RHA received a score of “fair” condition. Habitat scores for embeddedness, sediment deposition, bank stability, and riparian buffer zone (west side) reflect the deposition and widening that are occurring in M16-A.

M16-B has been heavily influenced by beaver dams (Figure 7.29). It starts just downstream of the Cemetery Road Bridge and continues upstream for 1,335 feet. The stream type is a gravel dominated “E” channel. Due to the presence of beaver dams, M16-B was not fully assessed. There is a short (about 300 feet) straightened and armored section associated with the Cemetery Road Bridge. The bridge is causing a channel and floodprone constriction. Stream buffers are not as wide as in M16-A, with a 26-50 foot buffer dominant on the east side and 51-100 foot buffer dominant on the west side. About one third of both banks have buffer widths of less than 25 feet. Hay fields are dominant on the east corridor, while residential land use is dominant within the west corridor.



Figure 7.29. Beaver dam influence in M16-B

At the point where the beaver dam influence ends, M16-C begins and continues three-quarters of a mile to 1,400 feet upstream of the West Hill Road Bridge. The buffers for M16-C are wider than the downstream segments. The dominant buffer width for both sides is greater than 100 feet and the subdominant is less than 25 feet. Within both east and west corridors, land use is predominantly shrub/sapling and subdominant is hay. Approximately 40 percent of each bank has experienced active erosion. There is some minor straightening and armoring associated with the bridge at West Hill Road. This bridge is constricting the channel and the floodplain and is responsible for some of the deposition in M16-C.

The channel adjustment processes in M16-C include: major historic incision, major aggradation and planform adjustment, and minor widening. As mentioned earlier, there are numerous depositional features and evidence of planform adjustment from an avulsion, neck cut off and flood chute. Like M16-A, the RGA and the RHA were scored in the “fair”

category. Low habitat scores for sediment deposition, substrate cover, embeddedness, and bank stability indicate that the aggradation and widening in the segment is negatively affecting the habitat.

Reach M17 **River Corridor Protection**

Reach M17 is about one-half mile long and very similar to segments M16-A and M16-C in that it is an incised depositional reach which has abandoned its old floodplain and is creating a new one. Gravel is the dominant substrate in this “C” channel, which is also in stage III of the F channel evolution model.

The dominant buffer in M17 is greater than 100 feet and the subdominant buffer is 51-100 feet for both sides. The dominant land use for both corridors is shrub/sapling. There is one beaver dam on the downstream end of M17 and numerous depositional features including large point bars at every bend. Both banks are sandy non-cohesive banks and are experiencing moderate to high erosion, especially on outside bends (Figure 7.30).



Figure 7.30. Bank erosion and point bar in M17

The channel adjustment processes within M17 are major historic incision, major aggradation and planform change, and minor widening. There are no flood chutes, but on the downstream end there is a channel avulsion indicating major planform adjustment. The RGA rated as “fair”, and the RHA rated in the lower end of the “good” category. The parameters most impacting the habitat condition are sediment deposition and bank stability.

Reach M18 **Buffer Restoration** **River Corridor Protection** **Bridge Replacement**

A change in planform resulted in three segments within reach M18. A straightened section of 514 feet was separated out as the middle segment (M18-B), while the rest of the reach upstream was not straightened. More planform adjustment was observed in the lowest and uppermost segments than in the middle segment. All segments are borderline “C” channels with width to depth ratios just under 12. As with downstream reaches, M18 has historically incised, is very depositional and experiencing planform adjustment. There has been a human caused change in valley confinement in only one segment (M18-B) from Little River Farm Road, but it is minor and has not changed the valley type.

Riparian buffers were predominantly greater than 100 feet in all three segments except for the east side of M18-A, which is 51-100 predominantly. In M18-A, the corridor to the west is primarily forested providing good riparian protection, while the eastern corridor is shrub/sapling. The corridors within M18-B are predominately forested and shrub/sapling for the east and west side, respectively, while both sides contain residential land use as subdominant. Shrub/sapling is the dominant land use within both corridors in segment M18-C. All three segments had RGA and RHA scores of “fair”.

The lower segment, M18-A, begins about one-half mile downstream of the Little River Farm Road crossing and is 2,350 feet in length. The segment is currently undergoing major aggradation (Figure 7.31), major planform adjustment with minor widening. Planform adjustment was evident from the two avulsions which have cut off meander bends to form new channels.

Located downstream of the Little River Farm Road Bridge, segment M18-B is 514 feet in length and has been extensively straightened (Figure 7.32). Segment M18-B contains a diagonal bar and steep riffle, indicating that the segment is aggrading. However, aggradation, widening, and planform adjustment are minor adjustment processes for Segment M18-B.



Figure 7.31. A large unvegetated gravel bar showing the major aggradation in



Figure 7.32. Straightened section of M18-B

Segment M18-C begins just upstream of Little River Farm Road and continues for $\frac{3}{4}$ mile until the confluence with Moss Glen Brook (T8.01). Degradation, aggradation, and widening are major adjustment processes in M18-C. Planform adjustment was rated as extreme with extensive lateral bank erosion, an avulsion and neck cutoffs. M18-C was the only segment in M18 with major widening, which was evident from the bank erosion along approximately 30 percent of both banks.

Reach M19
Streamside Plantings
Buffer Restoration
River Corridor Protection
CREP

Reach M19 was divided into two segments due to changes in valley width and incision. The downstream segment (M19-A) is more incised than the upstream segment (M-19-B). The upstream valley is wider than downstream, although both segments still have very broad valleys. Both segments are gravel dominated “C” riffle-pool channels in stage F-III of channel evolution. M19 is very depositional with twenty steep riffles and numerous bars. (Figure 7.33).

Segment M19-A begins at the confluence of Moss Glen Brook (T8.01) and continues for 1,044 feet until the valley becomes much wider. The dominant buffer in M19-A is greater than 100 feet and on the west side there are no buffers less than 25 feet. On the eastern side, buffers less than 25 feet in width make up about one-quarter of the length. Land use within the river corridor in M19-A is predominantly shrub/sapling and subdominant is pasture and hay.

The top part of M19-B begins about 500 feet downstream of the Moulton Lane crossing and flows for another mile through a forested section and then into a more agricultural area. In M19-B, buffer width is predominantly 26-50 on the east side and 51-100 feet on the west side. Buffer widths less than 25 feet in M19-B encompass approximately 30 percent of the east side and 10 percent of the west side, respectively. The nearby farm and adjacent hay fields make the middle to lower part of this segment an ideal CREP project location.

The percentage by length of erosion is greater in Segment M19-A indicating more widening than in Segment M19-B, although some of the outside bends in M19-B are eroding. Segment M19-B also has rip-rap armoring on its banks especially in the vicinity of Tansy Hill Road Bridge (Figure 7.34), while downstream there is none. This bridge is causing a channel and floodprone constriction. Just upstream of Tansy Hill Road Bridge, there is evidence of gravel mining. Dominant land use in M19-B is hay within the eastern corridor and forested in the western corridor. A berm, 225 feet in length, was observed just downstream of Tansy Hill Road Bridge in segment M19-B. Removal of this berm is not feasible given its purpose is to protect an adjacent pond.

Both segments have historically incised, but as mentioned before, M19-A is slightly more incised than M19-B. M19-A is currently undergoing major widening, while it is minor in M19-B. Both segments resulted in “fair” RGA scores and RHA scores in the higher end of the “fair” range. RHA scores were lower in Segment M19-A than M19-B primarily due to more bank erosion and poor fish cover and substrate for epifaunal colonization.



Figure 7.33. Large point bar in M19-A



Figure 7.34. Rip-rap along bank upstream of Tansy Hill Road Bridge in M20

Little River Section D: Section D is the most upstream section and includes reaches M20 and M21. This section, which is about 1.4 miles, is not incised and deposition is the dominant process, putting these reaches in stage IIc of the D channel evolution model. The main difference between Section D and Section C (downstream) is the lack of incision. The upper 1,050 feet of this Section D is a bedrock gorge and was, therefore, not fully assessed.

Reach M20
Buffer Restoration
River Corridor Protection
CREP

Reach M20 begins approximately 500 feet downstream of the bridge at Moulton Lane crossing and continues three-quarters of a mile to upstream of the Sterling Valley Road crossing. This reach has good floodplain access except for some areas where the access is poor due to streamside berms. One of these berms is 160 feet in length and is located just upstream of Moulton Lane Bridge. This berm is associated with a large pond within the river corridor. It is not practical to remove the berm because it is protecting the pond. The second berm is 140 feet in length, and is located downstream of the Moulton Lane crossing. The berm is preventing the road from flooding, and its removal is not feasible. Straightening has occurred along one-third of the reach due to association with the two bridges, which are both floodprone constrictions, but not channel constrictions. There are three areas that were identified earlier by LCPC as places where dredging has occurred. This reach contains four beaver dams, which have made parts of the channel very deep.

The dominant buffer category is greater than 100 feet on both banks, but there are some areas where the buffer is less than 25 feet. Some of these areas with limited buffer are experiencing major erosion within the vicinity of crop fields (Figure 7.35). Forest is the dominant land use within the corridor in this reach, but the subdominant is crop in the eastern corridor and residential in the western corridor. CREP may be an appropriate management option for the upstream end of the reach.

The channel adjustment processes for M20 include: major aggradation, major planform



adjustment, and minor widening. Aggradation is very evident in this reach with many depositional features including five diagonal bars and ten steep riffles. The width to depth ratio was difficult to measure in wider areas due to the presence of the diagonal bars. Planform adjustment was observed through four flood chutes and two islands. The RGA was scored on the higher end of “fair”, while the RHA came out as “good”. The only parameter that was rated in the fair category was channel alteration.

Figure 7.35. Severe erosion and lack of riparian buffer along east bank in Reach M20

Reach M21 **River Corridor Protection**

Reach M21 needed to be broken up into two segments due to the channel becoming a bedrock gorge in the upper 1,050 feet. Segment M21-A begins 400 feet upstream of the Sterling Valley Road crossing and continues 2,174 feet until the stream becomes a bedrock gorge. M21-B is a bedrock gorge and did not receive a full phase 2 assessment. A scenic waterfall, worthy of conservation, is located within the segment.

Channel straightening in the vicinity of roads and adjacent to agricultural lands has occurred in segment M21-A. There is a relatively good buffer in some areas with a dominant buffer of greater than 100 feet, but a subdominant buffer of 26-50 feet on both sides with some areas less than 25 feet. Sterling Valley Road runs parallel to M21-A along the west bank and encroaches on the corridor for approximately 1,200 feet. There are berms associated with the road, totaling 470 feet in length along the segment. These berms are not recommended for removal given the good floodplain access on the opposite bank and the close proximity to the road.

Segment M21-A has not incised and therefore follows the D channel evolution model. With the presence of steep riffles and diagonal bars among other depositional features (Figure 7.36), this reach is currently undergoing major aggradation. The combination of channel alteration and sediment deposition has resulted in major planform adjustment. Minor widening is occurring from the moderate to high erosion on both banks.

Similar to Reach M20, the RGA scored “fair” for M21-A and the RHA scored “good”. Except for bank stability and channel alteration, habitat parameters were scored either in good or reference categories.



Figure 7.36. Steep riffle and point bar within Segment M2I-A.

Miller Brook

Miller Brook is one of the major tributaries to the Little River. Five reaches of Miller Brook were assessed. All reaches were moderately or severely incised, with two reaches (the second most downstream and the most upstream) having stream type departures. The reference stream type for all reaches is “C”. With the exception of the most upstream reach (T4.05), the Miller Brook reaches are all stage III of the F channel evolution model. T4.05 has not yet widened and is in stage F-II.

Reach T4.01

Berm Removal

Bridge Replacement

Reach T4.01 begins at the confluence with the Little River, which is about 900 feet downstream of the Moscow Road Bridge, and continues for about one-half of a mile along Nebraska Valley Road. Of all the reaches in the study, T4.01 had the highest width to depth ratio indicating it has become extremely wide.

The Little River corridor is encroached by Nebraska Valley Road along the west side for approximately 2,100 feet. From the encroachment of the road, there is a human caused change in valley width, but not a change in valley type. Along the east side of the corridor in the upper part of T4.01, there is a 7 foot high berm that is about 115 feet long. The removal of this berm is low priority given the well established woody vegetation. The cost of removing the vegetation on the berm should be weighed with the benefit of improving floodplain access. Approximately one-quarter of the length of reach T4.01 has been historically straightened for the road and has a buffer less than 25 feet on the western bank. The lack of buffer has led to bank erosion mostly on the western bank with bank failures and a mass failure occurring on the upstream end of the reach (Figures 7.37 and 7.38). A

second mass failure was observed on the downstream end of the reach on the eastern bank (Figure 7.39).



Figure 7.37. Lack of buffer along western bank causing bank failure in Reach T4.01



Figure 7.38. Mass failure 12 feet high along western bank in Reach T4.01

Along the western side of T4.01, the dominant buffer is 51-100 feet and the subdominant is 26-50 feet. The eastern side contains a higher quality buffer with a dominant width of greater than 100 feet and subdominant of less than 25 feet. Forested land on the east side provides good river corridor habitat. However, the western side is predominantly residential land with hay as the subdominant land use.

The alteration of the corridor on the western side and the straightening of the channel have resulted in channel incision and then widening to extreme levels (50.4 width to depth ratio). Reach T4.01 is also experiencing major aggradation (Figure 7.40) and planform adjustment. The RGA scored in “fair” condition. Deposition within riffle areas has created many steep riffles and diagonal bars. Other depositional features include many side bars and four mid-channel bars. Planform adjustment is evident from one island and frequent flood chutes. The RHA scored in the low end of the “good” range.



Figure 7.39. Mass failure 20 feet high along eastern bank in Reach T4.01



Figure 7.40. Major aggradation shown by very large side bar in Reach T4.01

Reach T4.02

Berm Removal

Bridge Replacement

Reach T4.02 is a 1.5 mile long reach with a high width to depth ratio (30.5) and is very depositional. The incision ratio is 2.0; indicating Miller Brook has poor floodplain access. Signs of incision were also observed from the presence of rejuvenating tributaries. The incision has led to the channel becoming more entrenched causing a stream type departure from a “C” channel to an “F” channel. The Nebraska Valley Road Bridge is out of alignment with the stream channel and is causing a channel and floodprone constriction (Figure 7.41). There has been a human caused change in valley width due to the placement of Nebraska Valley Road within the valley of the eastern side.

Straightening has occurred along approximately 20 percent of the reach and T4.02 has lost access to its floodplain from the placement of a 330 foot berm along the west bank near the downstream end. The berm was likely placed in this location to protect agricultural fields. The feasibility of removing this berm requires further investigation. Other than the berm, the western corridor is generally in good condition with a dominant buffer width of greater than 100 feet and a subdominant width of 51-100 feet. The eastern corridor has been encroached upon with development for approximately twelve percent of the reach length. The dominant buffer width for the eastern side is greater than 100 feet with a subdominant width of 26-50 feet. Land use is predominantly forest on both sides with residential subdominant on both sides. Although deciduous trees are the dominant vegetation on the banks, invasive plants, such as Japanese knotweed, are subdominant.

Reach T4.02 has experienced extreme historic incision, major aggradation and planform adjustment, and minor widening. Numerous steep rifles, diagonal bars, side bars, point bars and mid-channel bars indicate that some sediment is working its way down Miller Brook is getting deposited here (Figure 7.42). Many islands and flood chutes were observed indicating major planform adjustment. The RGA and the RHA were scored as “fair”. The “fair” RHA rating was the result of numerous depositional features and the presence of invasive vegetation on the banks.



Figure 7.41. Bridge crossing of Nebraska Valley Road constricting Reach T4.02



Figure 7.42. Island with diagonal bar and steep riffle along Reach T4.02

Reaches T4.03
River Corridor Protection
Bridge Replacement

Reach T4.03 was broken into two segments due to differences in valley width, planform and slope, and depositional features. The stream type for both segments T4.03-A and T4.03-B is a cobble dominated “Cb” channel (Figure 7.43). Both segments are in stage III of the F channel evolution model. T4.03 is located along Nebraska Valley Road, which encroaches on the river corridor. Straightening has occurred on approximately one-quarter and one-half of the length of segments T4.03-A and T4.03-B, respectively, with windrowing having also taken place in segment T4.03-A.

Because of Nebraska Valley Road, the western buffer is much more impacted than the eastern buffer in Reach T4.03. The eastern side of both segments has a forested buffer greater than 100 feet. The subdominant buffer on the eastern side of T4.03-A is 51-100 feet. On the western side of Segment T4.03-A, the buffer is predominantly greater than 100 feet and less than 25 feet subdominant. The dominant buffer on the western side in T4.03-B is 26-50 feet with 51-100 feet subdominant. The two segments have good dominant bank and buffer vegetation, except for T4.03-A which has predominantly invasive species, such as Japanese knotweed, within the buffer and on the banks.

Segments T4.03-A and T4.03-B have historically incised, with greater incision in T4.03-B. Geomorphic processes in T4.03-A include minor historic incision and widening, major aggradation, and major planform adjustment. T4.03-B shows major historic incision and aggradation, while widening and planform adjustment are minor. Aggradation was evident from many steep riffles and diagonal bars along with other depositional features (Figure 7.44). The RGAs for both segments in T4.03 were scored in the “fair” category. The RHA was scored “fair” for T4.03-A and “good” for T4.03-B. In general, the RHA scored lower for T4.03-A primarily due to banks vegetated with invasive species, bank erosion, and lack of substrates for fish cover and epifaunal colonization.



Figure 7.43. Cobble dominated “Cb” channel in Reach T4.03



Figure 7.44. Steep riffle and mid-channel bar showing major aggradation in Segment T4.03-A

Reach T4.04 **River Corridor Protection**

Reach T4.04 begins just upstream of the confluence with an unnamed tributary (T4.03SI) and continues for about three-quarters of a mile along Nebraska Valley Road. The stream type for T4.04 is a gravel dominated “Cb” channel. The channel is in stage III of the F evolution model. Approximately 20 percent of Reach T4.04 has been historically straightened.

In T4.04, 70 percent of the buffer is less than 25 feet making it the dominant buffer width on the west side, while the subdominant width is 51-100 feet. The east side has a dominant buffer width greater than 100 feet and forest is the dominant land use. The west side has a dominant land use of residential due to the encroachment of Nebraska Valley Road.

Major historic incision and planform adjustment are evident in T4.04 by the presence of rejuvenating tributaries (Figure 7.45), four flood chutes, six islands (Figure 7.46), and one channel avulsion. Widening and aggradation are minor in T4.04. The RGA scored “fair”. Reach T4.04 has a diversity of velocity/depth patterns and stable banks. The habitat condition came out as “good”.



Figure 7.45. Rejuvenating tributary in Reach T4.04



Figure 7.46. One of many islands showing major planform adjustment in Reach T4.04

Reach T4.05 **River Corridor Protection** **Berm Removal** **Bridge Replacement**

Reach T4.05 is 1,925 feet long and is well forested along both banks. The reach begins at the confluence with an unnamed tributary (T4.04SI) and continues upstream to the dam at Lake Mansfield. Although T4.05 is well forested and has wide buffers, it has been impacted by the dam at Lake Mansfield (Figure 7.47). The dam has caused the reach to be sediment starved and to incise to an extreme degree (incision ratio of 2.0). The extreme historic incision has led to a stream type departure from a cobble dominated “C” channel to a

cobble dominated “Bc” channel. The stage of channel evolution is F-II, which indicates that the stream has lost access to its floodplain and has become more entrenched.

Nebraska Valley Road encroaches upon the eastern corridor for 360 feet at the upstream end. The buffers for this reach are very well forested with a dominant width of greater than 100 feet and subdominant 51-100 feet just at the upstream end where Nebraska Valley Road encroaches upon the corridor. Large trees along the banks are holding soil in place, thereby resulting in little bank erosion. The dominant land use within both corridors is forest. The subdominant corridor land use is residential due to the road. Nebraska Valley road crosses Miller Brook again with a bridge that is constricting both the channel and the floodplain (Figure 7.48). Two berms, each approximately 150 feet in length, are located downstream of the Nebraska Valley Road Bridge. The reason for placement of these berms is not known. The removal of the berm on the east side of the channel is not recommended given the remote, forested location and the mature tree growth on the berm. The berm on the west side of the channel needs further investigation for removal feasibility.



Figure 7.47. Lake Mansfield Trout Club dam at upstream end of T4.05



Figure 7.48. Constricting bridge at Nebraska Valley Road in Reach T4.05

Similar to reach T4.04, T4.05 has many depositional features as well as features indicating planform adjustment. Tributary rejuvenation was also observed in T4.05. Although there has been extreme historic incision; aggradation, widening, and planform adjustment are still minor processes. The RGA was scored as “fair” mainly due to the extreme incision. Because of wide and well vegetated buffers and banks, the RHA was scored in the high end of the “good” range. Reach T4.05 is a good candidate for river corridor protection due to its high quality river corridor. The only parameter that was scored low in the RHA was substrate exposure at riffles due to the presence of some depositional features.

Gold Brook

Gold Brook is a major tributary to the Little River. Seven reaches were assessed during Phase 2. The assessed reaches are variable in terms of stream type, degree of incision and

channel evolution stage, but in general most reaches have minor aggradation, widening, and planform adjustment currently occurring.

Reach T6.01

Streamside Plantings

Berm Removal

Bridge Replacement

Reach T6.01 is 2,235 feet long and begins at the confluence with the Little River. It follows along Gold Brook Campground on its southern bank and hayfields on its northern bank to upstream of the crossing at Waterbury Road (VT 100). The channel is a gravel dominated “C” stream type with major historic incision in stage F-III of the channel evolution model.

Approximately 70 percent of Reach T6.01 has been heavily bermed and about one-third has been armored with rip-rap and hard bank on the southern bank (Figure 7.49). Due to the armoring, there is little bank erosion on the southern bank. However, there is bank erosion along one-third of the northern bank. Roads and development encroach upon the corridor for approximately 60 percent of the channel length. Straightening has occurred along 80 percent of the reach. Gold Brook has also been dredged from its mouth up to VT 100. There is a bridge at the crossing at VT 100 causing both a channel and a floodprone constriction. The upstream part of this reach has a higher slope than near the mouth and includes a bedrock grade control (Figure 7.50).



Figure 7.49. Rip-rap along southern bank in Reach T6.01

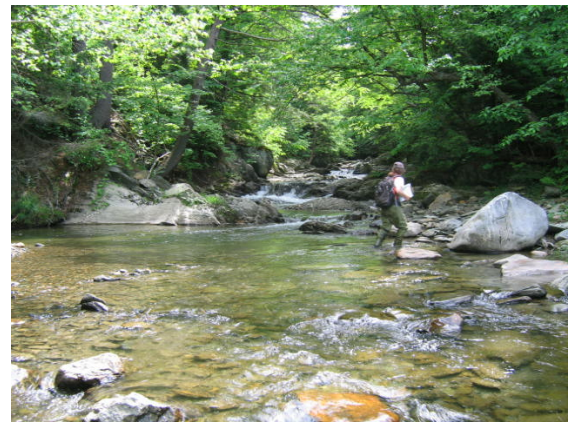


Figure 7.50. Bedrock grade control in upper part of Reach T6.01

Buffers in T6.01 are predominantly less than 25 percent on both banks. The subdominant buffer width is 26-50 feet for both sides. Dominant land use is residential in the southern corridor and hay in the northern corridor.

The widespread alteration of this channel has caused major historic incision as well as current major planform change. Widening is currently a minor process within the reach due to the presence of rip-rap on the southern bank. Although there was one steep riffle and diagonal bar, aggradation is still a minor process in T6.01. As a result of the deviation

from natural conditions of the corridor and channel, T6.01 rated as “fair” for both the RGA and RHA. The extensive channel straightening, lack of riparian buffers, and reduced vegetative protection on the west bank are the major factors that have led to the “fair” RHA score.

Reaches T6.02 **River Corridor Protection**

Reach T6.02 starts upstream of VT 100 and continues for about one-half mile. Reach T6.02 is a “B” type step-pool stream with no historic incision. There are many bedrock grade controls throughout Reach T6.02, thereby preventing downcutting of the bed (Figure 7.51). The bedrock in T6.02 is also causing channel constrictions in four locations.



Figure 7.51. Bedrock grade control in Reach T6.02 preventing incision in this segment

Gold Brook Road runs along approximately 70 percent of the one-half mile length of Reach T6.02, but the road is outside the valley wall. Reach T6.02 is semi-confined and has not been impacted by changes in valley width from human influences. Except for in a few locations where Gold Brook Road is within the valley wall, T6.02 has well vegetated buffers and banks.

The only major geomorphic process in Reach T6.02 is aggradation. The channel evolution stage is IIb of the D model, which signifies that the reach has not incised and the dominant active adjustment process is aggradation. Widening and planform change are minor active adjustment processes. The RGA and RHA for T6.02 were rated “good”. No habitat parameters scored in the fair or poor categories.

Reach T6.03 **Berm Removal** **River Corridor Protection**

Reach T6.03 was divided into four segments due to differences in channel dimensions, planform and slope, corridor encroachment, valley width, and to capture a subreach with a different reference stream type of “C” (T6.03-C). Except for one segment (T6.03-B), all of the segments in Reach T6.03 have not incised or are slightly incised.

Segment T6.03-A is one-quarter mile long and begins where the southern side has road encroachment, buffers less than 25 feet, and is straightened and armored. A 180 foot long berm exists between Gold Brook and Gold Brook Road. This berm should be investigated further to analyze the feasibility for removal. The bedrock grade control in T6.03-A is preventing incision in this segment (Figure 7.52).



Figure 7.52. Bedrock grade control in Segment T6.03-A

Segment T6.03-B, which is 536 feet long, is almost entirely straightened and rip-rapped on the southern bank with a buffer of less than 25 feet due to Gold Brook Road (Figure 7.53). Gold Brook begins to go away from the road at the start of T6.03-C, which is approximately one-quarter mile long. The buffers on T6.03-C are well forested and predominantly greater than 100 feet except for a short distance on the southern bank from encroaching development and roads. The corridor in Segment T6.03-D becomes heavily impacted again on the southern side from the encroachment of Gold Brook Road, rip-rap, straightening, and reduced buffer width. The dominant buffer on the southern side is 51-100 feet and subdominant is 26-50 feet. Dominant land use is forest on the northern side and residential on the southern side due to the road.

Segments T6.03-A and T6.03-D are “B” streams that are in stage I of the F channel evolution model, i.e. they have not incised and the sediment transport capacity is in equilibrium with its sediment load. The only minor active process in these segments is widening. For Segment T6.03-B, the scenario is very different. Segment T6.03-B stands out from the other Gold Brook segments/reaches. Extensive channel alteration in T6.03 has led to extreme historic incision (ratio of 2.85) and a stream type departure from a “B” to an “Fb” stream type. The active processes in T6.03-B are minor aggradation, widening, and planform adjustment. This segment is in stage II of the F model.

A subreach with a different reference stream type than the rest of the segments in T6.03 was captured in T6.03-C. Segment T6.03-C is predominantly a “C” stream with a slope more like a “B” stream. It has only slightly incised and is currently undergoing extreme aggradation (Figure 7.54). Therefore, the evolution stage of D-IId was assigned. Channelization in the upstream segment (T6.03-D) and the drop in slope and change in entrenchment in T6.03-C are the major causes of aggradation within this subreach. Historic incision, widening and planform adjustment are minor processes in T6.03-C.



Figure 7.53. Rip-rap armoring, lack of buffer, and stormwater input in Segment T6.03-B



Figure 7.54. Major aggradation in Segment T6.03-C

The RGA was rated “fair” in segments T6.03-B and T6.03-C and “good” in segments T6.03-A and T6.03-D. The extreme incision in T6.03-B contributed to the “fair” geomorphic condition and in T6.03-C, the extreme aggradation resulted in the “fair” rating. Segment T6.03-B was the only segment in Reach T6.03 with a “fair” score for the RHA. The rest of the segments had ratings of “good” for the RHA. Segment T6.03-B was rated as fair due to its heavily altered channel and lack of bank vegetative cover and riparian buffer on the southern side.

Reaches T6.04

River Corridor Protection

Berm Removal

Reach T6.04 begins where the channel becomes incised again about 200 feet upstream of the covered bridge at the confluence of an unnamed tributary, T6.03S1. The reach continues 1,065 feet until just upstream of the next unnamed tributary, T6.04S1. There has been a human caused change in valley width due to Stowe Hollow Road, but the valley width was not altered enough to change the valley type. The buffers in Reach T6.04 are wide and well vegetated with the dominant buffer width for both sides greater than 100 feet.

There are two berms within the river corridor preventing the stream from accessing its floodplain. On the southern bank of T6.04 there is a 150 foot berm constructed with fill preventing floodplain access (Figure 7.55) and another 100 foot berm upstream. The feasibility of removing these berms needs to be further investigated.

An incised tributary was observed in T6.04 indicating major historic incision. Reach T6.04 is a “Cb” channel in stage III of the F channel evolution model. Active geomorphic processes include minor aggradation, widening, and planform adjustment.

The RGA was rated as “fair” and the RHA was rated in the lower end of “good”. Major historic channel incision mostly contributed to the “fair” RGA score. Channel alteration from berms and armoring and reduced riparian buffer on the south side resulted in the low “good” score for the RHA.



Figure 7.55. Berm with fill preventing floodplain access in Reach T6.04

Reach T6.05
River Corridor Protection
Streamside Plantings
Culvert Replacement
Bridge Replacement

Reach T6.05 begins just downstream of the Stowe Hollow Road crossing and continues for approximately another three-quarters of a mile until one-quarter mile upstream of the Upper Hollow Road crossing. T6.05 is 35 percent straightened (Figure 7.56) and has had a human caused change in valley width due to Stowe Hollow Road and North Hollow Road. These roads encroach upon the corridor for approximately one-half of the channel length. A berm is located adjacent to the channel at the upper end of the reach and appears to be protecting North Hollow Road. Berm removal is not recommended at this time.

The dominant buffer width on the northern side of T6.05 is 51-100 feet and on the southern side is greater than 100 feet. The subdominant buffer width on both sides is less than 25 feet, with 50 percent of its length on the northern side within 25 feet of land cover other than riparian vegetation. There are three stream crossings in reach T6.05, two of which are constricting the channel.

An incised tributary was observed in T6.04 and T6.05 (Figure 7.57), but historic incision is still minor due to a moderate incision ratio (1.39). Although all other geomorphic processes are minor in T6.05, the RGA still scored as “fair”. The RHA scored in the “good” range with channel straightening the only parameter with a fair score.



Figure 7.56. Straightened section of Reach T6.05



Figure 7.57. A rejuvenating tributary indicates that T6.05 has incised

Reach T6.06
River Corridor Protection
Culvert Replacement
Berm Removal

Reach T6.06 was divided into two segments (T6.06-A and T6.06-B) due to variable channel dimensions and reference stream types. The first segment, T6.06-A (Figure 7.58), begins just upstream of the Upper Hollow Road crossing and continues about one-half mile until the Bryan Road crossing. T6.06-B, continues for 1,555 feet until just downstream of the crossing at North Hollow Road.

There has been a human caused change in valley width in both segments due to North Hollow Road. Approximately one-half of T6.06-A is straightened with possible windrowing, but T6.06-B is not straightened. Except for areas where development and North Hollow Road encroaches the corridor, the buffers are wide and well vegetated. There are several grade controls and bedrock constrictions (Figure 7.59).

Berms are located in both segments totaling approximately 600 feet. Segment A contains a 120 foot long berm along the north bank that is protecting a pond off of North Hollow Road and a 130 foot long berm that is protecting North Hollow Road. Both of these berms appear to be serving a purpose and are not recommended for removal. In segment B there are two berms, both of which need further investigation for removal.

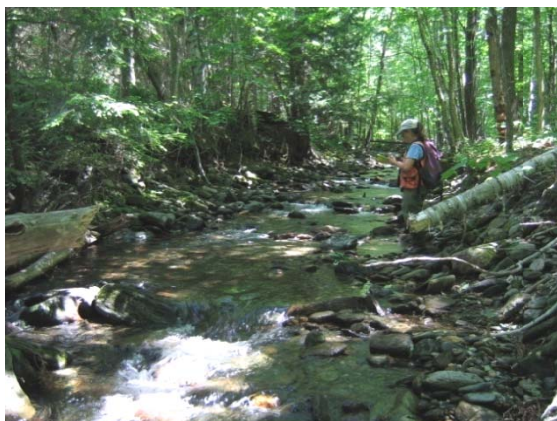


Figure 7.58. Typical channel in Segment T6.06-A

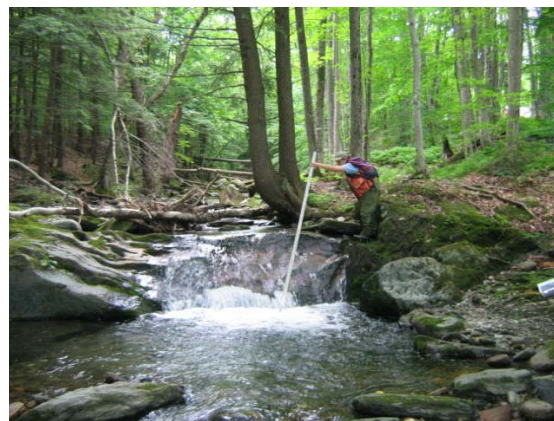


Figure 7.59. Bedrock grade control and channel constriction in T6.06-B

Segment T6.06-A is a cobble dominated “Cb” stream in stage III of the F channel evolution model, while T6.06-B is a “Ba” stream in stage F-II, indicating that it is more entrenched and has not yet widened. In Segment T6.06-A historic incision is minor with an incision ratio of 1.36. Historic incision is greater in T6.06-B (ratio of 1.76) and is therefore a major process. Aggradation and widening are minor in both segments, while planform adjustment is major due to the presence of islands, flood chutes, and a recent channel avulsion (Figure 7.60). The change in channel planform resulted in a “fair” RGA score for T6.06-A. Historic incision and planform adjustment contributed to the “fair” RGA score in T6.06-B.

The RHA scored “good” for T6.06-A with channel straightening, a reduced riparian buffer on the south side, and sediment deposition causing embedded substrate impacting the RHA score. In Segment T6.06-B, the only parameter noted as fair was sediment deposition causing increased embeddedness in the channel.



Figure 7.60. Outlet of channel avulsion in Segment T6.06-A

Reach T6.07

River Corridor Protection

Culvert Replacement

Dam Removal

Reach, T6.07 begins about 250 feet downstream of the North Hollow Road crossing and continues in between North Hollow Road and Putnam Forest Road for about another one-half mile. There has been a human caused change in valley width due to North Hollow Road and Putnam Forest Road, which encroach approximately 60 percent of the reach by

length. Channel straightening has occurred along about one-half of T6.07. There are many bedrock constrictions and grade controls including an old rock dam at the downstream end which is a fish passage issue and has caused significant scour just downstream (Figure 7.61). Two mass failures within T6.07 are providing a sediment source for the channel (Figure 7.62).

Compared to other reaches in Gold Brook, T6.07 has been severely incised (ratio of 2.41) and the stream type has departed from a “Ba” stream to a “Fa” stream in stage F-II. The severe historic incision is a result of the extensive channel straightening and alterations associated with the old dam.

Other geomorphic adjustment processes in Reach T6.07 are currently minor, but the RGA was scored “fair” due to the extreme historic incision and stream type departure. The RHA resulted in a score at the low end of the “good” range. Channel straightening and the riparian buffer width on the south side contributed to the RHA score as did depositional features and increased substrate embeddedness.



Figure 7.61. Old rock dam grade control in T6.07



Figure 7.62. Mass failure in T6.07

Moss Glen Brook

Moss Glen Brook is a major tributary that enters the Little River just downstream of the beginning of reach M19, where the Little River becomes Sterling Brook. This confluence is located just downstream of where Stagecoach Road crosses Moss Glen Brook. The three most downstream reaches on Moss Glen Brook were assessed for Phase 2 (T8.01, T8.02 and T8.03). In general, these reaches are very depositional, have been historically incised and in some cases their channels are over wide. All reaches are gravel dominated “C” channels by reference, but the upper portion of the assessed reaches have experienced stream types departures due to extreme historic channel incision.

Reach T8.01
Streamside Plantings
Buffer Restoration
CREP
Culvert Replacement

Reach T8.01 was divided into two segments due to channel dimensions. The upper segment is 950 feet in length, while the lower segment is about three-quarters mile in length. The bankfull width in the upstream segment (T8.01-B) is much wider than the downstream segment (T8.01-A). Both segments T8.01-A and T8.01-B are rather sinuous and flow through a very broad agricultural valley.

Channel straightening has occurred extensively in both segments, and bank erosion is moderate to high. The extensive erosion in Segment T8.01-B indicates that the channel is currently widening (Figure 7.63). Rip-rap armoring is most pervasive on the northern banks with approximately 20 percent in both segments. Other impacts include a mass failure at the upstream end of T8.01-B (Figure 7.64) providing sediment and causing increased deposition downstream. There is also a beaver dam in the center of T8.01-A causing deposition (Figure 7.65).



Figure 7.63 Over widened channel in cross section of T8.01-B



Figure 7.64. Mass failure acting as a major sediment source in Moss Glen Brook in T8.01-B

Buffers in both segments are lacking vegetation with the dominant buffer width on both sides of T8.01-A as 26-50 feet and the subdominant width less than 25 feet. The dominant buffer width in T8.01-B is less than 25 feet on both sides that covers the entire length of the segment. The dominant buffer vegetation on both sides of this segment is herbaceous indicating a lack of quality riparian vegetation. Land use within both corridors of T8.01-A is predominantly crop land with residential land subdominant. On the southern side of T8.01-B, bare land is the dominant land use with pasture subdominant. Pasture is dominant in the northern corridor in segment T8.01-B. This would be a good location for a CREP project due to the lack of buffer and proximity to cow pastures (Figure 7.66). Another impact present in both segments includes dredging. There is a channel avulsion in Segment T8.01-A which may have been caused by channel dredging.



Figure 7.65. Beaver dam causing deposition in T8.01-A



Figure 7.66. Lack of buffer and severe bank erosion in cow pasture area in T8.01-B

Segments T8.01-A and T8.01-B are similar in terms of their buffer and bank conditions, but they differ in channel morphology. Both segments are “C” channels that have major historic incision, but the width to depth ratio in T8.01-B is much higher (39.5). This high width to depth ratio, as well as the large amount of bank erosion, indicates the channel is currently undergoing major widening. Segment T8.01-A is in stage III of the F channel evolution model and segment T8.01-B is in stage IV. The presence of many depositional features including mid-channel, point, side, and diagonal bars and steep riffles shows that segment T8.01-A is currently undergoing major aggradation. Riffles are sedimented and diagonal. Aggradation is minor for T8.01-B and planform adjustment is minor for both segments.

The RHA and RGA scored as “fair” for both segments. The “fair” RGA score in T8.01-A was in response to the major historic incision and major active aggradation, while in T8.01-B, it was mostly due to major historic incision and widening. Reduced fish cover and epifaunal substrate, depositional features, channel straightening unstable banks on the south side and lack of vegetation in the riparian buffer have impacted the habitat in T8.01-A. The extensive straightening and extreme lack of buffer vegetation in T8.01-B contributed to the “fair” habitat condition. Depositional features, exposed substrate, unstable banks on the north side, and a lack of vegetation on both banks have contributed to the “fair” condition.

Reach T8.02
Streamside Plantings
Buffer Restoration
River Corridor Protection
CREP

Reach T8.02 was divided into two segments based on differences in channel dimensions. The downstream segment is 2,107 feet long and begins upstream of the Pucker Street Bridge. Channel characteristics in this segment are very similar to T8.01-B. The cross

section in this segment revealed that the width to depth ratio was very high (43.1) indicating major widening. Segment T8.02-B begins where the channel width becomes narrower and continues for 1,763 feet until just upstream of an unnamed tributary (T8.02S2). The stream channel in T8.02-B is much narrower than T8.02-A and is severely incised. The extreme incision has led to a stream type departure from a “C” to an “F” stream.

The southern buffer is forested in T8.02 with the dominant buffer width of greater than 100 feet in both segments. On the northern side however, the buffer width is less than 25 feet in half of Segment T8.02-A. The dominant buffer width on the northern side of Segment T8.02-B is 26-50 feet. Land use within the southern corridor is predominantly forest in both segments. The northern corridor is mostly crop land in T8.02-A and pasture in T8.02-B. Both segments have been impacted by extensive channel straightening. The entire length of T8.02-B has been straightened (Figure 7.67) and over half of T8.02-A has been straightened.

Segment T8.02-A is an interesting segment in that it is the only segment/reach in Moss Glen Brook that did not show any evidence of historic incision. However, all other geomorphic processes are actively occurring and major. The segment probably incised a long time ago, which led to the widening, aggradation and planform change but it is no longer incising. Similar to T8.01-B, T8.02-A is a “C” type stream in stage IV of the F channel evolution model. The extensive straightening in Segment T8.02-B led to severe historic incision (ratio of 2.79) resulting in a stream type departure from a “C” to an “F”. Segment T8.02-B is in stage F-III. Current geomorphic processes include minor aggradation, widening and planform adjustment.

Both the RGA and the RHA were scored as fair in both segments. The RGA was “fair” in T8.02-A due to major aggradation, widening and planform change. In Segment T8.02-B, the RGA was “fair” mostly due to the extreme incision. Extensive channel straightening, depositional features, lack of riparian buffer, and reduced vegetative cover on the northern bank contributed to a “fair” RHA score in T8.02-A. Unstable banks, extreme channelization, and lack of riparian buffer on the northern bank are the main causes for reduced habitat quality in T8.02-B.



Figure 7.67. Straightened section of segment T8.02-B

Reach T8.03
Buffer Restoration
CREP

Reach T8.03 is approximately 1,500 feet long and begins just upstream of an unnamed tributary (T8.02S2). Channel characteristics in this reach are very similar to T8.02-B. Severe incision has led to a stream type departure from a “C” to an “F” stream.

Buffer conditions are similar to downstream in that the southern buffer is very forested and greater than 100 feet. On the northern side, the dominant buffer width is 26-50 feet, and the subdominant width is less than 25 feet (Figure 7.68). Dominant land use in the southern corridor is forest and in the northern corridor is crop. Reach T8.03 has been extensively straightened which has led to extreme incision (2.3 incision ratio). Erosion is moderate to high in this reach indicating major widening (Figure 7.69).



Figure 7.68. Lack of buffer in Reach T8.03



Figure 7.69. Bank erosion on northern bank in Reach T8.03

The extensive straightening in T8.03 has led to a chain of events beginning with extreme historic incision which then resulted in major aggradation, major widening, and minor planform adjustment. Numerous depositional features were noted during the phase 2 assessment, including steep riffles and diagonal bars. The RGA resulted in “fair”. The RHA was scored in the low “good” range with depositional features, extensive channelization, unstable banks and lack of buffer on the northern side causing lower RHA scores. Habitat diversity and well vegetated banks and buffers on the southern side contributed to the “good” condition.

7.3 Site Level Opportunities

Site specific projects were identified using the criteria outlined by the VANR in Chapter 6 – Preliminary Identification and Prioritization (Vermont Agency of Natural Resources 2007a). This planning guide is intended to aid in the development of projects that protect and restore river equilibrium. Project maps (Figure 7.70 through Figure 7.74) and tables (Table 6 through 10) have been developed for the Lower Little River (reaches M06 through M14),

the Upper Little River (reaches M15 through M21), Miller Brook, Gold Brook and Moss Glen Brook. The tables provide information for each project, including the project strategy, technical feasibility, priority and general cost. A total of 42 projects were identified to promote the restoration or protection of channel stability and aquatic habitat in the Little River watershed. The projects are broken down by category as follows: 1 conservation (river corridor protection), 18 passive restoration (river corridor protection, streamside plantings and buffer improvement projects); 22 active restoration (12 bridge or culvert replacement or retrofit projects, and 8 berm and 2 dam removal projects), and one stormwater improvement project.

High priority projects include river corridor protection to provide attenuation of sediment and floodwaters through conservation and corridor easements, riparian buffer improvement areas, and the replacement or retrofitting of undersized stream crossing structures. Information from the Phase 2 stream geomorphic assessment and VANR bridge and culvert assessment could be used to inform the Town of Stowe of which stream crossings are contributing to localized instability. The high priority projects include:

Lower Little River (see Figure 7.70 and Table 6)

- **Passive Restoration** by augmenting existing tree plantings in the buffer within the Mount Mansfield State Forest (project #1);
- **Passive Restoration** of river corridor and streamside plantings from the confluence with Gold Brook to just downstream of River Road crossing (project #5).

Upper Little River (see Figure 7.71 and Table 7)

- **Active Restoration** by removing Pike Dam (project #1);
- **Active Restoration** by improving stormwater treatment at the Municipal Storage Facility (project #2);
- **Passive Restoration** of river corridor and riparian buffer from Mountain Road to Cemetery Road (project #3);
- **Passive Restoration** of river corridor from above Cemetery Road to end of reach M17 (project #4);
- **Passive Restoration** of river corridor and riparian buffer from Little River Farm Road to about 1,200 feet more downstream (project #5);
- **Passive Restoration** of river corridor from Little River Farm Road to confluence with Moss Glen Brook (project #7);
- **Passive Restoration** of river corridor and streamside plantings from just upstream of Moss Glen Brook to just below Tansy Hill Road (project #8);

Miller Brook (see Figure 7.72 and Table 8)

- **Active Restoration** by removing berm located about 600 feet downstream of first Nebraska Valley Road crossing (project #4);

- **Passive Restoration** of river corridor and riparian buffer from Nebraska Valley Road to 1,050 feet downstream of tributary confluence (project #6);
- **Active Restoration** by removing the berm near Nebraska Valley Road crossing (project #8);

Gold Brook (see Figure 7.73 and Table 9)

- **Active Restoration** by removing berm along Gold Brook Campground (project #1);
- **Passive Restoration** with streamside plantings from confluence of Little River and Gold Brook to Route 100 (project #3);
- **Active Restoration** by removing berm located approximately one-half mile upstream of Gold Brook Road crossing along Gold Brook Road (project #4);
- **Active Restoration** by removing berm just upstream of unnamed tributary to Gold Brook (project #6);
- **Passive Restoration** of river corridor from about 450 feet upstream of Waterbury Road crossing to just downstream of Stowe Hollow Road crossing (project #7);
- **Active Restoration** by replacing undersized culvert that is causing localized geomorphic instability (project #8).
- **Passive Restoration** of river corridor from forested area to one-half mile upstream of intersection of North Hollow Road and Putnam Forest Road (project #11);
- **Active Restoration** by removing berms upstream of Bryan Road (project #13);
- **Active Restoration** by removing dam just downstream of North Hollow Road crossing (project #15);

Moss Glen Brook (see Figure 7.74 and Table 10)

- **Active Restoration** by replacing double undersized culvert at Stagecoach Road that is causing localized geomorphic instability (project #1).
- **Passive Restoration** of river corridor and streamside plantings from confluence with Little River and upstream about 1,200 feet (project #2);
- **Passive Restoration** of river corridor and streamside plantings from Pucker Street to forested area (project #3);
- **Passive Restoration** of river corridor and riparian buffer adjacent to Pucker Street (project #4).

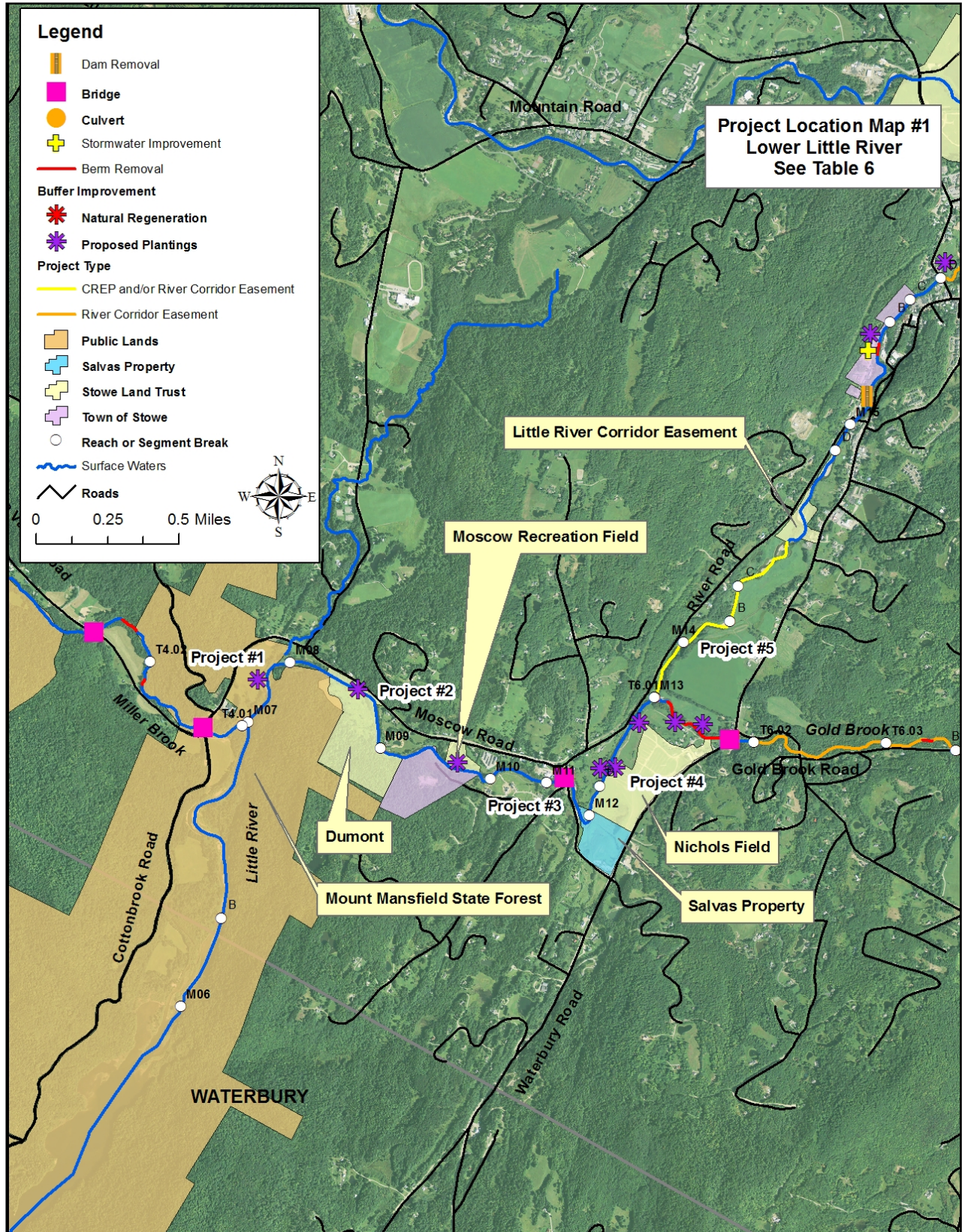


Figure 7.70. Proposed restoration and protection projects for Lower Little River mainstem

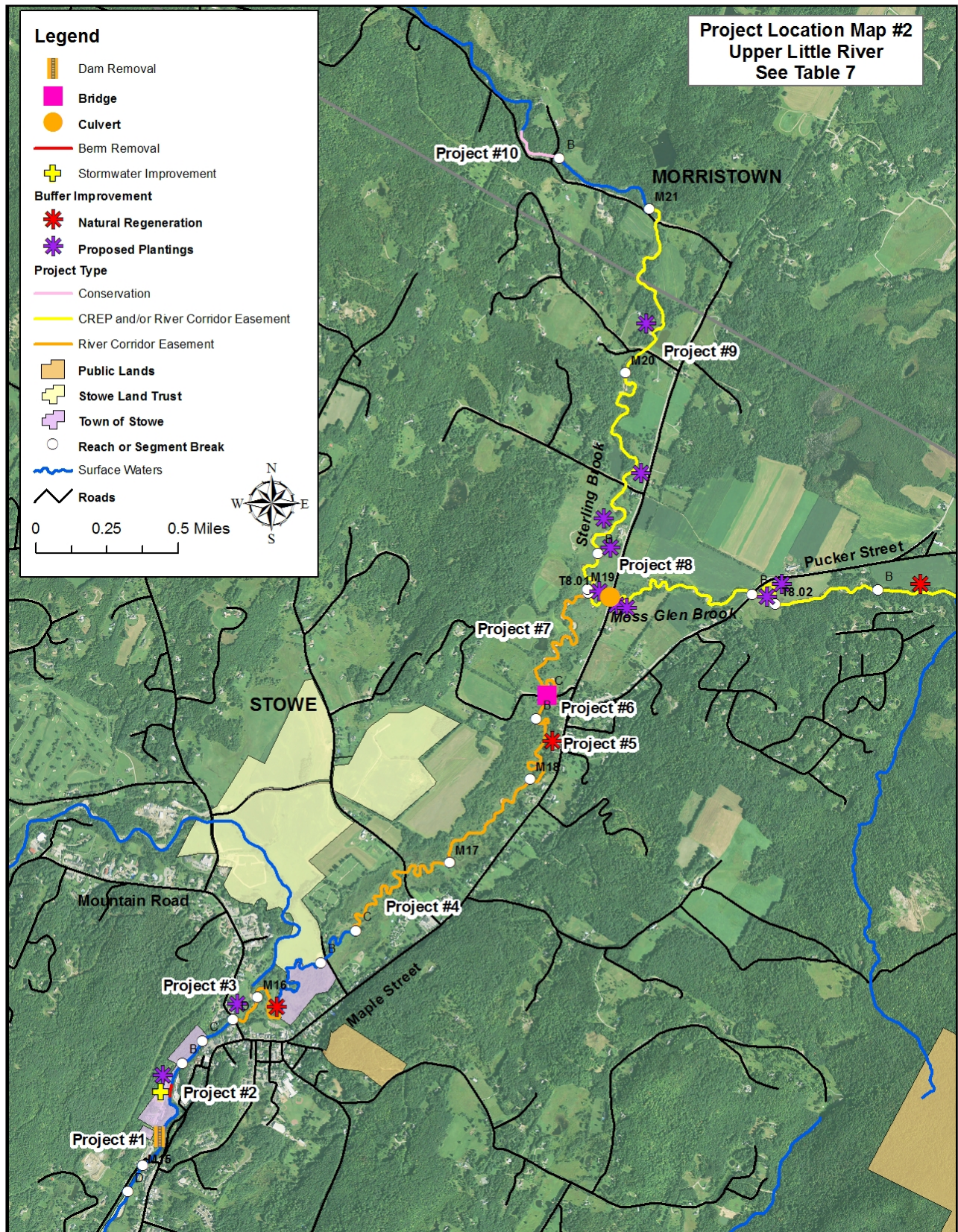


Figure 7.71. Proposed restoration and protection projects for Upper Little River mainstem

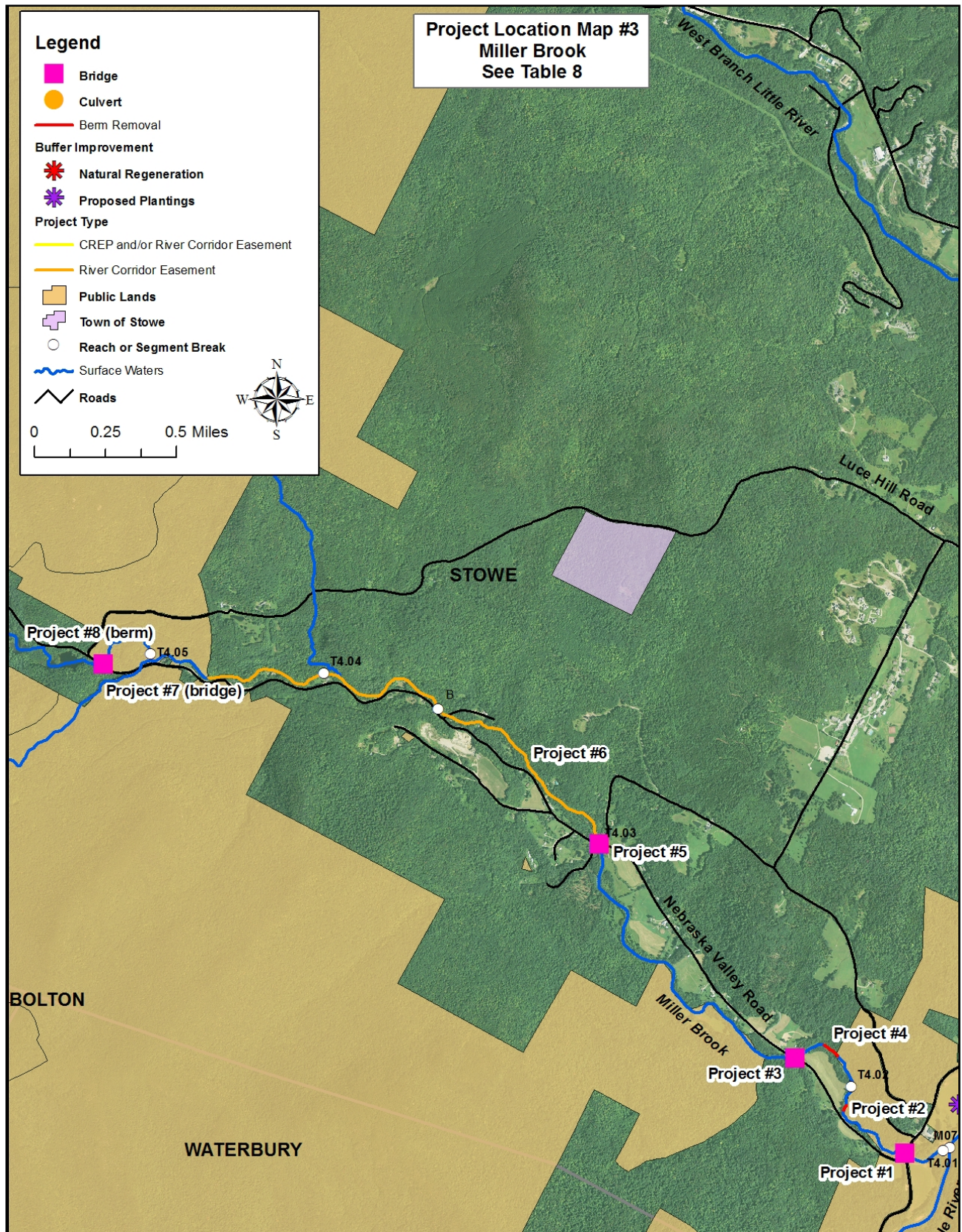


Figure 7.72. Proposed restoration and protection projects for Miller Brook

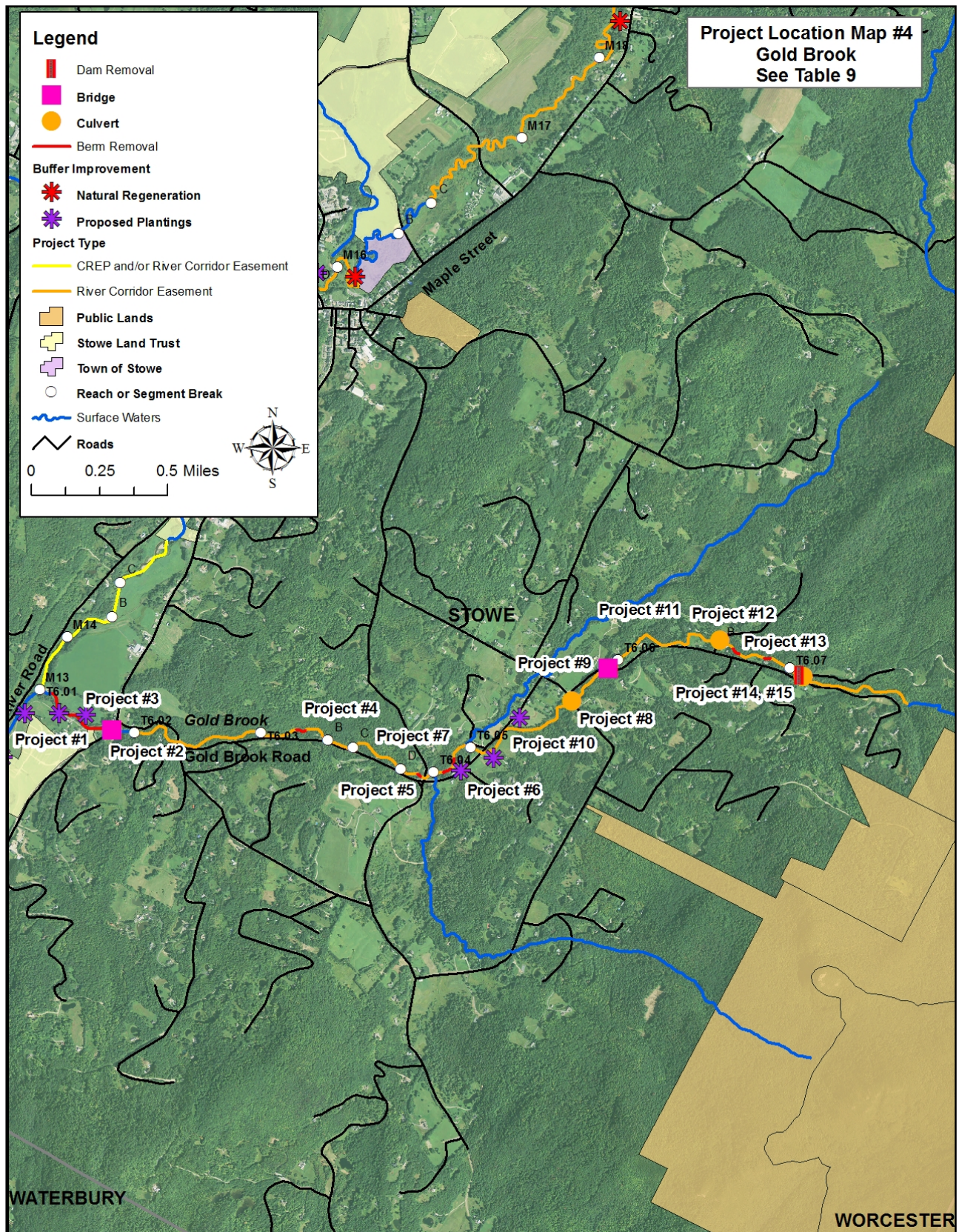


Figure 7.73. Proposed restoration and protection projects for Gold Brook

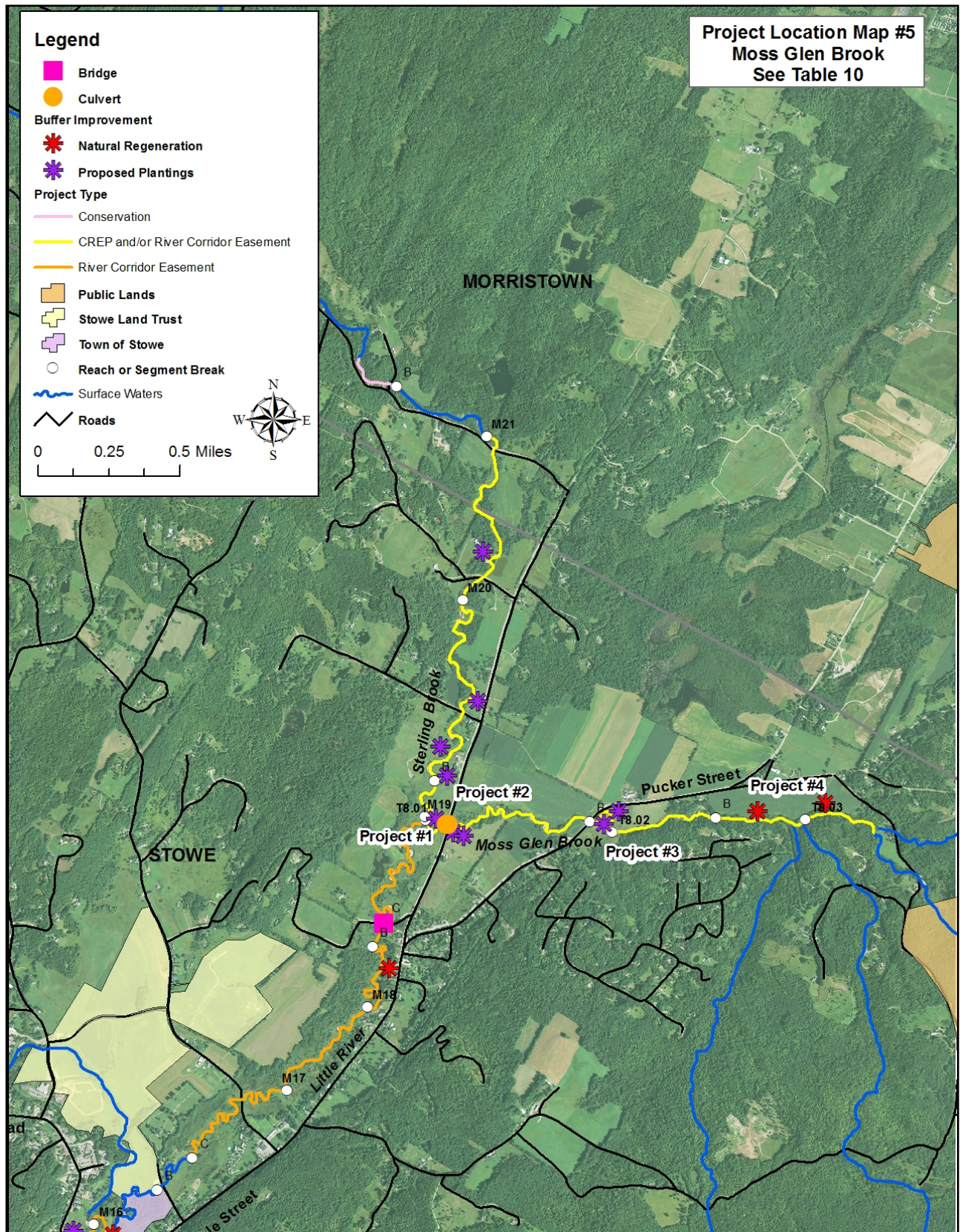


Figure 7.74. Proposed restoration and protection projects for Moss Glen Brook

**Table 6. Lower Little River Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#1 Next to former town garage about one-quarter mile upstream of confluence with Miller Brook M07	Passive Restoration	Hayfields along west bank on Mount Mansfield State Forest lands lack a healthy riparian buffer. A few trees have been recently planted. Bank erosion is prevalent within Reach M07.	Augment existing tree plantings on Mount Mansfield State Forest lands to improve buffer width	High priority	Improve water quality	Low cost	Hay fields to forested buffer	VANR, LCPC, USFWS, Vermont Forest Parks and Rec. Dept.
#2 From Barrows Brook confluence to old mill location off of Moscow Road. M08 and M09	Passive Restoration	The proximity of Moscow Road impedes a potential buffer improvement project in places. M08 and M09 are natural attenuation reaches. According to Tom Jackman, a knotweed eradication project is being considered for the Dumont parcel.	Streamside plantings at Dumont parcel are recommended as part of knotweed eradication project. Increase buffer width at Moscow Recreation Field, where feasible, by discontinuing mowing along river and planting native vegetation	Moderate priority	Improve water quality	Low cost	Hay fields and residential lawns to forested buffer	VANR, LCPC, landowner
#3 Moscow Road crossing M11	Active Restoration	The Moscow Road bridge was found to be partially compatible using the geomorphic screening tool. Scour and alignment are issues with the bridge.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC

**Table 6. Lower Little River Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#4 From downstream end of Gold Brook Campground to confluence with Gold Brook. M12-A and M12-B	Passive Restoration	Reaches are straightened; poor buffers due to campground and residential areas. The Nichols field abuts the river corridor at the southern end of the reach M12, and has about 1000 feet of river frontage. Vermont Electric Power Company (VELCO) is implementing a riparian planting plan for Nichols field.	Streamside plantings	Moderate priority for plantings due to minor widening and planform adjustment	Prevent erosion, improve habitat and reduce water temperature	Loss of campground sites for owner; Low cost for plantings	Commercial to forest.	VANR, LCPC, landowners
#5 From Gold Brook confluence to just downstream of River Road crossing. M13 and M14	Passive Restoration	Bank erosion and lack of buffer along residential land, agricultural fields and road. River Road impedes buffer improvement in many places. Very depositional and major planform change.	Protect River Corridor through corridor easement and/or CREP .	High priority for conservation easement.	Flood and sediment attenuation	Cost of corridor easements	Agricultural and residential land to forested	VANR, LCPC, landowners, CREP, land trust

**Table 7. Upper Little River Site Level Opportunities for Restoration and Protection
Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#1 Pike dam located about 550 feet upstream of River Road crossing M15-A	Active Restoration	Pike dam with 20 foot drop is a fish passage issue. Abutments are causing a channel constriction and deposition and scour. The dam is breached.	Alternative analysis for dam removal	High priority	Improve habitat and geomorphic stability	Cost of alternative analysis and dam destruction	Dammed stream to natural stream channel	VANR, LCPC, Town of Stowe
#2 Near the Municipal Storage Facility (Highway Department) M15-A	Active Restoration and Stormwater Improvement	A 215 foot long berm exists in the vicinity of the Municipal Storage Facility in Stowe. The berm is located above the floodprone elevation and removal will not result in improved floodplain access.	Berm removal, streamside plantings and stormwater improvement; relocate stockpiles away from streambank	High priority for stormwater improvements and streamside plantings; lower priority for berm removal.	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	Town of Stowe, VANR, LCPC
#3 From Mountain Road to above Cemetery Road M15- D and M16-A	Passive Restoration	Commercial and residential land uses lacking riparian vegetation; extensive erosion in M16-A	Protect River Corridor through corridor easement; Buffer restoration – Natural Regeneration: Increase buffer width where feasible with low cost plantings or let vegetation grow back on its own. Streamside plantings in M15-D.	High priority for corridor easement; High priority for plantings in M15-D and buffer restoration. Buffer restoration will allow connectivity to adjacent forested areas.	Flood and sediment attenuation; Improve water quality.	Cost of corridor easements; Low cost for buffer improvement.	Commercial and residential land to forested	VANR, LCPC, landowners, land trust

**Table 7. Upper Little River Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#4 About 700 feet above Cemetery Road to west of Pucker Street near intersection of Westview Heights Drive M16-C and M17	Passive Restoration	Well forested buffers. Abundant erosion on both banks. Very sinuous.	Protect River Corridor through corridor easement.	High priority for corridor easement	Flood and sediment attenuation.	Cost of conservation easement	No new structures in corridor	VANR, LCPC, landowners, land trust
#5 From Little River Farm Road to about 1,200 feet more downstream M18-A and M18-B	Passive Restoration	Forested corridor, but areas with little or no buffer. Also no buffer near crossing. Straightened section with recent channel avulsion.	Protect River Corridor through corridor easement; Buffer restoration – Natural Regeneration: Increase buffer width where feasible with low cost plantings or let vegetation grow back on its own.	High priority for corridor easement	Flood and sediment attenuation. Improve water quality.	Cost of corridor easements. Low cost of plantings.	Herbaceous to forested	VANR, LCPC, landowners, land trust

**Table 7. Upper Little River Site Level Opportunities for Restoration and Protection
Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#6 Little River Farm Road crossing M18-B	Active Restoration	The Little River Farm Road bridge was found to be partially compatible using the geomorphic screening tool. There is scour above and rip-rap within the structure. An impending channel avulsion and major deposition was noted upstream of the bridge on May 5, 2010, when the reach was visited by BCE.	Bridge Replacement	Moderate priority; given the impending channel avulsion upstream, a more detailed analysis is recommended for this structure,	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC
# 7 From Little River Farm Road to confluence with Moss Glen Brook M18-C	Passive Restoration	Very sinuous and extensive active planform adjustment. River needs room to reach its equilibrium stage.	Protect River Corridor	High priority for river corridor easement	Flood and sediment attenuation	Cost of river corridor easement	No new structures in corridor	VANR, LCPC, landowners, land trust
#8 From 800 feet upstream of Moss Glen Brook and continue along Stagecoach Road upstream to just downstream of Tansy Hill Road M19-A and M19-B	Passive Restoration	Agricultural and residential land uses; segment is in currently widening and aggrading and will continue to adjust its planform.	Protect river corridor through corridor easement and/or CREP; Improve riparian buffer. Streamside plantings.	High priority for corridor easement; high priority for plantings. In active erosion areas plant trees away from bank.	Flood and sediment attenuation. Prevent erosion, improve habitat and reduce water temperature	Cost of corridor easement; low cost for plantings	Agricultural and residential to forested	VANR, LCPC, landowners, CREP, land trust

**Table 7. Upper Little River Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#9 From just downstream of Moulton Lane crossing to Sterling Valley Road crossing M20	Passive Restoration	Modified channel on downstream end with mostly forested land but pockets of crop and residential also. Buffers could be improved in some locations. Beaver dam influence in one spot.	Protect River Corridor through conservation easement/CREP (at upstream end of reach); Buffer restoration – Natural Regeneration: Increase buffer width to extent feasible with low cost plantings or let vegetation grow back on its own. Establish no mow zones.	Low priority for planting anything due to beaver activity	Flood and sediment attenuation. Improved water quality	Low cost	Agricultural land to forested	VANR, LCPC, landowners, land trust, CREP
#10 From just downstream of Dr. Neel Road crossing to about 1000 feet upstream M21-B	Conservation	Well forested bedrock gorge	Protect River Corridor through corridor easement	Low priority for corridor easement due to bedrock control	Scenic location for recreation; preserve forested buffer for cool water temperatures for fish and other aquatic organisms	Cost of conservation easement	No new structures in corridor	VANR, LCPC, landowners, land trust

**Table 8. Miller Brook Site Level Opportunities for Restoration and Protection
Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#1 Moscow Road crossing T4.01	Active Restoration	The Moscow Road bridge is undersized and was found to be partially compatible using the geomorphic screening tool. Deposition and scour are issues with the bridge. There are plans to replace this bridge during summer 2010.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#2 Along island just upstream of where Nebraska Valley Road is near stream T4.01	Active Restoration	A 130 foot long, 7 foot high berm was observed at upstream end of reach along an island. Berm may have been placed to maintain straightened condition, and could have resulted in the formation of the island.	Alternative analysis for berm removal.	Low priority: well vegetated with trees. The cost of removing vegetation should be weighed with the benefit of restoring natural planform.	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	VANR, LCPC, landowners
#3 Nebraska Valley Road crossing T4.02	Active Restoration	The Nebraska Valley Road bridge is undersized and was found to be partially compatible using the geomorphic screening tool. Deposition, scour and alignment are issue with the bridge. The bridge is in poor condition.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC

**Table 8. Miller Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#4 Downstream of Nebraska Valley Road crossing T4.02	Active Restoration	A 330 foot long berm was observed near downstream end of reach. This berm was likely constructed to protect agricultural fields.	Alternative analysis for berm removal.	High priority	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	VANR, LCPC, landowners
#5 Nebraska Valley Road crossing T4.03-A	Active Restoration	The Nebraska Valley Road bridge is undersized and was found to be partially compatible using the geomorphic screening tool. Deposition, scour and alignment are issue with the bridge.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#6 Nebraska Valley Road bridge to 1,050 downstream of confluence with unnamed tributary T4.04S1 T4.03-A, T3.03- B, and T4.04	Passive Restoration	Well forested on eastern bank, but western bank is encroached by Nebraska Valley Road and therefore buffer improvement and easement in those spots are not possible.	Protect River Corridor through corridor easement.	High priority for corridor easement due to major planform adjustments and aggradation.	Flood and sediment attenuation. Improve water quality.	Cost of conservation easement	No new structures in corridor	VANR, LCPC, landowners, land trust

**Table 8. Miller Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#7 Nebraska Valley Road crossing T4.05	Active Restoration	The Nebraska Valley Road bridge is undersized and was found to be partially compatible using the geomorphic screening tool. Deposition and scour are issue with the bridge.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#8 In vicinity of Nebraska Valley Road crossing T4.05	Active Restoration	A 160 foot berm on the west bank is located downstream of Nebraska Valley Road Bridge	Alternative analysis for berm removal.	High priority	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	VANR, LCPC, landowners

**Table 9. Gold Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#1 Just upstream of confluence with Little River to Route 100 T6.01	Active Restoration	Campground within one corridor and agricultural in the other. Berm lines entire south bank between Route 100 and the Little River.	Alternative analysis for berm removal.	High priority; maybe low feasibility due to current land use.	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	Gold Brook Campground, VANR, LCPC
#2 Waterbury Road crossing T6.01	Active Restoration	The Waterbury Road bridge is partially compatible using the geomorphic screening tool. Deposition below is an issue with this bridge.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#3 Just upstream of confluence with Little River to Route 100 T6.01	Passive Restoration	Lack of adequate buffer on both sides due to agricultural fields and campground road.	Streamside plantings.	High Priority for stream plantings	Prevent erosion, improve habitat and reduce water temperature	Low cost for plantings	Agricultural and commercial to forested	VANR, LCPC, landowners
#4 Approximately 1/2 mile upstream of Gold Brook crossing along Gold Brook Road T6.03-A	Active Restoration	A 180 foot long berm between Gold Brook and Gold Brook Road.	Alternative analysis for berm removal.	High priority	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	VANR, LCPC. landowners

**Table 9. Gold Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#5 Just downstream of Stowe Hollow Road crossing T6.03-D	Active Restoration	A 50 foot long rock berm between Gold Brook and Gold Brook Road.	Alternative analysis for berm removal.	Low priority due to short length	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	VANR, LCPC. landowners
#6 Just upstream of unnamed tributary confluence on east bank. T6.04	Active Restoration	A 150 foot long berm of cobble and gravel fill between Gold Brook and Stowe Hollow Road behind house and a 100 foot long fill berm upstream. Buffer less than 25 feet on south bank near the berms.	Alternative analysis for berm removal. Streamside plantings.	High priority - the feasibility for removing these berms needs to be further investigated.	Improve habitat and geomorphic stability. Prevent erosion, improve habitat and reduce water temperature	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain. Residential to forest.	VANR, LCPC. landowners
#7 From about 450 feet upstream of Waterbury Road crossing to just downstream of Stowe Hollow Road T6.02, T6.03, T6.04	Passive Restoration	Except for road encroachment in T6.02 and T6.03 and some development in T6.04, well forested corridors.	Protect River Corridor through corridor easement.	High priority for corridor easement.	Improve sediment transport	Cost of conservation easement	No new structures in corridor	VANR, LCPC, landowners, land trust

**Table 9. Gold Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#8 Upper Hollow Road crossing T6.05	Active Restoration	The Upper Hollow Road culvert is undersized. It was found to be fully compatible using the geomorphic screening tool, but it is an aquatic organism passage issue. Deposition and scour are also issues with the culvert.	Culvert Replacement	High priority	Improved geomorphic stability	Moderate cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#9 North Hollow Road crossing T6.05	Active Restoration	The North Hollow Road bridge is undersized and mostly incompatible using the geomorphic screening tool. Deposition and scour are also issues with the bridge.	Bridge Replacement	Moderate priority	Improved geomorphic stability	High cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#10 From Stowe Hollow Road crossing upstream about 1,250 feet along no buffer areas. T6.05	Passive Restoration	Lack of adequate buffer on both sides.	Protect river corridor through corridor easement; Streamside plantings.	Moderate Priority due to moderate incision	Prevent erosion, improve habitat and reduce water temperature	Low cost for plantings	Agricultural to forested	VANR, LCPC, landowners, land trust

**Table 9. Gold Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#11 From forested area to one-half mile upstream of intersection of North Hollow Road and Putnam Forest Road T6.06, and T6.07	Passive Restoration	Except for stream crossings, some development and road encroachments, corridors are well forested.	Protect River Corridor through corridor easement.	High priority for corridor easement.	Flood and sediment attenuation and improve sediment transport in T6.07	Cost of conservation easement	No new structures in corridor	VANR, LCPC, landowners, land trust
#12 Bryan Road crossing T6.06-A	Active Restoration	Bryan Road culvert is very undersized and mostly compatible using the geomorphic screening tool. Deposition, scour, and a steep riffle are also issues with the culvert.	Culvert Replacement	Moderate priority	Improved geomorphic stability	Moderate cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#13 Upstream of Bryan Road crossing T6.06-B	Active Restoration	A 150 foot long berm upstream of Bryan Road and then another berm about 120 feet long approximately 550 feet more upstream.	Alternative analysis for berm removal.	High priority - the feasibility for removing these berms needs to be further investigated.	Improve habitat and geomorphic stability	Cost of alternatives analysis for berm removal, excavation, and planting	Berm to floodplain	VANR, LCPC. landowners

**Table 9. Gold Brook Site Level Opportunities for Restoration and Protection
Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#14 North Hollow Road crossing T6.07	Active Restoration	The North Hollow Road culvert is very undersized and mostly compatible using the geomorphic screening tool. Deposition and scour are also issues with the culvert.	Culvert Replacement	Moderate priority	Improved geomorphic stability	Moderate cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#15 Just downstream from North Hollow Road crossing. T6.07	Active Restoration	Reach is incised upstream of dam, but downstream of dam there is a bedrock gorge with many ledge grade controls that can prevent down cutting of bed. However, dam is a fish passage issue and is holding back sediment upstream.	Alternative analysis for dam removal	High priority due to fish passage issue and sediment retention.	Improve habitat and geomorphic stability	Cost of alternative analysis and dam destruction	Dam to natural stream channel	VANR, LCPC, landowners

**Table 10. Moss Glen Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#1 Stagecoach Road crossing T8.01-A	Active Restoration	Stagecoach Road has a double culvert that is undersized and mostly incompatible using the geomorphic screening tool. Deposition and scour are also issues with the culverts.	Replacement of double culverts	High priority	Improved geomorphic stability	Moderate cost for replacement	Unknown	Town of Stowe, VANR, LCPC
#2 From confluence with the Little River and upstream about 1,200. T8.01-A	Passive Restoration	Lack of adequate buffer on both sides due to agricultural fields. Buffer less than 25 feet mostly at downstream end on southern bank. Double culvert at Stagecoach Road crosses in this section. Erosion on outside bend upstream of confluence.	Protect River Corridor through river corridor easement or CREP. Improve Riparian Buffer. Streamside plantings.	High Priority for stream plantings.	Flood and sediment attenuation. Prevent erosion, improve habitat and reduce water temperature	Low cost for plantings	Agricultural to forested	VANR, LCPC, landowners, CREP, land trust

**Table 10. Moss Glen Brook Site Level Opportunities for Restoration and Protection
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#3 From Pucker Street bridge to 1,050 feet upstream of reach break where corridors become forested. T8.01-B and T8.02-A	Passive Restoration	Buffer less than 25 feet on both sides for 1,300 feet and then on the northern side for about another 900 feet along pasture fields. Channel has significant erosion on outside bends. Area with no buffer in T8.02-A has been straightened and has extensive erosion along the bank.	Protect river corridor through corridor easement or CREP. Improve Riparian Buffer. Streamside plantings.	High Priority for stream plantings in both segments. T8.02-A is not incising anymore, but the channel is over wide and there is significant aggradation and planform adjustment occurring.	Flood and sediment attenuation. Prevent erosion, improve habitat and reduce water temperature	Low cost for plantings	Agricultural to forested	VANR, LCPC, landowners, CREP, land trust
#4 Adjacent to Pucker Street T8.02-B and T8.03	Passive Restoration	Dominant buffer width is 26-50 feet in both segments. In T8.03, there is about 500 feet of buffer less than 25 feet in width. Well forested on southern side.	Protect river corridor through corridor easement or CREP. Buffer restoration – Natural Regeneration: Increase buffer width along crop field to extent feasible with low cost plantings or let vegetation grow back on its own.	High Priority due to high historic incision and stream type departures from “C” to “F”.	Improved water quality.	Low cost	Agricultural land to forested	VANR, LCPC, landowners, CREP, land trust

7.4 Next Steps

There are many opportunities to restore the Little River and its tributaries to a stable condition. Types of reach level and site level projects that have been identified in this plan include river corridor protection, streamside plants, retrofit and/or replacement of stream crossings, and dam removal. On the watershed level, the development and implementation of fluvial erosion hazard zones is recommended to avoid conflicts regarding land use and to save money spent on flood damage and river maintenance. The Town of Stowe could pursue the opportunity to work with the LCPC and the Vermont River Management Program to develop fluvial erosion hazard zones for the land surrounding the Little River and its tributaries. The following are recommendations for next steps:

1. Outreach to private landowners and the public about the plan and potential restoration and protection opportunities to be completed by the State and/or LCPC.
2. Town, State, and LCPC representatives meet to discuss the various restoration and protection opportunities and set priorities for action.
3. Meetings to be held with additional partners (Lamoille County Natural Resources Conservation District, Department of Agriculture, Natural Resources Conservation Service, Vermont Agency of Transportation, etc.) to discuss implementation of priority projects.
4. Summary and prioritization of potential projects.
5. Implementation of priority projects with project partners and landowners.

For additional information about fluvial erosion hazard (FEH) zones or project development, please contact the LCPC:

Lamoille County Planning Commission
632 LaPorte Road
Morrisville, VT 05661
(802)888-4548
lcpc@lcpv.org



8.0 Glossary of Terms

Adapted from:

Restoration Terms, by Craig Fischenich, February, 2000, USAE Research and Development Center, Environmental Laboratory, 3909 Halls Ferry Rd., Vicksburg, MS 39180

And

Vermont Stream Geomorphic Assessment Handbook, Appendix Q, 2004, VT Agency of Natural Resources, Waterbury, VT. http://www.vtwaterquality.org/rivers/docs/assessmenthandbooks/rv_apxglossary.pdf

Adjustment process – type of change that is underway due to natural causes or human activity that has or will result in a change to the valley, floodplain, and/or channel condition (e.g., vertical, lateral, or channel plan form adjustment processes).

Aggradation - A progressive buildup or raising of the channel bed and floodplain due to sediment deposition. The geologic process by which streambeds are raised in elevation and floodplains are formed. Aggradation indicates that the stream discharge and/or bed load characteristics are changing. Opposite of degradation.

Alluvial fan – A fan-shaped accumulation of alluvium (alluvial soils) deposited at the mouth of a ravine or at the juncture of a tributary stream with the main stem where there is an abrupt change in slope.

Alluvial soils – Soil deposits from rivers.

Alluvium – A general term for detrital deposits made by streams on riverbeds, floodplains, and alluvial fans.

Avulsion – A change in channel course that occurs when a stream suddenly breaks through its banks, typically bisecting an overextended meander arc.

Bank Stability – The ability of a streambank to counteract erosion or gravity forces.

Bankfull channel depth - The maximum depth of a channel within a riffle segment when flowing at a bankfull discharge.

Bankfull channel width - The top surface width of a stream channel when flowing at a bankfull discharge.

Bankfull discharge - The stream discharge corresponding to the water stage that overtops the natural banks. This flow occurs, on average, about once every 1 to 2 years and given its frequency and magnitude is responsible for the shaping of most stream or river channels.

Bar – An accumulation of alluvium (usually gravel or sand) caused by a decrease in sediment transport capacity on the inside of meander bends or in the center of an over wide channel.

Berms – Mounds of dirt, earth, gravel or other fill built parallel to the stream banks designed to keep flood flows from entering the adjacent floodplain.

Cascade – River bed form where the channel is very steep with narrow confinement. There are often large boulders and bedrock with waterfalls.

Channelization – The process of changing (usually straightening) the natural path of a waterway.

Culvert – A buried pipe that allows flows to pass under a road.

Degradation – (1) A progressive lowering of the channel bed due to scour. Degradation is an indicator that the stream's discharge and/or sediment load is changing. The opposite of aggradation. (2) A decrease in value for a designated use.

Delta bar – A deposit of sediment where a tributary enters the mainstem of a river.

Depositional features – Types of sediment deposition and storage areas in a channel (e.g. mid-channel bars, point bars, side bars, diagonal bars, delta bars, and islands).

Drainage Basin – The total area of land from which water drains into a specific river.

Dredging – Removing material (usually sediments) from wetlands or waterways, usually to make them deeper or wider.

Erosion – Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical, chemical, or biological forces.

Floodplain – Land built of sediment that is regularly covered with water as a result of the flooding of a nearby stream.

Gaging Station – A particular site in a stream, lake, reservoir, etc., where hydrologic data are obtained.

Grade control - A fixed feature on the streambed that controls the bed elevation at that point, effectively fixing the bed elevation from potential incision; typically bedrock, dams or culverts.

Gradient – Vertical drop per unit of horizontal distance.

Habitat – The local environment in which organisms normally grow and live.

Headwater – Referring to the source of a stream or river.

Incised River – A river that erodes its channel by the process of degradation to a lower base level than existed previously or is consistent with the current hydrology.

Islands – Mid-channel bars that are above the average water level and have established woody vegetation.

Lacustrine soils- Soil deposits from lakes.

Meander - The winding of a stream channel, usually in an erodible alluvial valley. A series of sine-generated curves characterized by curved flow and alternating banks and shoals.

Meander migration – The change of course or movement of a channel. The movement of a channel over time is natural in most alluvial systems. The rate of movement may be increased if the stream is out of balance with its watershed inputs.

Meander belt width – The horizontal distance between the opposite outside banks of fully developed meanders determined by extending two lines (one on each side of the channel) parallel to the valley from the lateral extent of each meander bend along both sides of the channel.

Meander wavelength - The lineal distance downvalley between two corresponding points of successive meanders of the same phase.

Meander wavelength ratio – The meander wavelength divided by the bankfull channel width.

Meander width ratio – The meander belt width divided by the bankfull channel width.

Mid-channel bar – Sediment deposits (bar) located in the channel away from the banks, generally found in areas where the channel runs straight. Mid-channel bars caused by recent channel instability are unvegetated.

Planform - The channel shape as if observed from the air. Changes in planform often involve shifts in large amount of sediment, bank erosion, or the migration of the channel.

Plane bed – Channel lacks discrete bed features (such as pools, riffles, and point bars) and may have long stretches of featureless bed.

Point bar – The convex side of a meander bend that is built up due to sediment deposition.

Pool -- A habitat feature (section of stream) that is characterized by deep, low-velocity water and a smooth surface.

Reach - Section of river with similar characteristics such as slope, confinement (valley width), and tributary influence.

Restoration – The return of an ecosystem to a close approximation of its condition prior to disturbance.

Riffle - A habitat feature (section of stream) that is characterized by shallow, fast-moving water broken by the presence of rocks and boulders.

Riffle-pool - Channel has undulating bed that defines a sequence of riffles, runs, pools, and point bars. Occurs in moderate to low gradient and moderately sinuous channels, generally in unconfined valleys with well-established floodplains.

Riparian Buffer – The width of naturally vegetated land adjacent to the stream between the top of the bank and the edge of other land uses. A buffer is largely undisturbed and consists of the trees, shrubs, groundcover plants, duff layer, and naturally uneven ground surface.

Riparian Corridor – Lands defined by the lateral extent of a stream's meanders necessary to maintain a stable stream dimension, pattern, profile and sediment regime.

Segment – A relatively homogeneous section of stream contained within a reach that has the same reference stream characteristics but is distinct from other segments in the reach.

Sensitivity – The valley, floodplain and/or channel condition's likelihood to change due to natural causes and/or anticipated human activity.

Side bar – Unvegetated sediment deposits located along the margins or the channel in locations other than the inside of channel meander bends.

Step-pool – Characterized by longitudinal steps formed by large particles (boulder/cobbles) organized into discrete channel-spanning accumulations that separate pools, which contain smaller sized materials. Often associated with steep channels in confined valleys.

Surficial sediment/geology – Sediment that lies on top of bedrock.

Tributary – A stream that flows into another stream, river, or lake.

Urban runoff – Storm water from city streets and gutters that usually carries a great deal of litter and organic and bacterial wastes into the receiving waters.

9.0 REFERENCES

- Barg, Lori. 2004. The Lamoille Watershed, Restoring the River: Recommendations to Protect Property, Respect the River, and Save Money. Step by Step Community Environmental Solutions. Plainfield, VT 05667.
- Doll, C. G. 1961. Centennial Geologic Map of Vermont.
<http://www.anr.state.vt.us/DEC/GEO/centennialmap.htm>. Accessed January 2010.
- Doolan, Barry L. 1996. The Geology of Vermont. Rocks and Minerals, Vol. 71, No.4. Washington, D.C.
- Foreman, R.T.T. and L.E. Alexander. 1998. Roads and Their Ecological Effects: Annual. Review of Ecological Systematics. Vol. 29: 207-231.
- Jackman, Tom (Director of Planning for Town of Stowe). 2010. Email communication dated March 15, 2010 re: Flood History – Little River Watershed (Stowe, Vermont).
- Leopold, L.B. 1994. A View of the River. Cambridge, Massachusetts.
- Lamoille County Planning Commission. 2007. West Branch of the Little River Corridor Management Plan, Stowe, Vermont.
- Milone & MacBroom, Inc. 2008a. The Vermont Culvert Geomorphic Capability Screening Tool. South Burlington, Vermont.
- Milone & MacBroom, Inc. 2008b. The Vermont Culvert Aquatic Organism Passage Screening Tool, South Burlington, Vermont.
- Montgomery, David and Buffington, John. 1997. Channel Reach Morphology in Mountain Basins. GSA Bulletin. Boulder, Colorado.
- Nealon, Mary. 2003. Little River Natural Channel Design/Restoration Project. Prepared by Pioneer Environmental Associates, LLC. Vergennes, Vermont. Prepared for the Lamoille County Natural Resources Conservation District.
- Olson, Scott., USGS. Personal communication 2004. (Cited in Lamoille County Planning Commission). 2007. West Branch of the Little River Corridor Management Plan, Stowe, Vermont.
- Rosgen, Dave. 1996. Applied River Morphology. Pagosa Springs, Colorado.
- Ryan, J. 2001. Stream stability assessment of Lamoille County, Vermont. Washington, Vermont.

- Stowe Land Trust. 2008a. Dumont-Conserved 2003.
<http://www.stowelandtrust.org/conserved/properties/17/>. Accessed April 20, 2010.
- Stowe Land Trust. 2008b. Moscow Recreation Field.
<http://www.stowelandtrust.org/conserved/properties/7/>. Accessed April 20, 2010.
- Stowe Land Trust. 2008c. Nichols Field-Gateway to Stowe.
<http://www.stowelandtrust.org/conserved/properties/6/>. Accessed April 20, 2010.
- Stowe Land Trust. 2008d. Little River Corridor Easement.
<http://www.stowelandtrust.org/conserved/properties/littlerivercorridor/>. Accessed April 20, 2010.
- Stowe Land Trust. 2008e. Mayo Farm-Conserved 1989.
<http://www.stowelandtrust.org/conserved/properties/10/>. Accessed April 20, 2010.
- Thompson and Sorenson. 2005. Wetland, Woodland, Wildland: A guide to the natural communities of Vermont. Capital City Press, Montpelier, Vermont.
- United States Department of Agriculture. 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division, Technical Release 55. Washington, D.C.
- USGS. 2009. United States Geologic Survey website. <http://waterdata.usgs.gov/vt/nwis/rt>
- Van Driesche, R., et al., 2002, Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04, 413 p.
<http://www.invasive.org/eastern/biocontrol/12Knotweed.html>. Accessed April 20, 2010.
Last Updated November 5, 2003.
- Vermont Center for Geographic Information. 2008. Geologic Soils_So. Soils – Natural Resources Conservation Service soil survey. <http://www.vcgi.org/dataware/>
- Vermont Agency of Natural Resources. 2006. Vermont Stream Geomorphic Assessment Phase I Handbook: Watershed Assessment Using Maps, Existing Data, and Windshield Surveys. Waterbury, Vermont.
- Vermont Agency of Natural Resources. 2006. Fluvial Erosion Municipal Guide. Waterbury, Vermont.
- Vermont Agency of Natural Resources. 2007a. Vermont Agency of Natural Resources River Corridor Planning Guide to Identify and Develop River Corridor Protection and Restoration Projects. (Partially Drafted July 2007). Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Program, Waterbury, Vermont.

Vermont Agency of Natural Resources. 2007b. Vermont Agency of Natural Resources Phase 2 Handbook, Rapid Stream Assessment Field Protocols. Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Program, Waterbury, Vermont.

Vermont Agency of Natural Resources. (2008). River Corridor Protection Guide: Fluvial Geomorphic-Based Methodology to Reduce Flood Hazards and Protect Water Quality. DEC River Management Program. Waterbury, Vermont.

Wemple, Beverly. 2002. Distributed Hydrology Soil Vegetation model for West Branch and Ranch Brook watersheds. University of Vermont. Department of Geology. Unpublished.

Wildernet.com, Undated (a). Little River State Park, Vermont State Parks, Forests and Historic Sites. http://www.wildernet.com/pages/area.cfm?areaID=VTSPLR&CU_ID=1. Accessed March 11, 2010.

Wildernet.com, Undated (b). Elmore State Park, Vermont State Parks, Forests and Historic Sites. http://www.wildernet.com/pages/area.cfm?areaID=VTSPLE&CU_ID=1. Accessed March 11, 2010.

Wright, Stephen. 2003. Glacial Geology of the Burlington and Colchester 7.5' Quads, VT. University of Vermont Burlington, Vermont.
<http://www.anr.state.vt.us/DEC/GEO/pdfdocs/GlacGeoBurlwright.pdf>

APPENDIX A

STANDARD PHASE 2 DMS REPORTS

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M06** Segment: **A** Completion Date: **August 3, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: **impounded** Rain: **No**
Segment Length (ft): **1,824** Segment Location: **Segment too deep to be assessed. Likely due to Waterbury Reservoir. Stream became very**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Flow Status**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,003	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0

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

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

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

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

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

1.5 Valley Features

Valley Width (ft)	890
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	0
2.2 Max Depth (ft)	0.00
2.3 Mean Depth (ft)	0.00
2.4 Floodprone Width (ft)	0

Notes:

Segment too deep to be assessed. Likely due to Waterbury Reservoir. Stream became very wide and deep, saw a power boat just downstream of segment break. Chose stream condition as Fair in administrative judgement because stream was so over-

Passed Step 2. (Contued)

2.5 Aband. Floodpln	0.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	0.00
2.7 Entrenchment Ratio	0.00
2.8 Incision Ratio	0.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	
2.10 Riffles Type	
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	

Silt/Clay Present?	
Detritus	0 %
# Large Woody	0
2.13 Average Largest Particle on	
Bed	0.0
Bar	0.0

2.14 Stream Type	
Stream Type:	C
Bed Material:	Sand
Subclass Slope:	None
Bed Form:	Dune-Ripple

Field Measured Slope:
2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Moderate	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	0	127
Erosion Height (ft)	0.00	2.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Herbaceous
Sub-dominant	Herbaceous	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	0-25
W less than 25	0	648
Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	None	Herbaceous

3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	None	Residential
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Abundant
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features		Braiding
Flood	Neck Cutoff	Avulsion
0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	Straightening
Straightening Length:	1,803
5.5 Dredging	None

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

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M06** Segment: **B** Completion Date: **August 3, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **No**
 Segment Length (ft): **4,418** Segment Location: **Begins upstream of Waterbury Reservoir, continues for one and a quarter miles, ending at**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Flow Status**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,454	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	108	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Steep
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	945
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	133
2.2 Max Depth (ft)	3.80
2.3 Mean Depth (ft)	3.21
2.4 Floodprone Width (ft)	393

Notes:

Segmented reach because river became too deep to assess downstream, power boat seen on lower segment. Likely due to Waterbury Reservoir. Point bars were very large, lots of erosion on outside bends.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.40 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	41.43
2.7 Entrenchment Ratio	2.95
2.8 Incision Ratio	1.95
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	618
2.12 Substrate Composition	
Bedrock	0%
Boulder	2%
Cobble	18%
Coarse Gravel	38%
Fine Gravel	22%
Sand	20%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	16
2.13 Average Largest Particle on	
Bed	5.5 inches
Bar	4.5 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	2,041	1,835
Erosion Height (ft)	5.09	4.98
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Coniferous
Sub-dominant	Invasives	Invasives
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	1-25	1-25
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	>100
Sub-dominant	None	51-100
W less than 25	0	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	Herbaceous	Herbaceous
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest	Forest
Sub-dominant	None	Hay
Mass Failures	175	165
Height	8	12
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	2	8
Diagonal	Delta	Island
0	1	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	3,030
5.5 Dredging	Gravel Mining

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M06** Segment: **B** Completion Date: **August 3, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **No**
 Segment Length (ft): **4,418** Segment Location: **Begins upstream of Waterbury Reservoir, continues for one and a quarter miles, ending**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		8	None	Yes
7.2 Channel Aggradation		8	None	No
7.3 Widening Channel		6		No
7.4 Change in Planform		13		No

Total Score **35**

Geomorphic Rating **0.4375**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	------	-------

6.1 Epifaunal Substrate - Available Cover		12
6.2 Embeddedness		9
6.3 Velocity/Depth Patterns		15
6.4 Sediment Deposition		7
6.5 Channel Flow Status		13
6.6 Channel Alteration		7
6.7 Frequency of Riffles/Steps		16
6.8 Bank Stability	Left: 4 Right: 4	
6.9 Bank Vegetation Protection	Left: 7 Right: 7	
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 9	

Total Score **120**

Habitat Rating **0.6**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, minor planform adjustment, major aggradation and widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M07** Segment: **0** Completion Date: **August 7, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **1,580** Segment Location: **Continues for a quarter mile, ending at the confluence of Barrows Brook (entering from the**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	150	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Extremely	Steep
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	708
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	111
2.2 Max Depth (ft)	4.80
2.3 Mean Depth (ft)	2.87
2.4 Floodprone Width (ft)	266

Notes:

Cross section measured at riffle head with major point bar on left bank, thus bankfull width is high. Short reach with very large mid-channel bar. No buffer on field along right bank. Reach is undergoing major widening. Recommend planting buffer a short distance

Passed Step 2. (Contued)

2.5 Aband. Floodpln	10.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	38.68
2.7 Entrenchment Ratio	2.39
2.8 Incision Ratio	2.08
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	550
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	22%
Coarse Gravel	46%
Fine Gravel	22%
Sand	10%
Silt and smaller	0%

Silt/Clay Present? **Yes**

Detritus **3 %**

Large Woody **7**

2.13 Average Largest Particle on

Bed	5.0	inches
Bar	4.0	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

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

Upper

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

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

Lower

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

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

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

Erosion Length (ft) **654** **963**

Erosion Height (ft) **4.38** **4.12**

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

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

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

Dominant **Invasives** **Herbaceous**

Sub-dominant **Herbaceous** **Invasives**

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

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

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

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

Dominant **>100** **>100**

Sub-dominant **None** **0-25**

W less than 25 **0** **367**

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

Dominant **Deciduous** **Deciduous**

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

3.3 Riparian Corridor

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

Dominant **Forest** **Hay**

Sub-dominant **None** **None**

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

Height **0** **0**

Gullies **0**

Length **0**

Height **0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening **Straightening**

Straightening Length: **506**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M07** Segment: **0** Completion Date: **August 7, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **1,580** Segment Location: **Continues for a quarter mile, ending at the confluence of Barrows Brook (entering from**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
------------------	-------	-----	----------

7.1 Channel Degradation	5	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	7		No
7.4 Change in Planform	10		No

Total Score **31**

Geomorphic Rating **0.3875**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
----------------------	-------

6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	14
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	9
6.5 Channel Flow Status	10
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 5 Right: 2
6.9 Bank Vegetation Protection	Left: 8 Right: 3
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 4

Total Score **119**

Habitat Rating **0.595**

Habitat Stream Condition **Fair**

Narrative:

Extreme historic degradation, major aggradation, widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M08** Segment: **0** Completion Date: **August 1, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **No**
Segment Length (ft): **2,648** Segment Location: **Continues for about a half mile, and ends at the large house with a pond, about a thousand**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None		
1.2 Alluvial Fan	None		
1.3 Corridor Encroachments			
Length (ft)	One	Both	
Berms	0	0	
height	0	0	
Roads	1,750	0	
height	0	0	
Railroads	0	0	
height	0	0	
Improved Paths	0	0	
height	0	0	
Development	705	0	
1.4 Adjacent Side	Left	Right	
Hillside Slope	Very Steep	Steep	
Continuous w/	Sometimes	Never	
W/in 1 Bankfill	Sometimes	Sometimes	
Texture	Not Evalua	Not Evalua	

1.5 Valley Features

Valley Width (ft)	450
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	92
2.2 Max Depth (ft)	4.55
2.3 Mean Depth (ft)	3.74
2.4 Floodprone Width (ft)	113

Notes:

Reach runs along road, likely entirely straightened. Numerous side bars providing opportunity for reach to start to regain sinuosity.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	8.85 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	24.60
2.7 Entrenchment Ratio	1.23
2.8 Incision Ratio	1.95
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	543
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	23%
Coarse Gravel	55%
Fine Gravel	14%
Sand	8%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	4
2.13 Average Largest Particle on	
Bed	6.0 inches
Bar	3.5 inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,167	1,533
Erosion Height (ft)	5.28	4.84
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	44	423
Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	26-50	26-50
Sub-dominant	0-25	0-25
W less than 25	508	226
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Invasives	Invasives

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Hay	Residential
Sub-dominant	Forest	Hay
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	1	6
Diagonal	Delta	Island
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
3	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	2,376
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M08** Segment: **0** Completion Date: **August 1, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **No**
 Segment Length (ft): **2,648** Segment Location: **Continues for about a half mile, and ends at the large house with a pond, about a**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		5	C to F	Yes
7.2 Channel Aggradation		11	None	No
7.3 Widening Channel		9		No
7.4 Change in Planform		11		No

Total Score **36**

Geomorphic Rating **0.45**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Extreme**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	------	-------

6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	7
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	11
6.5 Channel Flow Status	14
6.6 Channel Alteration	5
6.7 Frequency of Riffles/Steps	13
6.8 Bank Stability	Left: 5 Right: 3
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 3

Total Score **108**

Habitat Rating **0.54**

Habitat Stream Condition **Fair**

Narrative:

Extreme historic degradation, major widening, minor aggradation and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M09** Segment: **0** Completion Date: **August 1, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **No**
Segment Length (ft): **2,399** Segment Location: **Continues for a little under a half mile, and ends at a tributary entering from the south.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,030	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	751	231
1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	578
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	84
2.2 Max Depth (ft)	4.60
2.3 Mean Depth (ft)	3.63
2.4 Floodprone Width (ft)	275

Notes:

Reach runs along Moscow Road, houses, rec fields and commercial storage facility within corridor. Active development occurring on Adams Mill Road within and just outside corridor (new houses being built). Over half of reach has been historically straightened.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	9.10 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	23.14
2.7 Entrenchment Ratio	3.27
2.8 Incision Ratio	1.98
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	683
2.12 Substrate Composition	
Bedrock	0%
Boulder	1%
Cobble	16%
Coarse Gravel	54%
Fine Gravel	17%
Sand	12%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	5
2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	4.5 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	792	645
Erosion Height (ft)	6.63	7.22
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	152	467
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Invasives	Invasives
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	>100	0-25
Sub-dominant	0-25	>100
W less than 25	153	1,100
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Deciduous
Sub-dominant	Deciduous Shrubs/Saplin	
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Forest	Residential
Sub-dominant	Commercial	Forest
Mass Failures	182	0
Height	12	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	2	7
Diagonal	Delta	Island
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,388
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M09** Segment: **0** Completion Date: **August 1, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **No**
 Segment Length (ft): **2,399** Segment Location: **Continues for a little under a half mile, and ends at a tributary entering from the south.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		5	None	Yes
7.2 Channel Aggradation		10	None	No
7.3 Widening Channel		9		No
7.4 Change in Planform		11		No

Total Score **35**

Geomorphic Rating **0.4375**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	10
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	9
6.5 Channel Flow Status	10
6.6 Channel Alteration	8
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 3 Right: 5
6.9 Bank Vegetation Protection	Left: 7 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 2

Total Score **112**

Habitat Rating **0.56**

Habitat Stream Condition **Fair**

Narrative:

Extreme historic degradation, major widening and aggradation, minor planform adjustment. Widening is becoming the major process in this reach because there is a significant amount of erosion on both banks (where not rip rapped).

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M10** Segment: **0** Completion Date: **July 31, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **No**
 Segment Length (ft): **1,180** Segment Location: **Continues for a little over a thousand feet to a tributary entering from the southwest, about**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	92	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	456	718
1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	700
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	100
2.2 Max Depth (ft)	4.30
2.3 Mean Depth (ft)	3.21
2.4 Floodprone Width (ft)	138

Notes:

Cross section location had historic abandoned flood chute beyond left bankful feature. Dam at downstream end of reach M11 is likely reason for reaches M10 to M06 having extreme historic degradation (sediment starved).

Passed Step 2. (Contued)

2.5 Aband. Floodpln	9.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	31.00
2.7 Entrenchment Ratio	1.38
2.8 Incision Ratio	2.26
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	400
2.12 Substrate Composition	
Bedrock	0%
Boulder	3%
Cobble	25%
Coarse Gravel	47%
Fine Gravel	12%
Sand	13%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	5 %
# Large Woody	8
2.13 Average Largest Particle on	
Bed	10.0 inches
Bar	5.0 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Gravel
Subclass Slope:	c
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	140	208
Erosion Height (ft)	6.00	4.64
Revetmt. Type	Rip-Rap	Multiple
Revetmt. Length (ft)	466	589
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Invasives
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	26-50	26-50
Sub-dominant	0-25	0-25
W less than 25	197	80
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Residential	Residential
Sub-dominant	None	Commercial
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	Up Stream
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	0	2
Diagonal	Delta	Island
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening **Straightening**

Straightening Length: **955**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M10** Segment: **0** Completion Date: **July 31, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **No**
 Segment Length (ft): **1,180** Segment Location: **Continues for a little over a thousand feet to a tributary entering from the southwest,**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	10.00	4.00	Yes	
Ledge	Mid-segment	6.00	2.00	Yes	
Ledge	Mid-segment	3.00	0.00	Yes	

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Unconfined			
7.1 Channel Degradation	5	C to B	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	11		No
7.4 Change in Planform	14		No
Total Score	39		
Geomorphic Rating	0.4875		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	11
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	11
6.5 Channel Flow Status	13
6.6 Channel Alteration	5
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 7 Right: 6
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 3 Right: 3
Total Score	116
Habitat Rating	0.58

Habitat Stream Condition **Fair**

Narrative:

Extreme historic degradation. Major aggradation. Minor widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M11** Segment: **0** Completion Date: **July 31, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **No**
 Segment Length (ft): **1,515** Segment Location: **Continues for about 1500 feet, and ends just upstream of a hairpin bend, at a tributary**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,345	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	261	365
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	440
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	106
2.2 Max Depth (ft)	3.55
2.3 Mean Depth (ft)	2.75
2.4 Floodprone Width (ft)	509

Notes:

There is a dam at the downstream end of this reach. The reach is heavily rip rapped, and runs very close to Moscow Road for most of the reach. River makes a sharp turn at the upstream end of the reach, and there is a deep pool with an island at the bend. A large

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.55 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	38.36
2.7 Entrenchment Ratio	4.83
2.8 Incision Ratio	1.28
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	575
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	7%
Coarse Gravel	40%
Fine Gravel	30%
Sand	23%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	16
2.13 Average Largest Particle on	
Bed	6.0 inches
Bar	2.5 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	107	513
Erosion Height (ft)	4.00	4.60
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	1,014	301
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	0-25	0-25
Sub-dominant	26-50	26-50
W less than 25	1,187	824
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Deciduous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Residential	Pasture
Sub-dominant	None	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	0	1
Diagonal	Delta	Island
1	1	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,085
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M11** Segment: **0** Completion Date: **July 31, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **No**
 Segment Length (ft): **1,515** Segment Location: **Continues for about 1500 feet, and ends just upstream of a hairpin bend, at a tributary**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Dam	Mid-segment	20.00	20.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	94.0	Yes	No	Yes	Yes
Problem	Scour Above, Scour Below, Alignment				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	13	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	8		No
7.4 Change in Planform	13		No
Total Score	43		
Geomorphic Rating	0.5375		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	10	
6.2 Embeddedness	9	
6.3 Velocity/Depth Patterns	12	
6.4 Sediment Deposition	13	
6.5 Channel Flow Status	19	
6.6 Channel Alteration	7	
6.7 Frequency of Riffles/Steps	14	
6.8 Bank Stability	Left: 8	Right: 5
6.9 Bank Vegetation Protection	Left: 7	Right: 7
6.10 Riparian Vegetation Zone Width	Left: 2	Right: 2
Total Score	115	
Habitat Rating	0.575	
Habitat Stream Condition	Fair	

Narrative:

Minor historic degradation and minor planform adjustment. Major aggradation and widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M12** Segment: **A** Completion Date: **July 27, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **598** Segment Location: **Continues for about 600 feet upstream.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	398	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Steep
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	765
Width Determination	Estimated
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	69
2.2 Max Depth (ft)	4.85
2.3 Mean Depth (ft)	3.77
2.4 Floodprone Width (ft)	747

Notes:

Segment is largely plain bed, lacks depositional features, and has been channelized straight. Extreme channelization has resulted in narrower channel than reference channel width and may account for lack of bedform features.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.15 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	18.17
2.7 Entrenchment Ratio	10.91
2.8 Incision Ratio	1.47
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Not Applicable
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	18%
Coarse Gravel	41%
Fine Gravel	18%
Sand	21%
Silt and smaller	2%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	0
2.13 Average Largest Particle on	
Bed	5.0 inches
Bar	N/A inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Plane Bed

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		

Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	340	207
Erosion Height (ft)	5.00	4.00

Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives

Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	1-25	1-25

Mid-Channel Canopy	Open
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Canopy %	1-25	1-25
Mid-Channel Canopy	Open	

Sub-dominant	None	51-100
W less than 25	0	373

Buffer Veg. Type	Left	Right
Dominant	Invasives	Invasives

Sub-dominant	Herbaceous	Herbaceous
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Dominant	Invasives	Invasives
Sub-dominant	Herbaceous	Herbaceous

Sub-dominant	None	Shrubs/Saplin
Mass Failures	0	0
Height	0	0

Gullies	0
Length	0
Height	0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.9 # of Beaver Dams **0**
Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0

Diagonal	Delta	Island
0	0	0

5.2 Other Features	Braiding
Flood	0
Neck Cutoff	0
Avulsion	0

5.3 Steep Riffles and Head Cuts	Trib Rejuv.
Steep Riffles	0
Head Cuts	0

5.4 Stream Ford or Animal	No
5.5 Straightening	Straightening
Straightening Length:	565

5.5 Dredging	None
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Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M12	Segment: A	Completion Date: July 27, 2007
Organization: Bear Creek Environmental	Observers: CS, MN, MA		Rain: Yes
Segment Length (ft): 598	Segment Location: Continues for about 600 feet upstream.		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	12	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	11		No

Total Score **44**

Geomorphic Rating **0.55**

Channel Evolution Model	F
Channel Evolution Stage	III
Geomorphic Condition	Fair
Stream Sensitivity	Very High

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	11
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	7
6.4 Sediment Deposition	11
6.5 Channel Flow Status	18
6.6 Channel Alteration	5
6.7 Frequency of Riffles/Steps	5
6.8 Bank Stability	Left: 2 Right: 5
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 2

Total Score **91**

Habitat Rating **0.455**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, minor aggradation, widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M12** Segment: **B** Completion Date: **July 26, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **1,969** Segment Location: **Continues until the confluence of Gold Brook.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	335	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	985	296
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Steep
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	834
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	98
2.2 Max Depth (ft)	4.30
2.3 Mean Depth (ft)	3.56
2.4 Floodprone Width (ft)	1,253

Notes:

Segment has been straightened, agricultural field and campground are on left bank within corridor.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	5.60 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	27.46
2.7 Entrenchment Ratio	12.82
2.8 Incision Ratio	1.30
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	620
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	23%
Coarse Gravel	46%
Fine Gravel	16%
Sand	15%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	1 %
# Large Woody	5
2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	4.5 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	414	622
Erosion Height (ft)	4.00	5.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	106	156
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Coniferous
Bank Canopy	Left	Right
Canopy %	26-50	1-25
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	26-50	51-100
Sub-dominant	0-25	0-25
W less than 25	362	839
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Mixed Trees
Sub-dominant	Deciduous	Herbaceous
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Residential	Residential
Sub-dominant	Hay	Forest
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	0	5
Diagonal	Delta	Island
0	1	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
2	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,969
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M12	Segment: B	Completion Date: July 26, 2007
Organization: Bear Creek Environmental	Observers: CS, MN		Rain: Yes
Segment Length (ft): 1,969	Segment Location: Continues until the confluence of Gold Brook.		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	12	None	Yes
7.2 Channel Aggradation	11	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	11		No

Total Score **46**

Geomorphic Rating **0.575**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High
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Score

6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	9
6.5 Channel Flow Status	13
6.6 Channel Alteration	7
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 7 Right: 5
6.9 Bank Vegetation Protection	Left: 6 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 3 Right: 6

Total Score **118**

Habitat Rating **0.59**

Habitat Stream Condition	Fair
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Narrative:

Minor historic degradation, minor aggradation, widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M13** Segment: **0** Completion Date: **July 27, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MN, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **1,195** Segment Location: **Continues for about 1200 feet, and ends about 1000 feet downstream of a tributary entering**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

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

1.5 Valley Features

Valley Width (ft)	209
Width Determination	Measured
Confinement Type	Semi-confined
Rock Gorge?	No
Human-caused Change?	No

Step 2. Stream Channel

2.1 Bankfull Width	82
2.2 Max Depth (ft)	4.55
2.3 Mean Depth (ft)	3.52
2.4 Floodprone Width (ft)	169

Notes:

Entire reach was straightened as per Barry Cahoon. Confluence with Gold Brook at downstream end of reach. River Road runs along right bank, highly elevated from the river (above valley wall).

Passed Step 2. (Contued)

2.5 Aband. Floodpln	6.85 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	23.15
2.7 Entrenchment Ratio	2.07
2.8 Incision Ratio	1.51
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	375
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	5%
Fine Gravel	38%
Sand	57%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	5 %
# Large Woody	6
2.13 Average Largest Particle on	
Bed	2.5 inches
Bar	0.5 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Sand
Subclass Slope:	c
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type	
(if different from Phase 1)	

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	578	672
Erosion Height (ft)	6.00	5.00
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	42
Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy	Open	
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	51-100	26-50
Sub-dominant	>100	>100
W less than 25	0	0
Buffer Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Herbaceous	Herbaceous
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Crop Shrubs/Saplin	
Sub-dominant	Forest	Forest
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,155
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M13** Segment: **0** Completion Date: **July 27, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN, MA** Rain: **Yes**
 Segment Length (ft): **1,195** Segment Location: **Continues for about 1200 feet, and ends about 1000 feet downstream of a tributary**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
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7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	12	None	No
7.3 Widening Channel	9		No
7.4 Change in Planform	9		No

Total Score **39**

Geomorphic Rating **0.4875**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

Score

6.1 Epifaunal Substrate - Available Cover	10
6.2 Embeddedness	9
6.3 Velocity/Depth Patterns	7
6.4 Sediment Deposition	9
6.5 Channel Flow Status	14
6.6 Channel Alteration	2
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 8

Total Score **100**

Habitat Rating **0.5**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, minor aggradation. Major widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M14** Segment: **A** Completion Date: **August 7, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **1,065** Segment Location: **Continues for about 1065 feet until the straightened section.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Planform and Scope**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Sometimes	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	358
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	81
2.2 Max Depth (ft)	5.20
2.3 Mean Depth (ft)	3.71
2.4 Floodprone Width (ft)	177

Notes:

Stream was too deep to walk in last ~300 feet of segment. Data was collected from downstream and upstream of deep section. Large point bar with flood chute, and poor buffer on left bank across from point bar along agricultural field.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	8.40 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	21.83
2.7 Entrenchment Ratio	2.18
2.8 Incision Ratio	1.62
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	650
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	48%
Fine Gravel	22%
Sand	30%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	5
2.13 Average Largest Particle on	
Bed	4.0 inches
Bar	2.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	479	108
Erosion Height (ft)	5.43	4.00
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	143
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Invasives
Bank Canopy	Left	Right
Canopy %	1-25	0
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	0-25	>100
Sub-dominant	>100	51-100
W less than 25	427	0
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Deciduous
Sub-dominant	Deciduous	Invasives
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Hay	Forest
Sub-dominant	Forest Shrubs/Saplin	
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M14	Segment: A	Completion Date: August 7, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 1,065	Segment Location: Continues for about 1065 feet until the straightened section.		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	12	None	No
7.3 Widening Channel	13		No
7.4 Change in Planform	9		No
Total Score	43		
Geomorphic Rating	0.5375		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	10	
6.2 Embeddedness	8	
6.3 Velocity/Depth Patterns	12	
6.4 Sediment Deposition	11	
6.5 Channel Flow Status	13	
6.6 Channel Alteration	16	
6.7 Frequency of Riffles/Steps	14	
6.8 Bank Stability	Left: 4	Right: 8
6.9 Bank Vegetation Protection	Left: 4	Right: 8
6.10 Riparian Vegetation Zone Width	Left: 2	Right: 9
Total Score	119	
Habitat Rating	0.595	
Habitat Stream Condition	Fair	

Narrative:

Major planform adjustment. Major historic degradation, minor aggradation and widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M14** Segment: **B** Completion Date: **August 7, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **675** Segment Location: **Continues for about 675 feet of straightened channel.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Planform and Scope**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	64	129
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	537
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	67
2.2 Max Depth (ft)	5.30
2.3 Mean Depth (ft)	3.96
2.4 Floodprone Width (ft)	583

Notes:

Entire segment straightened and currently has planebed bedform. Ag fields both sides, farm bridge connecting them.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.80 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	16.79
2.7 Entrenchment Ratio	8.77
2.8 Incision Ratio	1.47
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Eroded
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	5%
Coarse Gravel	48%
Fine Gravel	31%
Sand	16%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	5
2.13 Average Largest Particle on	
Bed	4.0 inches
Bar	2.5 inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Plane Bed

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	275	218
Erosion Height (ft)	4.00	4.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	127	62
Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	0-25	26-50
Sub-dominant	None	>100
W less than 25	494	0
Buffer Veg. Type	Left	Right
Dominant	Invasives	Mixed Trees
Sub-dominant	Deciduous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Hay	Hay
Sub-dominant	None	Residential
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening **Straightening**

Straightening Length: **649**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M14** Segment: **B** Completion Date: **August 7, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **675** Segment Location: **Continues for about 675 feet of straightened channel.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	0.00	Yes	No	No	Yes
	Problem	None			

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Unconfined			
7.1 Channel Degradation	10	None	Yes
7.2 Channel Aggradation	12	None	No
7.3 Widening Channel	13		No
7.4 Change in Planform	12		No
Total Score	47		
Geomorphic Rating	0.5875		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
High	
6.1 Epifaunal Substrate - Available Cover	7
6.2 Embeddedness	7
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	16
6.5 Channel Flow Status	16
6.6 Channel Alteration	2
6.7 Frequency of Riffles/Steps	4
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 6 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 1 Right: 5
Total Score	95
Habitat Rating	0.475
Habitat Stream Condition	Fair

Narrative:

Major historic degradation, minor aggradation, widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M14** Segment: **C** Completion Date: **August 10, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **3,466** Segment Location: **Continues about 3466 feet, and ends at straightened and rip-rapped section.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,421	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	229	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	600
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	81
2.2 Max Depth (ft)	4.90
2.3 Mean Depth (ft)	3.48
2.4 Floodprone Width (ft)	465

Notes:

Large depositional features. Waterbury Road runs along left bank and River Road runs along right bank. VHD layer may be off; planform in the field did not match VHD layer, however segment appears to be undergoing major planform adjustment.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	8.40 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	23.28
2.7 Entrenchment Ratio	5.73
2.8 Incision Ratio	1.71
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	520
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	11%
Coarse Gravel	39%
Fine Gravel	21%
Sand	29%
Silt and smaller	0%

Silt/Clay Present? **Yes**

Detritus **3 %**

Large Woody **15**

2.13 Average Largest Particle on

Bed	8.0	inches
Bar	6.0	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

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

Upper

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

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

Lower

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

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

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

Erosion Length (ft) **1,036** **1,782**

Erosion Height (ft) **5.39** **4.11**

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **176** **395**

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

Dominant **Herbaceous** **Herbaceous**

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

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

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

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

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

Dominant **26-50** **0-25**

Sub-dominant **0-25** **26-50**

W less than 25 **808** **1,809**

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

Dominant **Deciduous** **Deciduous**

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

3.3 Riparian Corridor

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

Dominant **Residential** **Hay**

Sub-dominant **None** **Residential**

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

Height **0** **0**

Gullies **0**

Length **0**

Height **0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **Minimal**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.7 StormwaterInputs

Field Ditch **0** Road Ditch **1**

Other **0** Tile Drain **0**

Overland Flow **0** Urb Strm Wtr Pipe **0**

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	8	4
Diagonal	Delta	Island
2	0	1

5.2 Other Features **Braiding**

Flood **1** Neck Cutoff **0** Avulsion **1**

0

5.3 Steep Riffles and Head Cuts

Steep Riffles **5** Head Cuts **0** Trib Rejuv. **No**

No

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **1,341**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M14** Segment: **C** Completion Date: **August 10, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **3,466** Segment Location: **Continues about 3466 feet, and ends at straightened and rip-rapped section.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
------------------	-------	-----	----------

7.1 Channel Degradation	8	None	Yes
7.2 Channel Aggradation	8	None	No
7.3 Widening Channel	10		No
7.4 Change in Planform	6		No

Total Score **32**

Geomorphic Rating **0.4**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
----------------------	-------

6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	7
6.5 Channel Flow Status	10
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 3 Right: 3

Total Score **109**

Habitat Rating **0.545**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, major aggradation, widening and planform adjustment. Dominant process appears to be planform. Large flood chute, island and channel avulsion.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M14** Segment: **D** Completion Date: **August 10, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **590** Segment Location: **Continues to about 150 feet downstream of River Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	411	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	552	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Never	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	330
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	71
2.2 Max Depth (ft)	4.60
2.3 Mean Depth (ft)	3.17
2.4 Floodprone Width (ft)	103

Notes:

Used M15-A cross section for segment evaluation. Channels were similar, valley is slightly wider.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	8.60	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	22.24	
2.7 Entrenchment Ratio	1.45	
2.8 Incision Ratio	1.87	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Eroded	
2.11 Riffle/Step Spacing (ft)	600	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	3%	
Cobble	23%	
Coarse Gravel	32%	
Fine Gravel	23%	
Sand	19%	
Silt and smaller	0%	

Silt/Clay Present?	No	
Detritus	2	%
# Large Woody	0	
2.13 Average Largest Particle on		
Bed	5.5	inches
Bar	N/A	inches

2.14 Stream Type

Stream Type:	B	
Bed Material:	Gravel	
Subclass Slope:	c	
Bed Form:	Riffle-Pool	

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	248	496
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Deciduous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	26-50	0-25
Sub-dominant	None	None
W less than 25	0	563
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Deciduous	Deciduous
Sub-dominant	Invasives	Invasives

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Residential	Residential
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	558
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M14** Segment: **D** Completion Date: **August 10, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **590** Segment Location: **Continues to about 150 feet downstream of River Road.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		5	C to B	Yes
7.2 Channel Aggradation		12	None	No
7.3 Widening Channel		14		No
7.4 Change in Planform		11		No

Total Score **42**

Geomorphic Rating **0.525**

Channel Evolution Model **F**

Channel Evolution Stage **II**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	8
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	11
6.4 Sediment Deposition	15
6.5 Channel Flow Status	16
6.6 Channel Alteration	3
6.7 Frequency of Riffles/Steps	11
6.8 Bank Stability	Left: 7 Right: 7
6.9 Bank Vegetation Protection	Left: 6 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 2

Total Score **109**

Habitat Rating **0.545**

Habitat Stream Condition **Fair**

Narrative:

Extreme historic degradation, minor aggradation, widening and planform adjustment. Rip rap preventing segment from moving into stage III.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M15** Segment: **A** Completion Date: **July 24, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **2,326** Segment Location: **Continues for about 2000 feet to the start of the bedrock gorge section.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	215	0
height	0	0
Roads	1,181	581
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	1,073	679
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	245
Width Determination	Measured
Confinement Type	Semi-confined
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	71
2.2 Max Depth (ft)	4.60
2.3 Mean Depth (ft)	3.17
2.4 Floodprone Width (ft)	103

Notes:

Old dam causing fine sediment deposition upstream of structure. Lots of industrial and commercial buildings along reach. Bank erosion in vicinity of municipal sand storage location.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	8.60 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	22.24
2.7 Entrenchment Ratio	1.45
2.8 Incision Ratio	1.87
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	430
2.12 Substrate Composition	
Bedrock	0%
Boulder	3%
Cobble	23%
Coarse Gravel	32%
Fine Gravel	23%
Sand	19%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	7
2.13 Average Largest Particle on	
Bed	12.0 inches
Bar	11.0 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Gravel
Subclass Slope:	c
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	0	289
Erosion Height (ft)	0.00	10.00
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	1,649	518
Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	26-50	26-50
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	26-50	51-100
Sub-dominant	None	0-25
W less than 25	0	516
Buffer Veg. Type	Left	Right
Dominant	Invasives	Deciduous
Sub-dominant	Deciduous	Invasives

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Residential	Industrial
Sub-dominant	Commercial	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant		
4.2 Adjacent Wetlands	None		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	0		
4.5 Flow Regulation Type	Small Bypass		
Flow Regulation Use	Other		
Impoundments			
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg			
4.7 StormwaterInputs			
Field Ditch	1	Road Ditch	4
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	2,068
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M15	Segment: A	Completion Date: July 24, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 2,326	Segment Location: Continues for about 2000 feet to the start of the bedrock gorge section.		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	4.00	2.00	Yes	
Dam	Mid-segment	27.00	20.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Old	57.0	Yes	No	Yes	No
	Problem	Deposition Above		Scour Above	Scour
Bridge	0.00	Yes	No	Yes	Yes
	Problem	Deposition Above			

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic
7.1 Channel Degradation		7	None	Yes
7.2 Channel Aggradation		11	None	No
7.3 Widening Channel		13		No
7.4 Change in Planform		11		No
Total Score		42		
Geomorphic Rating		0.525		
Channel Evolution Model	F			
Channel Evolution Stage	II			
Geomorphic Condition	Fair			
Stream Sensitivity	Very High			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		8
6.2 Embeddedness		9
6.3 Velocity/Depth Patterns		16
6.4 Sediment Deposition		9
6.5 Channel Flow Status		19
6.6 Channel Alteration		2
6.7 Frequency of Riffles/Steps		11
6.8 Bank Stability		Left: 6 Right: 5
6.9 Bank Vegetation Protection		Left: 6 Right: 6
6.10 Riparian Vegetation Zone Width		Left: 3 Right: 5
Total Score		105
Habitat Rating		0.525
Habitat Stream Condition		Fair

Narrative:

Major historic degradation and planform adjustment. Minor aggradation and widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M15** Segment: **B** Completion Date: **July 24, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: **bedrock gorge** Rain: **Yes**
 Segment Length (ft): **559** Segment Location: **Continues for about 560 feet to end of bedrock gorge.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Valley Width**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

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

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

Hillside Slope	Very Steep	Very Steep
Continuous w/	Always	Always
W/in 1 Bankfill	Always	Always
Texture	Bedrock	Bedrock

1.5 Valley Features

Valley Width (ft)	75
Width Determination	Estimated
Confinement Type	Narrowly
Rock Gorge?	Yes

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	0
2.2 Max Depth (ft)	0.00
2.3 Mean Depth (ft)	0.00
2.4 Floodprone Width (ft)	0

Notes:

Administrative judgement indicates reference conditions because of bedrock gorge, narrowly confined valley, decent buffers, lack of aggradational features.

Passed *Step 2. (Contued)*

2.5 Aband. Floodpln	0.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	0.00
2.7 Entrenchment Ratio	0.00
2.8 Incision Ratio	0.00
Human Elevated Inc Rat	0.00

2.9 Sinuosity	
2.10 Riffles Type	
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	

Silt/Clay Present?	
Detritus	0 %
# Large Woody	0

2.13 Average Largest Particle on

Bed	0.0
Bar	0.0

2.14 Stream Type

Stream Type:	F
Bed Material:	Bedrock
Subclass Slope:	None
Bed Form:	Bedrock

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

F	1	Non Bedrock
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3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
--------------	-------------	--------------

Upper

Material Type	Bedrock	Bedrock
Consistency	Cohesive	Cohesive

Lower

Material Type	Bedrock	Bedrock
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	0	0

Erosion Height (ft)	0.00	0.00
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Revetmt. Type	None	None
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Revetmt. Length (ft)	0	0
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Near Bank Veg. Type **Left** **Right**

Dominant	Coniferous	Coniferous
----------	-------------------	-------------------

Sub-dominant	Deciduous	Deciduous
--------------	------------------	------------------

Bank Canopy	Left	Right
-------------	-------------	--------------

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

Mid-Channel Canopy	Closed
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3.2 Riparian Buffer

Buffer Width	Left	Right
--------------	-------------	--------------

Dominant	51-100	>100
----------	---------------	----------------

Sub-dominant	26-50	None
--------------	--------------	-------------

W less than 25	0	0
----------------	----------	----------

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

Dominant	Coniferous	Coniferous
----------	-------------------	-------------------

Sub-dominant	Deciduous	Deciduous
--------------	------------------	------------------

3.3 Riparian Corridor

Corridor Land	Left	Right
---------------	-------------	--------------

Dominant	Residential	Forest
----------	--------------------	---------------

Sub-dominant	Commercial	None
--------------	-------------------	-------------

Mass Failures	0	0
---------------	----------	----------

Height	0	0
--------	----------	----------

Gullies	0
---------	----------

Length	0
--------	----------

Height	0.00
--------	-------------

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
---------------------	----------------

4.2 Adjacent Wetlands	None
-----------------------	-------------

4.3 Flow Status	Moderate
-----------------	-----------------

4.4 # of Debris Jams	0
----------------------	----------

4.5 Flow Regulation Type	None
--------------------------	-------------

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.9 # of Beaver Dams	0
----------------------	----------

Affected Length (ft)	0
----------------------	----------

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0

Diagonal	Delta	Island
0	0	0

5.2 Other Features **Braiding**

Flood	Neck Cutoff	Avulsion
0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal	No
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5.5 Straightening	None
Straightening Length:	0

5.5 Dredging	None
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Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	2.00	1.00	Yes	

4.8 Channel Constrictions

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

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model
Channel Evolution Stage
Geomorphic Condition **Referenc**
Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M15** Segment: **C** Completion Date: **May 29, 2008**
Organization: **Bear Creek Environmental** Observers: **CS, MN** Why Not assessed: Rain: **No**
Segment Length (ft): **717** Segment Location: **Segment is located above bedrock gorge and continues upstream to the Route 108 bridge.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Subreach**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	9
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Always	Sometimes
W/in 1 Bankfill	Always	Always
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	110
Width Determination	Measured
Confinement Type	Narrowly
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	59
2.2 Max Depth (ft)	4.80
2.3 Mean Depth (ft)	3.22
2.4 Floodprone Width (ft)	71

Notes:

Segment was mostly plane bed, but did have some areas of deep pools and riffle-like characteristics. No steps in channel. Bank on right bank is highly variable with no evident RAF in most places. Segment is very straight and has old rip rap along most of left

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.80 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	18.17
2.7 Entrenchment Ratio	1.21
2.8 Incision Ratio	1.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	190
2.12 Substrate Composition	
Bedrock	0%
Boulder	29%
Cobble	27%
Coarse Gravel	19%
Fine Gravel	14%
Sand	11%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	5
2.13 Average Largest Particle on	
Bed	8.0 inches
Bar	6.0 inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Cobble
Subclass Slope:	None
Bed Form:	Plane Bed

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

F	3	Non Plane Bed
----------	----------	----------------------

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

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

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

Lower

Material Type **Sand Boulder/Cobbl**

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

Bank Erosion Left Right

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

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

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **426** **242**

Near Bank Veg. Type Left Right

Dominant **Invasives** **Deciduous**

Sub-dominant **Deciduous** **Invasives**

Bank Canopy Left Right

Canopy % **1-25** **51-75**

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

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

Sub-dominant **0-25** **None**

W less than 25 **110** **16**

Buffer Veg. Type Left Right

Dominant **Invasives** **Deciduous**

Sub-dominant **Deciduous Shrubs/Saplin**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Commercial** **Forest**

Sub-dominant **None** **None**

Mass Failures **0** **50**

Height **0** **20**

Gullies **0**

Length **0**

Height **0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features **Braiding**

Flood **0** Neck Cutoff **0** Avulsion **0**

0 **0** **0**

5.3 Steep Riffles and Head Cuts

Steep Riffles **0** Head Cuts **0** Trib Rejuv. **No**

0 **0** **No**

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **710**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls

and Step 4.8 - Channel Constrictions

are on The second page of this

report - with Steps 6 through 7.

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M15	Segment: C	Completion Date: May 29, 2008
Organization: Bear Creek Environmental	Observers: CS, MN		Rain: No
Segment Length (ft): 717	Segment Location: Segment is located above bedrock gorge and continues upstream to the Route 108		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	3.00	1.00	Yes	

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Plane Bed	Score	STD	Historic
7.1 Channel Degradation		16	None	No
7.2 Channel Aggradation		16	None	No
7.3 Widening Channel		13		Yes
7.4 Change in Planform		16		No
Total Score		61		
Geomorphic Rating		0.7625		
Channel Evolution Model		F		
Channel Evolution Stage		I		
Geomorphic Condition		Good		
Stream Sensitivity		High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	16
6.3 Velocity/Depth Patterns	10
6.4 Sediment Deposition	14
6.5 Channel Flow Status	9
6.6 Channel Alteration	13
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 9 Right: 7
6.9 Bank Vegetation Protection	Left: 2 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 9
Total Score	128
Habitat Rating	0.64
Habitat Stream Condition	Fair

Narrative:

Minor historic widening on RB due to influence of rip rap on LB. Large trees holding bank in place.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M15** Segment: **D** Completion Date: **July 24, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **746** Segment Location: **Continues to the confluence of the West Branch and the Little River, about 600 feet past**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Grade Controls**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	80
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	410
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	83
2.2 Max Depth (ft)	4.45
2.3 Mean Depth (ft)	3.31
2.4 Floodprone Width (ft)	236

Notes:

Segment has commercial development within corridor (Mountain Road and Main Street). Some large depositional features, and heavily armored banks. Segmented because upstream of Mountain road right valley wall opens up, this is the reason for the subreach

Passed *Step 2. (Contued)*

2.5 Aband. Floodpln	6.45 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	25.08
2.7 Entrenchment Ratio	2.84
2.8 Incision Ratio	1.45
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	330
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	8%
Coarse Gravel	56%
Fine Gravel	22%
Sand	14%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	1 %
# Large Woody	7
2.13 Average Largest Particle on	
Bed	4.0 inches
Bar	3.5 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

C	4	Non Riffle-Pool
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3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

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

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

Lower

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

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

Bank Erosion Left Right

Erosion Length (ft) **0** **98**

Erosion Height (ft) **0.00** **5.45**

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **438** **131**

Near Bank Veg. Type Left Right

Dominant **Invasives** **Invasives**

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

Bank Canopy Left Right

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

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **26-50** **51-100**

Sub-dominant **51-100** **0-25**

W less than 25 **169** **610**

Buffer Veg. Type Left Right

Dominant **Deciduous** **Deciduous**

Sub-dominant **Invasives** **Herbaceous**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Residential** **Commercial**

Sub-dominant **Commercial** **Residential**

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

Height **0** **0**

Gullies **0**

Length **0**

Height **0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.7 StormwaterInputs

Field Ditch **0** Road Ditch **1**

Other **0** Tile Drain **0**

Overland Flow **0** Urb Strm Wtr Pipe **0**

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	3	2
Diagonal	Delta	Island
0	0	0

5.2 Other Features **Braiding**

Flood **0** Neck Cutoff **0** Avulsion **0**

0 **0** **0**

5.3 Steep Riffles and Head Cuts

Steep Riffles **0** Head Cuts **0** Trib Rejuv. **No**

0 **0** **No**

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **39**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls

and Step 4.8 - Channel Constrictions

are on The second page of this

report - with Steps 6 through 7.

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M15	Segment: D	Completion Date: July 24, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 746	Segment Location: Continues to the confluence of the West Branch and the Little River, about 600 feet		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	100.	Yes	No	No	Yes
Problem	Deposition Above, Scour Below				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	13	None	No
7.3 Widening Channel	13		No
7.4 Change in Planform	14		No
Total Score	49		
Geomorphic Rating	0.6125		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		12
6.2 Embeddedness		10
6.3 Velocity/Depth Patterns		16
6.4 Sediment Deposition		11
6.5 Channel Flow Status		12
6.6 Channel Alteration		7
6.7 Frequency of Riffles/Steps		16
6.8 Bank Stability	Left: 9 Right: 7	
6.9 Bank Vegetation Protection	Left: 5 Right: 5	
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 6	
Total Score		121
Habitat Rating		0.605
Habitat Stream Condition	Fair	

Narrative:

Major historic degradation, minor aggradation ,widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M16** Segment: **A** Completion Date: **August 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **3,634** Segment Location: **A very sinuous segment that continues for about 3600 feet, to about 115 feet downstream of**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	325	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	1,300
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	59
2.2 Max Depth (ft)	3.90
2.3 Mean Depth (ft)	2.62
2.4 Floodprone Width (ft)	914

Notes:

Very sinuous segment, had trouble defining valley wall on right side because of the proximity of the West Branch in this region. Stowe bike path crosses river in this segment and runs between West Branch and Little River here, but field is perfectly flat between

Passed Step 2. (Contued)

2.5 Aband. Floodpln	5.10 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	22.52
2.7 Entrenchment Ratio	15.50
2.8 Incision Ratio	1.31
Human Elevated Inc Rat	0.00
2.9 Sinuosity	High
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	302
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	27%
Fine Gravel	23%
Sand	50%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	5 %
# Large Woody	33
2.13 Average Largest Particle on	
Bed	2.5 inches
Bar	2.0 inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Sand
Subclass Slope:	None
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,755	1,722
Erosion Height (ft)	3.85	4.16
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	151	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	51-100
Sub-dominant	0-25	0-25
W less than 25	232	1,362
Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Herbaceous
Sub-dominant	Herbaceous	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Residential
Sub-dominant	Commercial	Shrubs/Saplin
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	1
Affected Length (ft)	200

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	14	4
Diagonal	Delta	Island
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
2	1	1	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening Length:	127
5.5 Dredging		None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M16	Segment: A	Completion Date: August 21, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 3,634	Segment Location: A very sinuous segment that continues for about 3600 feet, to about 115 feet		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	0.00	Yes	No	No	Yes
	Problem	Deposition Below			

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	13	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	9		No
7.4 Change in Planform	7		No
Total Score	38		
Geomorphic Rating	0.475		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	11	
6.2 Embeddedness	8	
6.3 Velocity/Depth Patterns	16	
6.4 Sediment Deposition	5	
6.5 Channel Flow Status	14	
6.6 Channel Alteration	18	
6.7 Frequency of Riffles/Steps	17	
6.8 Bank Stability	Left: 2 Right: 2	
6.9 Bank Vegetation Protection	Left: 6 Right: 6	
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 5	
Total Score	117	
Habitat Rating	0.585	
Habitat Stream Condition	Fair	

Narrative:

Minor historic degradation, major aggradation, widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M16** Segment: **B** Completion Date: **August 14, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: **beaver dam** Rain: **Yes**
Segment Length (ft): **1,335** Segment Location: **A very sinuous segment that continues for about 1335 feet. A cross section was surveyed**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	475	79
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	1,100
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	36
2.2 Max Depth (ft)	5.30
2.3 Mean Depth (ft)	4.15
2.4 Floodprone Width (ft)	413

Notes:

Segment heavily influenced by beaver dams. Few depositional features and very low width to depth ratio. Phase 1 channel width is calculated by SGAT for a C channel, but two of the phase 2 reaches are E channels so the confinement ratio is likely underestimated.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.40 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	8.67
2.7 Entrenchment Ratio	11.47
2.8 Incision Ratio	1.40
Human Elevated Inc Rat	0.00
2.9 Sinuosity	High
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	625
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	17%
Fine Gravel	38%
Sand	45%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	10
2.13 Average Largest Particle on	
Bed	2.0 inches
Bar	N/A inches

2.14 Stream Type

Stream Type:	E
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,042	684
Erosion Height (ft)	4.44	4.49
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	270	302
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	26-50	26-50
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	26-50	51-100
Sub-dominant	0-25	0-25
W less than 25	568	410
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Hay	Residential
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	2
Affected Length (ft)	850

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	295
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M16	Segment: B	Completion Date: August 14, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 1,335	Segment Location: A very sinuous segment that continues for about 1335 feet. A cross section was		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	36.0	Yes	No	No	No
	Problem	None			

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model
Channel Evolution Stage
Geomorphic Condition
Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	8
6.3 Velocity/Depth Patterns	14
6.4 Sediment Deposition	16
6.5 Channel Flow Status	17
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	10
6.8 Bank Stability	Left: 1 Right: 3
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 4
Total Score	109
Habitat Rating	0.545

Habitat Stream Condition **Fair**

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M16** Segment: **C** Completion Date: **August 14, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **3,950** Segment Location: **A very sinuous segment that continues for about 3950 feet, to a tributary entering from the**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	92
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	975
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	42
2.2 Max Depth (ft)	4.70
2.3 Mean Depth (ft)	3.64
2.4 Floodprone Width (ft)	1,000

Notes:

Very sinuous segment, low width to depth ratio. Segment is on border of E and C stream types. Width to depth ratio borderline "C" channel.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.20 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	11.54
2.7 Entrenchment Ratio	23.81
2.8 Incision Ratio	1.53
Human Elevated Inc Rat	0.00
2.9 Sinuosity	High
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	425
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	8%
Fine Gravel	51%
Sand	41%
Silt and smaller	0%

Silt/Clay Present? **Yes**

Detritus **5 %**

Large Woody **41**

2.13 Average Largest Particle on

Bed	1.0	inches
Bar	0.5	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

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

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

Lower

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

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

Bank Erosion Left Right

Erosion Length (ft) **1,644** **1,502**

Erosion Height (ft) **4.88** **5.10**

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **54** **150**

Near Bank Veg. Type Left Right

Dominant **Herbaceous** **Herbaceous**

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

Bank Canopy Left Right

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

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **>100** **>100**

Sub-dominant **0-25** **0-25**

W less than 25 **152** **399**

Buffer Veg. Type Left Right

Dominant **Herbaceous** **Herbaceous**

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

3.3 Riparian Corridor

Corridor Land Left Right

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

Sub-dominant **Hay** **Hay**

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

Height **0** **0**

Gullies **0**

Length **0**

Height **0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **Minimal**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg

4.9 # of Beaver Dams **1**

Affected Length (ft) **300**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
5	19	3
Diagonal	Delta	Island
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	1	1	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening **Straightening**

Straightening Length: **171**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M16** Segment: **C** Completion Date: **August 14, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **3,950** Segment Location: **A very sinuous segment that continues for about 3950 feet, to a tributary entering**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	47.5	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
------------------	------------	-------	-----	----------

7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	7		No

Total Score **37**

Geomorphic Rating **0.4625**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	------	-------

6.1 Epifaunal Substrate - Available Cover	8
6.2 Embeddedness	6
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	6
6.5 Channel Flow Status	15
6.6 Channel Alteration	18
6.7 Frequency of Riffles/Steps	11
6.8 Bank Stability	Left: 2 Right: 2
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8

Total Score **113**

Habitat Rating **0.565**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation. Major aggradation planform adjustment, and minor widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M17** Segment: **0** Completion Date: **August 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **2,584** Segment Location: **Continues for about a half mile, about 300 feet upstream of the intersection of Pucker Street**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

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

1.5 Valley Features

Valley Width (ft)	699
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	57
2.2 Max Depth (ft)	4.10
2.3 Mean Depth (ft)	2.65
2.4 Floodprone Width (ft)	553

Notes:

Somewhat sinuous reach, with large point bars at every bend and erosion on outside bends. Major planform adjustment processes occurring.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	6.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	21.51
2.7 Entrenchment Ratio	9.70
2.8 Incision Ratio	1.63
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	395
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	23%
Fine Gravel	47%
Sand	30%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	6 %
# Large Woody	34
2.13 Average Largest Particle on	
Bed	2.0 inches
Bar	1.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,232	1,157
Erosion Height (ft)	4.85	4.76
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy	Open	
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	51-100	51-100
W less than 25	0	0
Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Deciduous	Deciduous
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	None	None
Mass Failures	0	35
Height	0	15
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	1
Affected Length (ft)	70

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
4	12	6
Diagonal	Delta	Island
0	0	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	1	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M17	Segment: 0	Completion Date: August 21, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 2,584	Segment Location: Continues for about a half mile, about 300 feet upstream of the intersection of Pucker		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
------------------	-------------------	-------	-----	----------

7.1 Channel Degradation	8	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	11		No
7.4 Change in Planform	7		No

Total Score **35**

Geomorphic Rating **0.4375**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	-------------	-------

6.1 Epifaunal Substrate - Available Cover	16
6.2 Embeddedness	10
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	6
6.5 Channel Flow Status	11
6.6 Channel Alteration	18
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 9

Total Score **131**

Habitat Rating **0.655**

Habitat Stream Condition **Good**

Narrative:

Major historic degradation, major aggradation and planform adjustment, minor widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M18** Segment: **A** Completion Date: **August 23, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **2,350** Segment Location: **Continues to about 500 feet downstream of Little River Farm Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Planform and Scope**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	800
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	44
2.2 Max Depth (ft)	4.50
2.3 Mean Depth (ft)	3.68
2.4 Floodprone Width (ft)	769

Notes:

Used cross section and pebble count from segment M18-C. The entire reach was fairly uniform with the exception of segment M18-B which has been straightened.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	6.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	11.96
2.7 Entrenchment Ratio	17.48
2.8 Incision Ratio	1.49
Human Elevated Inc Rat	0.00
2.9 Sinuosity	High
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	290
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	34%
Fine Gravel	43%
Sand	23%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	17
2.13 Average Largest Particle on	
Bed	2.5 inches
Bar	1.5 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	739	514
Erosion Height (ft)	5.00	4.69
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Lawn	Deciduous
Bank Canopy	Left	Right
Canopy %	1-25	26-50
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	>100
Sub-dominant	0-25	None
W less than 25	554	0
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Deciduous
Sub-dominant	Deciduous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Forest
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
4	6	2
Diagonal	Delta	Island
2	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	2	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	499
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Little River	Reach # M18	Segment: A	Completion Date: August 23, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 2,350	Segment Location: Continues to about 500 feet downstream of Little River Farm Road.		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
------------------	-------------------	-------	-----	----------

7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	8	None	No
7.3 Widening Channel	14		No
7.4 Change in Planform	6		No

Total Score **37**

Geomorphic Rating **0.4625**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	-------------	-------

6.1 Epifaunal Substrate - Available Cover	11
6.2 Embeddedness	10
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	8
6.5 Channel Flow Status	11
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 4 Right: 6
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 3 Right: 9

Total Score **116**

Habitat Rating **0.58**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, minor widening, major aggradation and plaform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M18** Segment: **B** Completion Date: **August 23, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **514** Segment Location: **Continues to about 15 feet upstream of Little River Farm Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Planform and Scope**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	54
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	650
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	40
2.2 Max Depth (ft)	4.20
2.3 Mean Depth (ft)	3.50
2.4 Floodprone Width (ft)	682

Notes:

Entire segment historically straightened. Old bridge crossing and rip rap evident in section. Segment "B" in early stage III due to historic straightening. Not as much planform adjustment going on compared with segments A & C.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.30 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	11.43
2.7 Entrenchment Ratio	17.05
2.8 Incision Ratio	1.74
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	325
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	52%
Fine Gravel	37%
Sand	11%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	5
2.13 Average Largest Particle on	
Bed	3.0 inches
Bar	2.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	124	46
Erosion Height (ft)	4.00	4.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	190	96
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	26-50	26-50
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	0-25
W less than 25	39	235
Buffer Veg. Type	Left	Right
Dominant	Deciduous Shrubs/Saplin	
Sub-dominant	Herbaceous	Deciduous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest Shrubs/Saplin	
Sub-dominant	Residential	Residential
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening Length:	500
5.5 Dredging		None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M18** Segment: **B** Completion Date: **August 23, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **514** Segment Location: **Continues to about 15 feet upstream of Little River Farm Road.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	47.5	Yes	No	Yes	Yes
Problem	Scour Above				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
------------------	------------	-------	-----	----------

7.1 Channel Degradation	8	None	Yes
7.2 Channel Aggradation	13	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	13		No

Total Score **46**

Geomorphic Rating **0.575**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	------	-------

6.1 Epifaunal Substrate - Available Cover	10
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	12
6.4 Sediment Deposition	12
6.5 Channel Flow Status	14
6.6 Channel Alteration	4
6.7 Frequency of Riffles/Steps	13
6.8 Bank Stability	Left: 6 Right: 7
6.9 Bank Vegetation Protection	Left: 8 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 2

Total Score **114**

Habitat Rating **0.57**

Habitat Stream Condition **Fair**

Narrative:

major historic degradation, minor aggradation, widening and planform adjustment.



Phase 2 Segment Summary Report Little River

Page 1

Stream: **Little River**
Reach: **M18-C**
Segment Length(ft): **3,940**
Rain: **Yes**

SGAT Version: **4.56**
Organization: **Bear Creek Environmental**
Observers: **CS, MA**
Completion Date: **8/23/2007**
Quality Control Status - Consultant: **Passed**
Quality Control Status - Staff: **Provisional**

Step 0 - Location: **Continues to the confluence of Moss Glen Brook and the Little River.**

Step 5 - Notes: **Sinuuous segment with large point bars and erosion on outside bends. Similar to M18-A.**

Step 7 - Narrative: **Major historic degradation, widening, aggradation and extreme planform adjustment. Channel had avulsed upstream of Little River Farm Road (5/5/10)**

Step 1. Valley and Floodplain

1.1 Segmentation: Planform and Scope	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Flat	Hilly	Valley Width (ft): 650
1.3 Corridor Encroachments:	Continuous w/ Bank:	Never	Never	Width Determination: Measured
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Never	Never	Confinement Type: VB
Berm: 0 0	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 0 0				Human Caused Change in Valley Width?: No
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 51				
1.6 Grade Controls: None				



Stream Geomorphic Assessment

Agency of Natural Resources



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Page 2

Phase 2 Segment Summary Report

Little River

Stream: **Little River**

Reach: **M18-C**

Step 2. Stream Channel

2.1 Bankfull Width (ft.):	44.00	2.11 Riffle/Step Spacing:	375 ft.	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	4.50	2.12 Substrate Composition		Bed:	2.5 inches
2.3 Mean Depth (ft.):	3.68	Bedrock:	0.0 %	Bar:	1.5 inches
2.4 Floodprone Width (ft.):	769.00	Boulder:	0.0 %	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	6.70	Cobble:	0.0 %	Stream Type:	C
Human Elev FloodPIn (ft.):		Coarse Gravel:	34.0 %	Bed Material:	Gravel
2.6 Width/Depth Ratio:	11.96	Fine Gravel:	43.0 %	Subclass Slope:	None
2.7 Entrenchment Ratio:	17.48	Sand:	23.0 %	Bed Form:	Riffle-Pool
2.8 Incision Ratio:	1.49	Silt and Smaller:	0.0 %	Field Measured Slope:	
Human Elevated Inc. Rat.:	0.00	Silt/Clay Present:	Yes	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	High	Detritus:	3.0 %	Reference Stream Type:	
2.10 Riffles Type:	Complete	# Large Woody Debris:	30	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	Steep		
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	1,376.6	1,270.9	Dominant: Herbaceous Herbaceous
Material Type:	Sand	Sand	Erosion Height (ft.):	5.1	5.1	Sub-dominant: Shrubs/Sapling Shrubs/Sapling
Consistency:	Non-cohesive	Non-cohesive	Revetment Type:	Rip-Rap	Rip-Rap	Bank Canopy
Lower			Revetment Length:	94.7	84.8	Canopy %: 1-25 1-25
Material Type:	Sand	Sand				Mid-Channel Canopy: Open
Consistency:	Non-cohesive	Non-cohesive				

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	>100	>100	Dominant
Sub-Dominant	26-50	26-50	Sub-dominant
W less than 25	0	0	(Legacy)
Buffer Vegetation Type			Failures
Dominant	Shrubs/Sapling	Shrubs/Sapling	Gullies
Sub-Dominant	Deciduous	Deciduous	

3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
	Shrubs/Sapling	Shrubs/Sapling	Mass Failures		
	None	None	Height		
	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	0	
	None		Gullies Length	0	
	None				



Stream Geomorphic Assessment

Agency of Natural Resources



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Phase 2 Segment Summary Report

Little River

Stream: **Little River**

Reach: **M18-C**

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		Diagonal:	2	5.2 Other Features		Neck Cutoff:	1	5.4 Stream Ford or Animal Crossing:		No
Mid:	0	Delta:	0	Flood chutes:	2	Avulsion:	1	5.5 Straightening:		Straightening
Point:	18	Island:	0	5.3 Steep Riffles and Head Cuts		Head Cuts:	0	Straightening Length (ft.):		82
Side:	5	Braiding:	0	Steep Riffles:	2	Trib Rejuv.:	No	5.5 Dredging:		None

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	8	6.4 Sediment Deposition:	6	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	10	6.5 Channel Flow Status:	13	6.8 Bank Stability:	4	4
6.3 Pool Variability:	15	6.6 Channel Alteration:	16	6.9 Bank Vegetation Protection	7	7
Total Score:	120	6.7 Channel Sinuosity:	12	6.10 Riparian Veg. Zone Width:	9	9
Habitat Rating:	0.60					
Habitat Stream Condition:	Fair					

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		9	None	Yes	Geomorphic Rating	0.38
7.2 Channel Aggradation		10	None	No	Channel Evolution Model	F
7.3 Widening Channel		8		No	Channel Evolution Stage	III
7.4 Change in Planform		3		No	Geomorphic Condition	Fair
Total Score		30			Stream Sensitivity	Very High

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M19** Segment: **A** Completion Date: **August 28, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **1,044** Segment Location: **Continues for just over 1000 feet upstream.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

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

1.5 Valley Features

Valley Width (ft)	850
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	46
2.2 Max Depth (ft)	3.20
2.3 Mean Depth (ft)	2.03
2.4 Floodprone Width (ft)	1,727

Notes:

Segment has higher banks and is more incised than upstream. Two flood chutes in only 1000. Fair amount of erosion (evidence of widening).

Passed Step 2. (Contued)

2.5 Aband. Floodpln	5.40 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	22.66
2.7 Entrenchment Ratio	37.54
2.8 Incision Ratio	1.69
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	330
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	5%
Coarse Gravel	59%
Fine Gravel	20%
Sand	16%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	5 %
# Large Woody	2
2.13 Average Largest Particle on	
Bed	4.0 inches
Bar	2.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	540	421
Erosion Height (ft)	4.68	4.34
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Herbaceous
Sub-dominant	Invasives	None
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	1-25	1-25
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	>100
Sub-dominant	0-25	None
W less than 25	285	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Hay	Pasture
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

<u>Mid</u>	<u>Point</u>	<u>Side</u>
1	6	1
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
2	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
2	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
3	0	No

5.4 Stream Ford or Animal

5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

Project: **Little River**
Stream: **Little River**
Organization: **Bear Creek Environmental**
Segment Length (ft): **1,044**

Phase 2 Reach Summary
Reach # **M19**
Observers: **CS, MA**
Segment Location: **Continues for just over 1000 feet upstream.**

page 2 of 2
Segment: **A**
Completion Date: **August 28, 2007**
Rain: **Yes**

1.6 Grade Controls None					
Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken

4.8 Channel Constrictions **None**

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

Narrative:
major historic incision, major aggradation widening and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M19** Segment: **B** Completion Date: **August 28, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **5,146** Segment Location: **Continues for just under a mile to a tributary entering from the west, about 500 feet**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Valley Width**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	433	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	974	101
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Flat	Hilly
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Never	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	965
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	51
2.2 Max Depth (ft)	3.40
2.3 Mean Depth (ft)	2.53
2.4 Floodprone Width (ft)	505

Notes:

Good CREP project in middle to lower segment. Overall valley width is wider than downstream, but both segments are very broad.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	5.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	20.16
2.7 Entrenchment Ratio	9.90
2.8 Incision Ratio	1.47
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	390
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	31%
Coarse Gravel	58%
Fine Gravel	7%
Sand	4%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	4 %
# Large Woody	18
2.13 Average Largest Particle on	
Bed	6.0 inches
Bar	5.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	<u>Left</u>	<u>Right</u>
--------------	-------------	--------------

Upper

Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Lower

Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	<u>Left</u>	<u>Right</u>
--------------	-------------	--------------

Erosion Length (ft)	1,521	1,393
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Erosion Height (ft)	3.35	3.15
---------------------	-------------	-------------

Revetmt. Type	Multiple	Multiple
---------------	-----------------	-----------------

Revetmt. Length (ft)	816	525
----------------------	------------	------------

Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
---------------------	-------------	--------------

Dominant	Herbaceous	Deciduous
----------	-------------------	------------------

Sub-dominant	Deciduous	Herbaceous
--------------	------------------	-------------------

Bank Canopy	<u>Left</u>	<u>Right</u>
-------------	-------------	--------------

Canopy %	26-50	26-50
----------	--------------	--------------

Mid-Channel Canopy	Open
--------------------	-------------

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
--------------	-------------	--------------

Dominant	26-50	51-100
----------	--------------	---------------

Sub-dominant	0-25	0-25
--------------	-------------	-------------

W less than 25	1,791	675
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Buffer Veg. Type	<u>Left</u>	<u>Right</u>
------------------	-------------	--------------

Dominant	Deciduous	Mixed Trees
----------	------------------	--------------------

Sub-dominant	Herbaceous	Herbaceous
--------------	-------------------	-------------------

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
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Dominant	Hay	Forest
----------	------------	---------------

Sub-dominant	Residential	Pasture
--------------	--------------------	----------------

Mass Failures	0	0
---------------	----------	----------

Height	0	0
--------	----------	----------

Gullies	0
---------	----------

Length	0
--------	----------

Height	0.00
--------	-------------

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
---------------------	----------------

4.2 Adjacent Wetlands	Minimal
-----------------------	----------------

4.3 Flow Status	Moderate
-----------------	-----------------

4.4 # of Debris Jams	0
----------------------	----------

4.5 Flow Regulation Type	None
--------------------------	-------------

Flow Regulation Use	
---------------------	--

Impoundments	
--------------	--

Impoundmt. Location	
---------------------	--

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

(old) Upstrm Flow Reg	
-----------------------	--

4.7 StormwaterInputs

Field Ditch	1	Road Ditch	0
-------------	----------	------------	----------

Other	0	Tile Drain	0
-------	----------	------------	----------

Overland Flow	0	Urb Strm Wtr Pipe	0
---------------	----------	-------------------	----------

4.9 # of Beaver Dams	2
----------------------	----------

Affected Length (ft)	470
----------------------	------------

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
-----	-------	------

7	14	9
----------	-----------	----------

Diagonal	Delta	Island
----------	-------	--------

11	0	0
-----------	----------	----------

5.2 Other Features

Flood	2	Neck Cutoff	0	Avulsion	1	Braiding	0
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5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
---------------	-----------	-------------

17	0	No
-----------	----------	-----------

5.4 Stream Ford or Animal

No

5.5 Straightening

Straightening

Straightening Length:	415
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5.5 Dredging

Dredging, Gravel Mining

Note: Step 1.6 - Grade Controls

and Step 4.8 - Channel Constrictions

are on The second page of this

report - with Steps 6 through 7.

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M19** Segment: **B** Completion Date: **August 28, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **5,146** Segment Location: **Continues for just under a mile to a tributary entering from the west, about 500 feet**

1.6 Grade Controls **None**

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

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	40.5	Yes	No	Yes	Yes
Problem	Deposition Below				
Bridge	54.0	Yes	No	No	Yes
Problem	Deposition Above, Deposition Below				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	8	None	No
7.3 Widening Channel	11		No
7.4 Change in Planform	7		No

Total Score **35**

Geomorphic Rating **0.4375**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	------	-------

6.1 Epifaunal Substrate - Available Cover	15
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	10
6.5 Channel Flow Status	10
6.6 Channel Alteration	11
6.7 Frequency of Riffles/Steps	13
6.8 Bank Stability	Left: 6 Right: 6
6.9 Bank Vegetation Protection	Left: 6 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 8

Total Score **125**

Habitat Rating **0.625**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, minor widening, major aggradation and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M20** Segment: **0** Completion Date: **August 28, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **4,102** Segment Location: **Continues for about three quarters of a mile to the confluence of Sterling Brook and the**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None		
1.2 Alluvial Fan	None		
1.3 Corridor Encroachments			
	Length (ft)	One	Both
Berms	304	0	0
height	0	0	0
Roads	205	0	0
height	0	0	0
Railroads	0	0	0
height	0	0	0
Improved Paths	0	0	0
height	0	0	0
Development	0	179	
1.4 Adjacent Side	Left	Right	
Hillside Slope	Flat	Flat	
Continuous w/	Sometimes	Never	
W/in 1 Bankfill	Sometimes	Never	
Texture	Not Evalua	Not Evalua	

1.5 Valley Features

Valley Width (ft)	934
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	34
2.2 Max Depth (ft)	3.70
2.3 Mean Depth (ft)	3.13
2.4 Floodprone Width (ft)	648

Notes:
 Perched tributary just upstream of Moulton Lane. Large offstream pond in old left corridor, now valley wall is inside of pond. Trib may be overflow or drainage from pond.

The reach had good floodplain access at the

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	10.86
2.7 Entrenchment Ratio	19.06
2.8 Incision Ratio	1.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	293
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	16%
Coarse Gravel	60%
Fine Gravel	16%
Sand	8%
Silt and smaller	0%

Silt/Clay Present?	Yes
Detritus	5 %
# Large Woody	30
2.13 Average Largest Particle on	
Bed	7.0 inches
Bar	5.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	874	1,533
Erosion Height (ft)	3.66	3.67
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	463	497
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	26-50	26-50
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	0-25	0-25
W less than 25	331	212
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Crop	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	Minimal
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.7 StormwaterInputs	
Field Ditch	1
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	4
Affected Length (ft)	1,530

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
7	9	9
Diagonal	Delta	Island
5	0	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
4	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
10	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,391
5.5 Dredging	Dredging

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M20** Segment: **0** Completion Date: **August 28, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **4,102** Segment Location: **Continues for about three quarters of a mile to the confluence of Sterling Brook and**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	60.0	Yes	No	No	Yes
Problem	Deposition Above				
Bridge	0.00	No	No	No	Yes
Problem	Deposition Above, Deposition Below				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	16	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	14		No
7.4 Change in Planform	9		No

Total Score **48**

Geomorphic Rating **0.6**

Channel Evolution Model **D**

Channel Evolution Stage **IIc**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
----------------------	------	-------

6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	11
6.5 Channel Flow Status	11
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 8 Right: 7
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 9

Total Score **135**

Habitat Rating **0.675**

Habitat Stream Condition **Good**

Narrative:

minor widening, major aggradation and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Little River** Reach # **M21** Segment: **A** Completion Date: **August 31, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **2,174** Segment Location: **Continues to about 140 feet downstream of Dr. Neal Road, just before a large bedrock grade**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Valley Width**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	472	0
height	0	0
Roads	1,197	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Steep
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	403
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	41
2.2 Max Depth (ft)	2.80
2.3 Mean Depth (ft)	1.97
2.4 Floodprone Width (ft)	351

Notes:
segmented because upper part of reach (not assessed) was bedrock waterfall/gorge.
Sterling Valley road runs along right bank and is bermed in places. This segment is immediately below SC bedrock dominated reaches. This likely contributes to reach

Passed Step 2. (Contued)

2.5 Aband. Floodpln	2.80 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	20.81
2.7 Entrenchment Ratio	8.56
2.8 Incision Ratio	1.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	400
2.12 Substrate Composition	
Bedrock	0%
Boulder	2%
Cobble	42%
Coarse Gravel	52%
Fine Gravel	3%
Sand	1%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	6
2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	7.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	844	670
Erosion Height (ft)	4.58	4.32
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	137	177
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	51-75	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	26-50	26-50
W less than 25	134	238
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Coniferous	Coniferous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Residential	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	3	3
Diagonal	Delta	Island
4	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
4	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,304
5.5 Dredging	Dredging

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Little River** Reach # **M21** Segment: **A** Completion Date: **August 31, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **2,174** Segment Location: **Continues to about 140 feet downstream of Dr. Neal Road, just before a large bedrock**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
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7.1 Channel Degradation	16	None	No
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	9		No

Total Score **46**

Geomorphic Rating **0.575**

Channel Evolution Model **D**
 Channel Evolution Stage **IIc**
 Geomorphic Condition **Fair**
 Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
----------------------	-------

6.1 Epifaunal Substrate - Available Cover	16
6.2 Embeddedness	16
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	14
6.5 Channel Flow Status	15
6.6 Channel Alteration	7
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 5 Right: 5
6.9 Bank Vegetation Protection	Left: 8 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 6

Total Score **136**

Habitat Rating **0.68**

Habitat Stream Condition **Good**

Narrative:
 minor widening, major aggradation and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Little River** Reach # **M21** Segment: **B** Completion Date: **August 28, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: **bedrock gorge** Rain: **Yes**
 Segment Length (ft): **1,050** Segment Location: **Continues to about 900 feet past Dr. Neal Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Valley Width**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	43
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Always	Always
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	85
Width Determination	Estimated
Confinement Type	Semi-confined
Rock Gorge?	Yes

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	0
2.2 Max Depth (ft)	0.00
2.3 Mean Depth (ft)	0.00
2.4 Floodprone Width (ft)	0

Notes:

Bedrock gorge segment, some cobble deposition on top of bedrock near upstream end of segment. Large bedrock grade control (waterfall). Segment in reference condition according to administrative judgement due to semi-confined valley, cascading bedrock

Passed Step 2. (Contued)

2.5 Aband. Floodpln	0.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	0.00
2.7 Entrenchment Ratio	0.00
2.8 Incision Ratio	0.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	
2.10 Riffles Type	
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	

Silt/Clay Present?	
Detritus	0 %
# Large Woody	0
2.13 Average Largest Particle on	
Bed	0.0
Bar	0.0

2.14 Stream Type

Stream Type:	B
Bed Material:	Bedrock
Subclass Slope:	None
Bed Form:	Bedrock

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Bedrock	Bedrock
Consistency	Cohesive	Cohesive
Lower		
Material Type	Bedrock	Bedrock
Consistency	Cohesive	Cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	98	114
Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	51-75	51-75
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	51-100
Sub-dominant	None	>100
W less than 25	56	68
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Coniferous	Coniferous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Residential
Sub-dominant	None	Forest
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	13.00	12.00	Yes	
Waterfall	Mid-segment	25.00	20.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	24.0	Yes	No	Yes	Yes
	Problem	Scour Below			
Bedrock	20.0	Yes	No	Yes	Yes
	Problem	Scour Below			

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model
Channel Evolution Stage
Geomorphic Condition **Referenc**
Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Miller Brook** Reach # **T4.01** Segment: **0** Completion Date: **June 26, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN, GA, SP** Why Not assessed: Rain: **No**
 Segment Length (ft): **2,924** Segment Location: **Begins at the confluence of the Little River and Miller Brook, crosses under Moscow Road,**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	115	0
height	7	0
Roads	2,135	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	64
1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Very Steep
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	475
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	63
2.2 Max Depth (ft)	2.70
2.3 Mean Depth (ft)	1.25
2.4 Floodprone Width (ft)	145

Notes:

Large island (~500 ft length) bermed (berm 130' long by 7'high) on left side likely due to past attempt to keep left channel straight. Right channel possibly formed as an avulsion. Moderate erosion on island banks.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.10 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	50.40
2.7 Entrenchment Ratio	2.30
2.8 Incision Ratio	1.52
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	95
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	27%
Coarse Gravel	53%
Fine Gravel	14%
Sand	6%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	90
2.13 Average Largest Particle on	
Bed	10.0 inches
Bar	8.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Moderate	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	319	506
Erosion Height (ft)	5.62	4.18
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	35	208
Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	26-50	26-50
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	51-100
Sub-dominant	0-25	26-50
W less than 25	74	679
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Residential
Sub-dominant	None	Hay
Mass Failures	117	43
Height	20	12
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
4	0	14
Diagonal	Delta	Island
5	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
3	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
7	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	776
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Miller Brook** Reach # **T4.01** Segment: **0** Completion Date: **June 26, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN, GA, SP** Rain: **No**
 Segment Length (ft): **2,924** Segment Location: **Begins at the confluence of the Little River and Miller Brook, crosses under Moscow**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	35.0	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Unconfined			
7.1 Channel Degradation	10	None	Yes
7.2 Channel Aggradation	8	None	No
7.3 Widening Channel	5		Yes
7.4 Change in Planform	10		No
Total Score	33		
Geomorphic Rating	0.4125		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
High	
6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	14
6.4 Sediment Deposition	9
6.5 Channel Flow Status	8
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 8 Right: 6
6.9 Bank Vegetation Protection	Left: 9 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 7
Total Score	130
Habitat Rating	0.65
Habitat Stream Condition	Good

Narrative:

Major historic degradation. Major aggradation and planform adjustment. Extreme historic widening.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Miller Brook** Reach # **T4.02** Segment: **0** Completion Date: **July 11, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA, PD** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **8,221** Segment Location: **Continues for about one and a half miles, to the intersection of Nebraska Valley Road and**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	333	0
height	0	0
Roads	554	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	983	108
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	530
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No
Human-caused Change?	Yes

Step 2. Stream Channel

2.1 Bankfull Width	53
2.2 Max Depth (ft)	2.40
2.3 Mean Depth (ft)	1.74
2.4 Floodprone Width (ft)	63

Notes:

Berm on right bank for ~400', possibly windrowed. Creating small bench of stream right. Eventhough poor for degradation there was no stream type departure because entrenchment was 2.8.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.80 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	30.46
2.7 Entrenchment Ratio	1.20
2.8 Incision Ratio	2.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	789
2.12 Substrate Composition	
Bedrock	1 %
Boulder	4 %
Cobble	40 %
Coarse Gravel	46 %
Fine Gravel	6 %
Sand	3 %
Silt and smaller	0 %

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	70
2.13 Average Largest Particle on	
Bed	13.0 inches
Bar	7.5 inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,550	1,082
Erosion Height (ft)	4.32	4.71
Revetmt. Type	Multiple	Rip-Rap
Revetmt. Length (ft)	612	165
Near Bank Veg. Type	Left	Right
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	51-75	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	26-50	51-100
W less than 25	480	85
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Invasives	Invasives

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Residential	Residential
Mass Failures	0	32
Height	0	20
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	9	23
Diagonal	Delta	Island
9	0	7

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
6	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
17	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,779
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Miller Brook	Reach # T4.02	Segment: 0	Completion Date: July 11, 2007
Organization: Bear Creek Environmental	Observers: CS, MA, PD		Rain: Yes
Segment Length (ft): 8,221	Segment Location: Continues for about one and a half miles, to the intersection of Nebraska Valley Road		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	5.00	3.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	42.0	Yes	No	No	Yes
	Problem	Deposition	Below	Scour	Above, Scour

Step 7. Rapid Geomorphic Assessment Data

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

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	15	
6.2 Embeddedness	12	
6.3 Velocity/Depth Patterns	16	
6.4 Sediment Deposition	8	
6.5 Channel Flow Status	11	
6.6 Channel Alteration	10	
6.7 Frequency of Riffles/Steps	11	
6.8 Bank Stability	Left: 7	Right: 8
6.9 Bank Vegetation Protection	Left: 5	Right: 5
6.10 Riparian Vegetation Zone Width	Left: 7	Right: 8
Total Score	123	
Habitat Rating	0.615	
Habitat Stream Condition	Fair	

Narrative:
 Extreme historic incision, major aggradation and planform change, some widening. Riffles sedimented with 9 diagonal bars. Seven islands and six flood chutes indicating major planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Miller Brook** Reach # **T4.03** Segment: **A** Completion Date: **July 6, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **4,275** Segment Location: **Continues for about 4275 feet, paralleling Nebraska Valley Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,000	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	160
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	305
Width Determination	Estimated
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	41
2.2 Max Depth (ft)	2.70
2.3 Mean Depth (ft)	1.85
2.4 Floodprone Width (ft)	93

Notes:
Nebraska Valley Road runs along right bank, in corridor in many places. Some very large bars and lots of steep riffles.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	21.89
2.7 Entrenchment Ratio	2.29
2.8 Incision Ratio	1.37
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	180
2.12 Substrate Composition	
Bedrock	0%
Boulder	6%
Cobble	47%
Coarse Gravel	37%
Fine Gravel	9%
Sand	1%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	3 %
# Large Woody	10
2.13 Average Largest Particle on	
Bed	14.0 inches
Bar	10.0 inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Cobble
Subclass Slope:	b
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	1,075	602
Erosion Height (ft)	5.13	3.59
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	80	584
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Deciduous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	51-75	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	>100
Sub-dominant	51-100	0-25
W less than 25	105	716
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Invasives	Invasives
Sub-dominant	Deciduous	Deciduous

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest Shrubs/Saplin	
Sub-dominant	Residential	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
4	1	21
Diagonal	Delta	Island
9	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
2	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
9	0	No

5.4 Stream Ford or Animal

5.5 Straightening	With Windrowing
Straightening Length:	1,154
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Miller Brook	Reach # T4.03	Segment: A	Completion Date: July 6, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 4,275	Segment Location: Continues for about 4275 feet, paralleling Nebraska Valley Road.		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	36.0	Yes	No	Yes	Yes
Problem	Deposition Above, Deposition Below, Scour				
Bridge	45.0	Yes	No	No	Yes
Problem	Deposition Above				
Bridge	59.0	No	No	No	Yes
Problem	Deposition Above				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	11	None	Yes
7.2 Channel Aggradation	7	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	10		No

Total Score **40**

Geomorphic Rating **0.5**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	8
6.2 Embeddedness	16
6.3 Velocity/Depth Patterns	12
6.4 Sediment Deposition	14
6.5 Channel Flow Status	9
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 8

Total Score **119**

Habitat Rating **0.595**

Habitat Stream Condition **Fair**

Narrative:

Minor historic degradation. Major aggradation, minor widening and major planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Miller Brook** Reach # **T4.03** Segment: **B** Completion Date: **July 6, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **2,667** Segment Location: **Continues paralleling Nebraska Valley Road for about 2667 feet, and ending at a tributary**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Depositional Features**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,916	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	351	39
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	195
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	37
2.2 Max Depth (ft)	3.05
2.3 Mean Depth (ft)	1.90
2.4 Floodprone Width (ft)	95

Notes:

One footbridge in this segment, but it has no footers and does not appear to be a permanent structure or constriction (floodprone or channel).

Passed Step 2. (Contued)

2.5 Aband. Floodpln	5.80 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	19.47
2.7 Entrenchment Ratio	2.57
2.8 Incision Ratio	1.90
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	170
2.12 Substrate Composition	
Bedrock	0%
Boulder	10%
Cobble	43%
Coarse Gravel	39%
Fine Gravel	6%
Sand	2%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	19
2.13 Average Largest Particle on	
Bed	12.0 inches
Bar	10.0 inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Cobble
Subclass Slope:	b
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

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

Upper

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

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

Lower

Material Type **Boulder/Cobbl** **Boulder/Cobbl**

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

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

Erosion Length (ft) **387** **347**

Erosion Height (ft) **4.83** **7.92**

Revetmt. Type **None** **Rip-Rap**

Revetmt. Length (ft) **0** **292**

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

Dominant **Deciduous** **Deciduous**

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

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

Canopy % **76-100** **51-75**

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

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

Dominant **>100** **26-50**

Sub-dominant **None** **51-100**

W less than 25 **241** **215**

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

Dominant **Deciduous** **Deciduous**

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

3.3 Riparian Corridor

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

Dominant **Forest** **Residential**

Sub-dominant **Residential** **None**

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

Height **0** **0**

Gullies **0**

Length **0**

Height **0.00**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Abundant**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

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

(old) Upstrm Flow Reg **None**

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	1	10
Diagonal	Delta	Island
5	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
5	0	Yes

5.4 Stream Ford or Animal

Yes

5.5 Straightening

Straightening

Straightening Length: **1,233**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls

and Step 4.8 - Channel Constrictions

are on The second page of this

report - with Steps 6 through 7.

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Miller Brook	Reach # T4.03	Segment: B	Completion Date: July 6, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: Yes
Segment Length (ft): 2,667	Segment Location: Continues paralleling Nebraska Valley Road for about 2667 feet, and ending at a		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	7	None	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	14		No
7.4 Change in Planform	12		No

Total Score **42**

Geomorphic Rating **0.525**

Channel Evolution Model **F**
Channel Evolution Stage **III**
Geomorphic Condition **Fair**
Stream Sensitivity **High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	16
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	14
6.5 Channel Flow Status	15
6.6 Channel Alteration	8
6.7 Frequency of Riffles/Steps	18
6.8 Bank Stability	Left: 6 Right: 6
6.9 Bank Vegetation Protection	Left: 8 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 5

Total Score **141**

Habitat Rating **0.705**

Habitat Stream Condition **Good**

Narrative:

Major historic degradation, major aggradation, and minor planform adjustment actively occurring. Minor widening, appears to be in early stage III.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Miller Brook** Reach # **T4.04** Segment: **0** Completion Date: **July 3, 2007**
Organization: **Bear Creek Environmental** Observers: **MN, CS** Why Not assessed: Rain: **Yes**
Segment Length (ft): **3,800** Segment Location: **Continues paralleling Nebraska Valley Road for about three quarters of a mile, and ends at a**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None		
1.2 Alluvial Fan	None		
1.3 Corridor Encroachments			
Length (ft)	One	Both	
Berms	80	0	
height	0	0	
Roads	1,833	0	
height	0	0	
Railroads	0	0	
height	0	0	
Improved Paths	0	0	
height	0	0	
Development	634	0	
1.4 Adjacent Side	Left	Right	
Hillside Slope	Very Steep	Very Steep	
Continuous w/	Sometimes	Sometimes	
W/in 1 Bankfill	Sometimes	Sometimes	
Texture	Not Evalua	Not Evalua	

1.5 Valley Features

Valley Width (ft)	192
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	35
2.2 Max Depth (ft)	2.10
2.3 Mean Depth (ft)	1.47
2.4 Floodprone Width (ft)	99

Notes:
Rocks somewhat iron stained from upstream dam.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.90 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	23.47
2.7 Entrenchment Ratio	2.88
2.8 Incision Ratio	1.86
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	175
2.12 Substrate Composition	
Bedrock	0%
Boulder	9%
Cobble	39%
Coarse Gravel	39%
Fine Gravel	12%
Sand	1%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	1 %
# Large Woody	11
2.13 Average Largest Particle on	
Bed	10.0 inches
Bar	8.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	323	469
Erosion Height (ft)	10.50	9.84
Revetmt. Type	None	Multiple
Revetmt. Length (ft)	0	787
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	None	Lawn
Bank Canopy	Left	Right
Canopy %	76-100	26-50
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	0-25
Sub-dominant	None	51-100
W less than 25	0	2,660
Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Deciduous
Sub-dominant	None	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Residential
Sub-dominant	None	None
Mass Failures	39	0
Height	30	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	4	22
Diagonal	Delta	Island
0	0	6

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
4	0	1	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	594
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Miller Brook** Reach # **T4.04** Segment: **0** Completion Date: **July 3, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, CS** Rain: **Yes**
 Segment Length (ft): **3,800** Segment Location: **Continues paralleling Nebraska Valley Road for about three quarters of a mile, and**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
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7.1 Channel Degradation	8	None	Yes
7.2 Channel Aggradation	11	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	8		No

Total Score **39**

Geomorphic Rating **0.4875**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
----------------------	-------

6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	15
6.3 Velocity/Depth Patterns	14
6.4 Sediment Deposition	11
6.5 Channel Flow Status	10
6.6 Channel Alteration	11
6.7 Frequency of Riffles/Steps	17
6.8 Bank Stability	Left: 9 Right: 8
6.9 Bank Vegetation Protection	Left: 9 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 4

Total Score **136**

Habitat Rating **0.68**

Habitat Stream Condition **Good**

Narrative:

Major historic degradation. Minor aggradation and widening, major planform adjustment. Appears to be in early stage III. Six islands and four flood chutes indicative of major planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Miller Brook** Reach # **T4.05** Segment: **0** Completion Date: **June 29, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, CS, PD, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **1,925** Segment Location: **Continues for about 2000 feet, and ends about 400 feet after crossing Nebraska Valley**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	313	0
height	0	0
Roads	363	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	69
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	142
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	29
2.2 Max Depth (ft)	1.80
2.3 Mean Depth (ft)	1.13
2.4 Floodprone Width (ft)	39

Notes:
 Black rocks (iron staining) from pond upstream. Berm along right bank 180'.
 Sediment starved due to onstream pond, which likely lead to historic incision.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.60 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	25.66
2.7 Entrenchment Ratio	1.33
2.8 Incision Ratio	2.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	150
2.12 Substrate Composition	
Bedrock	1%
Boulder	13%
Cobble	48%
Coarse Gravel	27%
Fine Gravel	9%
Sand	2%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	25
2.13 Average Largest Particle on	
Bed	10.0 inches
Bar	7.0 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Cobble
Subclass Slope:	c
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	63	78
Erosion Height (ft)	21.07	5.20
Revetmt. Type	Multiple	Rip-Rap
Revetmt. Length (ft)	99	61
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	76-100	76-100
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	51-100	None
W less than 25	52	50
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Residential	None
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	3	13
Diagonal	Delta	Island
0	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
5	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	354
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Miller Brook** Reach # **T4.05** Segment: **0** Completion Date: **June 29, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, CS, PD, MA** Rain: **Yes**
 Segment Length (ft): **1,925** Segment Location: **Continues for about 2000 feet, and ends about 400 feet after crossing Nebraska Valley**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Dam	Mid-segment	13.00	13.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	13.4	Yes	No	Yes	Yes
	Problem	Deposition	Below	Scour	Above

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		5	C to B	Yes
7.2 Channel Aggradation		15	None	No
7.3 Widening Channel		13		No
7.4 Change in Planform		12		No
Total Score		45		
Geomorphic Rating		0.5625		
Channel Evolution Model	F			
Channel Evolution Stage	II			
Geomorphic Condition	Fair			
Stream Sensitivity	Very High			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		13
6.2 Embeddedness		17
6.3 Velocity/Depth Patterns		16
6.4 Sediment Deposition		16
6.5 Channel Flow Status		10
6.6 Channel Alteration		14
6.7 Frequency of Riffles/Steps		18
6.8 Bank Stability	Left: 10 Right: 10	
6.9 Bank Vegetation Protection	Left: 9 Right: 10	
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 10	
Total Score		162
Habitat Rating		0.81
Habitat Stream Condition	Good	

Narrative:

Sediment starved due to upstream pond likely led to historic incision, minor widening, aggradation, and planform adjustment. Large trees are holding soil, some scour, but little erosion.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Gold Brook** Reach # **T6.01** Segment: **0** Completion Date: **June 7, 2007**
Organization: **Bear Creek Environmental** Observers: **MN, PD, CS** Why Not assessed: Rain: **Yes**
Segment Length (ft): **2,235** Segment Location: **Begins at the confluence of Gold Brook with the Little River about 150 feet west of River**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	1,508	0
height	0	0
Roads	1,357	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	1,395	93
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	531
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No
Human-caused Change?	No

Step 2. Stream Channel

2.1 Bankfull Width	38
2.2 Max Depth (ft)	2.60
2.3 Mean Depth (ft)	1.60
2.4 Floodprone Width (ft)	224

Notes:

Left bank bermed. Spoke with owner of campground: after 1990 flood owner brought in 1000 cu yards of material to create berm. He also rip rapped the left bank at that time. Gold Brook was dredged from its mouth up to VT100 as per Barry Cahoon.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.60 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	23.88
2.7 Entrenchment Ratio	5.86
2.8 Incision Ratio	1.77
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	530
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	34%
Coarse Gravel	46%
Fine Gravel	10%
Sand	9%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	1 %
# Large Woody	8
2.13 Average Largest Particle on	
Bed	8.0 inches
Bar	7.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	0	615
Erosion Height (ft)	0.00	4.83
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	747	58
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Deciduous
Sub-dominant	Shrubs/Saplin	Herbaceous
Bank Canopy	Left	Right
Canopy %	1-25	51-75
Mid-Channel Canopy	Open	
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	0-25	0-25
Sub-dominant	26-50	26-50
W less than 25	1,293	1,085
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Deciduous
Sub-dominant	Deciduous	Herbaceous
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Residential	Hay
Sub-dominant	None	Forest
Mass Failures	0	0
Height	0	0
Gullies	0	0
Length	0	0
Height	0.00	0.00

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	1	6
Diagonal	Delta	Island
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
2	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,784
5.5 Dredging	Dredging

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Gold Brook** Reach # **T6.01** Segment: **0** Completion Date: **June 7, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, PD, CS** Rain: **Yes**
 Segment Length (ft): **2,235** Segment Location: **Begins at the confluence of Gold Brook with the Little River about 150 feet west of**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	5.00	4.00	Yes	
Ledge	Mid-segment	0.00	0.00	No	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	25.0	Yes	No	Yes	No
	Problem	Deposition Below			
Bedrock	20.0	Yes	No	Yes	No
	Problem	Deposition Above			
Bridge	32.0	Yes	No	Yes	Yes
	Problem	Deposition Below			

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		8	None	Yes
7.2 Channel Aggradation		12	None	No
7.3 Widening Channel		12		No
7.4 Change in Planform		9		No
Total Score		41		
Geomorphic Rating		0.5125		
Channel Evolution Model	F			
Channel Evolution Stage	III			
Geomorphic Condition	Fair			
Stream Sensitivity	Very High			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		8
6.2 Embeddedness		12
6.3 Velocity/Depth Patterns		11
6.4 Sediment Deposition		11
6.5 Channel Flow Status		10
6.6 Channel Alteration		3
6.7 Frequency of Riffles/Steps		9
6.8 Bank Stability	Left: 9 Right: 7	
6.9 Bank Vegetation Protection	Left: 4 Right: 7	
6.10 Riparian Vegetation Zone Width	Left: 1 Right: 2	
Total Score		94
Habitat Rating		0.47
Habitat Stream Condition	Fair	

Narrative:

Rip rap on left bank preventing lateral migration. Some juvenile flood plain has developed on right bank. Historic degradation, minor aggradation and widening with major planform adjustment (mostly lower end of reach near big bend).

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	2,072	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	183	83
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	96
Width Determination	Estimated
Confinement Type	Semi-confined
Rock Gorge?	No
Human-caused Change?	No

Step 2. Stream Channel

2.1 Bankfull Width	43
2.2 Max Depth (ft)	2.70
2.3 Mean Depth (ft)	1.72
2.4 Floodprone Width (ft)	56

Notes:

Dewey Hill Road Bridge is not a floodprone or channel constriction. It is 80' wide and 50' high above channel. The reach was not incised and there were numerous grade controls both upstream and downstream of the reach. The downstream end of reach

Passed Step 2. (Contued)

2.5 Aband. Floodpln	2.70	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	24.71	
2.7 Entrenchment Ratio	1.33	
2.8 Incision Ratio	1.00	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Complete	
2.11 Riffle/Step Spacing (ft)	85	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	10%	
Cobble	31%	
Coarse Gravel	37%	
Fine Gravel	22%	
Sand	0%	
Silt and smaller	0%	

Silt/Clay Present?	No	
Detritus	1	%
# Large Woody	26	
2.13 Average Largest Particle on		
Bed	12.0	inches
Bar	9.0	inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Step-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Bedrock
Consistency	Non-cohesive	Cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	142	79
Erosion Height (ft)	5.73	5.57
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	51	61
Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	76-100	76-100
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	>100
Sub-dominant	>100	51-100
W less than 25	191	127
Buffer Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Residential	Forest
Sub-dominant	Forest	Residential
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	3	20
Diagonal	Delta	Island
0	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Gold Brook	Reach # T6.02	Segment: 0	Completion Date: June 25, 2007
Organization: Bear Creek Environmental	Observers: CS, MA		Rain: No
Segment Length (ft): 2,842	Segment Location: Continues for about a half mile, paralleling Gold Brook Road and ends about 500 feet		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	14.00	10.00	Yes	
Ledge	Mid-segment	13.00	8.00	Yes	
Ledge	Mid-segment	0.00	0.00	Yes	
Ledge	Mid-segment	0.00	0.00	Yes	
Ledge	Mid-segment	5.00	3.00	Yes	
Waterfall	Mid-segment	7.00	3.00	Yes	
Ledge	Mid-segment	3.00	3.00	Yes	
Ledge	Mid-segment	6.00	3.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	21.0	Yes	No	Yes	Yes
Problem	Deposition	Above,	Deposition	Below	
Bedrock	18.0	Yes	No	Yes	Yes
Problem	Deposition	Above,	Deposition	Below,	Scour
Bedrock	42.0	Yes	No	Yes	Yes
Problem	Deposition	Above,	Deposition	Below,	Scour
Bedrock	11.0	Yes	No	Yes	No
Problem	Deposition	Above,	Deposition	Below,	Scour

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic
7.1 Channel Degradation		18	None	No
7.2 Channel Aggradation		10	None	No
7.3 Widening Channel		13		No
7.4 Change in Planform		14		No
Total Score		55		
Geomorphic Rating		0.6875		
Channel Evolution Model	D			
Channel Evolution Stage	IIb			
Geomorphic Condition	Good			
Stream Sensitivity	Moderate			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		11
6.2 Embeddedness		14
6.3 Velocity/Depth Patterns		18
6.4 Sediment Deposition		13
6.5 Channel Flow Status		11
6.6 Channel Alteration		19
6.7 Frequency of Riffles/Steps		17
6.8 Bank Stability	Left: 8 Right: 8	
6.9 Bank Vegetation Protection	Left: 9 Right: 9	
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 8	
Total Score		151
Habitat Rating		0.755

Habitat Stream Condition **Good**

Narrative:
 Minor planform adjustment and widening with major aggradation. Twenty side bars in 2800 foot reach. Aggradation may be in part due to channelized segment (T6.03B) upstream, which is acting as a sediment transport reach.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Gold Brook** Reach # **T6.03** Segment: **A** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, MA** Why Not assessed: Rain: **No**
 Segment Length (ft): **1,457** Segment Location: **Continues for about 1457 feet to rip rapped section running along Gold Brook Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	180	0
height	0	0
Roads	747	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	481	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Extremely	Extremely
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Sometimes	Always
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	78
Width Determination	Measured
Confinement Type	Semi-confined
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	33
2.2 Max Depth (ft)	2.50
2.3 Mean Depth (ft)	1.43
2.4 Floodprone Width (ft)	63

Notes:

Even where stream has plenty of room (narrow confinement) is a "B" step pool, don't think this is a "C" channel by reference. Stream access point (driveway-like access from road), possible gravel mining, also may be for recreational use (fishing/swimming).

Passed Step 2. (Contued)

2.5 Aband. Floodpln	2.50 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	23.29
2.7 Entrenchment Ratio	1.89
2.8 Incision Ratio	1.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	160
2.12 Substrate Composition	
Bedrock	3%
Boulder	22%
Cobble	27%
Coarse Gravel	31%
Fine Gravel	13%
Sand	4%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	3
2.13 Average Largest Particle on	
Bed	11.0 inches
Bar	9.0 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Cobble
Subclass Slope:	None
Bed Form:	Step-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	359	349
Erosion Height (ft)	7.17	7.72
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	362	0
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Deciduous	Coniferous
Sub-dominant	Herbaceous	Deciduous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	26-50	76-100
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	51-100	>100
Sub-dominant	0-25	None
W less than 25	565	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Deciduous	Mixed Trees
Sub-dominant	Herbaceous	None
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Residential	Forest
Sub-dominant	Forest	None
Mass Failures	0	60
Height	0	19
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
2	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	450
5.5 Dredging	Gravel Mining

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Gold Brook	Reach # T6.03	Segment: A	Completion Date: June 21, 2007
Organization: Bear Creek Environmental	Observers: MN, MA		Rain: No
Segment Length (ft): 1,457	Segment Location: Continues for about 1457 feet to rip rapped section running along Gold Brook Road.		

1.6 Grade Controls					
Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	3.00	3.00	Yes	
Ledge	Mid-segment	2.00	1.00	Yes	

4.8 Channel Constrictions					
None					
Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Narrative:
Minor widening.

Step 7. Rapid Geomorphic Assessment Data			
Confinement Type	Confined	Score	STD
7.1 Channel Degradation		16	None
7.2 Channel Aggradation		18	None
7.3 Widening Channel		14	No
7.4 Change in Planform		16	No
Total Score		64	
Geomorphic Rating		0.8	
Channel Evolution Model		F	
Channel Evolution Stage		I	
Geomorphic Condition		Good	
Stream Sensitivity		Moderate	

<u>Step 6. Rapid Habitat Assessment Data</u>		
Stream Gradient Type	High	
		Score
5.1 Epifaunal Substrate - Available Cover		13
6.2 Embeddedness		14
6.3 Velocity/Depth Patterns		14
6.4 Sediment Deposition		14
6.5 Channel Flow Status		14
6.6 Channel Alteration		10
6.7 Frequency of Riffles/Steps		16
6.8 Bank Stability	Left: 7	Right: 7
6.9 Bank Vegetation Protection	Left: 6	Right: 9
6.10 Riparian Vegetation Zone Width	Left: 6	Right: 9
Total Score		139
Habitat Rating		0.695
Habitat Stream Condition		Good

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Gold Brook** Reach # **T6.03** Segment: **B** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, MA** Why Not assessed:
 Segment Length (ft): **536** Segment Location: **Continues for about 536 feet to the end of the rip rapped left bank.** Rain: **No**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	536	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Extremely	Extremely
Continuous w/	Always	Always
W/in 1 Bankfill	Always	Always
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	63
Width Determination	Estimated
Confinement Type	Narrowly
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	33
2.2 Max Depth (ft)	2.70
2.3 Mean Depth (ft)	1.55
2.4 Floodprone Width (ft)	42

Notes:

At first glance, right bank appeared to be windrowed. We returned to the site several times and determined the that there was no berm and and no windrowing had ocured. Segment runs tightly along Gold Brook Road. Rip rapped entirely along right bank and there

Passed Step 2. (Contued)

2.5 Aband. Floodpln	7.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	20.97
2.7 Entrenchment Ratio	1.28
2.8 Incision Ratio	2.85
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	105
2.12 Substrate Composition	
Bedrock	0%
Boulder	10%
Cobble	29%
Coarse Gravel	39%
Fine Gravel	17%
Sand	5%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	0 %
# Large Woody	0
2.13 Average Largest Particle on	
Bed	20.0 inches
Bar	6.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	0	168
Erosion Height (ft)	0.00	3.96
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	476	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Deciduous
Sub-dominant	Deciduous	Coniferous
Bank Canopy	Left	Right
Canopy %	1-25	76-100
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	0-25	>100
Sub-dominant	None	None
W less than 25	497	0
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Mixed Trees
Sub-dominant	Deciduous	None
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Residential	Forest
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	490
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Gold Brook** Reach # **T6.03** Segment: **B** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, MA** Rain: **No**
 Segment Length (ft): **536** Segment Location: **Continues for about 536 feet to the end of the rip rapped left bank.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
7.1 Channel Degradation	3	B to F	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	13		No
7.4 Change in Planform	12		No
Total Score	42		
Geomorphic Rating	0.525		
Channel Evolution Model	F		
Channel Evolution Stage	II		
Geomorphic Condition	Fair		
Stream Sensitivity	Extreme		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
6.1 Epifaunal Substrate - Available Cover	11
6.2 Embeddedness	16
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	13
6.5 Channel Flow Status	10
6.6 Channel Alteration	7
6.7 Frequency of Riffles/Steps	18
6.8 Bank Stability	Left: 9 Right: 7
6.9 Bank Vegetation Protection	Left: 3 Right: 10
6.10 Riparian Vegetation Zone Width	Left: 1 Right: 10
Total Score	128
Habitat Rating	0.64
Habitat Stream Condition	Fair

Narrative:

Minor aggradation, widening and planform adjustment due to extensive straightening and floodplain encroachment (road). Extreme historic degradation.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Gold Brook** Reach # **T6.03** Segment: **C** Completion Date: **June 21, 2007**
Organization: **Bear Creek Environmental** Observers: **MN, MA** Why Not assessed: Rain: **No**
Segment Length (ft): **1,176** Segment Location: **Continues for about 1176 feet to about 450 feet downstream of Covered Bridge Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Subreach**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	360	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	52	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Extremely	Extremely
Continuous w/	Never	Always
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	315
Width Determination	Measured
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	45
2.2 Max Depth (ft)	2.00
2.3 Mean Depth (ft)	1.54
2.4 Floodprone Width (ft)	125

Notes:

Segment starts out to be narrow confinement (B4) and changes to broad (C4) just upstream of island. First place with large bend that allows sediment coming from upstream to deposit. Chose D CEM because minor incision noted and aggradation from

Passed Step 2. (Contued)

2.5 Aband. Floodpln	2.40	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	29.22	
2.7 Entrenchment Ratio	2.78	
2.8 Incision Ratio	1.20	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	300	
2.12 Substrate Composition		
Bedrock	1%	
Boulder	3%	
Cobble	30%	
Coarse Gravel	40%	
Fine Gravel	20%	
Sand	6%	
Silt and smaller	0%	

Silt/Clay Present?	No	
Detritus	5%	
# Large Woody	8	
2.13 Average Largest Particle on		
Bed	14.0	inches
Bar	5.0	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

C	4	b	Riffle-Pool
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3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	336	126
Erosion Height (ft)	5.53	5.03
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	Left	Right
Canopy %	76-100	51-75
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	26-50	None
W less than 25	0	0
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Coniferous	Coniferous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Residential	None
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None

4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	0	5
Diagonal	Delta	Island
1	0	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal	No
5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Gold Brook** Reach # **T6.03** Segment: **C** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, MA** Rain: **No**
 Segment Length (ft): **1,176** Segment Location: **Continues for about 1176 feet to about 450 feet downstream of Covered Bridge Road.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		15	None	Yes
7.2 Channel Aggradation		5	None	No
7.3 Widening Channel		11		No
7.4 Change in Planform		11		No

Total Score **42**

Geomorphic Rating **0.525**

Channel Evolution Model **D**

Channel Evolution Stage **IIId**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	14
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	6
6.5 Channel Flow Status	9
6.6 Channel Alteration	15
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 5 Right: 8
6.9 Bank Vegetation Protection	Left: 7 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 10

Total Score **132**

Habitat Rating **0.66**

Habitat Stream Condition **Good**

Narrative:

Minor historic degradation. Extreme aggradation, major widening and planform adjustment. Aggradation in part due to channelization in upstream segment and also drop in slope and change in entrenchment in segment C.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Gold Brook** Reach # **T6.03** Segment: **D** Completion Date: **June 19, 2007**
Organization: **Bear Creek Environmental** Observers: **MN, CS, MA** Why Not assessed: Rain: **No**
Segment Length (ft): **725** Segment Location: **Continues for about 725 feet, and ends about 300 feet past Covered Bridge Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	55	0
height	0	0
Roads	565	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	67
1.4 Adjacent Side	Left	Right
Hillside Slope	Extremely	Extremely
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	80
Width Determination	Estimated
Confinement Type	Semi-confined
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	37
2.2 Max Depth (ft)	2.50
2.3 Mean Depth (ft)	1.66
2.4 Floodprone Width (ft)	56

Notes:

Segment has a few bedrock grade controls and some bedrock along banks. An old mill foundation or rock berm could be seen on LB about 125 feet downstream of covered bridge. Small section (~200 feet) of this segment where it runs close to Gold Brook

Passed Step 2. (Contued)

2.5 Aband. Floodpln	2.50 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	22.29
2.7 Entrenchment Ratio	1.50
2.8 Incision Ratio	1.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	125
2.12 Substrate Composition	
Bedrock	1%
Boulder	11%
Cobble	27%
Coarse Gravel	47%
Fine Gravel	11%
Sand	2%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	1 %
# Large Woody	3
2.13 Average Largest Particle on	
Bed	8.0 inches
Bar	7.0 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Step-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	0	83
Erosion Height (ft)	0.00	8.00
Revetmt. Type	Multiple	None
Revetmt. Length (ft)	319	0
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Herbaceous
Sub-dominant	Herbaceous	Deciduous
Bank Canopy	Left	Right
Canopy %	51-75	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	>100
Sub-dominant	26-50	None
W less than 25	46	44
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Residential	Forest
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	179
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Gold Brook** Reach # **T6.03** Segment: **D** Completion Date: **June 19, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, CS, MA** Rain: **No**
 Segment Length (ft): **725** Segment Location: **Continues for about 725 feet, and ends about 300 feet past Covered Bridge Road.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	3.00	2.00	Yes	
Ledge	Mid-segment	3.00	1.00	Yes	
Ledge	Mid-segment	4.00	3.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	15.0	Yes	No	Yes	No
Problem	Deposition Below			Scour Below	Alignment
Bedrock	25.0	Yes	No	Yes	Yes
Problem	Deposition Below			Scour Below	
Bridge	40.0	Yes	No	No	Yes
Problem	None				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Confined			
7.1 Channel Degradation	17	None	No
7.2 Channel Aggradation	16	None	No
7.3 Widening Channel	13		No
7.4 Change in Planform	16		No
Total Score	62		
Geomorphic Rating	0.775		
Channel Evolution Model	F		
Channel Evolution Stage	I		
Geomorphic Condition	Good		
Stream Sensitivity	Moderate		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	Score
High	
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	16
6.3 Velocity/Depth Patterns	17
6.4 Sediment Deposition	13
6.5 Channel Flow Status	11
6.6 Channel Alteration	12
6.7 Frequency of Riffles/Steps	18
6.8 Bank Stability	Left: 9 Right: 7
6.9 Bank Vegetation Protection	Left: 7 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 9
Total Score	146
Habitat Rating	0.73
Habitat Stream Condition	Good

Narrative:

Minor widening. Rip rap on left bank may be preventing stream widening on this side. Not much erosion on right bank.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Gold Brook** Reach # **T6.04** Segment: **0** Completion Date: **June 12, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, PD, CS** Why Not assessed: Rain: **No**
 Segment Length (ft): **1,065** Segment Location: **Continues for about 1000 feet, ending just past a tributary entering from the northeast.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
Length (ft)	One	Both
Berms	253	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	196	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	331
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	29
2.2 Max Depth (ft)	3.00
2.3 Mean Depth (ft)	2.06
2.4 Floodprone Width (ft)	166

Notes:

Short reach, some fill in backyards along Stowe Hollow Road has caused small section DS of cross section to be more entrenched. Incised trib noted in reach.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.30 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	13.83
2.7 Entrenchment Ratio	5.82
2.8 Incision Ratio	1.43
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	220
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	20%
Coarse Gravel	50%
Fine Gravel	16%
Sand	14%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	1 %
# Large Woody	11
2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	6.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	72	246
Erosion Height (ft)	4.57	6.37
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	83	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Shrubs/Saplin
Sub-dominant	Shrubs/Saplin	Deciduous
Bank Canopy	Left	Right
Canopy %	26-50	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	0-25	51-100
W less than 25	351	0
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Residential	Shrubs/Saplin
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	Unknown
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	None
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	1	5
Diagonal	Delta	Island
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening	None
Straightening Length:	0
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Gold Brook** Reach # **T6.04** Segment: **0** Completion Date: **June 12, 2007**
 Organization: **Bear Creek Environmental** Observers: **MN, PD, CS** Rain: **No**
 Segment Length (ft): **1,065** Segment Location: **Continues for about 1000 feet, ending just past a tributary entering from the**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		9	None	Yes
7.2 Channel Aggradation		14	None	No
7.3 Widening Channel		14		No
7.4 Change in Planform		12		No

Total Score **49**

Geomorphic Rating **0.6125**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	14
6.5 Channel Flow Status	13
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 8 Right: 6
6.9 Bank Vegetation Protection	Left: 6 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 9

Total Score **136**

Habitat Rating **0.68**

Habitat Stream Condition **Good**

Narrative:

Major historic degradation, minor aggradation, widening and planform change. Good floodplain access on right bank, left bank is bermed and rip rapped preventing lateral migration.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Gold Brook** Reach # **T6.05** Segment: **0** Completion Date: **June 14, 2007**
Organization: **Bear Creek Environmental** Observers: **MN, PD, CS** Why Not assessed: Rain: **No**
Segment Length (ft): **3,790** Segment Location: **Continues for about three quarters of a mile, and ends about 300 feet past North Hollow**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	60	0
height	0	0
Roads	1,873	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	553	166
1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Flat
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	300
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	26
2.2 Max Depth (ft)	2.30
2.3 Mean Depth (ft)	1.91
2.4 Floodprone Width (ft)	148

Notes:

Reach has 3 stream crossings, 2 undersized and some sharp bends. Reach becomes slightly entrenched for about 300 feet in middle

Many side bars, but less than half bankfull

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.20 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	13.61
2.7 Entrenchment Ratio	5.69
2.8 Incision Ratio	1.39
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	148
2.12 Substrate Composition	
Bedrock	0%
Boulder	3%
Cobble	32%
Coarse Gravel	41%
Fine Gravel	12%
Sand	12%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	34
2.13 Average Largest Particle on	
Bed	12.0 inches
Bar	6.0 inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	658	359
Erosion Height (ft)	5.34	3.92
Revetmt. Type	Multiple	Multiple
Revetmt. Length (ft)	318	876
Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	51-75	51-75
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	51-100
Sub-dominant	0-25	0-25
W less than 25	762	1,823
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	Residential	Hay
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	5	22
Diagonal	Delta	Island
3	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
3	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening **Straightening**

Straightening Length: **1,325**
5.5 Dredging **None**

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Gold Brook	Reach # T6.05	Segment: 0	Completion Date: June 14, 2007
Organization: Bear Creek Environmental	Observers: MN, PD, CS		Rain: No
Segment Length (ft): 3,790	Segment Location: Continues for about three quarters of a mile, and ends about 300 feet past North		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	1.00	0.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	17.0	Yes	No	Yes	Yes
Problem	Deposition Above, Deposition Below, Scour				
Bridge	18.0	Yes	No	Yes	Yes
Problem	Deposition Above, Deposition Below, Scour				
Bridge	35.0	Yes	No	No	Yes
Problem	Deposition Above, Deposition				
Bedrock	17.0	Yes	No	Yes	Yes
Problem	Deposition Above, Deposition Below				

Narrative:

Minor historic degradation, aggradation, widening and planform change.

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	11	None	Yes
7.2 Channel Aggradation	12	None	No
7.3 Widening Channel	12		No
7.4 Change in Planform	12		No
Total Score	47		
Geomorphic Rating	0.5875		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Very High		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	
	Score	
6.1 Epifaunal Substrate - Available Cover	15	
6.2 Embeddedness	13	
6.3 Velocity/Depth Patterns	17	
6.4 Sediment Deposition	13	
6.5 Channel Flow Status	14	
6.6 Channel Alteration	9	
6.7 Frequency of Riffles/Steps	18	
6.8 Bank Stability	Left: 6	Right: 7
6.9 Bank Vegetation Protection	Left: 8	Right: 7
6.10 Riparian Vegetation Zone Width	Left: 8	Right: 6
Total Score	141	
Habitat Rating	0.705	
Habitat Stream Condition	Good	

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Gold Brook** Reach # **T6.06** Segment: **A** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, PD** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **2,483** Segment Location: **Continues for about 2483 feet, and ends just upstream of Bryan Road crossing.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Subreach**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	299	0
height	0	0
Roads	666	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	198	43
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Flat	Steep
Continuous w/	Never	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	600
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	26
2.2 Max Depth (ft)	2.20
2.3 Mean Depth (ft)	1.65
2.4 Floodprone Width (ft)	89

Notes:

Large meander cutoff channel avulsion in segment, looks recent. Segment is in early stage 3, some widening, minor historic incision.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	15.76
2.7 Entrenchment Ratio	3.42
2.8 Incision Ratio	1.36
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	65
2.12 Substrate Composition	
Bedrock	0%
Boulder	17%
Cobble	35%
Coarse Gravel	26%
Fine Gravel	14%
Sand	8%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	25
2.13 Average Largest Particle on	
Bed	19.0 inches
Bar	14.0 inches

2.14 Stream Type

Stream Type:	C
Bed Material:	Cobble
Subclass Slope:	b
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	<u>Left</u>	<u>Right</u>
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Upper

Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Lower

Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	<u>Left</u>	<u>Right</u>
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Erosion Length (ft)	543	733
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Erosion Height (ft)	6.62	5.41
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Revetmt. Type	Rip-Rap	Rip-Rap
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Revetmt. Length (ft)	486	188
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Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
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Dominant	Deciduous	Deciduous
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Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
--------------	----------------------	----------------------

Bank Canopy	<u>Left</u>	<u>Right</u>
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Canopy %	51-75	51-75
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Mid-Channel Canopy	Open
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3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
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Dominant	51-100	>100
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Sub-dominant	0-25	0-25
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W less than 25	315	388
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Buffer Veg. Type	<u>Left</u>	<u>Right</u>
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Dominant	Mixed Trees	Mixed Trees
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Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
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3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>
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Dominant	Residential	Forest
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Sub-dominant	Forest	Shrubs/Saplin
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Mass Failures	0	42
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Height	0	80
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Gullies	0
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Length	0
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Height	0.00
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Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	1	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening **With Windrowing**

Straightening Length: **1,332**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Gold Brook** Reach # **T6.06** Segment: **A** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, PD** Rain: **Yes**
 Segment Length (ft): **2,483** Segment Location: **Continues for about 2483 feet, and ends just upstream of Bryan Road crossing.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Waterfall	Mid-segment	2.00	1.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	9.50	Yes	No	Yes	Yes
	Problem	Deposition Above,	Deposition Below,	Scour	
Bedrock	8.00	Yes	No	Yes	Yes
	Problem	Deposition Below,	Scour Below		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		12	None	No
7.2 Channel Aggradation		12	None	No
7.3 Widening Channel		12		No
7.4 Change in Planform		7		No
Total Score		43		
Geomorphic Rating		0.5375		
Channel Evolution Model	F			
Channel Evolution Stage	III			
Geomorphic Condition	Fair			
Stream Sensitivity	High			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		14
6.2 Embeddedness		8
6.3 Velocity/Depth Patterns		18
6.4 Sediment Deposition		10
6.5 Channel Flow Status		13
6.6 Channel Alteration		8
6.7 Frequency of Riffles/Steps		18
6.8 Bank Stability	Left: 6 Right: 6	
6.9 Bank Vegetation Protection	Left: 7 Right: 8	
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 9	
Total Score		129
Habitat Rating		0.645
Habitat Stream Condition	Good	

Narrative:

Minor aggradation and widening, major planform change due to meander cut off and avulsion. Minor historic incision.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Gold Brook** Reach # **T6.06** Segment: **B** Completion Date: **June 21, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, PD** Why Not assessed: Rain: **No**
 Segment Length (ft): **1,555** Segment Location: **Continues for about 1555 feet upstream from Bryan Road.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Subreach**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	267	0
height	0	0
Roads	228	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	272	16
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	160
Width Determination	Estimated
Confinement Type	Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	24
2.2 Max Depth (ft)	1.70
2.3 Mean Depth (ft)	1.10
2.4 Floodprone Width (ft)	39

Notes:

North Hollow Road runs within left corridor. Upstream of segment there is a rock wall with a waterfall, possibly responsible for the high incision.

The valley confinement in this segment was

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.00 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	21.82
2.7 Entrenchment Ratio	1.60
2.8 Incision Ratio	1.76
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	55
2.12 Substrate Composition	
Bedrock	0%
Boulder	9%
Cobble	36%
Coarse Gravel	39%
Fine Gravel	12%
Sand	4%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	22
2.13 Average Largest Particle on	
Bed	14.0 inches
Bar	10.0 inches

2.14 Stream Type

Stream Type:	B
Bed Material:	Gravel
Subclass Slope:	a
Bed Form:	Step-Pool

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

B	4	a	Step-Pool
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3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
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Upper

Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Lower

Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	93	0
Erosion Height (ft)	3.00	0.00

Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	274	4

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous

Bank Canopy	Left	Right
Canopy %	76-100	76-100

Mid-Channel Canopy	Closed
--------------------	--------

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100

Sub-dominant	51-100	None
W less than 25	138	0

Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Mixed Trees

Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
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3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest

Sub-dominant	Residential	None
Mass Failures	0	0

Height	0	0
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Gullies	0
Length	0
Height	0.00

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	2	10
Diagonal	Delta	Island
1	1	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	No

5.4 Stream Ford or Animal

5.5 Straightening

Straightening Length: 0

5.5 Dredging

None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Gold Brook	Reach # T6.06	Segment: B	Completion Date: June 21, 2007
Organization: Bear Creek Environmental	Observers: CS, PD		Rain: No
Segment Length (ft): 1,555	Segment Location: Continues for about 1555 feet upstream from Bryan Road.		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	2.00	1.00	Yes	
Waterfall	Mid-segment	8.00	4.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	10.0	Yes	No	Yes	Yes
	Problem	Deposition Above,	Deposition Below,	Scour	
Old	5.00	Yes	No	Yes	Yes
	Problem	Deposition Above,	Deposition Below,	Scour	

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		8	None	Yes
7.2 Channel Aggradation		14	None	No
7.3 Widening Channel		12		No
7.4 Change in Planform		10		No
Total Score		44		
Geomorphic Rating		0.55		
Channel Evolution Model	F			
Channel Evolution Stage	II			
Geomorphic Condition	Fair			
Stream Sensitivity	High			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		15
6.2 Embeddedness		9
6.3 Velocity/Depth Patterns		16
6.4 Sediment Deposition		10
6.5 Channel Flow Status		13
6.6 Channel Alteration		15
6.7 Frequency of Riffles/Steps		18
6.8 Bank Stability	Left: 7 Right: 8	
6.9 Bank Vegetation Protection	Left: 6 Right: 8	
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 9	
Total Score		141
Habitat Rating		0.705
Habitat Stream Condition	Good	

Narrative:

Major historic incision, minor aggradation and widening, major planform change due to split flow in main channel and island development.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Gold Brook** Reach # **T6.07** Segment: **0** Completion Date: **June 27, 2007**
 Organization: **Bear Creek Environmental** Observers: **PD, MA** Why Not assessed: Rain: **No**
 Segment Length (ft): **2,627** Segment Location: **Reach begins just upstream of where valley becomes narrower 330 feet downstream of**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None		
1.2 Alluvial Fan	None		
1.3 Corridor Encroachments			
Length (ft)	One	Both	
Berms	51	0	
height	0	0	
Roads	1,662	0	
height	0	0	
Railroads	0	0	
height	0	0	
Improved Paths	0	0	
height	0	0	
Development	0	63	
1.4 Adjacent Side	Left	Right	
Hillside Slope	Very Steep	Hilly	
Continuous w/	Sometimes	Sometimes	
W/in 1 Bankfill	Sometimes	Sometimes	
Texture	Sand	Sand	

1.5 Valley Features

Valley Width (ft)	106
Width Determination	Measured
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	26
2.2 Max Depth (ft)	1.70
2.3 Mean Depth (ft)	1.06
2.4 Floodprone Width (ft)	30

Notes:

This reach has been impacted by significant channel straightening and alterations associated with old mill rock dam at downstream end of reach. There is a large pool just downstream of dam and the channel is bermed with a rock wall along the left bank.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.10 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	24.53
2.7 Entrenchment Ratio	1.15
2.8 Incision Ratio	2.41
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	80
2.12 Substrate Composition	
Bedrock	0%
Boulder	10%
Cobble	31%
Coarse Gravel	35%
Fine Gravel	16%
Sand	7%
Silt and smaller	1%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	26
2.13 Average Largest Particle on	
Bed	12.0 inches
Bar	10.0 inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	a
Bed Form:	Step-Pool

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	170	321
Erosion Height (ft)	4.27	8.51
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	211	73
Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	76-100	76-100
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	26-50	>100
Sub-dominant	>100	51-100
W less than 25	43	45
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Mixed Trees
Sub-dominant	None	None

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Residential	Forest
Sub-dominant	Forest	Residential
Mass Failures	79	0
Height	25	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Abundant
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	Small Run of
Flow Regulation Use	Other
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
3	1	27
Diagonal	Delta	Island
0	0	2

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
3	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,201
5.5 Dredging	None

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Gold Brook	Reach # T6.07	Segment: 0	Completion Date: June 27, 2007
Organization: Bear Creek Environmental	Observers: PD, MA		Rain: No
Segment Length (ft): 2,627	Segment Location: Reach begins just upstream of where valley becomes narrower 330 feet downstream		

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	6.00	5.00	Yes	
Ledge	Mid-segment	15.00	11.00	Yes	
Dam	Mid-segment	20.00	15.00	Yes	

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	20.5	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		
Bedrock	2.00	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		
Bedrock	11.0	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		
Culvert	11.0	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		5	B to F	Yes
7.2 Channel Aggradation		13	None	No
7.3 Widening Channel		12		No
7.4 Change in Planform		13		No
Total Score		43		
Geomorphic Rating		0.5375		
Channel Evolution Model	F			
Channel Evolution Stage	II			
Geomorphic Condition	Fair			
Stream Sensitivity	Extreme			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
6.1 Epifaunal Substrate - Available Cover		14
6.2 Embeddedness		9
6.3 Velocity/Depth Patterns		16
6.4 Sediment Deposition		10
6.5 Channel Flow Status		14
6.6 Channel Alteration		10
6.7 Frequency of Riffles/Steps		17
6.8 Bank Stability	Left: 8 Right: 7	
6.9 Bank Vegetation Protection	Left: 6 Right: 8	
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 8	
Total Score		132
Habitat Rating		0.66
Habitat Stream Condition	Good	

Narrative:

Extreme historic incision, minor aggradation, widening and planform adjustment due to flood chutes.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Moss Glen Brook** Reach # **T8.01** Segment: **A** Completion Date: **July 17, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **4,348** Segment Location: **Begins at the confluence of Moss Glen Brook and the Little River, continues for about 4348**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation Channel Dimensions

1.2 Alluvial Fan None

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	177
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Never	Never
W/in 1 Bankfill	Sometimes	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	560
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? No

Step 2. Stream Channel

2.1 Bankfull Width	29
2.2 Max Depth (ft)	2.90
2.3 Mean Depth (ft)	2.06
2.4 Floodprone Width (ft)	57

Notes:

Channel avulsion likely man-made from recent dredging. The banks were particularly high where we measured our cross sections. Valley wall on right side was not evident in the field. There is expansive farmland that has likely been flattened, no natural valley

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	13.83
2.7 Entrenchment Ratio	2.01
2.8 Incision Ratio	1.62
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	340
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	40%
Fine Gravel	38%
Sand	20%
Silt and smaller	2%

Silt/Clay Present? Yes

Detritus 5 %

Large Woody 47

2.13 Average Largest Particle on

Bed	6.0	inches
Bar	3.0	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,135	320
Erosion Height (ft)	4.50	3.66
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	134	803
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	26-50	26-50
Sub-dominant	0-25	0-25
W less than 25	1,145	637
Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Crop	Crop
Sub-dominant	Residential	Residential
Mass Failures	0	0
Height	0	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal		
4.2 Adjacent Wetlands	Minimal		
4.3 Flow Status	Moderate		
4.4 # of Debris Jams	0		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments			
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg			
4.7 StormwaterInputs			
Field Ditch	2	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	1		
Affected Length (ft)	30		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
7	11	13
Diagonal	Delta	Island
5	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	0	1	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
4	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening Length:	1,257
5.5 Dredging		Dredging

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Moss Glen Brook** Reach # **T8.01** Segment: **A** Completion Date: **July 17, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **4,348** Segment Location: **Begins at the confluence of Moss Glen Brook and the Little River, continues for about**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	26.0	Yes	No	Yes	Yes
Problem	Deposition Above,	Deposition Below,	Scour		
Bridge	50.0	Yes	No	No	Yes
Problem	Deposition Above				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	10	None	No
7.3 Widening Channel	14		No
7.4 Change in Planform	12		No

Total Score **45**

Geomorphic Rating **0.5625**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	9
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	8
6.5 Channel Flow Status	12
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 4

Total Score **109**

Habitat Rating **0.545**

Habitat Stream Condition **Fair**

Narrative:

Major historic degradation, major aggradation, minor widening, minor planform adjustment. This is in late stage II or early III.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Moss Glen Brook** Reach # **T8.01** Segment: **B** Completion Date: **July 19, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **951** Segment Location: **Contines upstream and ends about 950 feet past Pucker Street (Route 100).**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	29
1.4 Adjacent Side	Left	Right
Hillside Slope	Flat	Flat
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	450
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	47
2.2 Max Depth (ft)	2.10
2.3 Mean Depth (ft)	1.18
2.4 Floodprone Width (ft)	532

Notes:
 Segment runs through the middle of a cow pasture. No buffers, animals are free to enter the stream throughout the entire segment. Noticed water got extremely silty/cloudy in downstream segment when cows were out in the field. May be a good location for CREP

Passed Step 2. (Contued)

2.5 Aband. Floodpln	3.90 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	39.46
2.7 Entrenchment Ratio	11.43
2.8 Incision Ratio	1.86
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	250
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	9%
Coarse Gravel	53%
Fine Gravel	25%
Sand	8%
Silt and smaller	5%

Silt/Clay Present?	Yes
Detritus	1 %
# Large Woody	5

2.13 Average Largest Particle on

Bed	5.0	inches
Bar	3.5	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Clay	Sand
Consistency	Cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	224	443
Erosion Height (ft)	3.63	3.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	6	150
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Pasture
Sub-dominant	Pasture	None
Bank Canopy	Left	Right
Canopy %	0	0
Mid-Channel Canopy		Open

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	0-25	0-25
Sub-dominant	None	None
W less than 25	951	951
Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	None

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Bare	Pasture
Sub-dominant	Pasture	None
Mass Failures	68	0
Height	30	0
Gullies		0
Length		0
Height		0.00

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	5	1
Diagonal	Delta	Island
1	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening Length:	434
5.5 Dredging		Dredging

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

Project: Little River	Phase 2 Reach Summary	page 2 of 2	April 19, 2010
Stream: Moss Glen Brook	Reach # T8.01	Segment: B	Completion Date: July 19, 2007
Organization: Bear Creek Environmental	Observers: CS, MN		Rain: Yes
Segment Length (ft): 951	Segment Location: Continues upstream and ends about 950 feet past Pucker Street (Route 100).		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation	7	None	Yes
7.2 Channel Aggradation	11	None	No
7.3 Widening Channel	6		No
7.4 Change in Planform	11		No

Total Score **35**

Geomorphic Rating **0.4375**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High
----------------------	-------------

Score

6.1 Epifaunal Substrate - Available Cover	3
6.2 Embeddedness	17
6.3 Velocity/Depth Patterns	11
6.4 Sediment Deposition	7
6.5 Channel Flow Status	9
6.6 Channel Alteration	8
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 6 Right: 4
6.9 Bank Vegetation Protection	Left: 5 Right: 4
6.10 Riparian Vegetation Zone Width	Left: 0 Right: 0

Total Score **89**

Habitat Rating **0.445**

Habitat Stream Condition	Fair
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Narrative:

Major historic degradation, major widening, minor aggradation and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Moss Glen Brook** Reach # **T8.02** Segment: **A** Completion Date: **July 19, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **2,107** Segment Location: **Continues for about 2107 feet upstream.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Flat
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	500
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	50
2.2 Max Depth (ft)	1.90
2.3 Mean Depth (ft)	1.16
2.4 Floodprone Width (ft)	453

Notes:

Cross section used for this segment actually collected at upstream end of T8.01-B (see Reach T8.01 spreadsheet - Segment B XS 1). The cross section at the upper end of T8.01-B was representative of segment T8.02 -A. Channel evolution stage is late stage IV

Passed Step 2. (Contued)

2.5 Aband. Floodpln	1.90 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	43.10
2.7 Entrenchment Ratio	9.06
2.8 Incision Ratio	1.00
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Moderate
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	450
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	9%
Coarse Gravel	53%
Fine Gravel	25%
Sand	8%
Silt and smaller	5%

Silt/Clay Present? **Yes**

Detritus **5 %**

Large Woody **12**

2.13 Average Largest Particle on

Bed	5.0	inches
Bar	3.5	inches

2.14 Stream Type

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

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Clay	Sand
Consistency	Cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	355	757
Erosion Height (ft)	4.13	3.25
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	26-50	1-25
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	Left	Right
Dominant	>100	0-25
Sub-dominant	0-25	>100
W less than 25	256	1,090
Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Herbaceous
Sub-dominant	Herbaceous	Mixed Trees
3.3 Riparian Corridor		
Corridor Land	Left	Right
Dominant	Forest	Pasture
Sub-dominant	None	Forest
Mass Failures	31	0
Height	30	0
Gullies		0
Length		0
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
6	2	8
Diagonal	Delta	Island
2	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
1	1	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
2	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	1,157
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Moss Glen Brook** Reach # **T8.02** Segment: **A** Completion Date: **July 19, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN** Rain: **Yes**
 Segment Length (ft): **2,107** Segment Location: **Continues for about 2107 feet upstream.**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
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7.1 Channel Degradation		17	None	No
7.2 Channel Aggradation		9	None	No
7.3 Widening Channel		6		No
7.4 Change in Planform		9		No

Total Score **41**

Geomorphic Rating **0.5125**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type	High	Score
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6.1 Epifaunal Substrate - Available Cover	13
6.2 Embeddedness	15
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	9
6.5 Channel Flow Status	10
6.6 Channel Alteration	8
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 8 Right: 6
6.9 Bank Vegetation Protection	Left: 6 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 4

Total Score **116**

Habitat Rating **0.58**

Habitat Stream Condition **Fair**

Narrative:

Major aggradation, widening and planform adjustment. Segment is in late stage IV (has widened and is in process of aggrading and narrowing). There is evidence that the channel historically incised upstream and downstream of this segment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
 Stream: **Moss Glen Brook** Reach # **T8.02** Segment: **B** Completion Date: **July 19, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN, MA** Why Not assessed: Rain: **Yes**
 Segment Length (ft): **1,763** Segment Location: **Continues for about 1763 feet and ends where two tributaries enter from the south.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Channel Dimensions**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Flat
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Always	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft)	700
Width Determination	Estimated
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width	36
2.2 Max Depth (ft)	2.40
2.3 Mean Depth (ft)	1.64
2.4 Floodprone Width (ft)	41

Notes:

Stream type departure C4 to F4. Upstream end of segment transitions back to C4.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	6.70 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	21.65
2.7 Entrenchment Ratio	1.15
2.8 Incision Ratio	2.79
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Complete
2.11 Riffle/Step Spacing (ft)	355
2.12 Substrate Composition	
Bedrock	0%
Boulder	6%
Cobble	17%
Coarse Gravel	52%
Fine Gravel	20%
Sand	5%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	2 %
# Large Woody	3
2.13 Average Largest Particle on	
Bed	9.0 inches
Bar	6.0 inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type

(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	594	594
Erosion Height (ft)	3.51	4.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Deciduous
Sub-dominant	Deciduous	Herbaceous
Bank Canopy	Left	Right
Canopy %	76-100	76-100
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	26-50
Sub-dominant	None	None
W less than 25	0	0
Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Crop
Sub-dominant	None	None
Mass Failures	43	0
Height	20	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	1	5
Diagonal	Delta	Island
3	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
6	0	Yes

5.4 Stream Ford or Animal

5.5 Straightening **Straightening**

Straightening Length: **1,746**

5.5 Dredging **None**

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Moss Glen Brook** Reach # **T8.02** Segment: **B** Completion Date: **July 19, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MN, MA** Rain: **Yes**
 Segment Length (ft): **1,763** Segment Location: **Continues for about 1763 feet and ends where two tributaries enter from the south.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	0.00	0.00	Yes	

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined		
	Score	STD	Historic
7.1 Channel Degradation	4	C to F	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	11		No
7.4 Change in Planform	13		No
Total Score	42		
Geomorphic Rating	0.525		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Extreme		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	8
6.2 Embeddedness	14
6.3 Velocity/Depth Patterns	12
6.4 Sediment Deposition	12
6.5 Channel Flow Status	9
6.6 Channel Alteration	1
6.7 Frequency of Riffles/Steps	13
6.8 Bank Stability	Left: 5 Right: 5
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 2
Total Score	109
Habitat Rating	0.545
Habitat Stream Condition	Fair

Narrative:

Extreme historic degradation, minor widening, aggradation, and planform adjustment.

Project: **Little River** Phase 2 Segment Summary page 1 of 2 April 19, 2010 SGAT Version: 4.56
Stream: **Moss Glen Brook** Reach # **T8.03** Segment: **0** Completion Date: **August 10, 2007**
Organization: **Bear Creek Environmental** Observers: **CS, MA** Why Not assessed: Rain: **Yes**
Segment Length (ft): **1,495** Segment Location: **Continues for about a quarter mile to a tributary entering from the east.**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

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

1.5 Valley Features

Valley Width (ft)	575
Width Determination	Measured
Confinement Type	Very Broad
Rock Gorge?	No

Human-caused Change? **yes**

Step 2. Stream Channel

2.1 Bankfull Width	40
2.2 Max Depth (ft)	1.90
2.3 Mean Depth (ft)	1.51
2.4 Floodprone Width (ft)	50

Notes:
Reach runs along field, buffer is lacking along portions of right bank. Becomes fairly wooded upstream of this segment.

Passed Step 2. (Contued)

2.5 Aband. Floodpln	4.50 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	26.16
2.7 Entrenchment Ratio	1.26
2.8 Incision Ratio	2.37
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Sedimented
2.11 Riffle/Step Spacing (ft)	238
2.12 Substrate Composition	
Bedrock	1%
Boulder	8%
Cobble	32%
Coarse Gravel	45%
Fine Gravel	9%
Sand	5%
Silt and smaller	0%

Silt/Clay Present?	No
Detritus	4 %
# Large Woody	16
2.13 Average Largest Particle on	
Bed	12.0 inches
Bar	7.0 inches

2.14 Stream Type

Stream Type:	F
Bed Material:	Gravel
Subclass Slope:	None
Bed Form:	Riffle-Pool

Field Measured Slope:

2.15 Reference Stream Type
(if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	Left	Right
Upper		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive
Lower		
Material Type	Gravel	Gravel
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	410	906
Erosion Height (ft)	3.32	3.88
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous	Deciduous
Bank Canopy	Left	Right
Canopy %	76-100	76-100
Mid-Channel Canopy	Closed	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	26-50
Sub-dominant	None	0-25
W less than 25	0	491
Buffer Veg. Type	Left	Right
Dominant	Mixed Trees	Deciduous
Sub-dominant	Shrubs/Saplin	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Crop
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies	0	
Length	0	
Height	0.00	

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal
4.2 Adjacent Wetlands	None
4.3 Flow Status	Moderate
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	
Impoundmt. Location	
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	3	5
Diagonal	Delta	Island
3	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
2	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
5	0	No

5.4 Stream Ford or Animal

5.5 Straightening	Straightening
Straightening Length:	966
5.5 Dredging	None

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

Project: **Little River** Phase 2 Reach Summary page 2 of 2 April 19, 2010
 Stream: **Moss Glen Brook** Reach # **T8.03** Segment: **0** Completion Date: **August 10, 2007**
 Organization: **Bear Creek Environmental** Observers: **CS, MA** Rain: **Yes**
 Segment Length (ft): **1,495** Segment Location: **Continues for about a quarter mile to a tributary entering from the east.**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Mid-segment	1.00	1.00	Yes	

4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
Unconfined			
7.1 Channel Degradation	5	C to F	Yes
7.2 Channel Aggradation	9	None	No
7.3 Widening Channel	8		No
7.4 Change in Planform	11		No
Total Score	33		
Geomorphic Rating	0.4125		
Channel Evolution Model	F		
Channel Evolution Stage	III		
Geomorphic Condition	Fair		
Stream Sensitivity	Extreme		

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	15
6.2 Embeddedness	15
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	13
6.5 Channel Flow Status	10
6.6 Channel Alteration	7
6.7 Frequency of Riffles/Steps	17
6.8 Bank Stability	Left: 7 Right: 6
6.9 Bank Vegetation Protection	Left: 9 Right: 9
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 2
Total Score	136
Habitat Rating	0.68
Habitat Stream Condition	Good

Narrative:

Extreme historic degradation. Major aggradation and widening, minor planform adjustment



Stream Geomorphic Assessment

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Phase 2 - Stream Geometry Data

Little River

		Phase 2 Stream Type					Phase 1 Data			Phase 2 Channel Data													
Reach	Seg- ment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel Width	Bankfull Width	Max Depth	Mean Depth	Floodpr Width	Recnt Abandn Fldpln	Width Depth Ratio	Entrench- ment Ratio	Incision Ratio	Channel Evolution Stage	Channel Evolution Model	Geo Assess Condition	Hab Assess Condition	QC Staff	QC Auto	
M06	A	C	Sand	Dune-Ripple	None	No	0.24							0.00	0.00	0.00			Fair		P	F	
M06	B	C	Gravel	Riffle-Pool	None	No	0.24		133	3.8	3.21	393	7.4	41.43	2.95	1.95	III	F	Fair	Fair	P	P	
M07	0	C	Gravel	Riffle-Pool	None	No	0.06		111	4.8	2.87	265.5	10	38.68	2.39	2.08	IV	F	Fair	Fair	P	P	
M08	0	F	Gravel	Riffle-Pool	None	No	0.04		92	4.55	3.74	113.2	8.85	24.60	1.23	1.95	III	F	Fair	Fair	P	P	
M09	0	C	Gravel	Riffle-Pool	None	No	0.33		84	4.6	3.63	275	9.1	23.14	3.27	1.98	III	F	Fair	Fair	P	P	
M10	0	B	Gravel	Riffle-Pool	c	No	0.76		99.5	4.3	3.21	137.5	9.7	31.00	1.38	2.26	III	F	Fair	Fair	P	P	
M11	0	C	Gravel	Riffle-Pool	None	No	0.07		105.5	3.55	2.75	509.3	4.55	38.36	4.83	1.28	III	F	Fair	Fair	P	P	
M12	A	C	Gravel	Plane Bed	None	No	0.19		68.5	4.85	3.77	747	7.15	18.17	10.91	1.47	III	F	Fair	Fair	P	P	
M12	B	C	Gravel	Riffle-Pool	None	No	0.19		97.75	4.3	3.56	1253	5.6	27.46	12.82	1.30	III	F	Fair	Fair	P	P	
T6.01	0	C	Gravel	Riffle-Pool	None	No	1.97		38.2	2.6	1.6	224	4.6	23.88	5.86	1.77	III	F	Fair	Fair	P	P	
T6.02	0	B	Gravel	Step-Pool	None	No	3.52	45	42.5	2.7	1.72	56.4	2.7	24.71	1.33	1.00	IIb	D	Good	Good	P	P	
T6.03	A	B	Cobble	Step-Pool	None	No	2.36		33.3	2.5	1.43	63.1	2.5	23.29	1.89	1.00	I	F	Good	Good	P	P	
T6.03	B	F	Gravel	Step-Pool	b	No	2.36		32.5	2.7	1.55	41.5	7.7	20.97	1.28	2.85	II	F	Fair	Fair	P	P	
T6.03	C	C	Gravel	Riffle-Pool	b	Yes	2.36		45	2	1.54	125	2.4	29.22	2.78	1.20	IIId	D	Fair	Good	P	P	
T6.03	D	B	Gravel	Step-Pool	None	No	2.36		37	2.5	1.66	55.5	2.5	22.29	1.50	1.00	I	F	Good	Good	P	P	
T6.04	0	C	Gravel	Riffle-Pool	b	No	2.16		28.5	3	2.06	166	4.3	13.83	5.82	1.43	III	F	Fair	Good	P	P	
T6.05	0	C	Gravel	Riffle-Pool	b	No	2.11		26	2.3	1.91	148	3.2	13.61	5.69	1.39	III	F	Fair	Good	P	P	
T6.06	A	C	Cobble	Riffle-Pool	b	No	4.09		26	2.2	1.65	89	3	15.76	3.42	1.36	III	F	Fair	Good	P	P	
T6.06	B	B	Gravel	Step-Pool	a	Yes	4.09		24	1.7	1.1	38.5	3	21.82	1.60	1.76	II	F	Fair	Good	P	P	
T6.07	0	F	Gravel	Step-Pool	a	No	6.66		26	1.7	1.06	30	4.1	24.53	1.15	2.41	II	F	Fair	Good	P	P	
M13	0	B	Sand	Riffle-Pool	c	No	0.42		81.5	4.55	3.52	168.5	6.85	23.15	2.07	1.51	III	F	Fair	Fair	P	P	
M14	A	C	Gravel	Riffle-Pool	None	No	0.26		81	5.2	3.71	176.7	8.4	21.83	2.18	1.62	III	F	Fair	Fair	P	P	
M14	B	C	Gravel	Plane Bed	None	No	0.26		66.5	5.3	3.96	583	7.8	16.79	8.77	1.47	II	F	Fair	Fair	P	P	
M14	C	C	Gravel	Riffle-Pool	None	No	0.26		81	4.9	3.48	464.5	8.4	23.28	5.73	1.71	III	F	Fair	Fair	P	P	
M14	D	B	Gravel	Riffle-Pool	c	No	0.26		70.5	4.6	3.17	102.5	8.6	22.24	1.45	1.87	II	F	Fair	Fair	P	P	
M15	A	B	Gravel	Riffle-Pool	c	No	0.92		70.5	4.6	3.17	102.5	8.6	22.24	1.45	1.87	II	F	Fair	Fair	P	P	



Stream Geomorphic Assessment

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Reach	Segment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel Width	Bankfull Width	Max Depth	Mean Depth	Floodpr Width	Recnt Abandn Fldpln	Width Depth Ratio	Entrenchment Ratio	Incision Ratio	Channel Evolution Stage	Channel Evolution Model	Geo Assess Condition	Hab Assess Condition	QC Staff	QC Auto
M15	B	F	Bedrock	Bedrock	None	Yes	0.92							0.00	0.00	0.00			Reference		P	F
M15	C	F	Cobble	Plane Bed	None	Yes	0.92		58.5	4.8	3.22	71	4.8	18.17	1.21	1.00	I	F	Good	Fair	P	P
M15	D	C	Gravel	Riffle-Pool	None	Yes	0.92		83	4.45	3.31	236	6.45	25.08	2.84	1.45	III	F	Fair	Fair	P	P
M16	A	C	Sand	Riffle-Pool	None	No	0.17		59	3.9	2.62	914.4	5.1	22.52	15.50	1.31	III	F	Fair	Fair	P	P
M16	B	E	Gravel	Riffle-Pool	None	No	0.17		36	5.3	4.15	413	7.4	8.67	11.47	1.40				Fair	P	F
M16	C	C	Gravel	Riffle-Pool	None	No	0.17		42	4.7	3.64	1000	7.2	11.54	23.81	1.53	III	F	Fair	Fair	P	P
M17	O	C	Gravel	Riffle-Pool	None	No	0.19		57	4.1	2.65	552.8	6.7	21.51	9.70	1.63	III	F	Fair	Good	P	P
M18	A	C	Gravel	Riffle-Pool	None	No	0.09		44	4.5	3.68	769	6.7	11.96	17.48	1.49	III	F	Fair	Fair	P	P
M18	B	C	Gravel	Riffle-Pool	None	No	0.09		40	4.2	3.5	682	7.3	11.43	17.05	1.74	III	F	Fair	Fair	P	P
M18	C	C	Gravel	Riffle-Pool	None	No	0.09		44	4.5	3.68	769	6.7	11.96	17.48	1.49	III	F	Fair	Fair	P	P
T8.01	A	C	Gravel	Riffle-Pool	None	No	0.57	28.5	28.5	2.9	2.06	57.2	4.7	13.83	2.01	1.62	III	F	Fair	Fair	P	P
T8.01	B	C	Gravel	Riffle-Pool	None	No	0.57	28.5	46.56	2.1	1.18	532	3.9	39.46	11.43	1.86	IV	F	Fair	Fair	P	P
T8.02	A	C	Gravel	Riffle-Pool	None	No	0.65		50	1.9	1.16	453	1.9	43.10	9.06	1.00	IV	F	Fair	Fair	P	P
T8.02	B	F	Gravel	Riffle-Pool	None	No	0.65		35.5	2.4	1.64	41	6.7	21.65	1.15	2.79	III	F	Fair	Fair	P	P
T8.03	O	F	Gravel	Riffle-Pool	None	No	1.14		39.5	1.9	1.51	49.9	4.5	26.16	1.26	2.37	III	F	Fair	Good	P	P
M19	A	C	Gravel	Riffle-Pool	None	No	0.39		46	3.2	2.03	1727	5.4	22.66	37.54	1.69	III	F	Fair	Fair	P	P
M19	B	C	Gravel	Riffle-Pool	None	No	0.39		51	3.4	2.53	505	5	20.16	9.90	1.47	III	F	Fair	Fair	P	P
M20	O	C	Gravel	Riffle-Pool	None	No	0.85	34	34	3.7	3.13	648	3.7	10.86	19.06	1.00	IIC	D	Fair	Good	P	P
M21	A	C	Gravel	Riffle-Pool	None	No	1.74		41	2.8	1.97	351	2.8	20.81	8.56	1.00	IIC	D	Fair	Good	P	P
M21	B	B	Bedrock	Bedrock	None	No	1.74							0.00	0.00	0.00			Reference		P	F
T4.01	O	C	Gravel	Riffle-Pool	None	No	0.51		63	2.7	1.25	144.7	4.1	50.40	2.30	1.52	III	F	Fair	Good	P	P
T4.02	O	F	Gravel	Riffle-Pool	None	No	1.22		53	2.4	1.74	63.4	4.8	30.46	1.20	2.00	III	F	Fair	Fair	P	P
T4.03	A	C	Cobble	Riffle-Pool	b	No	2.45		40.5	2.7	1.85	92.8	3.7	21.89	2.29	1.37	III	F	Fair	Fair	P	P
T4.03	B	C	Cobble	Riffle-Pool	b	No	2.45		37	3.05	1.9	95.2	5.8	19.47	2.57	1.90	III	F	Fair	Good	P	P
T4.04	O	C	Gravel	Riffle-Pool	b	No	2.55		34.5	2.1	1.47	99.2	3.9	23.47	2.88	1.86	III	F	Fair	Good	P	P
T4.05	O	B	Cobble	Riffle-Pool	c	No	1.71		29	1.8	1.13	38.5	3.6	25.66	1.33	2.00	II	F	Fair	Good	P	P



Stream Geomorphic Assessment

Agency of Natural Resources

VT DEC
Vermont.gov
June. 28 2010

Phase 2 - Rapid Geomorphic Assessment

Little River

Reach	Seg- ment	Sub Rch?	Degradation			Aggradation			Widening		Planform		Geo Score	Geo Condition	Evol. Stage	Confin. Type	Sensitivity	QC Staff	QC Auto
			Score	STD	Historic	Score	STD	Historic	Score	Historic	Score	Historic							
M06	A	No											0.00	Fair		BD		P	F
M06	B	No	8	None	Yes	8	None	No	6	No	13	No	0.44	Fair	III	VB	Very High	P	P
M07	O	No	5	None	Yes	9	None	No	7	No	10	No	0.39	Fair	IV	BD	Very High	P	P
M08	O	No	5	C to F	Yes	11	None	No	9	No	11	No	0.45	Fair	III	NW	Extreme	P	P
M09	O	No	5	None	Yes	10	None	No	9	No	11	No	0.44	Fair	III	BD	Very High	P	P
M10	O	No	5	C to B	Yes	9	None	No	11	No	14	No	0.49	Fair	III	BD	Very High	P	P
M11	O	No	13	None	Yes	9	None	No	8	No	13	No	0.54	Fair	III	NW	Very High	P	P
M12	A	No	9	None	Yes	12	None	No	12	No	11	No	0.55	Fair	III	BD	Very High	P	P
M12	B	No	12	None	Yes	11	None	No	12	No	11	No	0.58	Fair	III	VB	Very High	P	P
M13	O	No	9	None	Yes	12	None	No	9	No	9	No	0.49	Fair	III	SC	Very High	P	P
M14	A	No	9	None	Yes	12	None	No	13	No	9	No	0.54	Fair	III	NW	Very High	P	P
M14	B	No	10	None	Yes	12	None	No	13	No	12	No	0.59	Fair	II	BD	Very High	P	P
M14	C	No	8	None	Yes	8	None	No	10	No	6	No	0.40	Fair	III	BD	Very High	P	P
M14	D	No	5	C to B	Yes	12	None	No	14	No	11	No	0.53	Fair	II	NW	Very High	P	P
M15	A	No	7	None	Yes	11	None	No	13	No	11	No	0.53	Fair	II	SC	Very High	P	P
M15	B	Yes											0.00	Reference		NC		P	F
M15	C	Yes	16	None	No	16	None	No	13	Yes	16	No	0.76	Good	I	NC	High	P	P
M15	D	Yes	9	None	Yes	13	None	No	13	No	14	No	0.61	Fair	III	NW	Very High	P	P
M16	A	No	13	None	Yes	9	None	No	9	No	7	No	0.48	Fair	III	VB	Very High	P	P
M16	B	No											0.00			VB		P	F
M16	C	No	9	None	Yes	9	None	No	12	No	7	No	0.46	Fair	III	VB	Very High	P	P
M17	O	No	8	None	Yes	9	None	No	11	No	7	No	0.44	Fair	III	VB	Very High	P	P
M18	A	No	9	None	Yes	8	None	No	14	No	6	No	0.46	Fair	III	VB	Very High	P	P
M18	B	No	8	None	Yes	13	None	No	12	No	13	No	0.58	Fair	III	VB	Very High	P	P
M18	C	No	9	None	Yes	10	None	No	8	No	3	No	0.38	Fair	III	VB	Very High	P	P
M19	A	No	8	None	Yes	10	None	No	9	No	8	No	0.44	Fair	III	VB	Very High	P	P
M19	B	No	9	None	Yes	8	None	No	11	No	7	No	0.44	Fair	III	VB	Very High	P	P



Stream Geomorphic Assessment

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June. 28 2010

Reach	Segment	Sub Rch?	Score	STD	Historic	Score	STD	Historic	Score	Historic	Score	Historic	Geo Score	Geo Condition	Evol. Stage	Confin. Type	Sensitivity	QC Staff	QC Auto
M20	0	No	16	None	Yes	9	None	No	14	No	9	No	0.60	Fair	IIc	VB	Very High	P	P
M21	A	No	16	None	No	9	None	No	12	No	9	No	0.58	Fair	IIc	VB	Very High	P	P
M21	B	No											0.00	Reference		SC		P	F
T4.01	0	No	10	None	Yes	8	None	No	5	Yes	10	No	0.41	Fair	III	VB	Very High	P	P
T4.02	0	No	5	C to F	Yes	8	None	No	11	No	6	No	0.38	Fair	III	VB	Extreme	P	P
T4.03	A	No	11	None	Yes	7	None	No	12	No	10	No	0.50	Fair	III	BD	High	P	P
T4.03	B	No	7	None	Yes	9	None	No	14	No	12	No	0.53	Fair	III	NW	High	P	P
T4.04	0	No	8	None	Yes	11	None	No	12	No	8	No	0.49	Fair	III	BD	Very High	P	P
T4.05	0	No	5	C to B	Yes	15	None	No	13	No	12	No	0.56	Fair	II	BD	Very High	P	P
T6.01	0	No	8	None	Yes	12	None	No	12	No	9	No	0.51	Fair	III	VB	Very High	P	P
T6.02	0	No	18	None	No	10	None	No	13	No	14	No	0.69	Good	IIb	SC	Moderate	P	P
T6.03	A	No	16	None	No	18	None	No	14	No	16	No	0.80	Good	I	SC	Moderate	P	P
T6.03	B	No	3	B to F	Yes	14	None	No	13	No	12	No	0.53	Fair	II	NC	Extreme	P	P
T6.03	C	Yes	15	None	Yes	5	None	No	11	No	11	No	0.53	Fair	IId	BD	Very High	P	P
T6.03	D	No	17	None	No	16	None	No	13	No	16	No	0.78	Good	I	SC	Moderate	P	P
T6.04	0	No	9	None	Yes	14	None	No	14	No	12	No	0.61	Fair	III	VB	Very High	P	P
T6.05	0	No	11	None	Yes	12	None	No	12	No	12	No	0.59	Fair	III	VB	Very High	P	P
T6.06	A	No	12	None	No	12	None	No	12	No	7	No	0.54	Fair	III	VB	High	P	P
T6.06	B	Yes	8	None	Yes	14	None	No	12	No	10	No	0.55	Fair	II	BD	High	P	P
T6.07	0	No	5	B to F	Yes	13	None	No	12	No	13	No	0.54	Fair	II	NW	Extreme	P	P
T8.01	A	No	9	None	Yes	10	None	No	14	No	12	No	0.56	Fair	III	VB	Very High	P	P
T8.01	B	No	7	None	Yes	11	None	No	6	No	11	No	0.44	Fair	IV	VB	Very High	P	P
T8.02	A	No	17	None	No	9	None	No	6	No	9	No	0.51	Fair	IV	VB	Very High	P	P
T8.02	B	No	4	C to F	Yes	14	None	No	11	No	13	No	0.53	Fair	III	VB	Extreme	P	P
T8.03	0	No	5	C to F	Yes	9	None	No	8	No	11	No	0.41	Fair	III	VB	Extreme	P	P

APPENDIX B

PROBLEM STRUCTURES

Legend

Stream Crossing

■ Bridge

● Culvert

⊕ Town Boundary

⚡ Roads

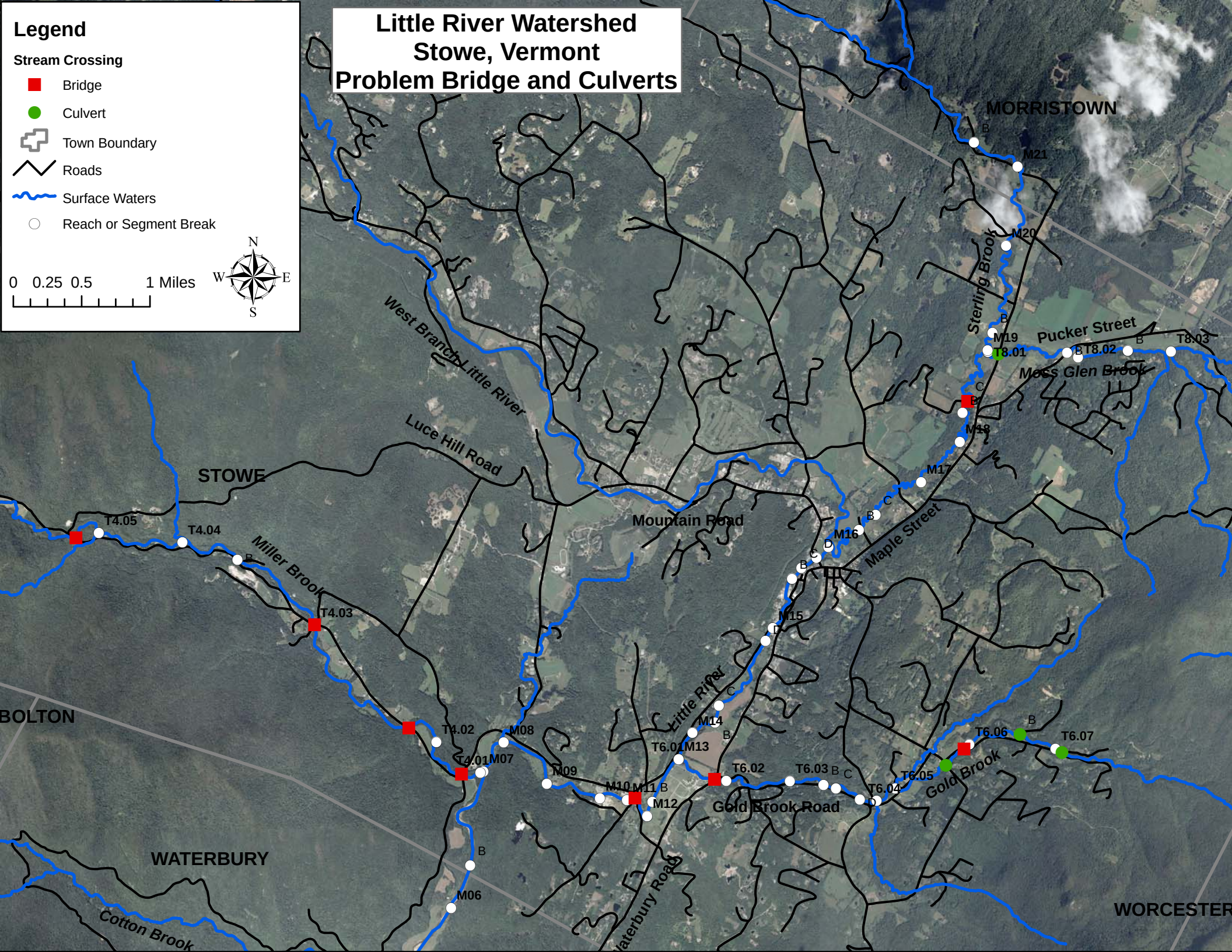
🌊 Surface Waters

○ Reach or Segment Break

0 0.25 0.5 1 Miles



Little River Watershed
Stowe, Vermont
Problem Bridge and Culverts



**Little River Mainstem
Moscow Road
Reach M11**

Road Width: 34 feet
Bridge Clearance: 30 feet
Bridge Span: 94



Inlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width – Undersized (89%)

Slope – Not applicable to bridges

Approach Angle – Sharp bend

Erosion and Armoring – None

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Additional problems noted: scour above, scour below

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Little River Mainstem
Little River Farm Road
Reach MI8-B**

Road Width: 20 feet
Bridge Clearance: 10 feet
Bridge Span: 26



Inlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width – Undersized (65%)

Slope – Not applicable to bridges

Approach Angle – Sharp bend

Erosion and Armoring – None

Sediment Continuity - No sediment deposits greater than 1/2 bankfull channel width

Notes: Scour above structure; riprap within structure is acting as a channel constriction

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Miller Brook
Moscow Road
Reach T4.01**

Road Width: 34 feet

Bridge Clearance: 30 feet

Bridge Span: 35



Inlet



Outlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width – Undersized (56%)

Slope – Not applicable to bridges

Approach Angle – Mild bend

Erosion and Armoring – Low bank erosion upstream; upstream hard armoring intact

Sediment Continuity – Elevation of sediment deposits greater than ½ bankfull width both upstream and downstream

Notes: scour above and below structure

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Miller Brook
Nebraska Valley Road
Reach T4.02**

Road Width: 27 feet

Bridge Clearance: 30 feet

Bridge Span: 42



Inlet



Outlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width – Undersized (79%)

Slope – Not applicable to bridges

Approach Angle – Sharp bend

Erosion and Armoring – None

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above, scour above and below structure; bridge appears to be in poor condition; bedrock present above, within and below structure (may be a good location for bridge due to bedrock control)

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Miller Brook
Nebraska Valley Road
Reach T4.03-A**

Road Width: 26 feet
Bridge Clearance: 7 feet
Bridge Span: 36



Inlet



Outlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width – Undersized (88%)

Slope – Not applicable to bridges

Approach Angle – Sharp bend

Erosion and Armoring – Upstream hard bank armoring intact

Sediment Continuity – Elevation of upstream sediment deposits greater than ½ bankfull width

Notes: Deposition above and below structure, scour above; low clearance

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Miller Brook
Nebraska Valley Road
Reach T4.05**

Road Width: 20 feet
Bridge Clearance: 7 feet
Bridge Span: 13.4



Inlet



Outlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width – Significantly Undersized (46%)

Slope – Not applicable to bridges

Approach Angle – Mild bend

Erosion and Armoring – Upstream hard bank armoring intact

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition below and above; steep riffle immediately upstream of structure; low clearance

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Gold Brook
Waterbury Road
Reach T6.01**

Road Width: 38 feet

Bridge Clearance: 18 feet

Bridge Span: 32



Inlet



Outlet

Geomorphic Compatibility – Partially Compatible

Percent Bankfull Width –Undersized (91%)

Slope – Not applicable to bridges

Approach Angle – Channelized straight

Erosion and Armoring – Upstream and downstream hard bank armoring failing

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition below; top of structure is deteriorating

Aquatic Organism Passage – Not applicable

Priority for Replacement - Moderate

**Gold Brook
Upper Hollow Road
Reach T6.05**

Culvert Length: 38 feet
Culvert Height: 10 feet
Culvert Width: 17



Inlet



Outlet – invert is freefall

Geomorphic Compatibility – Fully Compatible

Percent Bankfull Width – Undersized (65%)

Slope – Culvert slope as compared to channel slope is the same

Approach Angle – Naturally straight

Erosion and Armoring – None

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Outlet invert is freefall and outlet drop is 0.5 feet; Deposition above and below; scour below structure.

Aquatic Organism Passage – No aquatic organism passage except for adult salmonids

Priority for Replacement - High

**Gold Brook
North Hollow Road
Reach T6.05**

Road Width: 20 feet
Bridge Clearance: 7 feet
Bridge Span: 18



Inlet

Geomorphic Compatibility – Mostly Incompatible

Percent Bankfull Width –Undersized (69%)

Slope – Not applicable to bridges

Approach Angle – Sharp bend

Erosion and Armoring – Upstream and downstream armoring intact; stream bed scour causing undermining around or under downstream footers

Sediment Continuity – Elevation of upstream and downstream sediment deposits greater than 1/2 bankfull channel width

Notes: Downstream scour

Aquatic Organism Passage – Not applicable to bridges

Priority for Replacement - Moderate

**Gold Brook
Bryan Road
Reach T6.06-A**

Culvert Length: 50 feet
Culvert Height: 7 feet
Culvert Width: 9.5



Inlet

Geomorphic Compatibility – Mostly Compatible

Percent Bankfull Width – Significantly Undersized (37%)

Slope – Culvert slope compared to the channel slope is the same

Approach Angle – Mild bend

Erosion and Armoring – Upstream armoring is intact

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Structure undersized; scour below (pool immediately below structure); steep riffle upstream of structure

Aquatic Organism Passage – Sediment not throughout structure - Reduced

Priority for Replacement - Moderate

**Gold Brook
North Hollow Road
Reach T6.07**

Culvert Length: 50 feet
Culvert Height: 8 feet
Culvert Width: 11



Inlet



Outlet - Cascade

Geomorphic Compatibility – Mostly Compatible

Percent Bankfull Width – Significantly Undersized (42%)

Slope – Culvert slope compared to the channel slope is the same

Approach Angle – Mild bend

Erosion and Armoring – Upstream and downstream armoring is intact

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above and below; structure undersized; scour below (pool immediately below structure); outlet drop may be a fish passage issue

Aquatic Organism Passage – Sediment not throughout structure - Reduced

Priority for Replacement - Moderate

Little River Watershed Stream Crossing Assessments
Data collection by Bear Creek Environmental, LLC and J Schwartz
Stowe, Vermont
April 19, 2010

**Moss Glen Brook
Stage Coach Road
Reach T8.01-A**

Culvert Length: 65 feet

Culvert Height (left): 6 feet Culvert Height (right): 6 feet

Culvert Width (left): 7 feet Culvert Width (right): 7 feet



Inlet



Outlet – at grade

Geomorphic Compatibility – Mostly Incompatible

Percent Bankfull Width –Undersized (56%)

Slope – Culvert slope compared to the channel slope is the same

Approach Angle – Sharp bend

Erosion and Armoring – None

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above and below; structure undersized; scour below (pool immediately below structure)

Aquatic Organism Passage – Sediment not throughout structure - Reduced

Priority for Replacement - High