Centerville Brook Corridor Plan

Hyde Park, Vermont
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1.0 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 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 Centerville Brook watershed in the Town of Hyde Park. 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 Centerville Brook by LCPC during spring 2006, and a Phase 2 Stream Geomorphic Assessment following Agency of Natural Resources Protocols was completed for Centerville Brook by Bear Creek Environmental, LLC during summer 2006. Bridge and culvert data collected by LCPC during spring 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.

As the river works toward a more stable equilibrium, the community of Hyde Park 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 15 potential restoration and conservation projects was developed during project identification and is provided in Table 9 on pages 58 to 61 of this report. Types of projects include: river corridor protection through corridor easements and conservation efforts, replacing undersized structures causing localized channel instability, improving riparian buffers, and arresting a small headcut.

2.0 LOCAL PLANNING PROGRAM OVERVIEW

2.1 RIVER CORRIDOR PLANNING TEAM

The river corridor planning team for the Centerville 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. Staci Pomeroy 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 1 and 2 Stream Geomorphic Assessment data to identify and prioritize river corridor protection and restoration projects within the Centerville Brook 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 Centerville 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 Centerville Brook has a watershed size of 9.22 square miles just above the confluence of the Lamoille River in the Town of Hyde Park, Vermont (Figure 1). The

Phase 2 study focused on stream reaches on the main stem of the Centerville Brook. The combined length of the stream reaches assessed is approximately 5.6 miles. The Centerville Brook drains from its headwaters near McKinistry Hill through forest, pasture, and residential lands of the area known as Centerville. It flows south and joins the Lamoille River at approximately 534 feet above sea level, which then drains westerly into Lake Champlain.

3.1.2 Political Jurisdictions

Project reaches for the Centerville Brook are located in Lamoille County, Vermont almost entirely within the Town of Hyde Park. The Centerville watershed falls under the jurisdiction of the Lamoille County Planning Commission.

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 Centerville watershed. The majority of the Centerville Watershed is forested; however agricultural land uses are also prevalent (Figure 2). The landuse breakdown for the watershed is 44 percent forest, 20 percent crop, 14 percent field, 11 percent residential, 5 percent water and 6 percent other.

3.2 Geologic Setting

The Centerville 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 Centerville Brook watershed includes that of the Stowe Formation at its upper end, the Ottauquechee Formation near its mid-section, and the Hazens Notch Formation at its lower end. The Stowe Formation is comprised of quartz and chlorite phyllite and schist with abundant segregations of granular white quartz. The Ottauquechee Formation is a black carbonaceous phyllite or schist containing interbeds of massive dark gray to white quartzites and white quartz. The Hazens Notch unit is comprised of carbonaceous and noncarbonaceous quartz schist that grades to quartzite and geniss (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 Lamoille River Valley. As the climate warmed, the glacier slowly retreated and glacial lakes were dammed in the Lamoille River valley. Following the retreat of the ice sheet, the Lamoille River and its tributaries began eroding the glacial and lake sediments that were left behind (Wright, 2003).

The dominant surficial geology of the Centerville River watershed consists of glacial till, glacial lake deposits, and recent aluvium (Doll, 1970). The reaches studied in the Phase 2 geomorphic assessment have recent alluvium and glaciolacustrine well sorted sandy deposits as their dominant geology. Alluvial soils are frequently flooded, however are only slightly to moderately erodible from overland flow; but may be more susceptible to stream bank erosion processes. Glacial lake deposits are rarely flooded and have very severe erodibility.

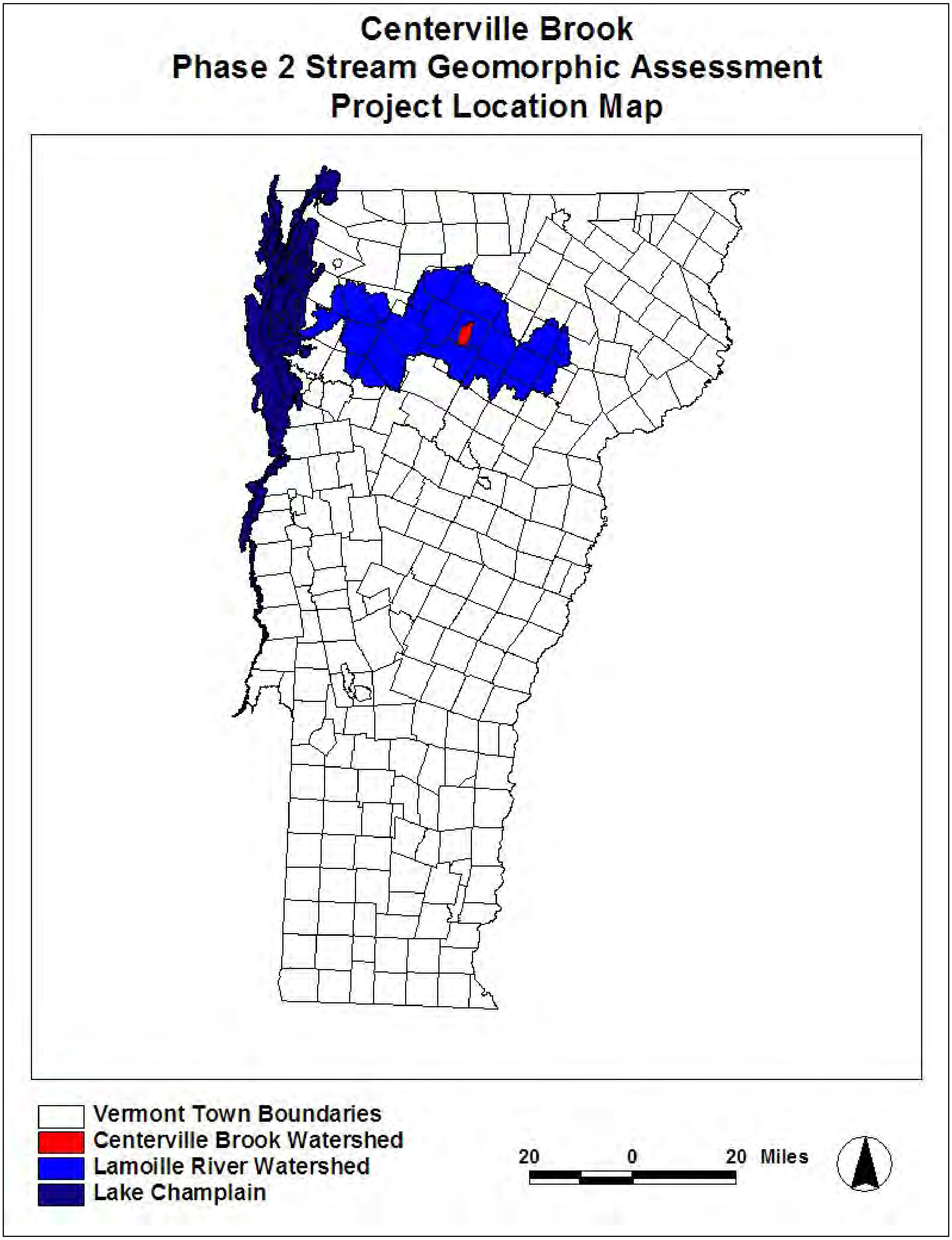


Figure 1: Project location map

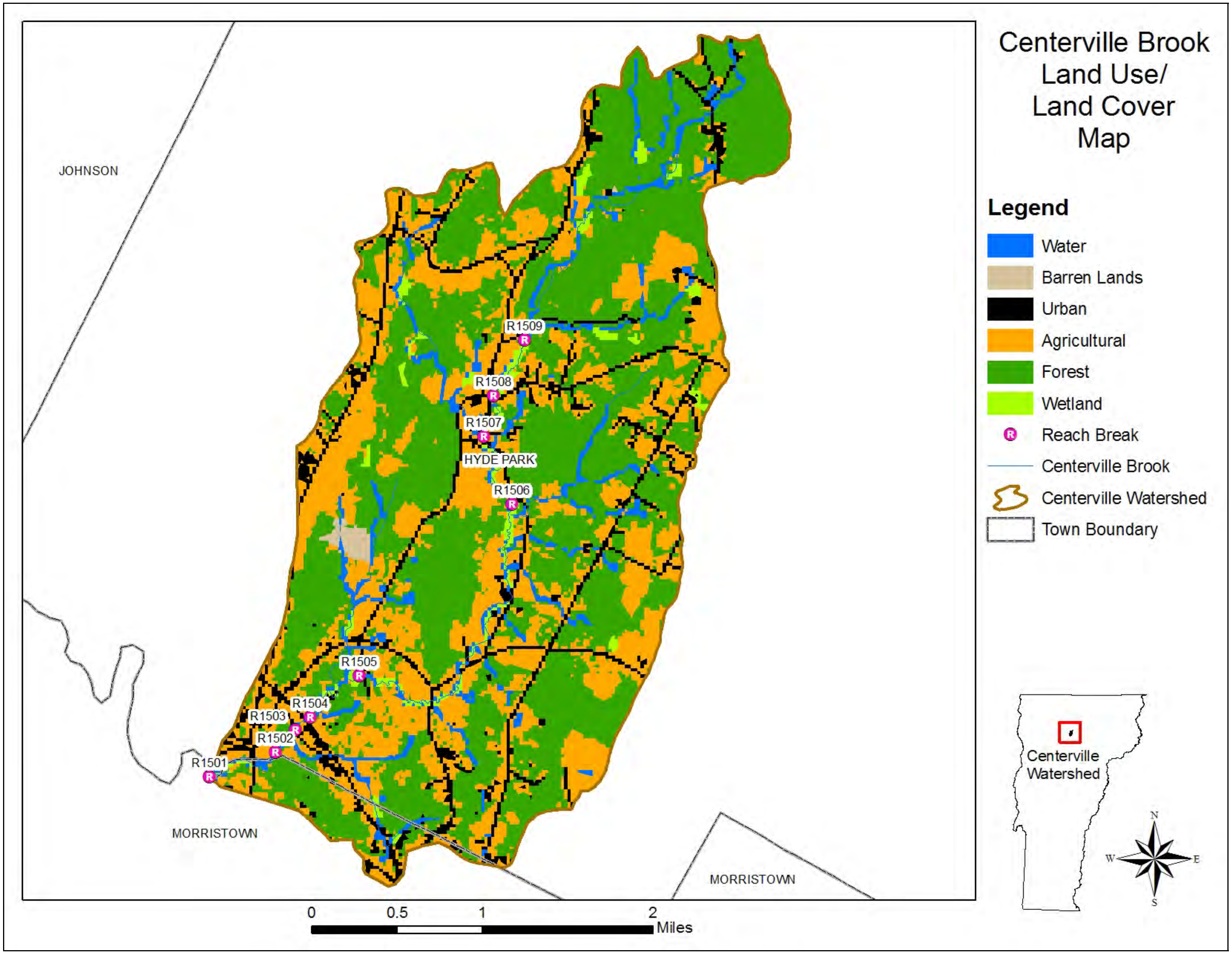


Figure 2. Land cover and land use for Centerville watershed

3.3 Geomorphic Setting

A Phase 1 Stream Geomorphic Assessment was conducted on 17 reaches of the main stem of Centerville Brook and one major tributary. The Phase 2 study focused on eight stream reaches on the main stem of the Centerville Brook within the Town of Hyde Park from the confluence with the Lamoille River upstream to Centerville. The combined length of the stream reaches assessed during the phase 2 study is approximately 5.6 miles (Figure 3). 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 (VANR, 2007b). Reference stream types for the assessed reaches are listed in Table 2. With the exception of reach R1503 which is semi-confined, all reaches are classified as "C" or "E" channels by reference. These reaches flow through unconfined valleys, where "C" channels have moderate to high width to depth ratios and "E" channels have low width to depth ratios.

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

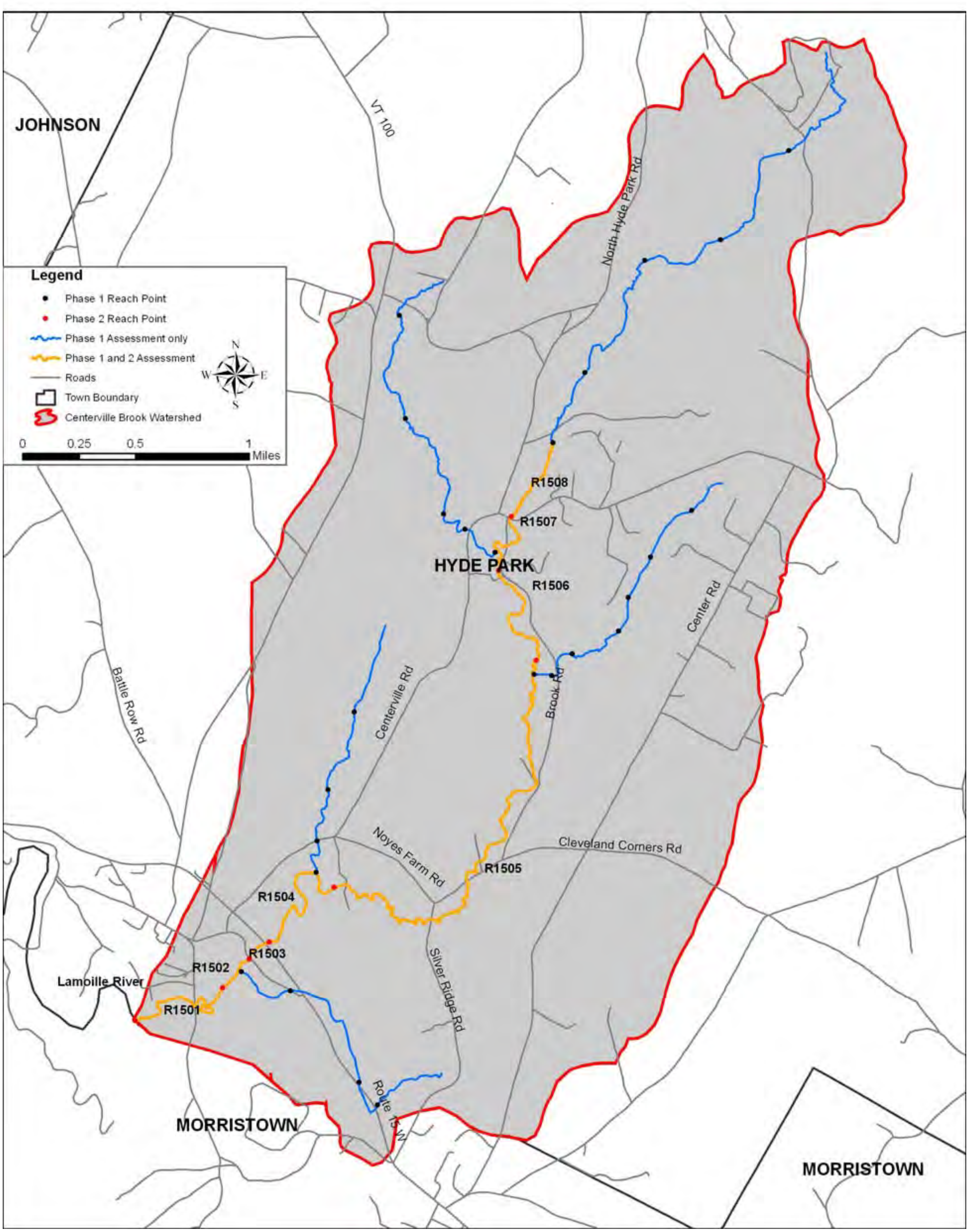


Figure 3. Reach location map for Phase 2 Stream Geomorphic Assessments

Table 2: Geomorphic Setting of Assessed Reaches				
Reach ID	**Reference Stream Type**	**Confinement**	**Valley Slope**	**Bedform**
R1501	E	Very Broad	1.73	Riffle-Pool
R1502	Cb	Broad	2.49	Riffle-Pool
R1503	Ba	Semi-confined	4.07	Step-Pool
R1504	C	Broad	1.54	Riffle-Pool
R1505	E	Very Broad	0.67	Riffle-Pool
R1506	E	Broad	0.51	Riffle-Pool
R1507	Eb	Broad	3.17	Riffle-Pool
R1508	E	Very Broad	0.97	Riffle-Pool

Natural bedrock grade controls were noted in seven of the eight assessed reaches (R1501, R1502, R1503, R1504, R1505, R1506 and R1507). The steepness of the valley side slopes was determined using a combination of a topographic map and the soils layer. No alluvial fans were identified in the study area.

3.4 Hydrology

In order to better understand the flood history of the Centerville Brook, long term data from the U.S. Department of the Interior, U.S. Geological Survey (USGS) gauge on the Lamoille River in Johnson, VT and data from a smaller brook, Stony Brook in Eden, VT, were obtained (USGS 2007). Eighty-two years of record (1912-1913 and 1929-2008) are available for the Lamoille River gauge at Johnson, VT. A total of twenty-one years of record (1964-1974 and 1999-2008) are currently available for Stony Brook.

The near term record for Lamoille River and Stony Brook both show that 1973 was a high flow year. The long term record on the Lamoille gauge shows major flood events also occurred in the years 1912, 1936, 1984, 1995 and 1997. The two graphs below (Figure 4 and 5) provide a flood frequency analysis for the Lamoille River gauge and the Stony Brook gauge respectively.

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).

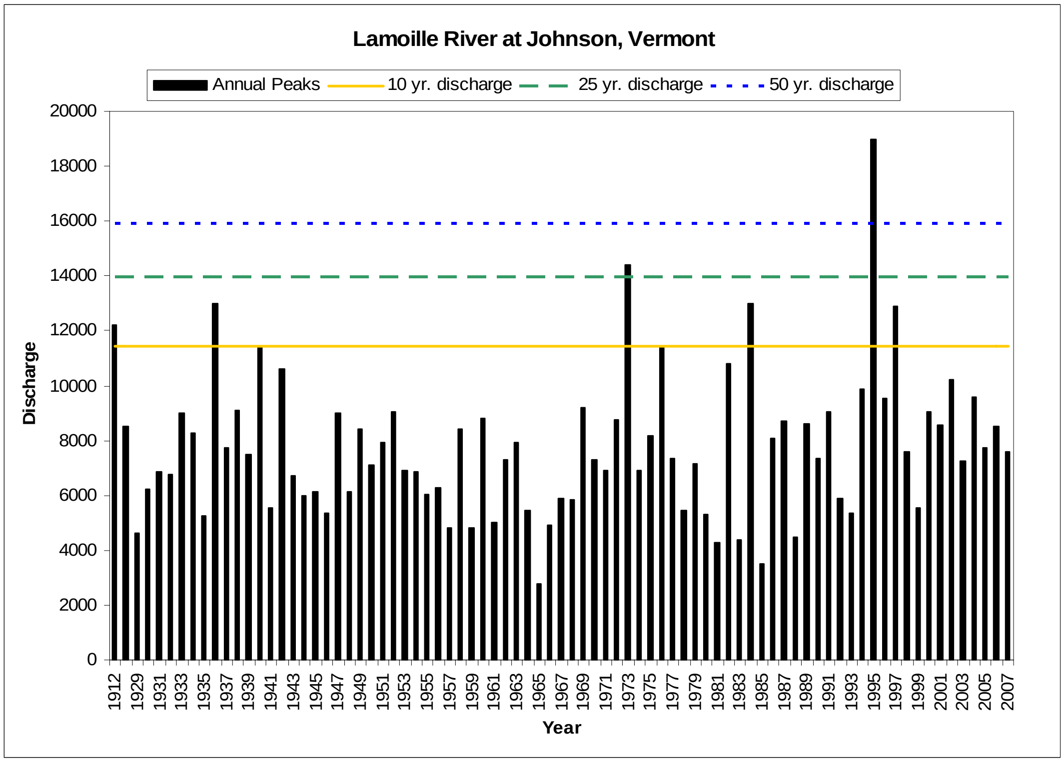


Figure 4. Flood frequency analysis for Lamoille River at Johnson, VT

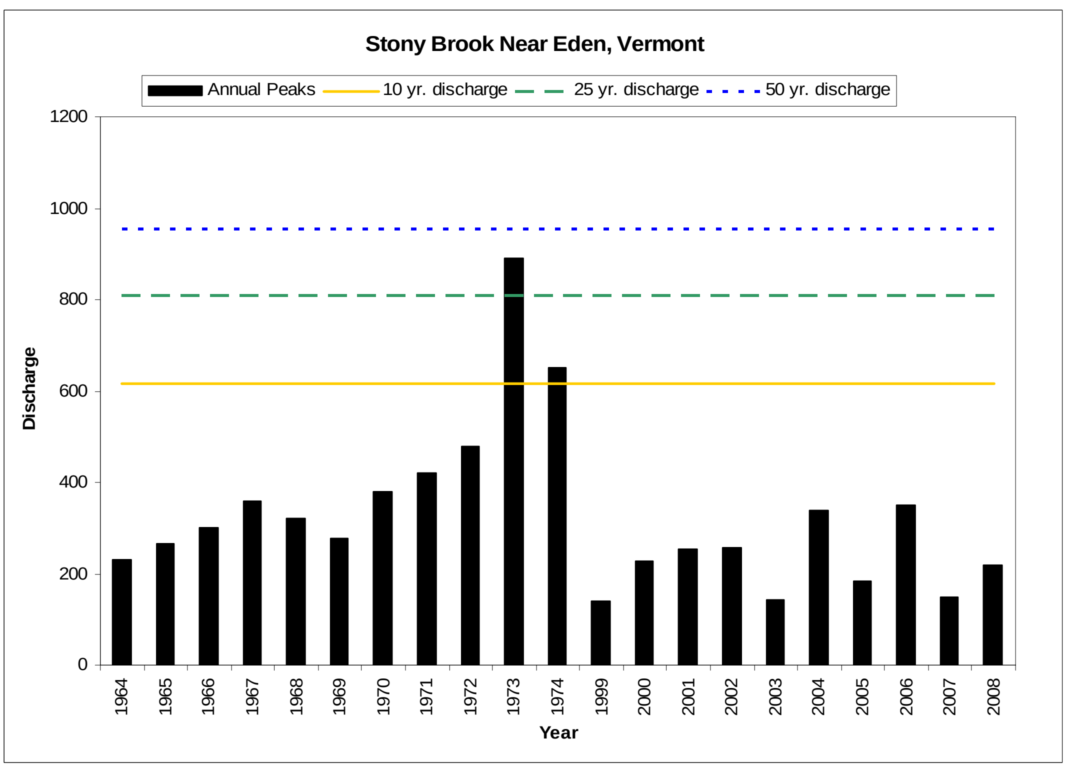


Figure 5. Flood frequency analysis for Stony Brook, Eden, VT

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, whose role in power generation and transportation at first 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 Centerville Brook, which are unstable and prone to fluvial erosion (Vermont Agency of Natural Resources 2006).

Through Vermont's history, flood waters on the Centerville Brook have destroyed property. Near Silver Ridge Road, two undersized culverts have been replaced after flood events. Flood events have also damaged road infrastructure (Ryan 2001). Severe storms and flooding from July 21 through August 12, 2008 resulted in a federal disaster (DR 1790) to be declared in Addison, Caledonia, Essex, Lamoille, Orange, Washington and Windsor counties on September 12, 2008 (FEMA 2008). According to Gary Schelley of the Vermont Agency of Transportation (VTrans), $75,675.31 of federal funds and $12,612.56 of state funds were allocated for public assistance within the Town of Hyde Park following the summer 2008 flooding (personal communication between Schelley and Andrew Flagg of LCPC). Public assistance money can be used towards infrastructure for projects such as debris clean up and bridge and road repair/maintenance.

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 Centerville Brook 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 Centerville Brook watershed. Channel morphologic responses to these practices contribute to channel adjustment that may further create unstable channels. The most common adjustment processes in the Centerville Brook are widening and planform migration as a result of historic degradation within the channel. 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 is the channel 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.

3.5 Ecological Setting

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

4.0 METHODS

4.1 Phase 1 Methodology

A Stream Geomorphic Assessment process is divided into three phases, based on VANR protocols. Phase 1, 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." The Phase 1 assessment provides an overview of the general physical nature of the watershed, identifies which reaches are in particular need. A Phase 1 Assessment of the Centerville Brook was completed by the Lamoille County Planning Commission in 2006.

4.2 Phase 2 Methodology

The Phase 2 assessment of the Centerville Brook followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase 2 (Vermont Agency of Natural Resources, 2005). All assessment data were recorded on the Agency of Natural Resources Phase 2 data sheets, and were entered in to the ANR Stream Geomorphic Assessment data management system (DMS). The Phase 1 database was updated using the field data from the Phase 2 assessment in 2006.

The parameters and protocols used for undertaking each of the above steps are outlined in the Phase 2 Handbook (Vermont Agency of Natural Resources, 2005). 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 4.53 to index features that were mapped during the Phase 2 assessment. SGAT is an ArcView extension. BCE also indexed locations where riparian buffers are less than 25 feet on either side of the channel using SGAT version 4.56 based on National Agriculture Imagery Program (NAIP 2003) photos during winter 2008. Valley widths for reaches R15.03 and R15.04 were revised based on mapping conducted in fall 2007 by Colleen Sullivan and Mary Nealon of Bear Creek Environmental, LLC.

4.3 Bridge and Culvert

A watershed-wide bridge and culvert inventory and assessment was conducted by LCPC in 2006 to determine if stream crossings were contributing to localized streambank erosion, sedimentation, and reduced fish passage. Nine bridges and culverts were assessed within the Centerville Brook watershed. Eight of these structures are located within the Phase 2 study area. The Agency of Natural Resources Bridge and Culvert protocols were used (VANR, 2003). 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 Centerville Brook 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 2006, 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 Michael Blazewicz and Pamela DeAndrea based on the Phase 2 field assessment work during the Phase 2 QA/QC process. The DMS and the ArcView shapefiles for the Centerville Brook Phase 2 study were submitted to Staci Pomeroy of the ANR for a Quality Assurance review in September 2007. Some minor revisions were made by BCE to the DMS following this review and the ANR QA review was completed in January 2008.

5.0 RESULTS

5.1 Phase 2 Results

Rapid Geomorphic Assessment

During the Phase 2 assessments, the eight reaches on Centerville Brook were broken into 18 segments based on more detailed field observations. The reference stream type for each assessed segment is included in Figure 6. Detailed segment summary data are provided in Appendix A. Most of the reaches are Rosgen (1996) "E" channels by reference. E channels have wide valleys, high sinuosity, low width to depth ratios, and moderate to gentle gradients. C channels have wide valleys and moderate to gentle gradients but have higher width to depth ratios than E channels. B channels have moderate to steep slopes and have narrower valleys than C and E channels. The existing geomorphic condition is depicted in Figure 7. All assessed segments and reaches in the Centerville watershed were found to be in good or fair geomorphic condition. Geomorphic condition is determined based on the degree (if any) of channel degradation, aggradation, widening and planform adjustment. Six segments were not assessed because they were largely bedrock controlled segments. Four segments were not assessed because they were wetlands.

The reach condition ratings of Centerville Brook indicate that several of the reaches are actively, or have historically, undergone a process of minor or major geomorphic adjustment. The most common adjustment processes in the Centerville Brook watershed are widening and planform migration as a result of historic degradation within the channel. Several of the reaches studied in the Centerville Brook 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. Once a stream begins to incise, it will typically erode its way through an evolution process until it has created a new floodplain at a lower elevation in the landscape. The common stages of channel evolution, as shown below in Figure 8, 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

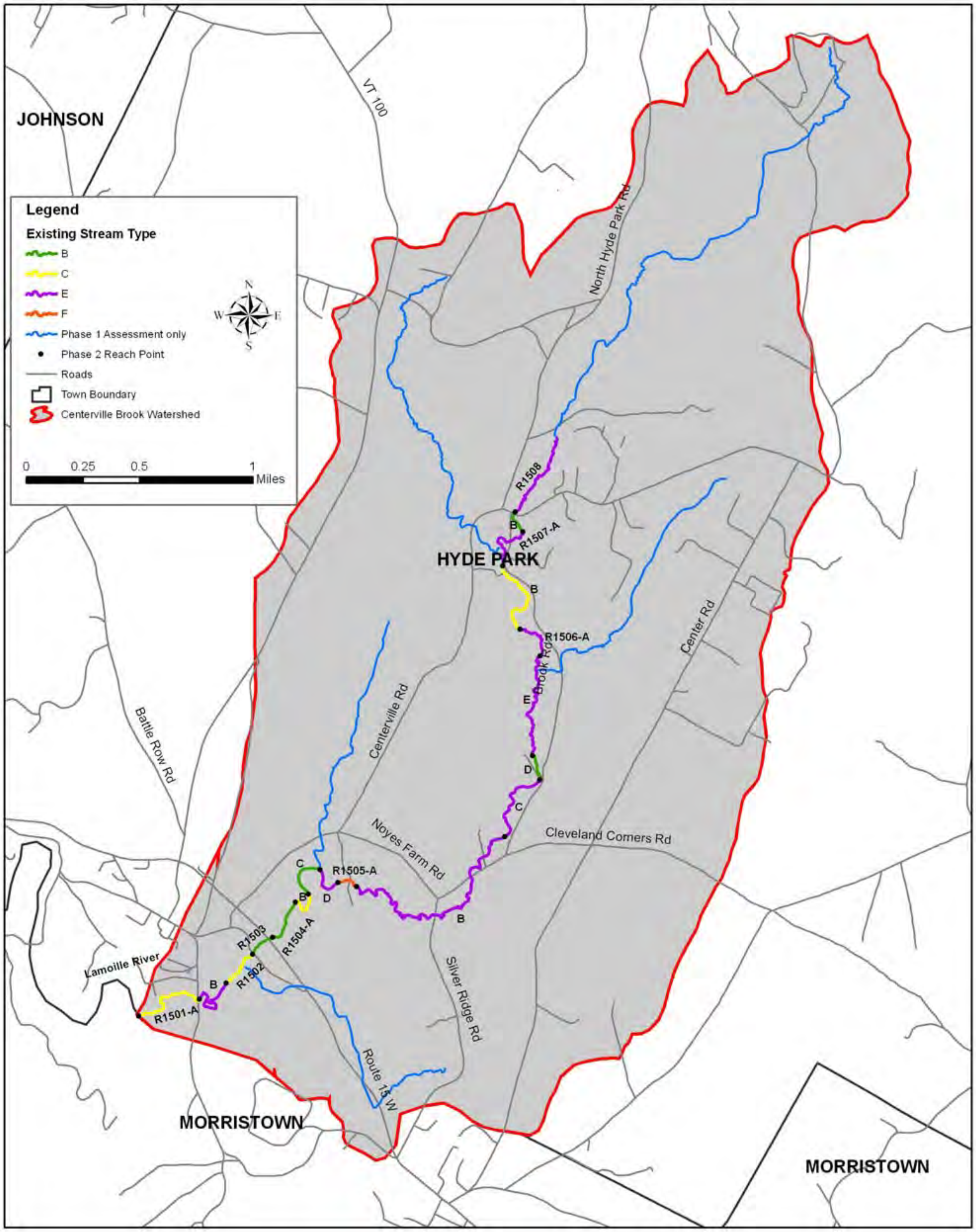


Figure 6. Phase 2 Existing Stream Types

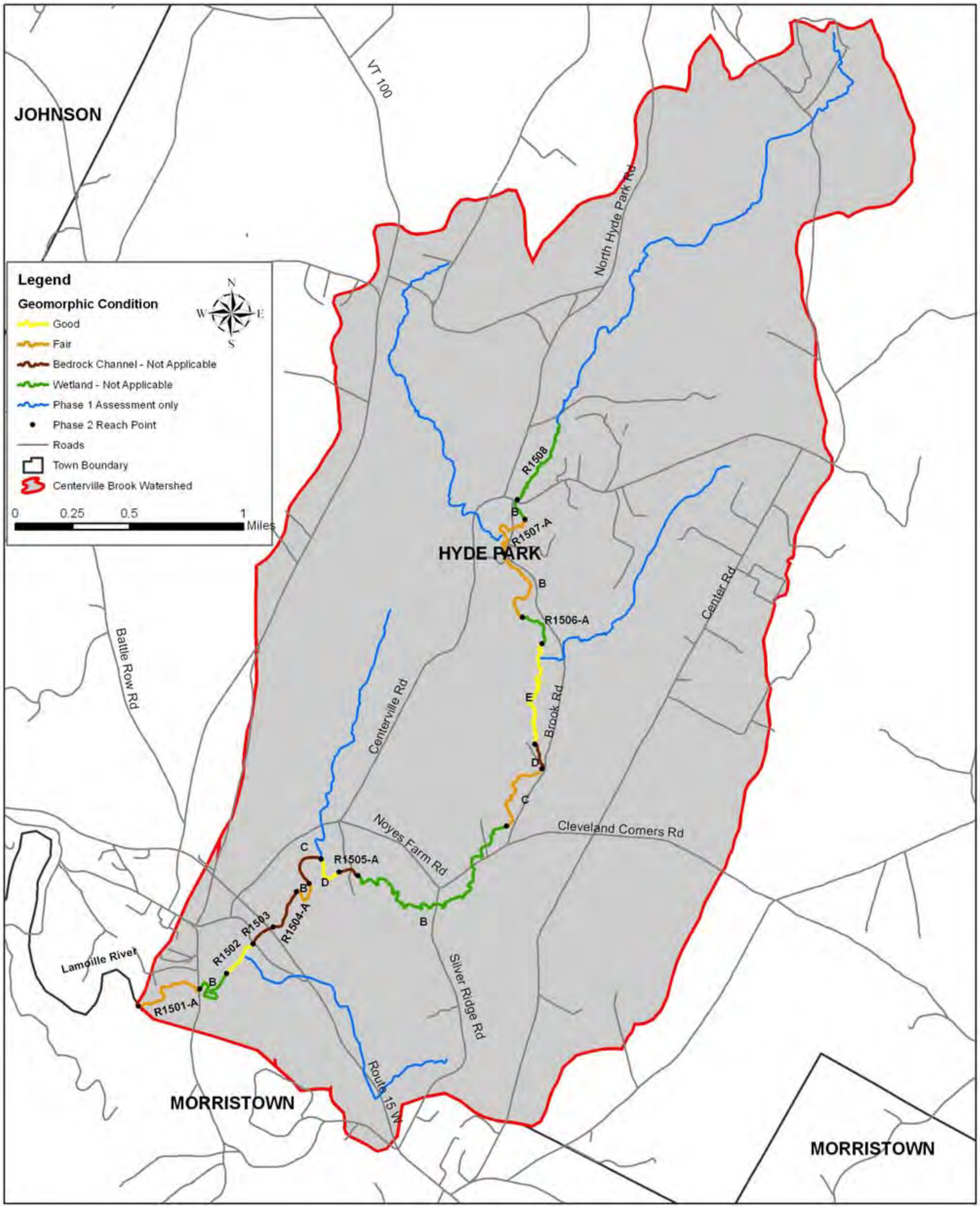


Figure 7. Phase 2 Geomorphic condition of the Centerville Watershed

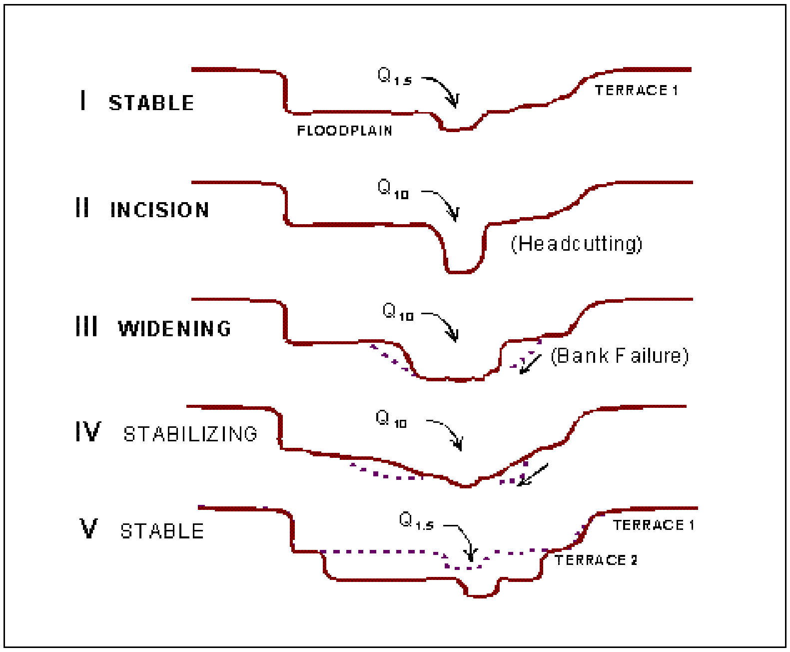


Figure 8. F-stage Channel Evolution Process (from Vermont Agency of Natural Resources, 2007a)

Table 3. Stream Type and Channel Evolution Stage

Segment Number	Entrenchment Ratio	Width to Depth Ratio	Reference Stream Type	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
R15.01-A	12.06	13.35	E4	C4	III	Aggradation **Widening** **Planform**
R15.01-B	Wetland – Not Assessed					
R15.02	3.22	18.71	C3b	C3b	I	Aggradation
R15.03	Bedrock Channel – Not Assessed					
R15.04-A	Bedrock Channel – Not Assessed					
R15.04-B	10.49	17.78	C4	C4	III	Aggradation Widening **Planform**
R15.04-C	Bedrock Channel – Not Assessed					
R15.04-D	10.72	8.33	E4	E4	I	Aggradation Widening Planform
R15.05-A	Bedrock Channel – Not Assessed					

Table 3. Stream Type and Channel Evolution Stage

Segment Number	Entrenchment Ratio	Width to Depth Ratio	Reference Stream Type	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
R15.05-B	Wetland - Not Assessed					
R15.05-C	8.43	8.01	E4	E4	III	Aggradation Widening **Planform**
R15.05-D	Bedrock Channel – Not Assessed					
R15.05-E	17.08	11.01	E4	E4	III	Aggradation Widening Planform
R15.06-A	Wetland – Not Assessed					
R15.06-B	3.57	14.30	E4	C4	III	Aggradation **Widening** Planform
R15.07-A	5.56	7.62	E4b	E4	DIIc	Aggradation Widening Planform
R15.07-B	Bedrock Channel – Not Assessed					
R15.08	Wetland - Not Assessed					
Bold Red lettering – denotes extreme adjustment process **Bold Black lettering** – denotes major adjustment process Black lettering (no bold) – denotes minor adjustment process						

In terms of the ANR channel evolution model, the Centerville Brook is predominately at stage III of the "F-stage" channel evolution model. In some reaches the channel has undergone historic degradation as evidenced by abandoned terraces and rejuvenating tributaries. Some of the cross sections on study reaches were found to be incised. The incision ratio ranged from 1.0 to 1.87. 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 Centerville Brook 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 in "E" type channels, side bars and impending neck cutoffs confirm the channel is undergoing extensive lateral migration. Two segments in the study area (R15.02 and R15.04-D) were found to be in stage I of the "F-stage" channel evolution model, wherein the channel has not yet incised.

One segment within the Centerville Brook study area (R1507-A) fell into another channel evolution model. 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 then 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.

The stream channel has not incised in segment R1507-A. In the DIIc 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 an "E" Stream Type). The channel is widening and migrating 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.

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 four of the eight assessed segments, both the RHA and the RGA resulted in a fair rating. Two segments had a rating of good for both the RHA and the RGA. One segment (R1504-D) had a rating of fair for habitat but good for geomorphic condition, and one other segment (R1504-B) had a rating of good for habitat but fair for geomorphic condition. Instream cover within many of the upstream reaches included large boulders, tree roots and depth cover in pools, many of which were well shaded by a healthy riparian corridor. 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. Many reaches had major intrusion into their river corridor from roads and many 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 Centerville Brook 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
R1501-A	0.55	0.41	Fair	Fair
R1501-B	Wetland – Not Assessed			
R1502	0.74	0.76	Good	Good
R1503	Bedrock – Not Assessed			
R1504-A	Bedrock – Not Assessed			
R1504-B	0.65	0.55	Good	Fair
R1504-C	Bedrock – Not Assessed			
R1504-D	0.56	0.70	Fair	Good
R1505-A	Bedrock – Not Assessed			
R1505-B	Wetland – Not Assessed			

Table 4. Comparison of RHA and RGA for Phase 2 Reaches

Segment Number	Score RHA	Score RGA	Rating RHA	Rating RGA
R1505-C	0.58	0.55	Fair	Fair
R1505-D	Bedrock – Not Assessed			
R1505-E	0.73	0.66	Good	Good
R1506-A	Wetland – Not Assessed			
R1506-B	0.46	0.49	Fair	Fair
R1507-A	0.59	0.63	Fair	Fair
R1507-B	Bedrock – Not Assessed			
R1508	Wetland – Not Assessed			

5.2 Bridge and Culvert Assessment

A total of 14 structures (seven bridges and seven culverts) are located with the Phase 2 study area of Centerville Brook (R15.01 through R15.08) where Phase 2 assessments were conducted in 2006 (see Figure 9). The LCPC assessed eight of these structures during summer 2006 using the ANR Bridge and Culvert Assessment Protocol. General notes during the Phase 2 assessment were taken of the remaining six structures. 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 eight structures that were assessed using the ANR Bridge and Culvert Assessment protocol. The final column of the table includes a prioritization of structures for replacement or retrofit based on three criteria: structure width in relation to bankfull channel width, aquatic organism passage and geomorphic compatibility. Only one of the structures, a crossing on East Main Street in Hyde Park, had a percent bankfull width of less than 50%. Although this structure has a span of less than 50% of the bankfull width, it was not identified for retrofit or replacement at this time because it is an open bottom arch with a stable stream bed dominated by bedrock.

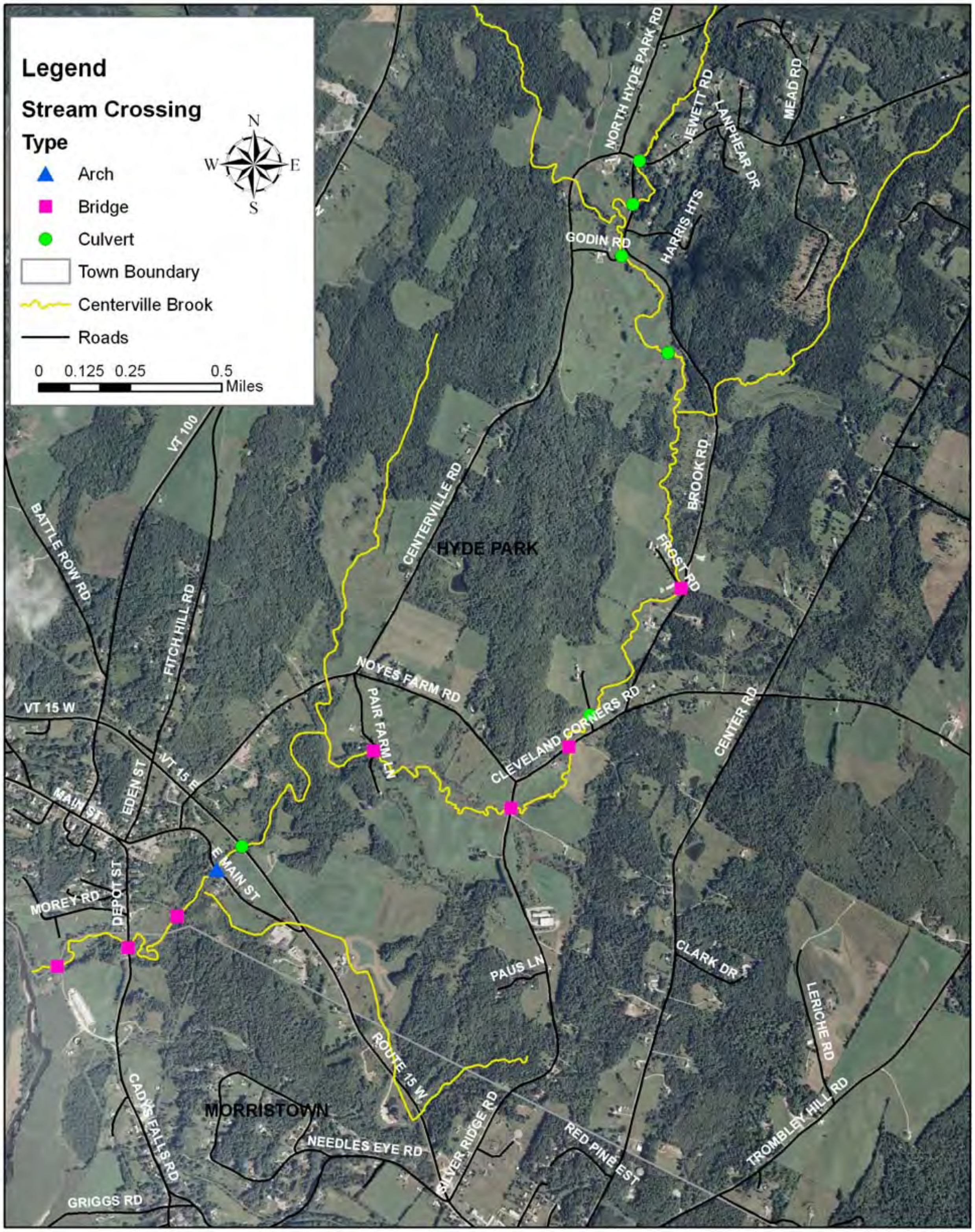


Figure 9. Stream Crossings within the Centerville Brook Watershed

None of the culverts had sediment throughout the structure and were flagged as having reduced aquatic organism passage. The culvert crossing at Centerville Road in reach R1507-B is freefall with an outlet drop of 1 foot (see Figure 10). Using the VT Organism Passage Coarse Screen (Milone and MacBroom 2008) this culvert was flagged as no AOP for all aquatic organisms including adult salmonids. This structure is a high priority for replacement or retrofit.

Figure 10. Culvert at Centerville Road in reach R15.07-B was flagged as "No Aquatic Organism Passage" using the Vermont Culvert Aquatic Organism Passage Screening Tool (Milone and MacBroom, Inc, 2008)

Seven of the eight structures in Table 5 were found to be fully or mostly compatible using the geomorphic screening tool. The bridge on Frost Road in Hyde Park (Figure 11) was found to be partially compatible using the Vermont Geomorphic Screening Tool (Milone & MacBroom, Inc., 2008). This structure is rated as moderate to high priority for replacement due to the sharp bend and scour above and below the structure. The alignment of this crossing should be reconsidered if the structure is replaced at some point in the future.

Table 5
Centerville Brook Crossings
Evaluation using VTANR Geomorphic Compatibility Screening Tool

Reach/ Segment No.	Road Name, Town	Structure Type	Condition/Observation	Percent Bankfull Channel Width[1]	Aquatic Organism Passage (AOP)	Geomorphic Compatibility	Priority for Replacement or Retrofit
R1501-A	Depot Street, Hyde Park	Bridge	Mild bend	56%[2]	NA	Mostly compatible	Low
R1503	E. Main Street, Hyde Park	Arch	Bedrock dominated bed material above, below and within structure	43%[2]	NA	Fully compatible	Low
R1503	VT 15 E, Hyde Park	Culvert	Sediment obstructing opening of culvert	54%[2]	Reduced AOP	Fully compatible	Moderate
R1505-B	Silver Ridge Road, Hyde Park	Bridge	Effective bankfull width only 15 feet due to riprap	200%[2,5]	NA	Fully compatible	NR[4]
R1505-B	Cleveland Corners Road, Hyde Park	Bridge	Mild bend	103%[3]	NA	Mostly compatible	NR
R1505-B	Sloboda Road, Hyde Park	Culvert	Twin culverts – each 7 feet wide (Structure width revised by BCE); BCE notes indicate scour below, scour above, alignment problem	82%[2]	Reduced AOP	Fully compatible	Moderate
R1505-D	Frost Road, Hyde Park	Bridge	Sharp bend	56%[2]	NA	Partially compatible	Moderate to high
R1507-B	Centerville Road, Hyde Park	Culvert	Free fall	57%[3]	No AOP[6]	Mostly compatible	High

[1]Shaded for bankfull width percentage less than 50%, [2]Percent bankfull width measured in the field, [3]Percent bankfull width based on Vermont Hydraulic Geometry Curves, [4]NR- not recommended for replacement or retrofit at this time; [5]BCE Phase 2 field sheet shows a structure span of 15 feet rather than 30 feet, which results in a percent bankfull width of 100%, [6]No AOP for all aquatic organisms including adult salmonids.

Figure 11. Bridge crossing at Frost Road within segment R15.05D. Centerville Brook approaches this structure at a sharp bend.

The following general criteria were used to evaluate the structures which were included within the Phase 2 reaches but did not receive a full bridge and culvert assessment. The bridge span and culvert diameter was used as a first cut in prioritizing the structures for replacement. Geomorphic stability and aquatic organism passage was also considered when prioritizing bridges and culverts for replacement or retrofit.

High Priority: Structures with spans of approximately 50 percent of the bankfull width or less, which are significantly impeding natural sediment transport. Culverts that are impeding the passage of aquatic organisms are automatically placed in the high priority category (e.g. free fall outlet).

Moderate Priority: Structures with spans less than 50 percent that are not causing significant geomorphic instability <u>and</u> structures with spans greater than 50 percent that are causing instability. Culverts that are resulting in reduced aquatic organism passage (e.g. do not have material throughout the structure or have a cascade outfall) result in at least moderate priority)

Low Priority: Stream crossing structures that are not included in either of the two categories above.

Three of the structures included in Table 6 were identified to have a width that is less than 50% of the bankfull width. Undersized bridges and culverts are not designed to accommodate both flow and sediment. During flood events large point bars can consequently deposit upstream of undersized bridges and culverts. During catastrophic flood events crossings can become outflanked, taking out large sections of roads and driveways. Significant sediment discharges to waterways can result. Sedimentation of the river poses water quality and aquatic habitat concerns.

The bridge in reach R15.02, which crosses the Rail to Trail network, is undersized relative to the bankfull width and was noted to cause localized geomorphic instability due to sediment transport and alignment. As shown in Figure 12, the bank above the outlet of this structure is eroding. It is recommended that this structure be replaced.

Figure 12. Rail to trail crossing in reach R15.02 has bank erosion above the outlet. This structure is undersized relative to the bankfull channel width and is recommended for replacement.

Table 6. Centerville Brook Stream Crossing Structures Evaluation using Phase 2 Data								
Reach/ Segment No.	**Structure Type**	**Road Name/ Location**	**Notes**	**Percent Channel Width[1]**	**Aquatic Organism Passage**	**Problems Noted**		**Priority for Replacement**
						Sediment Transport	**Alignment**	
R1501-A	Bridge	Farm Bridge	Cracks in concrete	60[2]	NA	√	√	Moderate to high
R1502	Bridge	Rail to trail	Bank eroded above outlet	38[2]	NA	√	√	High
R1505-A	Bridge	Pair Farm Lane	No problems noted	93[3]	NA			NR[4]
R1506-A	Culvert	Farm crossing	Scour above, scour below; Wetland, floodwaters have access to floodplain	22[3]	Reduced	√		Low - wetland
R1506-B	Twin Culverts	Godin Road	Deposition above, scour above	71[2]	Reduced	√		Moderate
R1507-A	Culvert	Brook Road	Deposition above, scour above, scour below; poor condition	47[2]	Reduced	√		Moderate to high

[1]Shaded for bankfull width percentage less than 50%, [2]Percent bankfull width based on cross section data from Phase 2 assessment conducted by Bear Creek Environmental, LLC and LCPC, [3]Percent bankfull width based on Vermont Hydraulic Geometry Curves, [4]NR-not recommended for replacement or retrofit at this time

The farm crossing in reach R1506-A is also undersized, but is rated low priority for replacement at this time. The structure is located in a wetland and floodwaters have access to the floodplain. The culvert crossing at Brook Road (Figure 13) is undersized and was given a moderate to high priority to replacement due to sediment transport problems; reduced AOP and the poor condition of the culvert.

Figure 13. Brook Road culvert crossing in reach R15.07-A is undersized and impeding sediment transport. The culvert is in poor condition and has the potential to reduce AOP.

The farm bridge in reach R1501-A does not have a span which is less than 50% of the bankfull width, but was nonetheless rated as moderate to high priority for replacement. This span of this structure is 50% of the bankfull width and was noted to be causing sediment transport problems (deposition above, deposition below, score above, scour below) and was poorly aligned. The structure is in poor condition as shown in Figure 14.

Figure 14. Farm bridge in reach R15.01-A that is structurally unsound and is causing localized geomorphic instability.

Stream crossings identified as moderate to high or high priority for replacement/retrofit are included in the project identification table (Table 9) in Section 7. It is recommended that stream crossings that have not yet been assessed within the Centerville Brook watershed be assessed by the LCPC using the latest version of the ANR Bridge and Culvert Assessment protocols . This assessment will further refine the priority for replacement/retrofit of structures that are impeding aquatic organism passage or are undersized.

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 Centerville Brook network 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 Departure Analysis and 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 Centerville watershed is forest. None of the eight reaches 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. Historical deforestation in the Centerville watershed may also have contributed to historic incision.

The Centerville watershed has a modest network of roads as shown in Figure 15. 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 approximately 35 percent of the Centerville watershed.

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 16) shows the distribution of sediment load indicators in the Centerville watershed at the watershed scale. An isolated mass wasting site was identified during the Stream Geomorphic Assessments in reach R1504-B, and a gully was identified in reach R1505-B. Localized areas of bank erosion and depositional features (steep riffles, mid channel bars, delta bars, flood chutes, and/or avulsions) are prevalent.

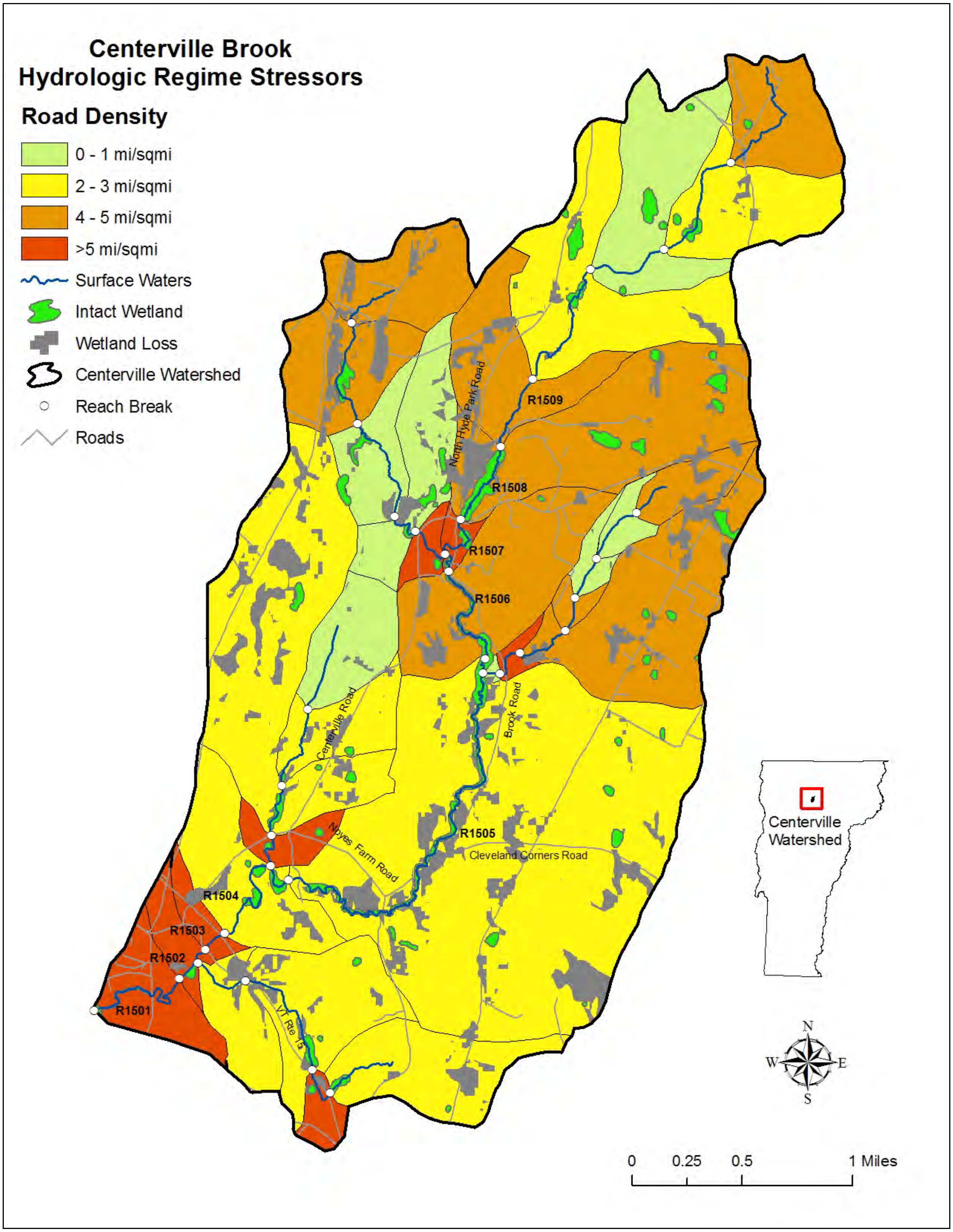


Figure 15. Land use map showing cumulative percent of urban land use, road density and lost wetlands

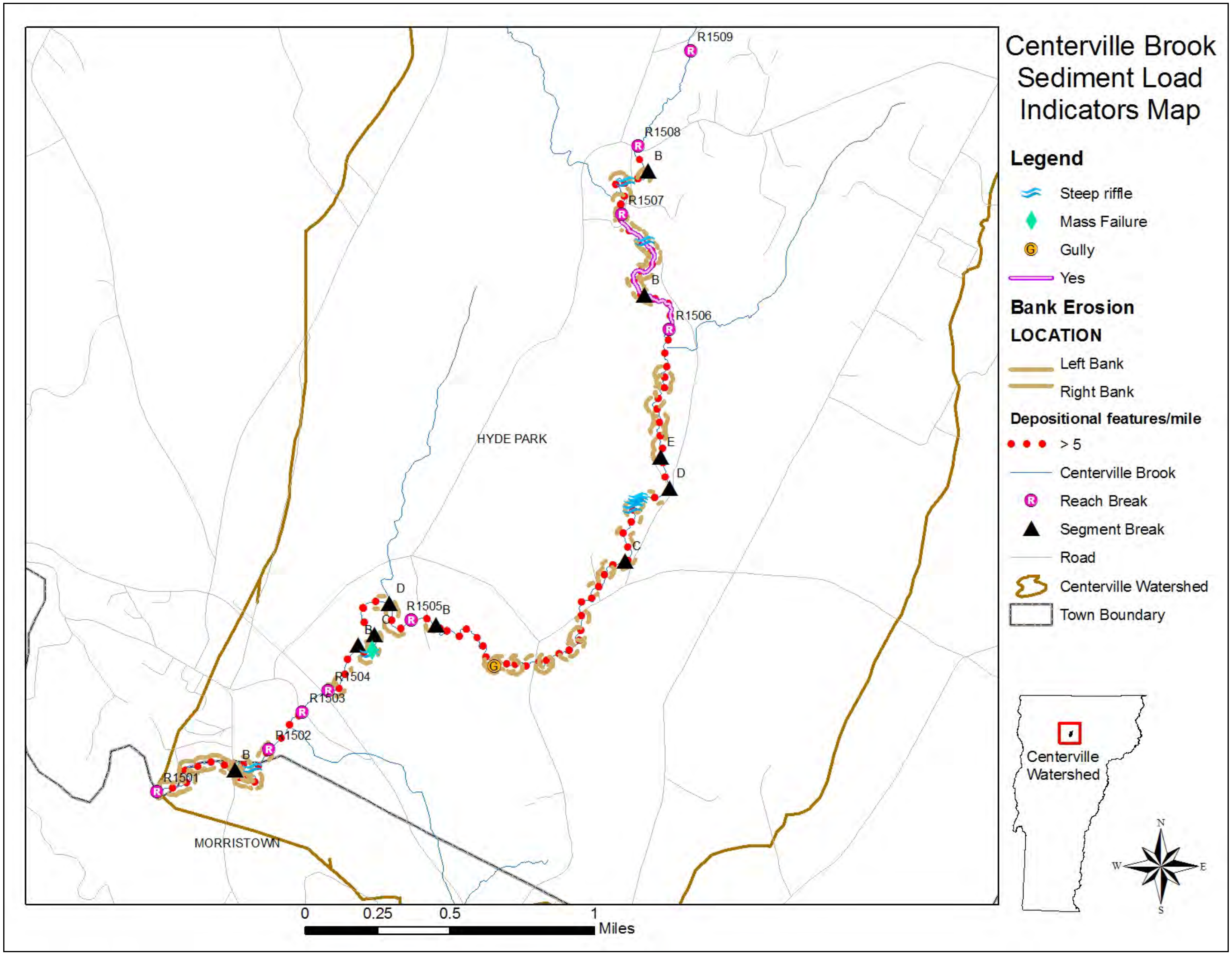


Figure 16. Sediment load indicators map showing depositional features per mile, bank erosion, steep riffles, mass failures, gullies and areas of tributary rejuvenation

6.1.3 Reach Scale Sediment Regime Stressors

The previously discussed alterations to flow and sediment load at the watershed scale serve as a pretext for understanding the timing and degree to which reach scale modifications are contributing to field observed channel adjustment. When the valley, floodplain, channel and channel boundary conditions are modified, a stream may change the way sediment is transported, sorted, stored and distributed. The stressors that alter these conditions either increase or decrease stream power and or increase or decrease the resistance of its boundary conditions. This is helpful for determining why a reach is under adjustment and what types of management activities will be beneficial in returning the stream to equilibrium conditions. The primary stressors in each segment of the Centerville watershed are identified in Table 7.

Table 7. Centerville Brook Stressors

	Watershed Input Stressors [Moderate (M), High (H), Extreme (E)]		Reach Modification Stressors [Moderate (M), High (H), Extreme (E)]	
River Segment	Hydrologic	Sediment load	Stream Power **Bold**=increase Plain=decrease	Boundary Resistance **Bold**=increase Plain=decrease
R1501 A	% Urban (M) Road Density (E)	Historic Degradation Erosion (H) Depositional Features (H)	Grade Controls Constrictions **Encroachment (M)**	Reduced Riparian Vegetation (H)
R1501 B	Minor Wetland loss % Urban (M) Road Density (E)	Historic Degradation Erosion (H) Depositional Features (H)	**Encroachment (M)**	Reduced Riparian Vegetation (H)
R1502	Wetland loss % Urban (M) Road Density (E)	Erosion (M) Depositional Features (H)	Grade Control Constriction **Straightening (M)**	No Stressor Identified
R1503	Wetland loss % Urban (M) Road Density (E)	No Stressor Identified	Grade Controls Constrictions	Reduced Riparian Vegetation (M)
R1504 A	Wetland loss % Urban (M)	Historic Degradation Erosion (H) Depositional Features (H)	Grade Controls	No Stressor Identified
R1504 B	Wetland loss % Urban (M)	Historic Degradation Erosion (H) Depositional Features (H)	Constriction	No Stressor Identified
R1504 C	Wetland loss % Urban (M)	Historic Degradation Erosion (H) Depositional Features (H)	Grade Controls Constriction	No Stressor Identified
R1504 D	Wetland loss % Urban (M)	Historic Degradation Erosion (H) Depositional Features (H)	Grade Control	No Stressor Identified

Table 7. Centerville Brook Stressors

	Watershed Input Stressors [Moderate (M), High (H), Extreme (E)]		Reach Modification Stressors [Moderate (M), High (H), Extreme (E)]	
River Segment	Hydrologic	Sediment load	Stream Power **Bold**=increase Plain=decrease	Boundary Resistance **Bold**=increase Plain=decrease
R1505 A	Minor Wetland loss % Urban (M) Road Density (M)	Historic Degradation Erosion (M) Depositional Features (H)	Grade Controls Constrictions **Encroachment (M)**	No Stressor Identified
R1505 B	Wetland loss % Urban (M) Road Density (M)	Historic Degradation Erosion (M) Depositional Features (H)	Constrictions **Encroachment (M)**	Reduced Riparian Vegetation (H)
R1505 C	Wetland loss % Urban (M) Road Density (M)	Historic Degradation Erosion (M) Depositional Features (H)	**Encroachment (M)**	Reduced Riparian Vegetation (E)
R1505 D	Wetland loss % Urban (M) Road Density (M)	Historic Degradation Erosion (M) Depositional Features (H)	Grade Controls Constrictions **Encroachment (M)**	Reduced Riparian Vegetation (E)
R1505 E	Wetland loss % Urban (M) Road Density (M)	Historic Degradation Erosion (M) Depositional Features (H)	**Encroachment (M)**	Reduced riparian vegetation (H)
R1506 A	Wetland loss % Urban (M) Road Density (H)	Historic Degradation Erosion (H)	Constriction **Straightening (H)** **Encroachment (H)**	Reduced Riparian Vegetation (H)
R1506 B	Wetland loss % Urban (M) Road Density (H)	Historic Degradation Erosion (H)	Grade Controls Constrictions **Straightening (H)** **Encroachment (H)**	Reduced Riparian Vegetation (E)
R1507 A	% Urban (M) Road Density (E)	Erosion (H) Depositional Features (M)	**Head Cut** Constriction **Straightening (M)** **Encroachment (H)**	**Armoring (M)** Reduced Riparian Vegetation (H)
R1507 B	% Urban (M) Road Density (E)	Erosion (H) Depositional Features (M)	Grade Controls Constrictions **Straightening (M)** **Encroachment (H)**	**Armoring (M)** Reduced Riparian Vegetation (M)

Table 7. Centerville Brook Stressors

	Watershed Input Stressors [Moderate (M), High (H), Extreme (E)]		Reach Modification Stressors [Moderate (M), High (H), Extreme (E)]	
River Segment	Hydrologic	Sediment load	Stream Power **Bold**=increase Plain=decrease	Boundary Resistance **Bold**=increase Plain=decrease
R1508	Wetland loss % Urban (M) Road Density (M)	No Stressor Identified	Grade Control	No Stressor Identified
Moderate	Stormwater Inputs and Depositional Features 2-5 per mile; Road Density 3-4 mi/sq. mi. Straightening, Bank Armoring, Erosion, and Encroachments 5-20% Urban 5-10%; Reduced Riparian Buffer 5-20%			
High	Stormwater Inputs and Depositional Features >5 per mile; Road Density 5-6 mi/sq. mi. Straightening, Bank Armoring, Erosion, and Encroachment >20% Urban 10-20%; Reduced Riparian Buffer 20-50%			
Extreme	Reduced Riparian Buffer>50%; % Urban>20%			

6.1.4 Channel Modifiers

Results from the Centerville watershed indicate that primary stressors include road crossings and encroachments (Figure 17). The majority of the channel straightening within the Centerville watershed was associated with roads that run parallel to the stream and farm fields within the river corridor.

No dredging of the channel was observed or was reported by the Vermont ANR to have taken place in the watershed. However, where the channel showed that it had been straightened, it is likely that some dredging that may have occurred during the straightening process.

6.1.5 Boundary Conditions and Riparian Modifiers

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. Two stream segments, R1505-C and R1506-B had over 70 percent of the reach with little or no buffer on at least one bank. One other segments, R1505-D, had between 50 and 70 percent of the segment with riparian buffers less than 25 feet on at least one bank. The data for the locations indicated as having little to no buffer on the Boundary Conditions and Riparian Modifiers map (Figure 18) were indexed by Bear Creek Environmental based on NAIP photos. These stream reaches which lack a high quality riparian buffer are at a significantly higher risk of experiencing high rates of lateral erosion.

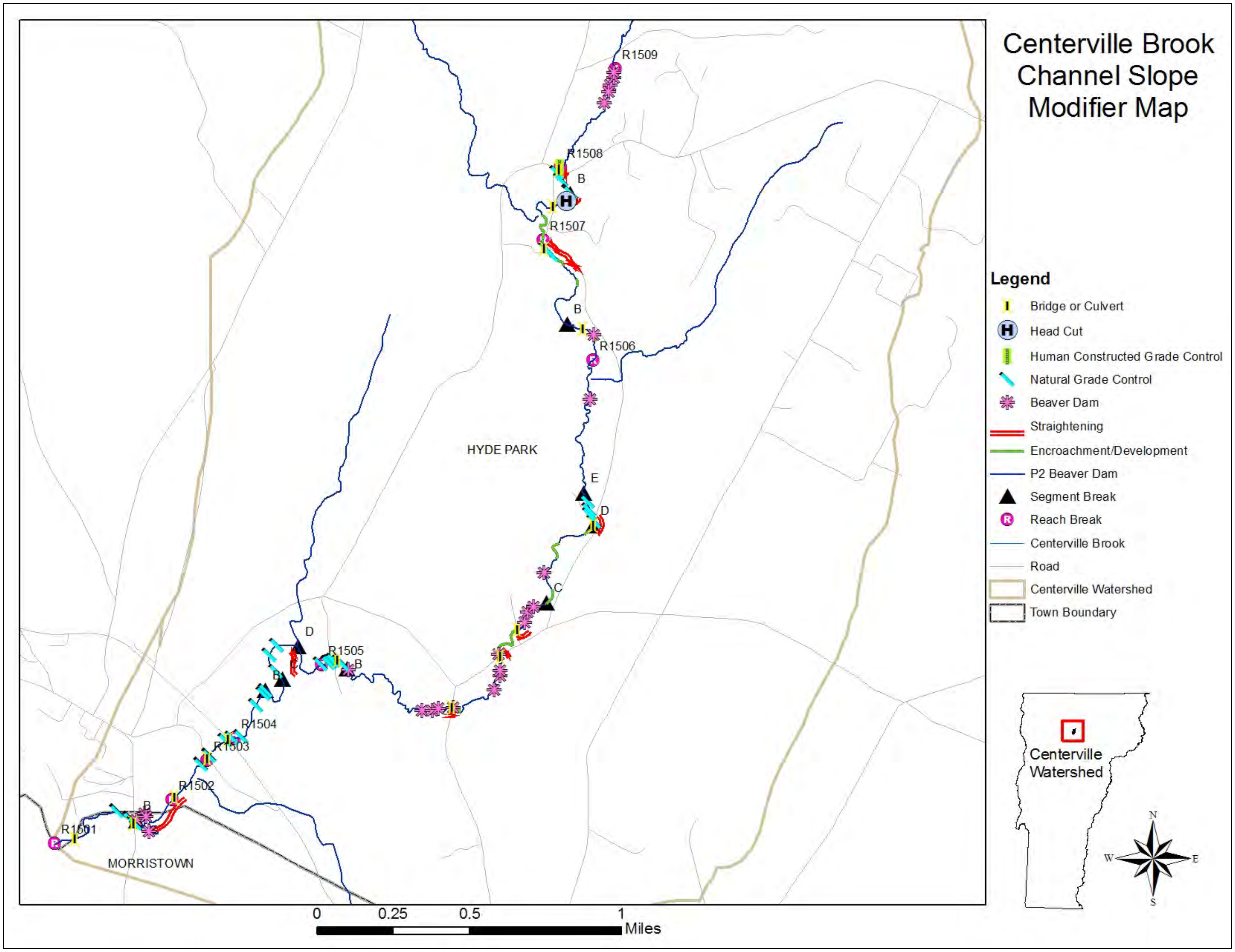


Figure 17. Channel depth modifiers map showing areas of straightening, dredging, grade controls, beaver dams and development.

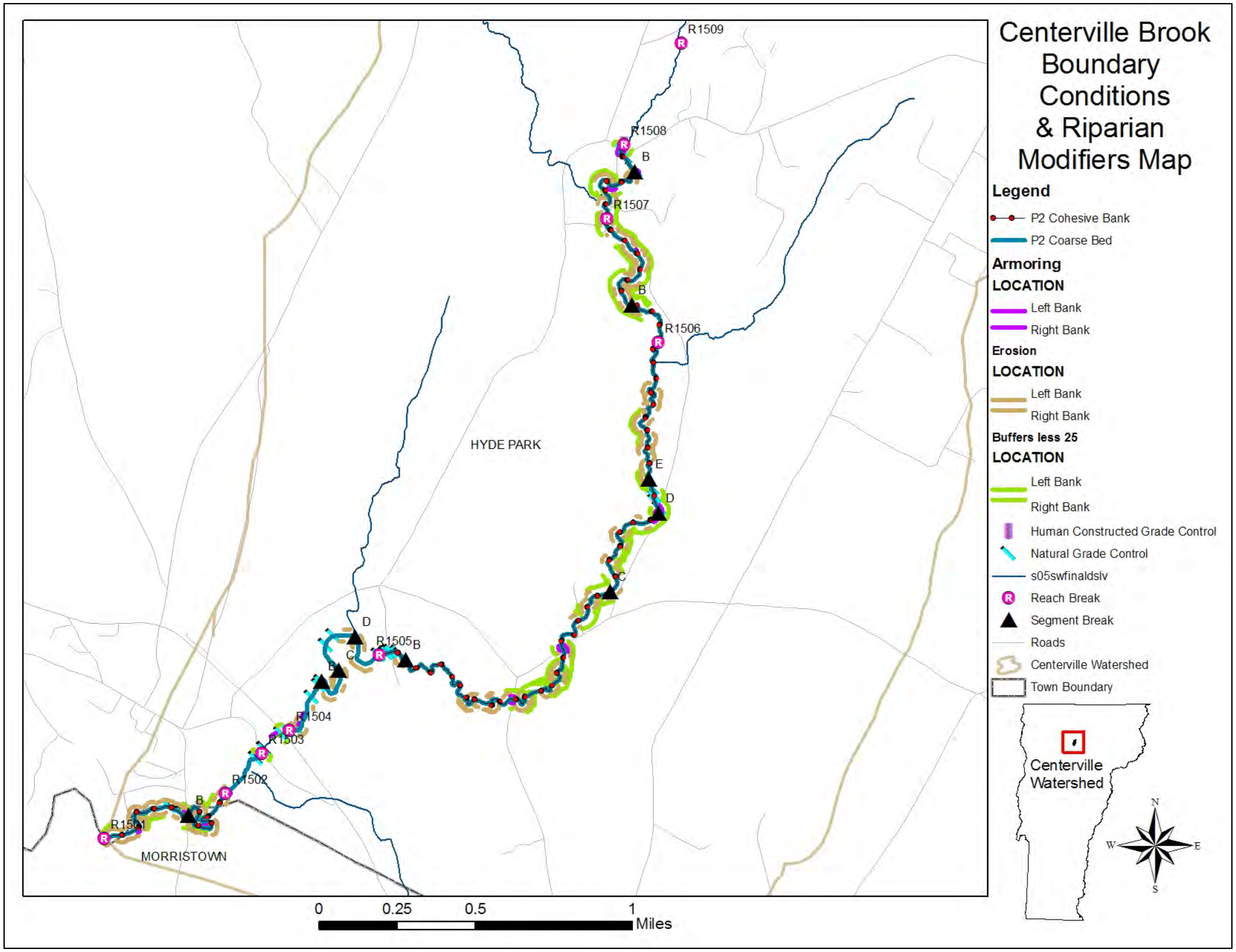


Figure 18. Boundary conditions and riparian modifications map showing areas of erosion, buffers less than 25 feet, bank armoring, cohesive banks, grade controls and coarse bed materials

6.1.6 Constraints to Sediment Transport and Attenuation

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 sediment regime departure map (Figure 19) shows the Phase 1 reference stream sediment conditions for each reach within the stream network. These reference type streams use available floodplain access as a means to store sediment within the watershed. The majority of the stream network has a reference sediment regime of a *Coarse Equilibrium (in=out) & Fine Deposition*.

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. Some 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. 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.

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.

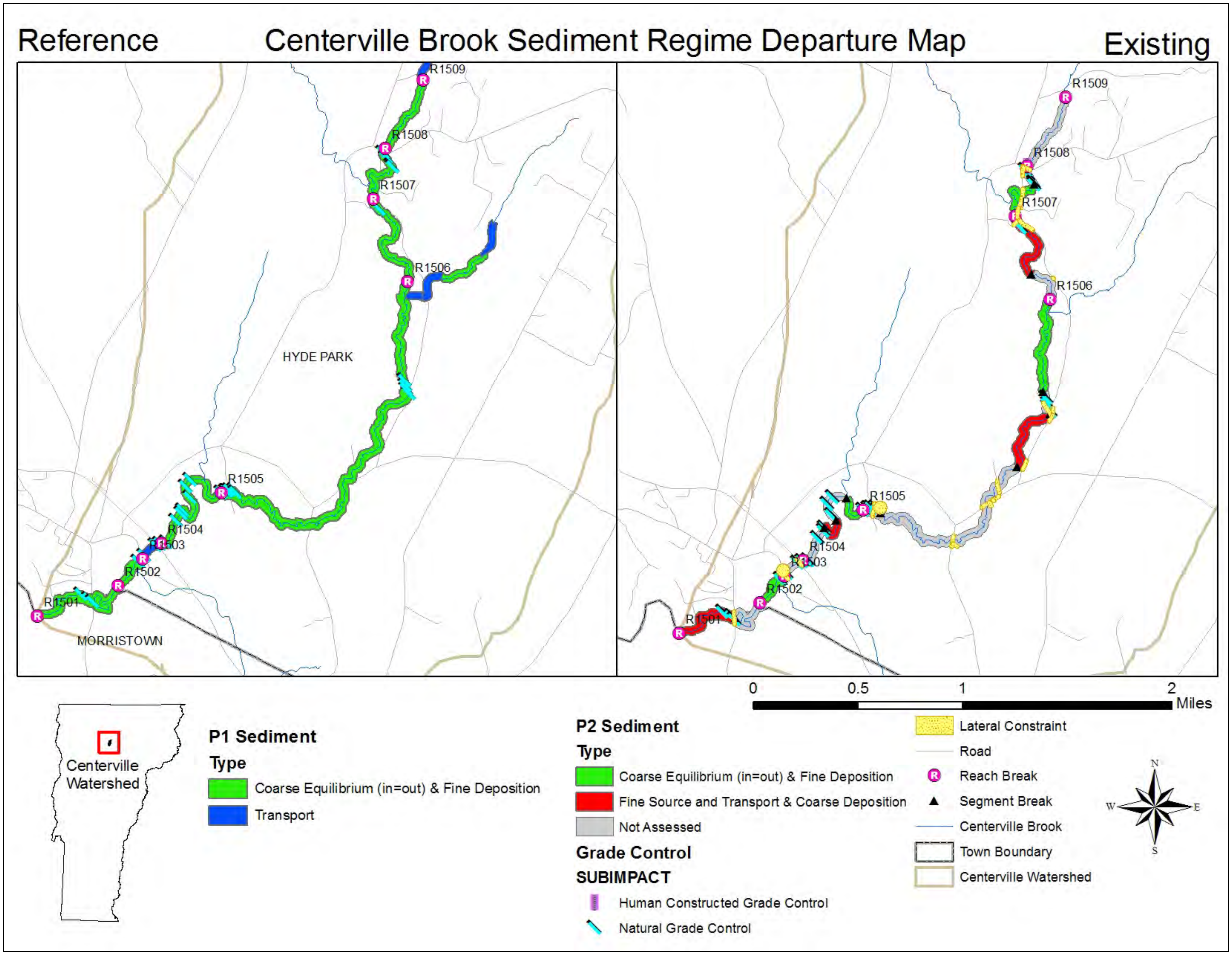


Figure 19. Sediment Regime Departure Map

The existing sediment regime for the Centerville watershed includes reduced floodplain access, increased stream power, reduced boundary resistance, and lateral constraints 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). Segments and reaches of the Centerville watershed that can act as attenuation assets are identified below to help in designing stream corridor protection and restoration projects within the stream network. These segments include:

R1501-A
R1504-B
R1505-C
R1506-B

6.2 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 setting 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. 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.

There are many variables that are contributing to the sensitivity of the reaches in the Centerville watershed. The existing geomorphic condition and stream sensitivity of the Phase 2 assessed reaches are presented in Table 8.

Table 8. Stream Sensitivity for Phase 2 Reaches					
Segment Number	**Reference Stream Type**	**Existing Stream Type**	**Stream Type Departure**	**Geomorphic Condition**	**Sensitivity**
R1501-A	E4	C4	E to C	Fair	Extreme
R1501-B	Wetland – Not Assessed				
R1502	C3b	C3b	None	Good	High
R1503	Bedrock – Not Assessed				
R1504-A	Bedrock – Not Assessed				
R1504-B	C4	C4	None	Fair	Very High
R1504-C	Bedrock – Not Assessed				
R1504-D	E4	E4	None	Good	High
R1505-A	Bedrock – Not Assessed				
R1505-B	Wetland – Not Assessed				
R1505-C	E4	E4	None	Fair	Very High
R1505-D	Bedrock – Not Assessed				
R1505-E	E4	E4	None	Good	High
R1506-A	Wetland – Not Assessed				
R1506-B	E4	C4	E to C	Fair	Extreme
R1507-A	E4b	E4	None	Fair	Very High
R1507-B	Bedrock – Not Assessed				
R1508	Wetland – Not Assessed				

The location and slope of a stream also affects is morphology and sensitivity. Streams that are transporting sediment through the channel are less sensitive than streams that are storing and responding to sediment. Additionally, flow regime and floodplain constrictions may be affecting the sensitivity of the Centerville Brook. 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. Segments R1501-A and R1506-B are gravel dominated segments that have undergone a stream type departure from a reference "E" channel to a "C" channel. This has resulted in a change in sensitivity from high to extreme (Figure 20). Figure 20 is a map presenting the stream sensitivity, generalized according to stream type and condition as per the ANR protocol, and current adjustments for each reach segment in the Centerville watershed. Sensitivity ratings have not been assigned for bedrock dominated segments and impounded segments that were not assessed. No vertical channel adjustments were found to be actively occurring within the watershed.

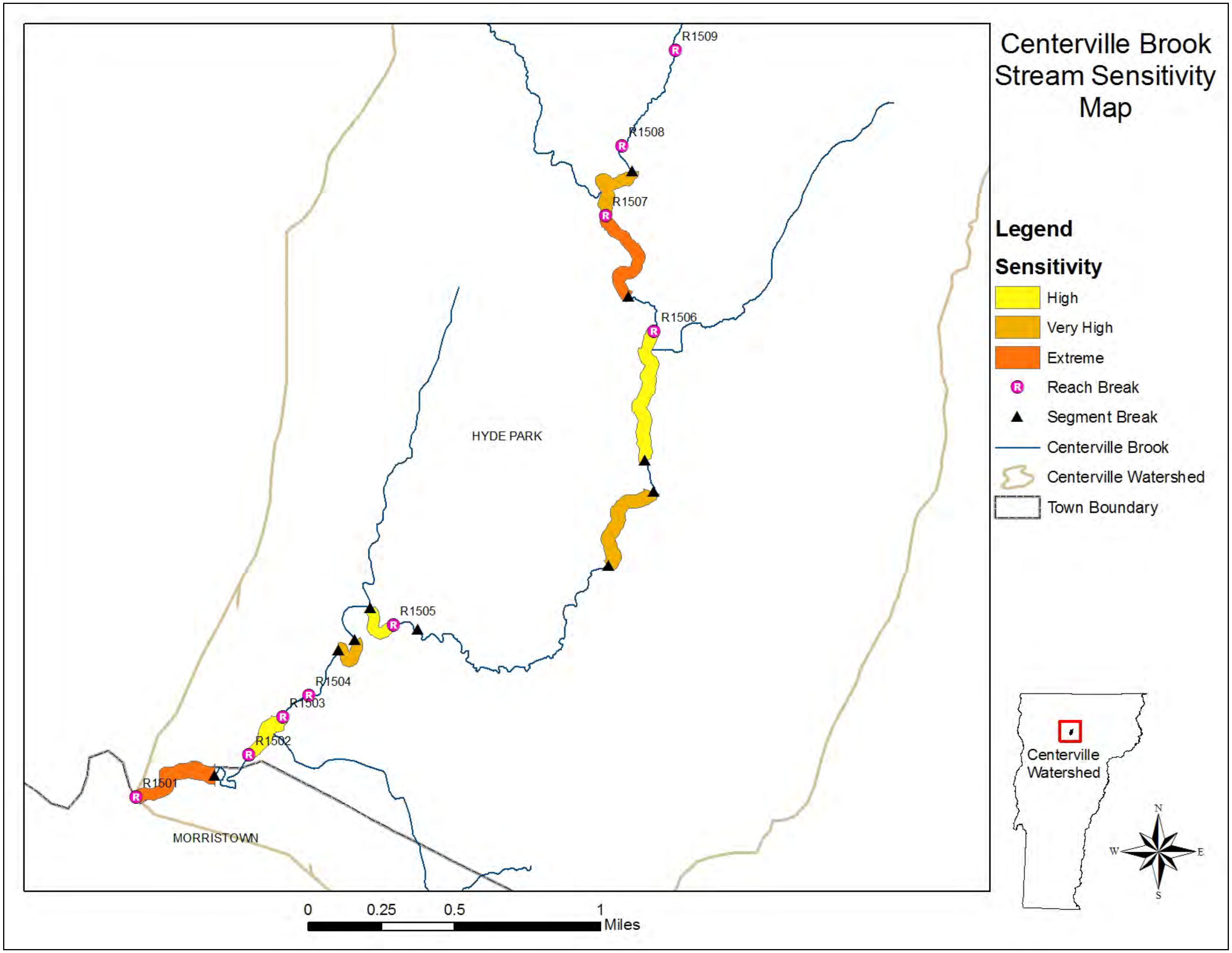


Figure 20. Centerville Watershed Stream Sensitivity and Current Adjustment

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 one time 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 management plan accompanies the easement outlining the management and land use practices expected to occur within the corridor and describe any accommodations that must be made for existing structures (e.g. outbuildings, stream crossing, etc.).
- 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, defined through VTANR Stream Geomorphic Assessment (2007b), 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 Centerville 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.

Reach R15.01

Centerville Brook reach R15.01 begins at the railroad bridge east of Hyde Park village and flows downstream to the confluence with the Lamoille River. The reach was segmented into two sections due to beaver dams that had impounded the upper half of the reach.

Segment R15.01-A

Passive Restoration: Corridor Easement and Improve Riparian Buffer
Replace undersized farm bridge

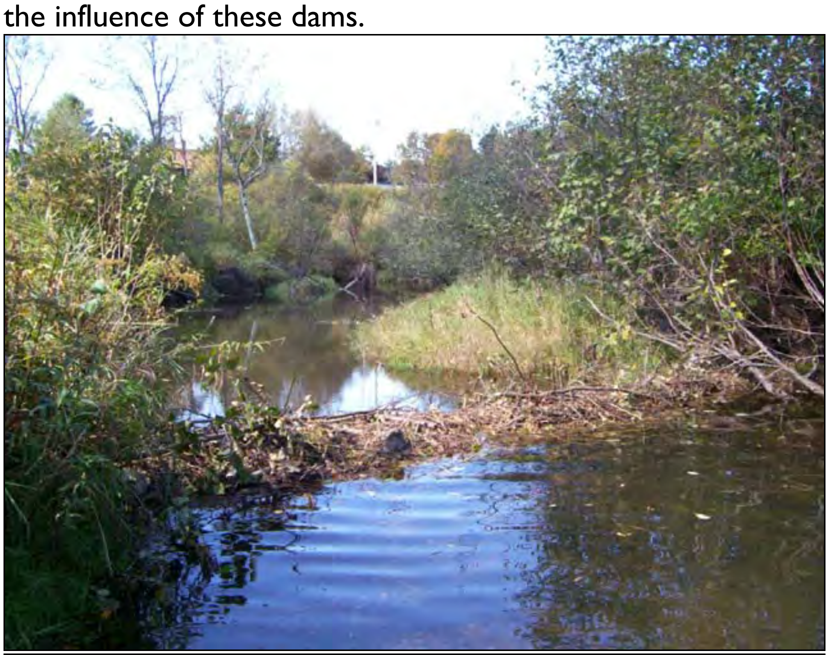
Centerville Brook segment R15.01-A begins just above the Depot Street bridge and continues downstream to the confluence with the Lamoille River. The reach is bordered by agricultural fields near the confluence. Significant historic channel incision has occurred (perhaps as a result of degradation in the Lamoille or as a result of channel straightening in this segment). The channel is undergoing active adjustment through this reach. The reference stream type is an "E" channel; however, due to major adjustment the channel is a "C" riffle-pool bedform undergoing major widening and extreme planform adjustment as a new floodplain is being developed.

Centerville Brook segment R15.01-A is an "E" type channel that has undergone a stream type departure and major existing channel adjustment.

Segment R15.01-B (Wetland)

Improve Riparian Buffer

Centerville Brook segment R15.01-B flows through abandoned agricultural lands east of Hyde Park village. The stream in this reach has been impounded by several beaver dams. A complete geomorphic assessment was not conducted in this segment due to the influence of these dams.



Centerville Brook R15.01-B has been dammed by beavers in numerous locations.

Reach R15.02
Protect River Corridor
Replace undersized bridge

Centerville Brook reach R15.02 begins at the Main Street culvert and flows downstream for several hundred feet to the crossing of the old railway. The stream in this segment has some bedrock grade control. The lower two-thirds of the reach has enough floodplain access to make it a "C" type riffle-pool channel. The railroad crossing at the lower end of the stream reach is particularly narrow. The bridge on the rail to trail path is undersized and creating localized geomorphic instability.

Centerville R15.02 is a "C" type channel.

Reach R15.03 (Bedrock)

Centerville Brook segment R15.03 is a bedrock gorge between the Route 15 and Main Street crossings east of Hyde Park village. In accordance with ANR protocol, only a partial assessment was conducted on this reach.

Centerville Brook segment R15.03 is a bedrock dominated channel.

Reach R15.04

Centerville Brook reach R15.04 begins just upstream of a major tributary (R15.T04) and flows downstream to the Route 15 culvert crossing just east of Hyde Park village. This reach was divided into four segments due to significant changes in channel confinement and bedrock grade controls.

Segment R15.04-A (Bedrock)

Protect River Corridor

Centerville Brook segment R15.04-A is a bedrock dominated channel. In accordance with ANR protocol, only a partial assessment was conducted on this reach.

Centerville Brook segment R15.04-A is a bedrock gorge.

Segment R15.04-B
Protect River Corridor
Centerville Brook segment R15.04-B is located in between two bedrock dominated segments. The valley walls in this segment broaden allowing for the deposition of sediments and a more active stream channel. Evidence of beaver damming was found near the downstream end. This damming in addition to the natural bedrock constriction found at the downstream end may account for some of the extensive sediment storage, incision, and planform adjustment that was observed in this reach. The stream is a "C" channel with a riffle-pool bedform through this segment.

Centerville Brook segment R15.04-B appears to have historically incised.

Segment R15.04-C (Bedrock)
Protect River Corridor
Centerville Brook segment R15.05-C begins just below the confluence with a tributary. In accordance with ANR protocol, only a partial assessment was conducted on this bedrock dominated segment.

Centerville Brook segment R15.04-C is a bedrock gorge.

Segment R15.04-D

Protect River Corridor

Centerville Brook R15.04-D is a short segment (850 ft.) which flows between two sections of bedrock gorge. The valley in this segment widens considerably and the streambed turns into an "E" steam type with a gravel riffle-pool bedform. The stream through this section appears to have been historically straightened and the buffer on the west bank seems to have been greatly altered. In response to these alterations, the channel was found to be undergoing minor aggradation, widening and planform adjustments.

Centerville Brook segment R15.04-D is an "E" channel that has been historically straightened.

Reach R15.05
Centerville Brook reach R15.05 begins at the confluence with a major tributary (R15.T05) and continues downstream for over two miles to just below the Pair Farm Road crossing). The reach was broken into five segments due to changes in reference stream type, bed and bank material, and confinement.

Segment R15.05-A (Bedrock)
Centerville Brook R15.05-A begins just upstream from the private Pair Farm Road bridge where a very broad valley becomes confined and where the Centerville Brook encounters a bedrock dominated channel and a series of small waterfalls. Due to these waterfalls this segment only received a partial geomorphic assessment.

Segment R15.05-A is a bedrock dominated channel with several small waterfalls.

Segment R15.05-B (Wetland)
Protect River Corridor
Centerville Brook segment R15.05-B begins above Slobada Road and continues downstream for over a mile crossing under Cleveland Corners and Silver Ridge roads. The stream corridor through this long reach is surrounded by hay fields; however, due to the wetland-type nature of the stream channel, agriculture has generally remained out of the immediate floodplain. Instead, a healthy riparian corridor lines both banks through almost the entire segment. This riparian vegetation is providing food and habitat for beavers that are actively damming the channel throughout this segment.

Centerville Brook segment R15.05-B has good floodplain access and numerous active beaver dams.

Segment R15.05-C
Improve Riparian Buffer (CREP)
Protect River Corridor

Centerville Brook segment R15.05-C begins at the Frost Road culvert off of Brook Road and continues downstream for 2200 feet to where the slope, sinuosity and influence of beavers were reason for a segment break.

The channel in Segment R15.05-C is narrow and deep.

Segment R15.05-D (Bedrock)
Improve Riparian Buffer
Replace bridge

Centerville segment R15.05-D is a short (600 ft.) section of channel that begins where bedrock grade controls appear in the channel near the upper pastures of a dairy farm and ends at the culvert under Frost Road. The stream in this segment is controlled by bedrock on the bed and banks and therefore only received a partial Phase 2 assessment.

Centerville Brook segment R15.05-D is controlled by bedrock on the bed and banks.

Segment R15.05-E
Improve Riparian Buffer
Protect River Corridor

Centerville Brook segment R15.05-E begins at the confluence with a major tributary. The segment flows through a predominately undisturbed wetland area that is heavily vegetated with alder, willow, spruce, and fir. The channel through this segment is highly sinuous and has good floodplain access with abundant floodplain wetland noted. The stream is an "E" type channel that has been historically influenced by beavers (currently only the very upper portion of the segment is impounded). The channel did have evidence of some minor channel adjustment such as widening, aggradation, and planform. These observed adjustments are likely attributed to the highly dynamic nature (dam and avulsion, store and release) of beaver influenced channels.

Segment R15.05-E is a heavily vegetated "E" type channel.

Reach R15.06

Centerville Brook reach R15.06 begins just below the confluence with a major tributary (R15.T07) and ends at the confluence with another major tributary (R15.T05). The reach was broken into two segments due to a large beaver dam that created an impoundment in the lower 1000 feet of the reach.

Segment R15.06-A (Wetland)
Improve Riparian Buffer
Protect River Corridor

Centerville Brook segment R15.06-B has been impounded by a large beaver dam. Due to this impoundment this segment did not receive a full geomorphic and habitat assessment.

Segment R15.06-A is a wetland system due to a beaver dam.

Segment R15.06-B
Improve Riparian Buffer (CREP)
Protect River Corridor

Segment R15.06-B begins just below the confluence with tributary R15T.07. The land use on both banks is pasture for a dairy operation. Brook Road borders the stream on the east bank.

R15.06-B is a C channel that is widening and adjusting planform.

Reach R15.07

Centerville Brook reach R15.07 begins at the dam on Centerville Road and continues downstream to just below the confluence of a major tributary which enters on the west bank. The reach was segmented due to bedrock grade control which dominated the channel bottom in the upper portion of the reach.

Segment R15.07-A
Improve Riparian Buffer
Replace undersized culvert
Arrest headcut

Centerville Brook segment R15.07-A is drastically different from its upstream segment. The segment begins at a small waterfall where the valley walls broaden and the slope of the channel decreases. This upper most area was historically an alder swamp until a landslide during the summer of 2006 occurred. Following the slide the material was allowed to be graded out at the site and the stream was locked into place with stone rip-rap for one hundred feet. There was excessive erosion, an active headcut, and very soft sediments in this upper portion of the reach. These sediments were found to be transporting downstream to a culvert under Brook Road. On the other side of the culvert the land use changes to pasture, however, the stream remains an “E” type channel with alder lining the banks except where cows have trampled the banks and vegetation for access to the stream. With the exception of the uppermost area where a small headcut is active, the channel does not appear to have incised recently, however there is evidence of minor widening, aggradation, and planform adjustment in response to changes in boundary conditions, heavy pasturing in the floodplain, a culvert, and the mass failure.

R15.07-A is an “E” channel with alder vegetation and active pasture on both banks.

Segment R15.07-B (Bedrock)

Replace freefall culvert

Centerville Brook segment R15.07-B is a short section of channel that begins at the Centerville Road crossing and continues downstream through a series of bedrock waterfalls. Due to the extensive bedrock in the stream channel only a partial stream geomorphic assessment was conducted.

Centerville Brook segment R15.07-B is dominated by bedrock grade controls.

Reach R15.08 (Wetland)

Protect River Corridor

Centerville Brook reach R15.08 begins at a human-made dam just upstream from the crossing of Centerville Road. This dam, along with several beaver dams, creates a series of wetlands through most of this reach. Due to the impoundments a complete geomorphic assessment of the reach was not possible; however, field scientists walked the majority of the reach in order to evaluate some of the Phase 2 parameters. The dominant impact to this reach is the lack of a wide riparian buffer or filter strip along an active cow pasture.

Reach R15.08 is a wetland system due to a human-made dam and several beaver dams.

7.3 Site Level Opportunities

Site specific projects were identified using the criteria outlined by the ANR 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 project and restore river equilibrium. The site level projects that were developed for the Centerville Brook are provided below in Table 9. 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 ANR bridge and culvert assessment could be used to inform the Town of Hyde Park of which stream crossings are contributing to localized instability.

The project strategy, technical feasibility, and priority for each project are listed by project number and reach. A total of fifteen projects were identified to promote the restoration or projection of channel stability and aquatic habitat in the Centerville Brook watershed. Table 9 provides information for each project, including the project strategy, technical feasibility, and general cost. The projects are broken down by category as follows: 5 passive restoration (corridor protection and buffer improvement projects); 7 active restoration (5 bridge or culvert replacement or retrofit projects, and a potential channel restoration and dam removal project). The project locations and categories identified for Centerville Brook are depicted below in Figure 21 for the lower part of the study area and Figure 22 for the upper portion. The high priority projects are all located within the Town of Hyde Park. These high priority projects include:

- **Passive Restoration** of river corridor and riparian buffer from Cady's Falls Road to Lamoille River in Hyde Park and Morristown (project #1)
- **Conservation** of river corridor from below Main Street in Hyde Park (project #3);
- **Active Restoration** by replacing/removing undersized and deteriorated railroad bridge near Rail to Trail Project (project #4);
- **Passive Restoration** of river corridor and riparian buffer between Pair Farm Lane and VT15E in Hyde Park (project #5);
- **Passive Restoration** of river corridor and riparian buffer from above Frost Road to Silver Ridge Road (project #6);
- **Passive Restoration** of river corridor and riparian buffer near Godin Road Crossing (project #10)
- **Passive Restoration** of river corridor **and active** buffer plantings upstream of Godin Road Crossing (Project #11);
- **Active Restoration** of straightened and filled channel and possible restoration work to arrest localized head cut upstream of Brook Road Crossing (project #12);
- **Active Restoration** of reach above Centerville Road by removing concrete dam (project #15)

Table 9. Centerville Brook Site Level Opportunities for Restoration and Protection Hyde Park, 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 Cady's Falls Road to Lamoille River in Hyde Park and Morristown R1501-A	Passive Restoration	Abandoned agricultural fields; segment A is currently widening and will continue to adjust.	Protect River Corridor through corridor easement and Improve stream buffer by establishing no mow zone	High priority for corridor easement (natural attenuation area); Low priority for plantings	Flood and sediment attenuation; Prevent erosion, improve habitat and reduce water temperature	Cost of corridor easements; Low cost for plantings; no cost to stop mowing	Abandoned fields to forested	ANR, LCPC, landowners
#2 Approximately 500 feet upstream of Lamoille River on Hyde Park/ Morristown line R1501-A	Active Restoration	Abandoned agricultural fields	Replace undersized farm bridge	Moderate to high priority if financially feasible; private stream crossing	Improve sediment transport, reduce debris jam potential	High cost to replace structure	None	ANR, landowner
#3 Below E. Main Street in Hyde Park R1502	Conservation	Upper end of reach is bedrock dominated with grade controls; stream reach in good condition with healthy riparian corridor near town center	Conserve River Corridor through corridor easement	High priority for conservation easement	Nice resource	Cost of corridor easements	No new structures in corridor	ANR, LCPC, landowners, land trust
#4 Old railroad bridge about 900 feet south-west of E. Main Street in Hyde Park R1502	Active Restoration	Old railroad bridge undersized and causing problems	Replace/remove undersized bridge	High priority if this is not being addressed as part of the rail to trail project	Improve sediment transport, reduce debris jam potential	High cost to replace structures/ lower cost to remove	None	ANR, Town of Hyde Park, LCPC, Lamoille Valley Recreation Trail Committee

Table 9. Centerville Brook Site Level Opportunities for Restoration and Protection
Hyde Park, 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 R1504-B Between Pair Farm Lane and VT15E in Hyde Park	Passive Restoration	Natural flood and sediment attenuation area between bedrock grade controls; excessive sediment storage noted; channel is currently widening and will continue to adjust.	Protect River Corridor through corridor easement	High priority for corridor easement	Important flood and sediment attenuation asset	Cost of corridor easements	No new structures in corridor	ANR, LCPC, landowners, land trust
#6 From above Frost Road to Silver Ridge Road R1505- C	Passive Restoration	Residential and agricultural land uses and an area of bedrock gorge lacking riparian vegetation; segments C and E are currently widening and will continue to adjust.	Protect River Corridor through corridor easement and/or CREP; Improve Riparian Buffer	High priority for corridor easement; Low priority for plantings; establish no mow zone	Flood and sediment attenuation; Prevent erosion, improve habitat and reduce water temperature	Cost of corridor easements; Low cost of plantings or no cost to stop mowing	Agricultural and residential land to forested	ANR, LCPC, landowners, CREP
#7 Frost Road in Hyde Park R1505-D	Active Restoration	At transition between bedrock controlled section and gravel dominated section	Replace Undersized bridge with poor alignment	Moderate –high priority	Improve sediment transport, reduce debris jam potential	High cost to replace structure	None	ANR, Town of Hyde Park, VTRANS
#8 Above bedrock controlled section near Frost Road in Hyde Park R1505-E	Conservation	Small areas of agricultural land, upper end is forested	Protect River Corridor	Moderate priority for conservation easement; wetland at upper end of segment offers some protection	Flood and sediment attenuation	Cost of corridor easements	No new structures in corridor	ANR, LCPC, landowners, land trust, CREP
# 9 Adjacent to Brook Road in Hyde Park R1506-A	Conservation	Beaver dam influence	Protect River Corridor	Low priority for conservation easement; wetland already offers some protection	Flood and sediment attenuation	Cost of conservation easement	No new structures in corridor	ANR, LCPC, landowners, land trust

**Table 9. Centerville Brook Site Level Opportunities for Restoration and Protection
Hyde Park, 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
#10 Segment runs adjacent to Brook Road near Godin Road Crossing R1506-B	Passive Restoration	Agricultural and residential land uses; segment is in currently widening and will continue to adjust.	Protect river corridor through corridor easement; Improve Riparian Buffer	High priority for corridor easement); Low priority for plantings; establish no mow zone	Prevent erosion, improve habitat and reduce water temperature	Cost of corridor easement; plantings not recommended	Agricultural to forested	ANR, LCPC, landowners, CREP
#11 Upstream of Godin Road Crossing R1507-A	Passive Restoration	Modified channel with agricultural land use; active livestock grazing is disturbing banks; segment is an important sediment attenuation area	Protect river corridor through corridor easement; Improve Riparian buffer through voluntary plantings or CREP; fence livestock	High priority for corridor easement; high priority for plantings	Prevent erosion, improve habitat and reduce water temperature	Cost of plantings and corridor easement	Agricultural to forested	ANR, LCPC, landowners, CREP
#12 Upstream of Brook Road Crossing R1507-A	Active Restoration	Modified channel with agricultural land use; channel alterations and floodplain filled in at upstream end of segment. Fill was from a mass failure that filled in wetland. Area was regarded and seeded during summer 2006. Two foot headcut noted in field.	Alternatives analysis to determine is segment would benefit from restoration options. Restoration may involve arresting localized headcut.	High priority	Prevent incision and restore aquatic habitat	Variable depending on cost	None	ANR, LCPC, landowner
#13 Brook Road Crossing R1507-A	Active Restoration	Modified channel with agricultural land use	Replace undersized culvert at Brook Road	Moderate to high	Improve sediment transport, reduce debris jam potential	High cost to replace structures	None	ANR, Town of Hyde Park, VTRANS

Table 9. Centerville Brook Site Level Opportunities for Restoration and Protection Hyde Park, 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 Centerville Road Crossing R1507-B	Active Restoration	Bedrock gorge	Replace undersized, freefall culvert at Centerville Road	Moderate to high	Improve sediment transport, reduce debris jam potential	High cost to replace structures	None	ANR, Town of Hyde Park, VTRANS
#15 Upstream of Centerville Road Crossing R1508	Active Restoration	Wetland channel due to concrete dam, which is 7.5 feet high.	Alternatives analysis for dam removal	High priority for dam removal	Restore aquatic organism passage and riverine habitat.	Very high construction and permitting costs for structure removal and channel restoration	Wetland to riverine habitat	ANR, LCPC, landowners

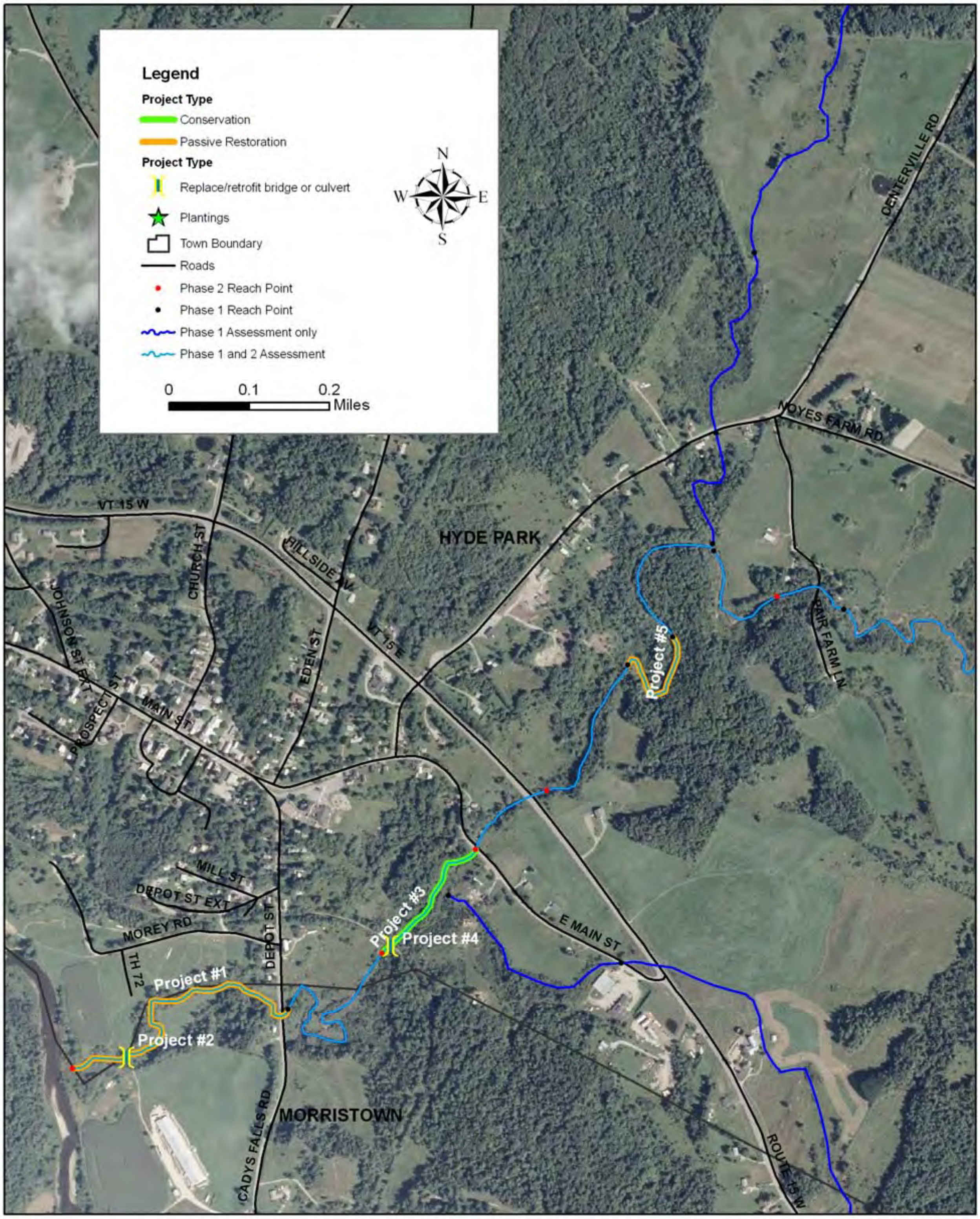


Figure 21. Proposed restoration and protection projects for the lower Centerville Brook mainstem.

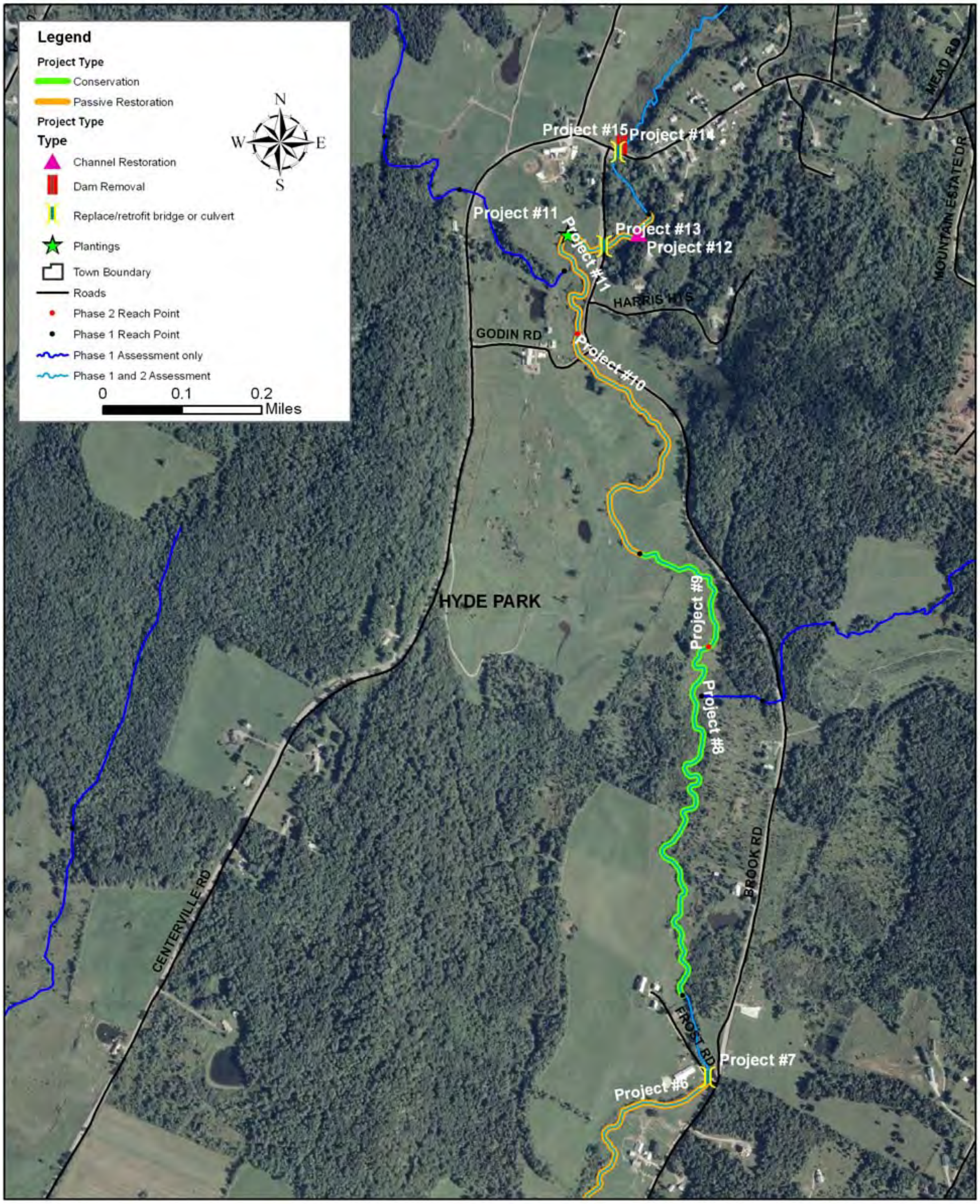


Figure 22. Proposed restoration and protection projects for the upper Centerville Brook mainstem.

7.4 Next Steps

There are many opportunities to restore the Centerville Brook 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, dam removal, and active restoration projects. 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 Hyde Park 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 Centerville Brook. 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@lcpcvt.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_apxqglossary.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 overwide 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.

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Appendix

Phase 2 Stream Geomorphic Assessment Reports

Centerville Brook

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Project: Centerville Brook
Stream: Centerville Brook — Reach # R1501 — Segment: A — Completion Date: **September 27, 2006**
Organization: **Bear Creek Environmental** — Observers: **Mike Blazewicz and Mary** — Why Not assessed: — Rain: **No**
Segment Length (ft): **1,850** — Segment Location: **Reach begins at confluence with Lamoille River and continues upstream to Cady's Falls Rd.**

QC Status - Staff: Passed — Cons Passed

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	238	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	142

1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features
Valley Width (ft) **420**
Width Determination **Estimated**
Confinement Type **Very Broad**
Rock Gorge? **No**
Human-caused Change? **No**

Step 2. Stream Channel

2.1 Bankfull Width **32**
2.2 Max Depth (ft) **3.70**
2.3 Mean Depth (ft) **2.36**
2.4 Floodprone Width (ft) **380**

Notes:
Bedrock on bed and banks in upper ~200 ft; "E" channel by reference (low width to depth ratio and cohesive soils); stream type departure (STD) from "E" to "C" channel. Evidence of major widening.

Step 2. (Contued)

2.5 Aband. Floodpln **5.50** ft.
Human Elev Floodpln **0.00** ft.
2.6 Width/Depth Ratio **13.35**
2.7 Entrenchment Ratio **12.06**
2.8 Incision Ratio **1.49**
Human Elevated Inc Rat **0.00**
2.9 Sinuosity **Moderate**
2.10 Riffles Type **Complete**
2.11 Riffle/Step Spacing (ft) **170**

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	2 %
Coarse Gravel	44 %
Fine Gravel	25 %
Sand	29 %
Silt and smaller	0 %

Silt/Clay Present? **Yes**
Detritus **3** %
Large Woody **25**

2.13 Average Largest Particle on
Bed **10.0** 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	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive
Bank Erosion	Left	Right
Erosion Length (ft)	1,004	1,010
Erosion Height (ft)	5.26	5.73
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	40	44
Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	None	None
Bank Canopy	Left	Right
Canopy %	1-25	1-25
Mid-Channel Canopy	Open	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	51-100	0-25
Sub-dominant	0-25	26-50
W less than 25	0	0
Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Hay	Hay
Sub-dominant	Crop	Forest
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**
4.2 Adjacent Wetlands **Minimal**
4.3 Flow Status **Low**
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
(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
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	Diagonal	Delta	Island
3	8	3	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 **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.

Stream: Centerville Brook | Reach # R1501 | Segment: A | Completion Date: September 27,

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mary Nealon | Rain: No

Segment Length (ft): 1,850 | Segment Location: Reach begins at confluence with Lamoille River and continues upstream to Cady's Falls

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Upstream	2.00	1.00		
Ledge	Upstream	0.00	0.00		
Ledge	Upstream	0.00	0.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	19.0	Yes	No	Yes	Yes
Problem	Deposition Above,Deposition Below,Scour				
Bridge	12.0	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	**9**	**Other**	**Yes**
7.2 Channel Aggradation	**11**	**None**	**No**
7.3 Widening Channel	**8**		**No**
7.4 Change in Planform	**5**		**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: High

	Score
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	12
6.4 Sediment Deposition	8
6.5 Channel Flow Status	9
6.6 Channel Alteration	18
6.7 Frequency of Riffles/Steps	17
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 4 Right: 4
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 2
Total Score	110
Habitat Rating	0.55

Habitat Stream Condition: Fair

Narrative:

Historic degradation (likely associated with incision of Lamoille), active widening and extensive platform adjustment.

Stream: Centerville Brook | Reach # R1501 | Segment: B | Completion Date: September 27, 2006

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mary | Why Not assessed: impounded | Rain: No

Segment Length (ft): 1,909 | Segment Location: Begins at Cady's Falls Rd. bridge and continues upstream to just below Railroad crossing.

QC Status - Staff: Provisional Cons Passed

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	148	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/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

- Valley Width (ft): **520**
- Width Determination: **Estimated**
- Confinement Type: **Very 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:

Reference E4 stream. Straightened and not impounded by beaver in upper 250 ft. otherwise beaver impounded. Administrative judgment of "fair" entered. This segment is experiencing a moderate amount of bank erosion. The flood chute and neck cutoff

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

Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	0%
Sand	0%
Silt and smaller	0%

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: **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	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive
Bank Erosion	**Left**	**Right**
Erosion Length (ft)	587	672
Erosion Height (ft)	5.00	5.00
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	47
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	0-25
Sub-dominant	None	0-25
W less than 25	0	0
Buffer Veg. Type	**Left**	**Right**
Dominant	Mixed Trees	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

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

Step 4. Flow & Flow Modifiers

- 4.1 Springs / Seeps: **Minimal**
- 4.2 Adjacent Wetlands: **Abundant**
- 4.3 Flow Status: **Low**
- 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
  - (old) Upstrm Flow Reg: **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams: **4**

Affected Length (ft): **1,252**

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

Flood	Neck Cutoff	Avulsion	Braiding
1	1	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
1	0	

- 5.4 Stream Ford or Animal: **No**
- 5.5 Straightening: **Straightening**
  - Straightening Length: **567**
- 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.

Stream: Centerville Brook | Reach # R1501 | Segment: B | Completion Date: September 27,

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mary Nealon | Rain: No

Segment Length (ft): 1,909 | Segment Location: Begins at Cady's Falls Rd. bridge and continues upstream to just below Railroad

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken

4.8 Channel Constrictions **None**

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

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Fair

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Project: Centerville Brook
Stream: Centerville Brook Reach # R1502 Segment: 0 Completion Date: September 25, 2006
Organization: Bear Creek Environmental Observers: Michael Blazewicz and Mike Why Not assessed: Rain: No
Segment Length (ft): 971 Segment Location: Reach begins at railroad bridge crossing and continues upstream to the Main Street bridge.

QC Status - Staff: Passed Cons Passed

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	99	47

1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Always	Never
Texture	Bedrock	Not Evalua

1.5 Valley Features
Valley Width (ft) 250
Width Determination Estimated
Confinement Type Broad
Rock Gorge? No
Human-caused Change? no

Step 2. Stream Channel

2.1 Bankfull Width 32
2.2 Max Depth (ft) 2.70
2.3 Mean Depth (ft) 1.71
2.4 Floodprone Width (ft) 103

Notes:
upstream 250 of reach is bedrock dominated channel w/ grade control

Step 2. (Contued)

2.5 Aband. Floodpln 3.10 ft.
Human Elev Floodpln 0.00 ft.
2.6 Width/Depth Ratio 18.71
2.7 Entrenchment Ratio 3.22
2.8 Incision Ratio 1.15
Human Elevated Inc Rat 0.00
2.9 Sinuosity Low
2.10 Riffles Type Complete
2.11 Riffle/Step Spacing (ft) 250

2.12 Substrate Composition

Bedrock	0%
Boulder	11%
Cobble	47%
Coarse Gravel	21%
Fine Gravel	12%
Sand	9%
Silt and smaller	0%

Silt/Clay Present? No
Detritus 5 %
Large Woody 5

2.13 Average Largest Particle on
Bed 24.0 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	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	59
Erosion Height (ft)	0.00	3.00
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	49	0
Near Bank Veg. Type	**Left**	**Right**
Dominant	Deciduous	Deciduous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin
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	None	None
W less than 25	0	0
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	None
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps Minimal
4.2 Adjacent Wetlands 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
(old) Upstrm Flow Reg None

4.7 StormwaterInputs

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

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
2	0	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 No
5.5 Straightening Straightening
Straightening Length: 168
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.

Stream: Centerville Brook | Reach # R1502 | Segment: 0 | Completion Date: September 25,

Organization: Bear Creek Environmental | Observers: Michael Blazewicz and Mike Adams | Rain: No

Segment Length (ft): 971 | Segment Location: Reach begins at railroad bridge crossing and continues upstream to the Main Street

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken
Ledge	Upstream	0.00	0.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	12.0	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	**16**	**None**	**No**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**16**		**No**
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	15
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	13
6.5 Channel Flow Status	13
6.6 Channel Alteration	14
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 9 Right: 9
6.9 Bank Vegetation Protection	Left: 8 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 8 Right: 9
Total Score	148
Habitat Rating	0.74

Habitat Stream Condition Good

Narrative:

No major adjustments

Project: Centerville Brook	Phase 2 Segment Summary	page 1 of 2	June 19, 2009 SGAT Version: 4.53
Stream: Centerville Brook	Reach # R1503	Segment: 0	Completion Date: **September 25, 2006**
Organization: **Bear Creek Environmental**	Observers: **Mike Blazewicz and Mike**	Why Not assessed: **Other (to be explained in**	Rain: **No**
Segment Length (ft): **642**	Segment Location: **Reach is between Main Street Bridge and Route 15 Culvert.**		

QC Status - Staff: Provisional Cons Passed

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	124

1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Always	Always
Texture	Bedrock	Bedrock

1.5 Valley Features

- Valley Width (ft) **130**
- Width Determination **Estimated**
- Confinement Type **Semi-confined**
- 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:

Bedrock Controlled reach, some B/c 3 channel. Reach does not meet the description of a bedrock gorge in the Phase 2 protocol (bedrock banks as least 10 feet high), yet is heavily influeced by bedrock at both ends of the reach. This reach is in good

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

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	0 %
Fine Gravel	0 %
Sand	0 %
Silt and smaller	0 %

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	None	Rip-Rap
Revetmt. Length (ft)	0	81

Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
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	26-50
Sub-dominant	None	None
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	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

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

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
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
0	0	0
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	

- 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.

Stream: Centerville Brook | Reach # R1503 | Segment: 0 | Completion Date: September 25,

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mike Adams | Rain: No

Segment Length (ft): 642 | Segment Location: Reach is between Main Street Bridge and Route 15 Culvert.

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Downstream	0.00	0.00		
Ledge	Upstream	0.00	0.00		
Ledge	Upstream	0.00	0.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	15.0	Yes	No	Yes	Yes
Problem	Scour Below				
Bedrock	15.0	Yes	No	Yes	Yes
Problem	None				
Culvert	12.0	Yes	No	Yes	Yes
Problem	Scour Below				

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Stream: Centerville Brook	Reach # R1504	Segment: A	Completion Date: September 28, 2006
Organization: Bear Creek Environmental	Observers: Mike Blazewicz, Mike Adams	Why Not assessed: Other (to be explained in	Rain: No
Segment Length (ft): 1,100	Segment Location: Segment begins at Route 15 culvert and continues upstream for 1100 feet to a bedrock		

QC Status - Staff: Provisional Cons Passed

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	0

1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Bedrock	Bedrock

1.5 Valley Features

Valley Width (ft) **190**

Width Determination **Measured**

Confinement Type **Narrow**

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:

Bedrock dominated channel. B1 or F1 by reference. Reach does not meet the description of a bedrock gorge in the Phase 2 protocol (bedrock banks as least 10 feet high), yet is heavily influeced by bedrock and unassessable. Segment not assessed for

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

Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	0%
Sand	0%
Silt and smaller	0%

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)

B **1** **Non Bedrock**

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)	165	177
Erosion Height (ft)	3.54	2.59
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	155

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

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	None	None
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	None	Shrubs/Saplin

3.3 Riparian Corridor

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

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Low**

4.4 # of Debris Jams **1**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments **None**

Impoundmt. Location

4.6 Up/Down strm flow reg

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

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	

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.

Stream: Centerville Brook | Reach # R1504 | Segment: A | Completion Date: September 28,

Organization: Bear Creek Environmental | Observers: Mike Blazewicz, Mike Adams | Rain: No

Segment Length (ft): 1,100 | Segment Location: Segment begins at Route 15 culvert and continues upstream for 1100 feet to a

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Downstream	0.00	0.00		
Waterfall	Mid-Segment	3.00	3.00		
Ledge	Upstream	0.00	0.00		
Waterfall	Upstream	4.00	4.00		

4.8 Channel Constrictions **None**

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

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Project: Centerville Brook | **Phase 2 Segment Summary** June 19, 2009 SGAT Version: 4.53

Stream: **Centerville Brook** Reach # **R1504** Segment: **B** Completion Date: **September 28, 2006**

Organization: **Bear Creek Environmental** Observers: **Mike Blazewicz, Mike Adams** Why Not assessed: Rain: **No**

Segment Length (ft): **700** Segment Location: **Segment begins above a grade control and goes upstream for 700 feet to where the valley**

QC Status - Staff: Passed **Cons** Passed

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

1.5 Valley Features

Valley Width (ft) **362**

Width Determination **Estimated**

Confinement Type **Very Broad**

Rock Gorge? **No**

Human-caused Change? **no**

Step 2. Stream Channel

2.1 Bankfull Width **35**

2.2 Max Depth (ft) **2.90**

2.3 Mean Depth (ft) **1.94**

2.4 Floodprone Width (ft) **362**

Notes:

Segment R15.04-B is located between two bedrock dominated segments. The valley walls in this segment broaden allowing for the deposition of sediments and a more active stream channel. Evidence of beaver damming was found near the downstream

Step 2. (Contued)

2.5 Aband. Floodpln **4.40** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **17.78**

2.7 Entrenchment Ratio **10.49**

2.8 Incision Ratio **1.52**

Human Elevated Inc Rat **0.00**

2.9 Sinuosity **Moderate**

2.10 Riffles Type **Complete**

2.11 Riffle/Step Spacing (ft) **200**

2.12 Substrate Composition

Bedrock	0%
Boulder	4%
Cobble	26%
Coarse Gravel	35%
Fine Gravel	18%
Sand	17%
Silt and smaller	0%

Silt/Clay Present? **Yes**

Detritus **5** %

Large Woody **15**

2.13 Average Largest Particle on

Bed **24.0** 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	One	15.00
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	Sand
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	291	345
Erosion Height (ft)	6.45	3.59
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

Bank Canopy	Left	Right
Canopy %	26-50	1-25

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	None
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Coniferous	Shrubs/Saplin
Sub-dominant	Deciduous	Coniferous

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **Minimal**

4.3 Flow Status **Low**

4.4 # of Debris Jams **2**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments **None**

Impoundmt. Location

4.6 Up/Down strm flow reg

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

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

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.
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.

Stream: Centerville Brook | Reach # R1504 | Segment: B | Completion Date: September 28,

Organization: Bear Creek Environmental | Observers: Mike Blazewicz, Mike Adams | Rain: No

Segment Length (ft): 700 | Segment Location: Segment begins above a grade control and goes upstream for 700 feet to where the

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	25.0	Yes	No	Yes	Yes

Problem Deposition Above

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Unconfined

	Score	STD	Historic
7.1 Channel Degradation	**12**	**None**	**Yes**
7.2 Channel Aggradation	**12**	**None**	**No**
7.3 Widening Channel	**11**		**No**
7.4 Change in Planform	**9**		**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
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	14
6.4 Sediment Deposition	9
6.5 Channel Flow Status	12
6.6 Channel Alteration	16
6.7 Frequency of Riffles/Steps	11
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 8 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 9
Total Score	129
Habitat Rating	0.645

Habitat Stream Condition Good

Narrative:

Channel appears to have incised. Grade control at upstream and downstream end of this short reach. Aggradation may have been from beavers and channel is cutting back through this sediment. Minor agg and widening. Major planform adjst. III to IV

Project: Centerville Brook | **Phase 2 Segment Summary** | June 19, 2009 SGAT Version: 4.53

Stream: **Centerville Brook** Reach # **R1504** Segment: **C** Completion Date: **September 28, 2006**

Organization: **Bear Creek Environmental** Observers: **Mike Blazewicz, Mike Adams** Why Not assessed: **Other (to be explained in** Rain: **No**

Segment Length (ft): **1,186** Segment Location: **Begins at the bottom of a bedrock dominated section and continues upstream for 1186 feet.**

QC Status - Staff: **Provisional** Cons **Passed**

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	0

1.4 Adjacent Side	Left	Right
Hillside Slope	**Steep**	**Steep**
Continuous w/	**Sometimes**	**Sometimes**
W/in 1 Bankfill	**Sometimes**	**Always**
Texture	**Bedrock**	**Bedrock**

1.5 Valley Features

Valley Width (ft) **190**

Width Determination **Measured**

Confinement Type **Narrow**

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:

Bedrock dominated B/F1 channel. Reach does not meet the description of a bedrock gorge in the Phase 2 protocol (bedrock banks as least 10 feet high), yet is heavily influeced by bedrock and unassessable. For these reasons, this segment was not assessed. In

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

Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	0%
Sand	0%
Silt and smaller	0%

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)

B **1** **Non Bedrock**

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)	**78**	**107**
Erosion Height (ft)	**2.00**	**2.00**
Revetmt. Type	**None**	**None**
Revetmt. Length (ft)	**0**	**0**

Near Bank Veg. Type	Left	Right
Dominant	**Coniferous**	**Coniferous**
Sub-dominant	**None**	**None**

Bank Canopy	Left	Right
Canopy %	**76-100**	**76-100**

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**>100**
Sub-dominant	**None**	**None**
W less than 25	**0**	**0**

Buffer Veg. Type	Left	Right
Dominant	**Coniferous**	**Coniferous**
Sub-dominant	**None**	**None**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Forest**
Sub-dominant	**None**	**None**
Mass Failures	**0**	**0**
Height	**0**	**0**
Gullies	**0**	**0**
Height	**0**	**0**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Low**

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

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	**0**	**0**
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**	

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.

Stream: Centerville Brook   Reach # R1504   Segment: C   Completion Date: September 28,

Organization: Bear Creek Environmental   Observers: Mike Blazewicz, Mike Adams   Rain: No

Segment Length (ft): 1,186   Segment Location: Begins at the bottom of a bedrock dominated section and continues upstream for 1186

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Downstream	0.00	0.00		
Ledge	Mid-Segment	0.00	0.00		
Ledge	Mid-Segment	0.00	0.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bedrock	25.0	Yes	No	Yes	No

Problem None

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Narrative:

Project: Centerville Brook

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Stream: Centerville Brook   Reach # R1504   Segment: D   Completion Date: September 28, 2006

Organization: Bear Creek Environmental   Observers: Mike Blazewicz, Mike Adams   Why Not assessed: Rain: No

Segment Length (ft): 850   Segment Location: Begins at the top of a bedrock gorge where the valley widens and continues upstream to the

QC Status - Staff: Passed   Cons   Passed

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	Very Steep	Hilly
Continuous w/	Never	Never
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? **No**

Step 2. Stream Channel

2.1 Bankfull Width **25**

2.2 Max Depth (ft) **3.90**

2.3 Mean Depth (ft) **3.00**

2.4 Floodprone Width (ft) **268**

Notes:

some evidence of historic channel straightening, looks like some very old rip-rap in channel

Step 2. (Contued)

2.5 Aband. Floodpln **3.90** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **8.33**

2.7 Entrenchment Ratio **10.72**

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) **400**

2.12 Substrate Composition

Bedrock	0 %
Boulder	1 %
Cobble	11 %
Coarse Gravel	54 %
Fine Gravel	18 %
Sand	16 %
Silt and smaller	0 %

Silt/Clay Present? **Yes**

Detritus **5** %

Large Woody **14**

2.13 Average Largest Particle on

Bed **6.0** inches

Bar **4.0** 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)

E 4 Non Riffle-Pool

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture	Left	Right
Upper		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Sand	Sand
Consistency	Non-cohesive	Non-cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	285	185
Erosion Height (ft)	4.25	3.55
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	51-100
Sub-dominant	None	>100
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Shrubs/Saplin
Sub-dominant	None	Hay
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **Abundant**

4.3 Flow Status **Low**

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

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	1	2
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 **No**

5.5 Straightening **Straightening**

Straightening Length: **387**

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: Centerville Brook | Phase 2 Reach Summary | June 19, 2009

Stream: Centerville Brook | Reach # R1504 | Segment: D | Completion Date: September 28,

Organization: Bear Creek Environmental | Observers: Mike Blazewicz, Mike Adams | Rain: No

Segment Length (ft): 850 | Segment Location: Begins at the top of a bedrock gorge where the valley widens and continues upstream

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Upstream	0.00	0.00		

4.8 Channel Constrictions **None**

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

Narrative:

only minor adjustment observed

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Unconfined

	Score	STD	Historic
7.1 Channel Degradation	**16**	**None**	**No**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**14**		**No**
7.4 Change in Planform	**13**		**No**
Total Score	**56**		
Geomorphic Rating	**0.7**		

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	8
6.2 Embeddedness	10
6.3 Velocity/Depth Patterns	10
6.4 Sediment Deposition	9
6.5 Channel Flow Status	13
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	10
6.8 Bank Stability	Left: 5 Right: 7
6.9 Bank Vegetation Protection	Left: 7 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 6
Total Score	111
Habitat Rating	0.555

Habitat Stream Condition Fair

Stream: **Centerville Brook** Reach # **R1505** Segment: **A** Completion Date: **October 4, 2006**

Organization: **Bear Creek Environmental** Observers: **Mike Blazewicz and Mike** Why Not assessed: **bedrock gorge** Rain: **No**

Segment Length (ft): **525** Segment Location: **Begins downstream from the Pair Farm Road bridge and continues upstream to where the**

QC Status - Staff: **Provisional** Cons **Passed**

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	116	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) **35**

Width Determination **Measured**

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:

Bedrock channel - F1 stream type. This segment has multiple bedrock grade controls (5 mapped). A small amount of bank erosion was mapped at the upper end of this segment. Other than one flood chute, there was no evidence of planform adjustment.

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**

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)	90	0
Erosion Height (ft)	4.00	0.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	None	None

Bank Canopy	Left	Right
Canopy %	51-75	26-50

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	None
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	None	Shrubs/Saplin

3.3 Riparian Corridor

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

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments **None**

Impoundmt. Location

4.6 Up/Down strm flow reg

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0
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	

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.

Stream: Centerville Brook | Reach # R1505 | Segment: A | Completion Date: October 4, 2006

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mike Adams | Rain: No

Segment Length (ft): 525 | Segment Location: Begins downstream from the Pair Farm Road bridge and continues upstream to where

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Waterfall	Downstream	6.00	6.00		
Waterfall	Downstream	4.00	4.00		
Ledge	Mid-Segment	0.00	0.00		
Ledge	Downstream	0.00	0.00		
Waterfall	Downstream	4.00	4.00		
Ledge	Upstream	0.00	0.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	28.0	Yes	No	Yes	Yes
Problem	None				
Bedrock	25.0	Yes	No	Yes	Yes
Problem	None				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Narrative:

Stream: **Centerville Brook** Reach # **R1505** Segment: **B** Completion Date: **October 4, 2006**

Organization: **Bear Creek Environmental** Observers: **Mike Blazewicz and Mike** Why Not assessed: **impounded** Rain: **Yes**

Segment Length (ft): **6,524** Segment Location: **Begins where the valley broadens upstream of the Pair Farm Rd bridge and continues**

QC Status - Staff: **Provisional Cons Passed**

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	823	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	153

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) **300**

Width Determination **Estimated**

Confinement Type **Very 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:

E5, channel heavily influenced by beaver activity, intact alder swamp corridor (Below Silver Ridge Road) - This is a potential conservation section. For the most part this segment appears to be in "good" geomorphic condition. No bars were noted in the reach.

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

Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	0%
Sand	0%
Silt and smaller	0%

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: **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	One	4.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Undercut**

Bank Texture	Left	Right
Upper		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	876	636
Erosion Height (ft)	4.00	4.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	191	142

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	None	None

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	0	0

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

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	0
Height	4	4

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 **None**

Impoundmt. Location

4.6 Up/Down strm flow reg

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **12**

Affected Length (ft) **6,000**

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

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **568**

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.

Stream: Centerville Brook Reach # R1505 Segment: B Completion Date: October 4, 2006

Organization: Bear Creek Environmental Observers: Mike Blazewicz and Mike Adams Rain: Yes

Segment Length (ft): 6,524 Segment Location: Begins where the valley broadens upstream of the Pair Farm Rd bridge and continues

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	15.0	Yes	No	Yes	Yes
Problem	Deposition Above,Scour Below				
Bridge	15.0	Yes	No	Yes	Yes
Problem	Deposition Above,Scour Below				
Culvert	14.0	Yes	No	Yes	Yes
Problem	Scour Above,Scour Below,Alignment				

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Project: Centerville Brook

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Stream: Centerville Brook | Reach # R1505 | Segment: C | Completion Date: October 4, 2006

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mike | Why Not assessed: | Rain: Yes

Segment Length (ft): 2,200 | Segment Location: Reach begins at a bedrock ledge and continues upstream through several farms to the

QC Status - Staff: Passed Cons Passed

Step 1. Valley and Floodplain

1.1 Segmentation **Substrate Size**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	292	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	559	7

1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Sometimes	Never
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? **no**

Step 2. Stream Channel

2.1 Bankfull Width **19**

2.2 Max Depth (ft) **3.30**

2.3 Mean Depth (ft) **2.31**

2.4 Floodprone Width (ft) **156**

Notes:

Segment R15.05C is located immediately downstream of segment R15.05D that is controlled by bedrock on the bed and banks and upstream of Segment R15.05B that was heavily influenced by beaver activity.

Step 2. (Contued)

2.5 Aband. Floodpln **5.00** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **8.01**

2.7 Entrenchment Ratio **8.43**

2.8 Incision Ratio **1.52**

Human Elevated Inc Rat **0.00**

2.9 Sinuosity **Moderate**

2.10 Riffles Type **Complete**

2.11 Riffle/Step Spacing (ft) **200**

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	4 %
Coarse Gravel	55 %
Fine Gravel	29 %
Sand	12 %
Silt and smaller	0 %

Silt/Clay Present? **Yes**

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: **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	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	407	211
Erosion Height (ft)	4.00	4.00
Revetmt. Type	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	84	26

Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
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	26-50	26-50
Sub-dominant	0-25	0-25
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

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

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **Minimal**

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

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **1**

Affected Length (ft) **150**

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	1	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
4	0	No

5.4 Stream Ford or Animal **Yes**

5.5 Straightening **Straightening**

Straightening Length: **31**

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.

Stream: Centerville Brook
Reach # R1505
Segment: C
Completion Date: October 4, 2006
Organization: Bear Creek Environmental
Observers: Mike Blazewicz and Mike Adams
Rain: Yes
Segment Length (ft): 2,200
Segment Location: Reach begins at a bedrock ledge and continues upstream through several farms to the

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?

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Unconfined

	Score	STD	Historic
7.1 Channel Degradation	**10**	**None**	**Yes**
7.2 Channel Aggradation	**14**	**None**	**No**
7.3 Widening Channel	**11**		**No**
7.4 Change in Planform	**9**		**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
6.1 Epifaunal Substrate - Available Cover	11
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	16
6.4 Sediment Deposition	10
6.5 Channel Flow Status	15
6.6 Channel Alteration	13
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 4 Right: 4
6.9 Bank Vegetation Protection	Left: 6 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 4 Right: 4
Total Score	116
Habitat Rating	0.58

Habitat Stream Condition Fair

Narrative:
Some evidence of historic straightening, incision. Current widening and planform adjustment.

Project: Centerville Brook

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Stream: Centerville Brook | Reach # R1505 | Segment: D | Completion Date: October 4, 2006

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mike | Why Not assessed: bedrock gorge | Rain: Yes

Segment Length (ft): 600 | Segment Location: Begins at Frost Road Bridge and continues upstream for 600 feet to end of bedrock

QC Status - Staff: Provisional Cons Passed

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	178	125
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	27

1.4 Adjacent Side	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Always	Always
Texture	Bedrock	Bedrock

1.5 Valley Features

- Valley Width (ft) **30**
- Width Determination **Estimated**
- Confinement Type **Narrowly**
- 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:

Bedrock controlled channel. Reach does not meet the description of a bedrock gorge in the Phase 2 protocol (bedrock banks as least 10 feet high), yet is heavily influeced by bedrock and unassessable. Other than riprap associated with a road crossing at the lower

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

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	0 %
Fine Gravel	0 %
Sand	0 %
Silt and smaller	0 %

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)

B 1 Non Bedrock

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	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	122	60

Near Bank Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	26-50	26-50

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	0-25	0-25
Sub-dominant	None	None
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Deciduous	Deciduous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Pasture	Shrubs/Saplin
Sub-dominant	None	Forest
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

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

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	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	

- 5.4 Stream Ford or Animal **No**
- 5.5 Straightening **Straightening**
  - Straightening Length: **138**
- 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.

Stream: Centerville Brook | Reach # R1505 | Segment: D | Completion Date: October 4, 2006

Organization: Bear Creek Environmental | Observers: Mike Blazewicz and Mike Adams | Rain: Yes

Segment Length (ft): 600 | Segment Location: Begins at Frost Road Bridge and continues upstream for 600 feet to end of bedrock

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Downstream	0.00	0.00		
Ledge	Mid-Segment	0.00	0.00		
Ledge	Mid-Segment	0.00	0.00		
Ledge	Upstream	0.00	0.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	14.0	Yes	No	Yes	Yes
Problem	Scour Above,Scour Below,Alignment				
Bedrock	18.0	Yes	No	Yes	Yes
Problem	Deposition Above				

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Project: **Centerville Brook**
Stream: **Centerville Brook** Reach # **R1505** Segment: **E** Completion Date: **October 4, 2006**
Organization: **Bear Creek Environmental** Observers: **Mike Blazewicz and Mike** Why Not assessed: Rain: **Yes**
Segment Length (ft): **2,900** Segment Location: **Begins upstream from Frost Farm Road where bedrock in channel ends and continues**

QC Status - Staff: Passed Cons Passed

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	Hilly	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features
- Valley Width (ft) **400**
- Width Determination **Estimated**
- Confinement Type **Very Broad**
- Rock Gorge? **No**
- Human-caused Change? **no**

Step 2. Stream Channel

- 2.1 Bankfull Width **24**
- 2.2 Max Depth (ft) **3.80**
- 2.3 Mean Depth (ft) **2.18**
- 2.4 Floodprone Width (ft) **410**

Notes:
Beaver dam/ swamp at upper end of reach

Step 2. (Contued)

- 2.5 Aband. Floodpln **3.80** ft.
- Human Elev Floodpln **0.00** ft.
- 2.6 Width/Depth Ratio **11.01**
- 2.7 Entrenchment Ratio **17.08**
- 2.8 Incision Ratio **1.00**
- Human Elevated Inc Rat **0.00**
- 2.9 Sinuosity **High**
- 2.10 Riffles Type **Complete**
- 2.11 Riffle/Step Spacing (ft) **200**

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	21 %
Fine Gravel	47 %
Sand	32 %
Silt and smaller	0 %

- Silt/Clay Present? **Yes**
- Detritus **5** %
- # Large Woody **10**

2.13 Average Largest Particle on
- Bed **2.5** inches
- Bar **1.0** 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	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	396	588
Erosion Height (ft)	4.00	4.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	1-25	1-25

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	None
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Forest	Forest
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

- 4.1 Springs / Seeps **Abundant**
- 4.2 Adjacent Wetlands **Abundant**
- 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
- (old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
Other	1	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0

4.9 # of Beaver Dams **1**
Affected Length (ft) **700**

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
2	1	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

- 5.4 Stream Ford or Animal **Yes**
- 5.5 Straightening **None**
- Straightening Length: **0**
- 5.5 Dredging **None**

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

Project:	Centerville Brook		Phase 2 Reach Summary	page 2 of 2	June 19, 2009
Stream:	Centerville Brook	Reach #	R1505	Segment: E	Completion Date: October 4, 2006
Organization:	Bear Creek Environmental	Observers:	Mike Blazewicz and Mike Adams		Rain: Yes
Segment Length (ft):	2,900	Segment Location:	Begins upstream from Frost Farm Road where bedrock in channel ends and continues		

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken

4.8 Channel Constrictions **None**

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

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Unconfined

	Score	STD	Historic
7.1 Channel Degradation	**15**	**None**	**No**
7.2 Channel Aggradation	**13**	**None**	**No**
7.3 Widening Channel	**13**		**No**
7.4 Change in Planform	**12**		**No**
Total Score	**53**		
Geomorphic Rating	**0.6625**		

Channel Evolution Model F
Channel Evolution Stage III
Geomorphic Condition Good
Stream Sensitivity High

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type High

	Score
6.1 Epifaunal Substrate - Available Cover	15
6.2 Embeddedness	8
6.3 Velocity/Depth Patterns	17
6.4 Sediment Deposition	8
6.5 Channel Flow Status	16
6.6 Channel Alteration	17
6.7 Frequency of Riffles/Steps	12
6.8 Bank Stability	Left: 6 Right: 6
6.9 Bank Vegetation Protection	Left: 10 Right: 10
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 10
Total Score	145
Habitat Rating	0.725

Habitat Stream Condition Good

Narrative:

Area has current and historic beaver activity but currently only the upper portion is impounded. Adjustment observed is attributed to the highly dynamic nature of beaver influenced channels.

Stream: **Centerville Brook** Reach # **R1506** Segment: **A** Completion Date: **September 28, 2006**

Organization: **Bear Creek Environmental** Observers: **Mary Nealon, Stacey Ambler** Why Not assessed: **impounded** Rain: **No**

Segment Length (ft): **1,000** Segment Location: **Begins at the confluence with a tributary entering from the east and continues upstream**

QC Status - Staff: Provisional Cons Passed

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	223	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	Hilly
Continuous w/	Never	Never
W/in 1 Bankfill	Never	Never
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft) **225**

Width Determination **Estimated**

Confinement Type **Very 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:

The area below the earthen dam was inaccessible; it was a wetland with abundance of standing water. It was difficult to assign a geomorphic condition to this segment due to the inaccessibility and the standing water. There was low bank erosion

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

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	0 %
Fine Gravel	0 %
Sand	0 %
Silt and smaller	0 %

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: **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	Clay	Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	0	77
Erosion Height (ft)	0.00	3.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

Bank Canopy	Left	Right
Canopy %	1-25	1-25

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	0-25	0-25
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Herbaceous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

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	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **Abundant**

4.3 Flow Status **Low**

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

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

4.9 # of Beaver Dams **1**

Affected Length (ft) **330**

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

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 **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.

Stream: Centerville Brook | Reach # R1506 | Segment: A | Completion Date: September 28,

Organization: Bear Creek Environmental | Observers: Mary Nealon, Stacey Ambler | Rain: No

Segment Length (ft): 1,000 | Segment Location: Begins at the confluence with a tributary entering from the east and continues

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	5.20	Yes	No	Yes	No
Problem	Scour Above,Scour Below				
Other	25.0	Yes	No	No	Yes
Problem	None				

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Fair

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Project: Centerville Brook
Stream: Centerville Brook
Reach # R1506
Segment: B
Completion Date: September 28, 2006
Organization: Bear Creek Environmental
Observers: Mary Nealon, Stacey Ambler
Why Not assessed:
Rain: No
Segment Length (ft): 2,172
Segment Location: Begins upstream from the confluence with a tributary to the east and ends at a culvert

QC Status - Staff: Passed Cons Passed

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	760	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	25

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) **205**
Width Determination **Estimated**
Confinement Type **Broad**
Rock Gorge? **No**
Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **17**
2.2 Max Depth (ft) **2.30**
2.3 Mean Depth (ft) **1.21**
2.4 Floodprone Width (ft) **62**

Notes:

Livestock accessing stream in many locations - erosion as a result. Evidence of widening, but good shrub-sapling reg. in place. Could increase buffers. Very minor human caused change in valley confinement from road.

Step 2. (Contued)

2.5 Aband. Floodpln **4.30** ft.
Human Elev Floodpln **0.00** ft.
2.6 Width/Depth Ratio **14.30**
2.7 Entrenchment Ratio **3.57**
2.8 Incision Ratio **1.87**
Human Elevated Inc Rat **0.00**
2.9 Sinuosity **Moderate**
2.10 Riffles Type **Complete**
2.11 Riffle/Step Spacing (ft) **80**

2.12 Substrate Composition

Bedrock	0 %
Boulder	0 %
Cobble	0 %
Coarse Gravel	31 %
Fine Gravel	36 %
Sand	33 %
Silt and smaller	0 %

Silt/Clay Present? **Yes**
Detritus **3** %
Large Woody **12**

2.13 Average Largest Particle on

Bed **2.5** inches
Bar **1.8** 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	Clay
Consistency	Cohesive	Cohesive
Bank Erosion	**Left**	**Right**
Erosion Length (ft)	989	751
Erosion Height (ft)	3.83	4.00
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	22	0
Near Bank Veg. Type	**Left**	**Right**
Dominant	Shrubs/Saplin	Shrubs/Saplin
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	0-25	0-25
Sub-dominant	None	None
W less than 25	0	0
Buffer Veg. Type	**Left**	**Right**
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

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

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**
4.2 Adjacent Wetlands **None**
4.3 Flow Status **Low**
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
(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

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

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	7	7
Diagonal	**Delta**	**Island**
1	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.
1	0	Yes

5.4 Stream Ford or Animal **Yes**
5.5 Straightening **Straightening**
Straightening Length: **740**
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.

Stream: Centerville Brook | Reach # R1506 | Segment: B | Completion Date: September 28,

Organization: Bear Creek Environmental | Observers: Mary Nealon, Stacey Ambler | Rain: No

Segment Length (ft): 2,172 | Segment Location: Begins upstream from the confluence with a tributary to the east and ends at a culvert

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Ledge	Upstream	2.00	1.00		
Ledge	Upstream	2.00	1.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	6.30	Yes	No	Yes	Yes
Problem	Deposition Above,Scour Above				
Culvert	6.00	Yes	No	Yes	Yes
Problem	Deposition Above				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type: Unconfined

	Score	STD	Historic
7.1 Channel Degradation	**7**	**Other**	**Yes**
7.2 Channel Aggradation	**12**	**None**	**No**
7.3 Widening Channel	**8**		**No**
7.4 Change in Planform	**12**		**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	6
6.2 Embeddedness	7
6.3 Velocity/Depth Patterns	13
6.4 Sediment Deposition	9
6.5 Channel Flow Status	10
6.6 Channel Alteration	9
6.7 Frequency of Riffles/Steps	14
6.8 Bank Stability	Left: 5 Right: 5
6.9 Bank Vegetation Protection	Left: 5 Right: 5
6.10 Riparian Vegetation Zone Width	Left: 2 Right: 2
Total Score	92
Habitat Rating	0.46

Habitat Stream Condition: Fair

Narrative:

Historic degradation w/ major channel widening.

Project: Centerville Brook — **Phase 2 Segment Summary** — — June 19, 2009 SGAT Version: 4.53

Stream: **Centerville Brook** | Reach # **R1507** | Segment: **A** | Completion Date: **October 13, 2006**

Organization: **Bear Creek Environmental** | Observers: **Mike Blazewicz, Mike Adams** | Why Not assessed: | Rain: **No**

Segment Length (ft): **1,601** | Segment Location: **Begins at a culvert under a driveway to a farm and continues upstream, crossing under**

QC Status - Staff: Provisional Cons Passed

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	588	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	47

1.4 Adjacent Side	Left	Right
Hillside Slope	Hilly	Hilly
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Bedrock	Bedrock

1.5 Valley Features

Valley Width (ft) **138**

Width Determination **Estimated**

Confinement Type **Broad**

Rock Gorge? **No**

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **16**

2.2 Max Depth (ft) **3.10**

2.3 Mean Depth (ft) **2.10**

2.4 Floodprone Width (ft) **89**

Notes:

A large mass failure occurred in upstream area. The failure covered in a wetland. The area was regraded and seeded by the landowner and the channel left in its new location.

Step 2. (Contued)

2.5 Aband. Floodpln **3.10** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **7.62**

2.7 Entrenchment Ratio **5.56**

2.8 Incision Ratio **1.00**

Human Elevated Inc Rat **0.00**

2.9 Sinuosity **High**

2.10 Riffles Type **Complete**

2.11 Riffle/Step Spacing (ft) **100**

2.12 Substrate Composition

Bedrock	3 %
Boulder	0 %
Cobble	17 %
Coarse Gravel	39 %
Fine Gravel	25 %
Sand	16 %
Silt and smaller	0 %

Silt/Clay Present? **Yes**

Detritus **5** %

Large Woody **5**

2.13 Average Largest Particle on

Bed **6.0** 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	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	232	465
Erosion Height (ft)	5.25	3.21
Revetmt. Type	Rip-Rap	None
Revetmt. Length (ft)	148	0

Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

Bank Canopy	Left	Right
Canopy %	26-50	26-50

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	0-25	0-25
Sub-dominant	>100	>100
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous

3.3 Riparian Corridor

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

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **Abundant**

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

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
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
0	0	0
Diagonal	**Delta**	**Island**
0	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.
1	1	No

5.4 Stream Ford or Animal **Yes**

5.5 Straightening **Straightening**

Straightening Length: **175**

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.

Stream: Centerville Brook Reach # R1507 Segment: A Completion Date: October 13, 2006

Organization: Bear Creek Environmental Observers: Mike Blazewicz, Mike Adams Rain: No

Segment Length (ft): 1,601 Segment Location: Begins at a culvert under a driveway to a farm and continues upstream, crossing under

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	7.50	Yes	No	Yes	Yes

Problem Deposition Above,Scour Above,Scour

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Unconfined

	Score	STD	Historic
7.1 Channel Degradation	**13**	**None**	**No**
7.2 Channel Aggradation	**11**	**None**	**No**
7.3 Widening Channel	**13**		**No**
7.4 Change in Planform	**13**		**No**
Total Score	**50**		
Geomorphic Rating	**0.625**		

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	14
6.2 Embeddedness	11
6.3 Velocity/Depth Patterns	15
6.4 Sediment Deposition	10
6.5 Channel Flow Status	16
6.6 Channel Alteration	10
6.7 Frequency of Riffles/Steps	17
6.8 Bank Stability	Left: 7 Right: 6
6.9 Bank Vegetation Protection	Left: 4 Right: 4
6.10 Riparian Vegetation Zone Width	Left: 2 Right: 2
Total Score	118
Habitat Rating	0.59

Habitat Stream Condition Fair

Narrative:

Channel does not appear to have incised recently, however there is evidence of minor widening, aggradation, and planform adjustment in response to changes in boundary conditions, heavy pasturing in the floodplain, a culvert, and a mass failure.

Project: Centerville Brook — **Phase 2 Segment Summary** — June 19, 2009 SGAT Version: 4.53

Stream: **Centerville Brook** Reach # **R1507** Segment: **B** Completion Date: **October 13, 2006**

Organization: **Bear Creek Environmental** Observers: **Mike Blazewicz, Mike Adams** Why Not assessed: **bedrock gorge** Rain: **Yes**

Segment Length (ft): **600** Segment Location: **Begins at the end of a bedrock dominated section about 600 feet downstream from the**

QC Status - Staff: Provisional Cons Passed

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	170	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	61

1.4 Adjacent Side

	Left	Right
Hillside Slope	Steep	Steep
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Always	Always
Texture	Bedrock	Bedrock

1.5 Valley Features

Valley Width (ft) **25**

Width Determination **Measured**

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:

Bedroll controlled channel. No channel bed and planform changes were mapped under Step 5. There is minor human influence at the top of this segment from an undersized culvert that is causing some deposition above and some scour below. Near the upper end of

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

Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	0%
Sand	0%
Silt and smaller	0%

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)

A **1** **Non Bedrock**

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	Rip-Rap	Rip-Rap
Revetmt. Length (ft)	49	104

Near Bank Veg. Type	Left	Right
Dominant	Coniferous	Coniferous
Sub-dominant	Deciduous	Deciduous

Bank Canopy	Left	Right
Canopy %	26-50	26-50

Mid-Channel Canopy **Closed**

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	>100	>100
Sub-dominant	None	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	Forest	Forest
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **Moderate**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type

Flow Regulation Use

Impoundments **Small**

Impoundmt. Location

4.6 Up/Down strm flow reg

(old) Upstrm Flow Reg **None**

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
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
0	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	

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **162**

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.

Stream: Centerville Brook Reach # R1507 Segment: B Completion Date: October 13, 2006
Organization: Bear Creek Environmental Observers: Mike Blazewicz, Mike Adams Rain: Yes
Segment Length (ft): 600 Segment Location: Begins at the end of a bedrock dominated section about 600 feet downstream from the

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Take	GPSTaken
Waterfall	Mid-Segment	6.00	6.00		
Ledge	Mid-Segment	0.00	0.00		
Ledge	Upstream	0.00	0.00		
Ledge	Downstream	0.00	0.00		
Waterfall	Downstream	6.00	6.00		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Culvert	12.5	Yes	No	Yes	Yes
Problem	Deposition Above,Scour Below				
Bedrock	13.5	Yes	No	Yes	Yes
Problem	None				

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model
Channel Evolution Stage
Geomorphic Condition Good
Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Phase 2 Segment Summary

June 19, 2009 SGAT Version: 4.53

Project: Centerville Brook
Stream: Centerville Brook
Reach # R1508
Segment: 0
Completion Date: October 13, 2006
Organization: Bear Creek Environmental
Observers: Mike Blazewicz, Mike Adams
Why Not assessed: impounded
Rain: No
Segment Length (ft): 2,356
Segment Location: Begins at the human-made dam just upstream from the Centerville Road crossing.

QC Status - Staff: Provisional Cons Passed

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	0	0
height	0	0
Railroads	0	0
height	0	0
Improved Paths	0	0
height	0	0
Development	0	0

1.4 Adjacent Side

	Left	Right
Hillside Slope	Steep	Hilly
Continuous w/	Sometimes	Sometimes
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Not Evalua	Not Evalua

1.5 Valley Features

Valley Width (ft): 200
Width Determination: Estimated
Confinement Type: Very 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:

Centerville Brook reach R15.08 begins at a human-made dam just upstream from the crossing of Centerville Road. This dam, along with several beaver dams, creates a series of wetlands through most of this reach. Due to the impoundments a complete

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

Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	0%
Sand	0%
Silt and smaller	0%

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: 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	Clay	Clay
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Clay
Consistency	Cohesive	Cohesive

Bank Erosion	Left	Right
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0

Near Bank Veg. Type	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
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	51-100
Sub-dominant	0-25	0-25
W less than 25	0	0

Buffer Veg. Type	Left	Right
Dominant	Deciduous	Herbaceous
Sub-dominant	Shrubs/Saplin	Shrubs/Saplin

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Residential	Pasture
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: Minimal
4.2 Adjacent Wetlands: Abundant
4.3 Flow Status: Moderate
4.4 # of Debris Jams: 0
4.5 Flow Regulation Type: None
Flow Regulation Use
Impoundments: Small
Impoundmt. Location: In Reach
4.6 Up/Down strm flow reg: None
(old) Upstrm Flow Reg: None

4.7 StormwaterInputs

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

4.9 # of Beaver Dams: 5
Affected Length (ft): 1,500

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

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	

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.

Stream: Centerville Brook | Reach # R1508 | Segment: 0 | Completion Date: October 13, 2006

Organization: Bear Creek Environmental | Observers: Mike Blazewicz, Mike Adams | Rain: No

Segment Length (ft): 2,356 | Segment Location: Begins at the human-made dam just upstream from the Centerville Road crossing.

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Dam	Downstream	8.00	5.00		

4.8 Channel Constrictions **None**

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

Narrative:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition Good

Stream Sensitivity

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Stream Geometry Data

Centerville Brook

Reach	Seg-ment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel width	Bankfull width	Max. depth	Mean depth	Floodpr. width	Abandn FldPln	W/D Ratio	Entrench-ment	Incision Ratio	Stage Evol.	Evol. Model	RGA Cond.	RHA Cond.	QC Stf	QC Aut
		Phase 2 Stream Type					Phase 1 Data		Phase 2 Channel Data													
R1501	A	C	Gravel	Riffle-Pool	None	No	1.06	34.82	31.5	3.7	2.36	380.0	5.5	13.35	12.06	1.49	III	F	Fair	Fair	P	P
R1501	B	E	Gravel	Riffle-Pool	None	No	1.06	34.82											Fair		P	F
R1502	0	C	Cobble	Riffle-Pool	b	No	2.37	34.52	32.0	2.7	1.71	103.0	3.1	18.71	3.22	1.15	I	F	Good	Good	P	P
R1503	0	B	Bedrock	Bedrock	None	No	4.05	33.00											Good		P	F
R1504	A	B	Bedrock	Bedrock	None	Yes	1.38	32.90											Good		P	F
R1504	B	C	Gravel	Riffle-Pool	None	No	1.38	32.90	34.5	2.9	1.94	362.0	4.4	17.78	10.49	1.52	III	F	Fair	Good	P	P
R1504	C	B	Bedrock	Bedrock	None	Yes	1.38	32.90											Good		P	F
R1504	D	E	Gravel	Riffle-Pool	None	Yes	1.38	32.90	25.0	3.9	3.0	268.0	3.9	8.33	10.72	1.00	I	F	Good	Fair	P	P
R1505	A	F	Bedrock	Bedrock	None	Yes	0.51	29.99											Good		P	F
R1505	B	E	Gravel	Riffle-Pool	None	No	0.51	29.99											Good		P	F
R1505	C	E	Gravel	Riffle-Pool	None	No	0.51	29.99	18.5	3.3	2.31	156.0	5.0	8.01	8.43	1.52	III	F	Fair	Fair	P	P
R1505	D	B	Bedrock	Bedrock	None	Yes	0.51	29.99											Good		P	F
R1505	E	E	Gravel	Riffle-Pool	None	No	0.51	29.99	24.0	3.8	2.18	410.0	3.8	11.01	17.08	1.00	III	F	Good	Good	P	P
R1506	A	E	Gravel	Riffle-Pool	None	No	0.44	23.20											Fair		P	F
R1506	B	C	Gravel	Riffle-Pool	None	No	0.44	23.20	17.3	2.3	1.21	61.8	4.3	14.30	3.57	1.87	III	F	Fair	Fair	P	P
R1507	A	E	Gravel	Riffle-Pool	None	No	2.36	21.90	16.0	3.1	2.1	89.0	3.1	7.62	5.56	1.00	IIc	D	Fair	Fair	P	P
R1507	B	B	Bedrock	Bedrock	None	Yes	2.36	21.90											Good		P	F
R1508	0	E	Gravel	Riffle-Pool	None	No	0.85	18.75											Good		P	F

Rapid Geomorphic Assessment

Centerville Brook

Reach	Seg-ment	Sub-Rch?	Degradation Score	Degradation STD	Degradation Historic	Aggradation Score	Aggradation STD	Aggradation Historic	Widening Score	Widening Historic	Planform Score	Planform Historic	Geo. Score	Geo. Condition	Evol. Stage	Confin-ement Type	Sens-itivity	QC Stf	QC Aut
R1501	A	No	9	Other	Yes	11	None	No	8	No	5	No	0.41	Fair	III	VB	Very	P	P
R1501	B	No											0.00	Fair		VB		P	F
R1502	0	No	16	None	No	13	None	No	16	No	16	No	0.76	Good	I	BD	High	P	P
R1503	0	No											0.00	Good		SC		P	F
R1504	A	Yes											0.00	Good		NW		P	F
R1504	B	No	12	None	Yes	12	None	No	11	No	9	No	0.55	Fair	III	VB	Very	P	P
R1504	C	Yes											0.00	Good		NW		P	F
R1504	D	Yes	16	None	No	13	None	No	14	No	13	No	0.70	Good	I	VB	High	P	P
R1505	A	Yes											0.00	Good		NC		P	F
R1505	B	No											0.00	Good		VB		P	F
R1505	C	No	10	None	Yes	14	None	No	11	No	9	No	0.55	Fair	III	VB	Very	P	P
R1505	D	Yes											0.00	Good		NC		P	F
R1505	E	No	15	None	No	13	None	No	13	No	12	No	0.66	Good	III	VB	High	P	P
R1506	A	No											0.00	Fair		VB		P	F
R1506	B	No	7	Other	Yes	12	None	No	8	No	12	No	0.49	Fair	III	BD	Very	P	P
R1507	A	No	13	None	No	11	None	No	13	No	13	No	0.63	Fair	IIc	BD	Very	P	P
R1507	B	Yes											0.00	Good		NC		P	F
R1508	0	No											0.00	Good		VB		P	F