

Rodman Brook Corridor Plan

Morristown and Hyde Park, Vermont

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EXECUTIVE SUMMARY

Rodman Brook Corridor Plan
Morrystown and Hyde Park, Vermont

Rodman Brook flows southerly from its headwaters in Hyde Park to the confluence with the Lamoille River in Morrystown. The watershed size of Rodman Brook at the mouth is 4.25 square miles. The Lamoille County Planning Commission conducted a Phase 1 stream geomorphic assessment of six miles of Rodman Brook in 2006 using remote sensing (orthophotos and topographic maps). A more detailed field study of the brook was conducted in 2007 by Bear Creek Environmental, LLC. The Phase 2 stream geomorphic assessment study area focused on three stream reaches on Rodman Brook in Morrystown. The combined length of Phase 2 reaches assessed is approximately one mile.

Four of five segments of Rodman Brook were found to be in fair geomorphic condition based on the rapid geomorphic assessment in 2007. The most upstream segment, located upstream of the Garfield Road crossing was found to be in good geomorphic condition. Geomorphic condition is determined based on the degree (if any) the channel is out of balance with the flow and sediment in its watershed.

Rodman Brook Hyde Park and Morrystown	
Watershed Size	4.25 sq. miles
Length of Assessed Reaches	1 mile
Phase 1 by LCPC	2006
Phase 2 by BCE	2007
Bridge and Culvert Survey by LCPC	2006
Phase 2 Focus	Main Stem at mouth
Most Common Active Adjustment Process	Planform migration
Number of Potential Municipal Projects	1
Number of Potential Landowner Projects	5

Riprap and berms at a former mill site are evidence of past channel management activities that have straightened Rodman Brook. Garfield Road is within the stream corridor along almost the entire length of the Phase 2 assessment reaches and is a major floodplain encroachment. In some locations, the valley width is reduced to almost half of the natural confinement. The past channel management activities and influence of Garfield Road has caused the brook to incise (downcut into the bed). In some of the segments, this has led to a stream type departure, where the stream type has deviated from the reference channel type. The close proximity of Rodman Brook to Garfield Road has also resulted in narrow buffers and unstable banks along the west side of the channel. In areas where Rodman Brook is not confined by the road and rock riprap, the brook is widening and migrating laterally to recreate a new floodplain at a lower elevation to dissipate energy and become more stable. As the river works toward a more stable equilibrium, the communities of Hyde Park and Morrystown have the opportunity to protect the river from further encroachments through the adoption of fluvial erosion hazard zones.

Site specific projects are identified for the Rodman Brook main stem in the river corridor plan. The project strategy, technical feasibility, and priority for each project are listed by project number and reach. Proposed river restoration and protection projects include: river corridor protection to provide attenuation of sediment and floodwaters through corridor easements, the replacement of an undersized bridge, iron seep remediation, a possible berm removal project and improved stormwater treatment.

Rodman Brook Corridor Plan Morristown and Hyde Park

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Rodman Brook Corridor Plan Morrystown and Hyde Park, Vermont

1.0 INTRODUCTION

Watershed planning in Vermont is experiencing rapid and positive change. The most significant changes are the growing recognition of environmental concerns and the broad acceptance of public participation in decision making processes. Currently the Agency of Natural Resources (ANR) is actively involved in watershed and corridor planning throughout the State. The purpose of this summary is to outline the methods used to study the Rodman Brook, define the top water quality issues to be addressed, and outline steps to begin protecting and restoring the Rodman Brook.

The Phase I assessment of the Rodman Brook was conducted by the Lamoille County Planning Commission (LCPC) during June of 2006. The assessment was conducted according to the protocols of the Vermont Agency of Natural Resources geomorphic assessment. A bridge and culvert assessment was also conducted on the Rodman Brook using the Vermont Agency of Natural Resources standards. The LCPC retained Bear Creek Environmental, LLC to perform Phase 2 Stream Geomorphic Assessments of select reaches of Rodman Brook during 2007.

2.0 BACKGROUND WATERSHED INFORMATION

2.1 Watershed Description

The Rodman Brook is located in the towns of Hyde Park and Morrystown, Vermont, and flows into the Lamoille River which flows into Lake Champlain. Most of the river flows through forested land, with portions running through agricultural land and residential development. The approximately six mile river drains a 4.25 square mile watershed. There are 15 reaches (sections of brook with similar characteristics such as slope, valley width, and tributary influence), which were assessed on the main stem of the river (see Figure 1). Details of reach locations are included in Appendix A.

Rodman Brook is located mostly within the Town of Hyde Park. The brook flows down the middle of the town, and about a third of the brook (the downstream end) flows through Morrystown.

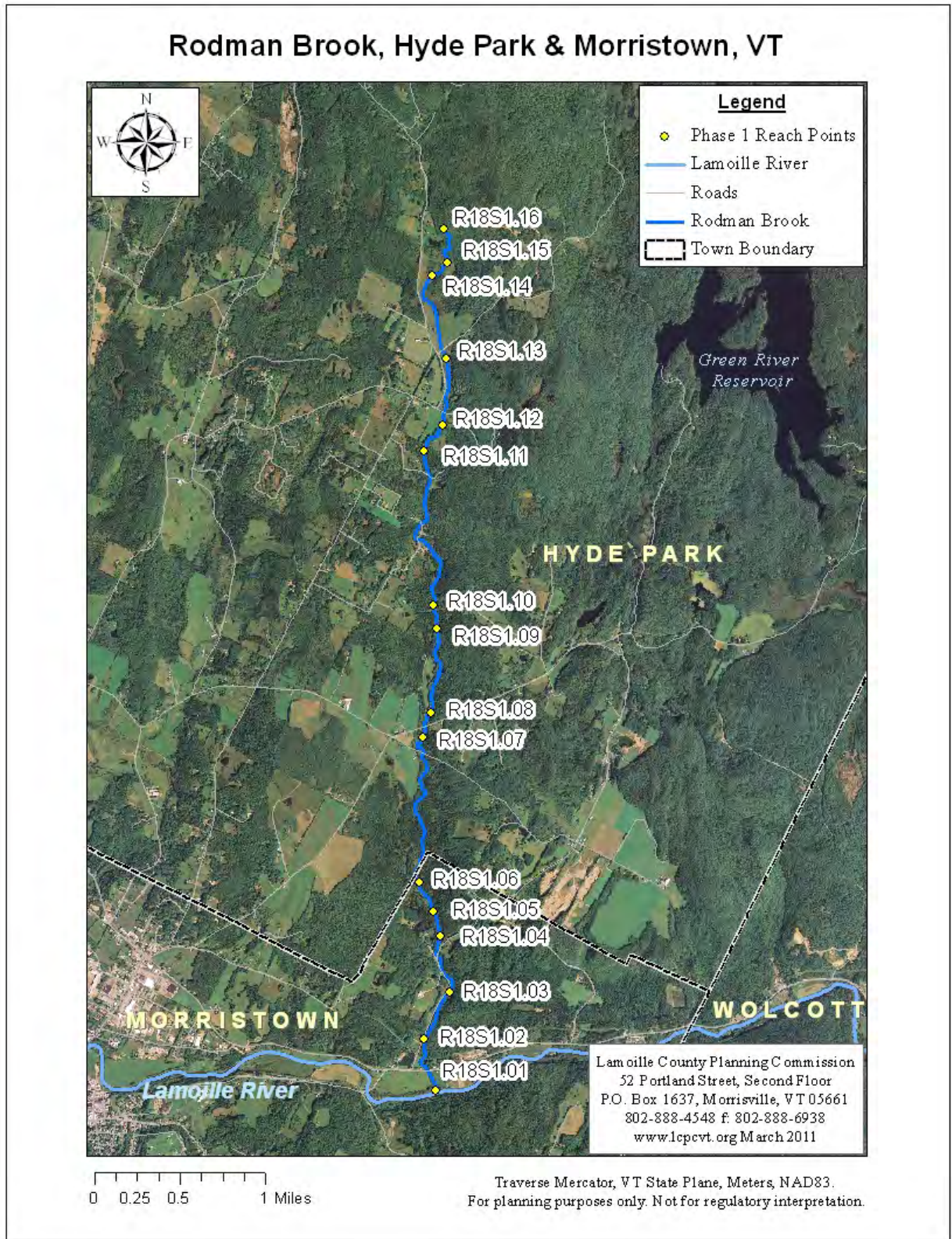


Figure 1: Project location map

2.2 Flood History

According to the Vermont Agency of Natural Resources document “Municipal Guide to Fluvial Erosion Hazard Mitigation” (2006a), “Of all the natural hazards experienced in Vermont, flooding is the most frequent, damaging, and costly.” The guide documents that over the last 50 years, flood recovery has cost the state an average of \$14 million a year and that during the period of 1995-1998 alone, flood losses in Vermont totaled almost \$57 million. Of particular concern for towns are properties near streams. It notes that, “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.”

The Municipal Guide further documents that, “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 and streams, such as Rodman Brook, are unstable and prone to fluvial erosion (Vermont Agency of Natural Resources 2006).

In order to better understand the flood history of Rodman 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 were obtained (USGS 2011). Johnson Village sits upstream and is approximately 8 miles west of the Rodman Brook. Eighty-two years of record are available for the Lamoille River gauge at Johnson, VT which provides nearly contiguous records of flow from 1929 through the present, with individual records dating as far back as 1912.

The long term record on the Lamoille gauge shows major flood events also occurred in the years 1912, 1936, 1973, 1984, 1995 and 1997. The figure below (Figure 2) provides a graph of the annual peak stream flow for the Lamoille River gauge.

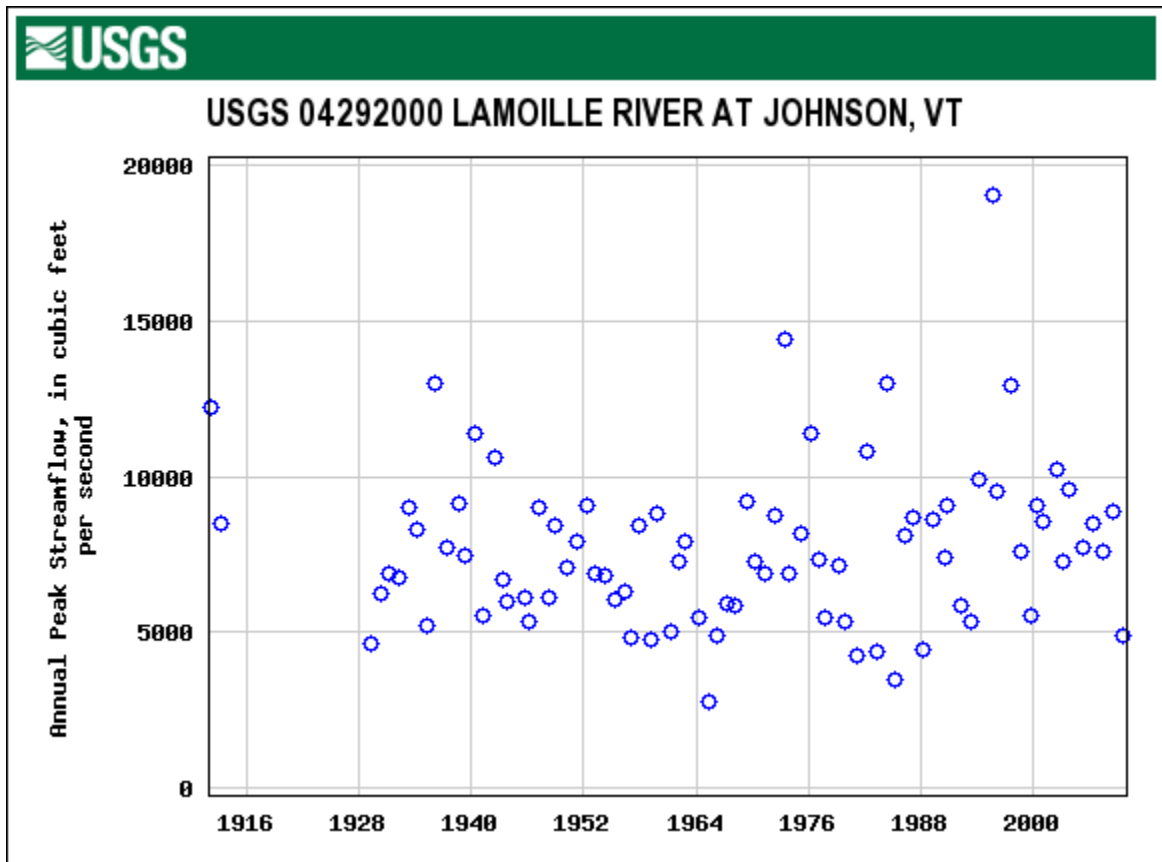


Figure 2. Annual Peak Stream Flow for Lamoille River at Johnson, Vermont

3.0 PHASE I METHODS AND RESULTS

3.1 Phase I Methodology

Stream reaches were defined by creating reach breaks using valley width and slope, geologic materials, and tributary influence. Fifteen reaches were delineated on the Rodman Brook main stem within Lamoille County. Reaches were numbered to efficiently organize, track, and communicate reach-related data. After stream reaches were defined, watershed, sub-watershed, and reach watershed areas were delineated. See Figure I for a stream reach identification map.

Stream Geomorphic Assessment Tool

Using the Stream Geomorphic Assessment Tool (SGAT), numerous parameters were calculated including: valley width, length, and slope; channel length and slope; stream confinement; sinuosity; and reference channel width (see glossary for definitions). Based on this data, reference stream types were classified according to characteristics of the valley, geology, and climate of the stream. The reference stream type describes the natural channel tendency of channel form and process in the absence of human-related changes to the channel.

SGAT, Remote Sensing, Local Knowledge, and Field Verification:

Using a combination of SGAT, remote sensing, local knowledge, and windshield surveys (field verification), the following parameters and their respective impacts were inventoried and/or calculated, and assessed. Individually, the parameters are designed to describe the basic physical features of the river and each reach. Together, the parameters form an overall picture of the stream and the watershed.

- Valley side slopes
- River corridor delineation
- River corridor and reach land use and land cover
- Riparian buffer condition
- Hydrologic groups
- Soils and geology influences
- Alluvial fans
- Grade controls
- River corridor development
- Bank armoring
- Bridge and culverts
- Flow regulation and water withdrawal
- Channel modifications
- Floodplain encroachments
- Dredging and channel mining history
- Depositional features
- Meander migration
- Meander width ratio
- Stream wavelength
- Debris jam potential

- Dominant bed form and material

3.2 Rodman Brook Report Impact Rating Methodology and Reach Results

The following parameters are assigned impact ratings of Not Significant to High Significance, based on certain criteria for each impact type. These parameters are used because they can be effectively measured using maps and other remote sensing tools. They also examine watershed influences which may be producing channel adjustments. After all the impacts are looked at, a reach can be further evaluated for the degree to which cumulative impacts are affecting the reach and how it compares to other reaches in the watershed. This evaluation helps with focusing resources for additional assessments of the river.

Phase I Parameters highlighted for data interpretation:

- Watershed Land Cover/Land Use
- Corridor Land Cover/Land Use
- Riparian Buffer Width
- Channel Modification
- Depositional Features
- Meander Migration
- Bridge and Culvert Survey-using the ANR Appendix G datasheet

Watershed Land Cover/Land Use:

Lakes, wetlands, and perennial vegetation play an important role in a watershed by storing water and trapping sediment, which helps reduce flood peaks and maintain summer base flows in rivers and streams. Urban development and cropland typically increase the peak and change the duration of stormwater and sediment runoff events. Orthophotos were used to evaluate this parameter.

High impact rating scores indicate 10% or more of the reach watershed cover is crop and/or urban. Reaches R18SI.01-R18SI.07 (downstream and south of Trombley Hill Rd in Morristown and Hyde Park) and R18SI.11- R18SI.13 (upstream and north of Trombley Hill Rd in Hyde Park) recorded high impact ratings for watershed land use land cover.

Corridor Land Cover/Land Use:

Land use/land cover within the stream corridor is particularly important with respect to sediment deposition and erosion during annual flood events. Wetlands, ponds, and perennial vegetation moderate stormwater and sediment runoff, while impervious surfaces (impenetrable surfaces such as rooftops, sidewalks and roads) within urban areas and the exposed soils found in cropland have the potential to increase watershed inputs.

High impact rating scores indicate 10% or more of the reach corridor cover is crop and/or developed. Reaches R18SI.01- R18SI.03 (downstream reaches that begin at the confluence with the Lamoille River), R18SI.07 (south of Trombley Hill Rd in Hyde Park), and R18SI.12- R18SI.14 (north of Trombley Hill Rd), received high impact rating scores.

Riparian Buffer Width:

The riparian buffer is the area of land directly adjacent to the channel along the channel's banks and floodplain that is covered with woody vegetation and largely unmanaged. Riparian buffers protect and enhance water quality, fish and wildlife habitats, aesthetics, and recreational values associated with streams. Streams without riparian vegetation often experience high rates of lateral erosion and may see such large increases in sediment that they undergo major adjustment of channel dimension, pattern, and profile. Orthophotos were used to estimate the percent of each buffer width category along the right and left banks.

High impact rating scores indicate that 26% of the reach has little or no buffer (0-25 feet) on one or both banks. Reaches RI8SI.02 (downstream reach that begin at the confluence with the Lamoille River), RI8SI.12, RI8SI.13, and RI8SI.14 (north of Centerville Rd in Hyde Park) received high impact rating scores for riparian buffer width.

Channel Modifications:

Channelization is the process of changing the natural path of a river through activities such as windrowing (pushing gravel up from the stream bed onto the top of either bank as part of the straightening of the river) and straightening. A channelized stream may degrade, or cut down vertically into its bed and cause the channel to lose access to its floodplain. If floodplain access is lost, the banks will erode until new floodplains are formed. The sediment resulting from the degradation process is re-deposited downstream of the channelized area. This results in aggradation, or building up, of the channel bed in this downstream area. Aggradation can result in channel widening, bank instability, and other channel responses, most of which are detrimental to both riverside land and aquatic habitat. Reviews of orthophotos and topographic maps were used to examine this parameter.

High impact rating scores indicate that greater than 20% of the reach had been channelized. Reaches RI8SI.01- RI8SI.03 (downstream reaches that begin at the confluence with the Lamoille River), RI8SI.10, and RI8SI.13 (north of Trombley Hill Rd in Hyde Park) received high impact scores. The percent of channelization for these high impact scores ranged from 34.1% to 62.2%.

Dredging and Gravel Mining History:

Dredging and mining gravel bars from a channel may initiate a channel evolution process. Such activities straighten and steepen the channel and cause the river to cut down and erode its bed. The stream channel eventually aggrades with sediment supplied from upstream reaches as headcuts (an abrupt change in the slope of the channel bed caused by erosion) in the streambed move up-valley. These headcuts occur where there is an abrupt vertical drop in the stream bed. They often resemble a small waterfall or, when not flowing, headcuts will resemble a very short cliff or bluff. Information and records from DEC's Stream Alteration Engineer was used to determine the relative frequency and volume of gravel extraction.

High Impact Rating scores indicate that the reach was historically used for commercial gravel mining and/or dredged for flood remediation. None of the reaches studied along Rodman Brook had any significant dredging or gravel mining.

Depositional Features:

An unvegetated bar is sign that the bar was recently formed and is growing. Mid-channel bars, large unvegetated point bars, and delta bars may indicate an increased sediment load (from upstream) and a high likelihood that the streambed is actively aggrading and/or undergoing rapid lateral movement. The sediment sources for these bars may be from bank failures or the degradation of the channel upstream. It may also be from upland watershed sources. Orthophoto interpretation and windshield surveys were used to evaluate this parameter.

High impact rating scores indicate numerous, large unvegetated mid-channel, point and/or delta bars present. There were no reaches on Rodman Brook that received high impact scores during the Phase I assessment.

Meander Migration/ Channel Avulsions:

Some amount of lateral migration is natural in most alluvial stream systems, but the rate of migration may be increased in streams due to changes in the sediment supply and/or sediment transport capacity of the channel. Comparisons of paths of the channel from similarly scaled orthophotos, including black and white half meter resolution imagery from 1995 and one meter color National Agriculture Imagery Program imagery from 2003 and 2006, were used to identify channel migration, bifurcation, and/or avulsions. Channel migration occurs as the channel erodes its outer banks on meander bends. Bifurcation describes when the stream has split into two or more active channels. An avulsion describes a channel plan form change due to meander cutoffs.

High impact rating scores indicate frequent occurrences of channel migration, bifurcation, and/or channel avulsions along the reach. R18SI.01 (which flows into the Lamoille in Morristown) was the only reach on Rodman Brook that received a high impact score for this parameter.

Meander Width Ratio:

The meander belt width is the horizontal distance between the opposite banks of fully developed meanders. Unconfined, gravel-based streams in shallow-sloped valleys, which are in reference or good condition, have belt widths generally in the range of 5 to 8 times the width of the channel. Higher values may indicate that the stream, possibly due to an increase in fine sediment, has started to aggrade and become more sinuous, decreasing its channel slope as it migrates laterally. Lower values may indicate that the stream has become straighter and steeper, possibly degrading its bed and losing access to its floodplain. Orthophotos and topographic maps were used to determine the reach's average belt width.

High impact rating scores indicate the meander width ratio is less than 3 or greater than 10, well outside the 5-8 range of reaches within regime. Reaches R18SI.01 and R18SI.02 received high impact ratings. Reach R18SI.01 begins at the confluence with the Lamoille River and continues for about 2000 feet. Reach R18SI.02 extends 1700 feet north, parallel to Garfield Road.

Bridge and Culvert Field Verified Data:

A watershed-wide bridge and culvert inventory and assessment was conducted to determine if stream crossings were contributing to localized stream bank erosion, sedimentation, and impaired fish passage. The Agency of Natural Resources Bridge and Culvert Phase I protocols were used (ANR, 2003). Bridge spans and culvert diameter measurements were compared to calculated bankfull width measurements. The bankfull width, also known as the channel forming flow, is directly related to watershed drainage area. The bankfull flow is the discharge at which the majority of erosion and deposition takes place. 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.

Six bridges and culverts were assessed on the Rodman Brook main stem. There were no bridges or culverts along the Rodman Brook that received high impact rating scores. High impact scores are assigned if >20% of the reach length is channelized, has split flow, or makes a sharp “s” bend upstream or downstream of bridges or culverts. However, all six of the structures were undersized and the widths ranged from 44% to 78% of the bankfull width. These undersized structures were not designed to have room for both the flow of the water and the sediment carried in the flow. One box culvert near the intersection of Garfield Road and Stearns Road was replaced in 1995 after it washed out in a flooding event; however, none of the other structures along the Phase I reaches of Rodman Brook have been replaced in over twenty years.

3.3 Phase I Stream Geomorphic Reach Condition

As part of this assessment, land use, encroachments, and buffer condition were analyzed within 150 feet on each side of the river. The headwaters of the stream are located in land with sparse residential development adjacent to the steep McKinstrey Hill Road. There is a section that has been dammed by beavers at the upstream end of the stream. There are a few significant bedrock grade controlled sections of the river which will help maintain stability in those areas. There was one section along the river corridor where some logging activity has taken place very close to the channel (see Figure 3).

The results of the assessment concluded that overall, the river is in fair condition on a scale that includes the following four classifications: poor, fair, good and reference. (See glossary for definitions.) There were a few sections that had significant bedrock grade controls, and much of the stream had an adequate riparian buffer. Of the 15 reaches assessed on the main stem of Rodman Brook, three reaches (R18S1.01, R18S1.02, and R18S1.03) had total impact scores of 21, 21, and 15 respectively, out of a possible score of 32. A total impact score greater than 12 is considered high. Encroachments from Garfield Road within the river corridor accounted for the majority of these high impact scores on Rodman Brook.



Figure 3. Trees cleared on river bank

3.4 Predicted Stream Channel Adjustment Processes

The Rodman Brook is undergoing a variety of geomorphic processes specifically in the lower reaches where historically the channel has been adjusted by human activity. Reaches R18S1.01-R18S1.03, R18S1.07 and R18S1.12 are undergoing the most active adjustments including degradation, aggradation, planform adjustment, and widening. Aggradation and degradation are the major adjustment process on most of these reaches as multiple channel bars indicate. Planform adjustment is the major adjustment process for reach R18S1.12. This process changes the shape and size of meander bends and the overall path the river follows. If further development and modifications within the floodplain are avoided, the river will establish a stable condition on its own. The middle reaches are in fair to good reach condition with healthy riparian buffer widths as well as having the potential to be conservation areas for the river corridor.

The results of the Phase I study concluded overall that the river is in fair condition. Geomorphic processes are taking place throughout the reaches (sections of brook with similar characteristics such as slope, valley width, and tributary influence), especially in those reaches that are being encroached by roads. Sediment buildup has occurred and the degradation (a progressive lowering of the channel bed due to scour) of some channels is evident in the lower reaches. Degradation is an indicator that the stream's discharge and/or sediment load is changing.

4.0 PHASE 2 METHODS AND RESULTS

4.1 Phase 2 Methodology

The Phase 2 assessment of the Rodman Brook watershed followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase 2 (Vermont Agency of Natural Resources, 2007). All assessment data were recorded on the Agency of Natural Resources Phase 2 data sheets, and were entered in to the VANR Stream Geomorphic Assessment Data Management System (DMS). The Phase 1 database was updated using the field data from the Phase 2 assessment in 2008.

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.

4.2 Phase 2 Study Area

The Phase 2 study of Rodman watershed focused on three stream reaches (R18S1.01 through R18S1.03) on the main stem near the confluence of the Lamoille River. These three lowest reaches were selected for additional study because of the high Phase 1 impact scores. The combined length of the stream reaches assessed during the Phase 2 study is approximately one mile (Figure 4). 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.

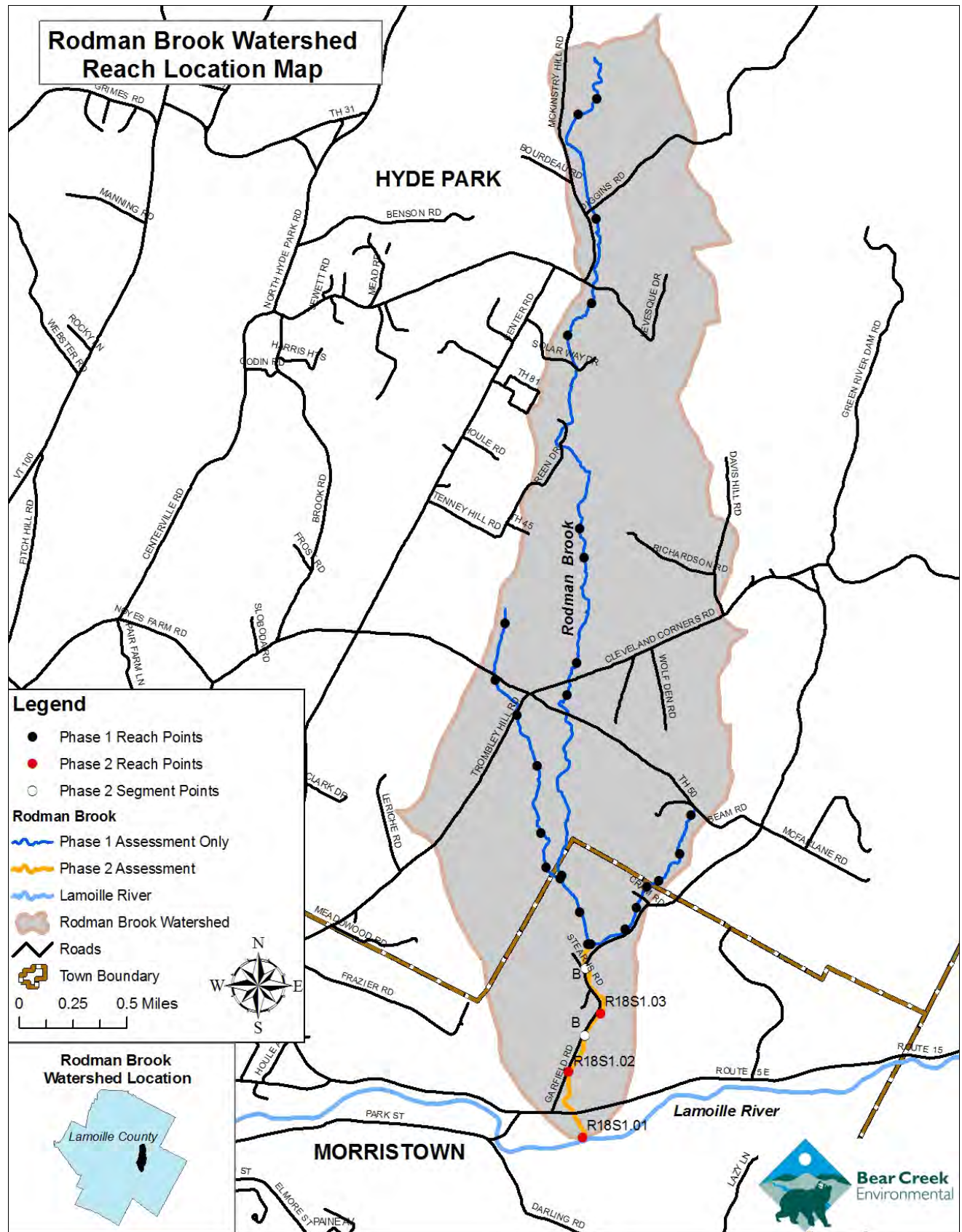


Figure 4 Phase 2 Reach Location Map

4.3 Geomorphic Evaluation and Reach Condition

The geomorphic condition for each Phase 2 reach is determined using the rapid geomorphic assessment (RGA) protocol, and is based on the degree of departure of the channel from its reference stream type (Vermont Agency of Natural Resources, 2005). As shown in Figure 5, four of the five assessed segments rated in the “fair” category for geomorphic condition. The most upstream segment (R18SI.03-B), which includes the Garfield Road crossing, is in “good” category. Detailed segment summary data are provided in Appendix B.

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. The most common major adjustment processes in the Rodman Brook watershed is planform migration as a result of historic degradation within the channel (Table I). R18SI.02-B and R18SI.03-A are adjacent segments where the channel has incised, but widening has not yet occurred.

Table I. Stream Type and Channel Evolution Stage						
Segment Number	Entrenchment Ratio	Incision Ratio	Reference Stream Type	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
R18SI.01	1.65	1.56	C3b	B3	F-III	Aggradation Widening Planform
R18SI.02-A	5.79	1.52	C3b	C3b	F-IV	Aggradation Widening Planform
R18SI.02-B	1.51	2.14	C4b	B4	F-II	Aggradation Widening Planform
R18SI.03-A	1.36	2.13	C3b	B3	F-II	Aggradation Planform
R18SI.03-B	1.40	1.0	B3	B3	F-I	Planform
<p>Black lettering – denotes major adjustment process Black lettering (no bold) – denotes minor adjustment process</p>						

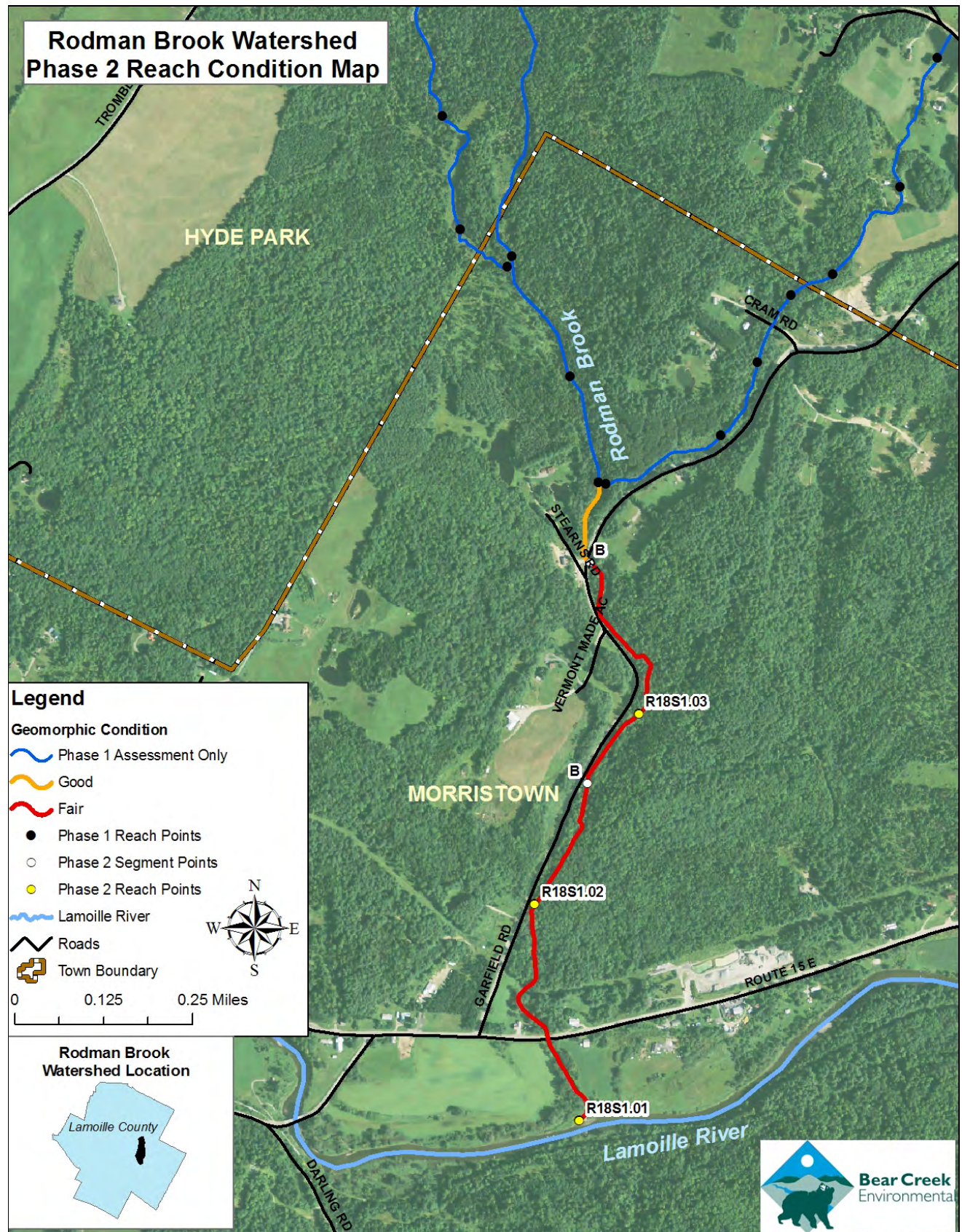


Figure 5. Rodman Brook Phase 2 Geomorphic Condition

4.4 Reach Descriptions

Reach RI8SI.01

The most downstream reach on Rodman Brook, RI8SI.01, starts at the confluence of the Lamoille River and extends upstream 1,878 feet. The top of the reach is approximately 1,100 feet upstream of the Route 15 crossing. Before Hyde Park was founded, this area adjacent to Rodman Brook and near the confluence with the Lamoille River was a mill town known as the Town of Garfield. Garfield was abandoned in the late 1800s, and berms adjacent to the Rodman Brook upstream of Route 15 are remnant of the old town. Also in the vicinity of the berms are two bedrock grade controls (see Figure 6) and what appears to be the foundation of an old mill.

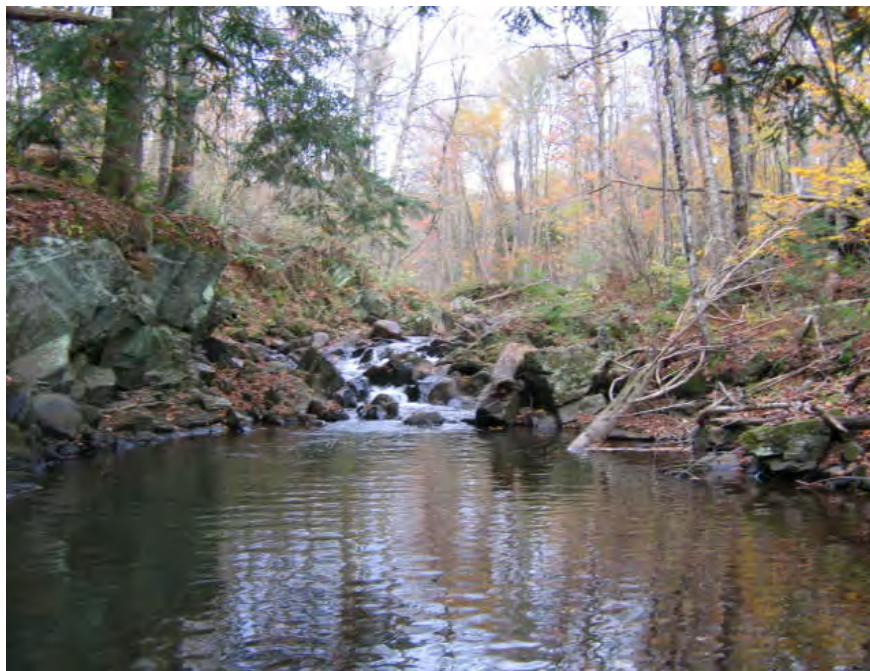


Figure 6. Bedrock grade control near former mill dam

Downstream of Route 15, Rodman Brook has been straightened with rock riprap. A third bedrock grade control is located at the Route 15 crossing. The span of the bridge is only 13 feet (Figure 7), making this structure a significant channel constriction as compared with the reference channel width of 24.8 feet. Major scour above and below this bridge were noted during the Phase 2 assessment.



Figure 7. Bedrock grade control at Route 15 Crossing

The valley in reach R18S1.01 is very broad by reference. There is a minor human-caused change in channel confinement, but no change in valley type. Over half of reach R18S1.01 was indexed as straightened. This straightening is attributed to past channel management activities as evidenced by the riprapping and berming. As a result of this straightening, the channel has incised and a stream type departure from a reference “C” channel “B” channel (with a narrower floodplain) has occurred. The dominant bedform is still riffle-pool; however, the channel has changed to a different stream type resulting in altered channel geometry.

The dominant buffer width on the east side of the channel is greater than 100 feet, while the dominant buffer width on the west side is 51 to 100 feet. The eastern corridor is primarily forest, although hay fields are also present. The dominant land use in the western corridor is residential. No areas with buffers less than 25 feet in width were noted on the east side of the channel. Approximately 75 feet of buffer s 25 feet was indexed on the west side of the channel about 200 feet upstream of the Route 15 Bridge. This area of narrow buffer appears to be related to a powerline crossing, and is not a suitable planting location for trees due to the overhead utility line. A second area of buffer less than 25 feet is located at the top of the reach and is associated the close proximity to Garfield Road. This second location is also not suitable for a tree planting project because the area between the channel and the road is narrow.

The geomorphic condition scored in the “fair” category. Channel adjustment processes included extreme historic degradation, minor aggradation, widening and planform adjustment. The channel is expected to continue to widen until a juvenile floodplain is developed at a lower elevation. The rapid habitat assessment scored in the “good” range. Low substrate embeddedness, little sediment deposition, and a high quality riparian buffer on the east side all contributed to the “good” habitat condition.

Reach R18SI.02

R18SI.02 was divided into two segments to account for differences in banks and buffers, channel dimensions, depositional features, and channel evolution stage. The most downstream segment in R18SI.02-A is 597 feet in length and the upstream segment is 1,079 feet long. Both segments are “C” channels with a b subslope by reference.

R18SI.02-A is a “C” cobble dominated segment with a weak riffle-pool bedform in portions of the segment that have been straightened. In general, the stream channel is much more sinuous (i.e. meandering) in this segment than is evident on the Vermont Hydrography stream layer. Two bedrock grade controls are present within segment A (Figure 8).



Figure 9. Bedrock grade controls in R18SI.02-A

As shown in Figure 9, heavy iron precipitate was noted on the substrate. This heavy iron precipitate can result in a decrease in available food and loss of habitat for aquatic insects. Iron precipitate often occurs in areas where soil has been disturbed or iron rich soils used as fill is mobilized to the groundwater. In Vermont, water quality impairments from iron precipitate are common adjacent to road fill, landfills, and areas where structures, such as culverts, have been installed. According to Jim Ryan, Watershed Coordinator, with the Vermont Department of Water Resource, the Lamoille landfill, which has been capped and shut down for decades, is the cause of the water quality impairment. The impacted stretch of Rodman Brook was recommended for the draft State of Vermont 2010 303(d) list of impaired surface waters needing TMDL. (Personal communication with Jim Ryan, January 24, 2011).



Figure 9. Heavy iron precipitate layer on substrate in R18SI.02-A

Reach R18SI.02-A is further along in the channel evolution process than both the downstream reach (R18SI.01) and the upstream segment (R18SI.02-B). A juvenile floodplain at a lower elevation has formed on the inside of bends. Some widening in the middle of the section was noted where floodplain access is limited. In other areas, riprap and large trees are preventing the channel from widening further. The rapid geomorphic assessment scored in the “fair” category due to the major historic degradation, major planform adjustment and minor widening and aggradation. The rapid habitat assessment rated in the “fair” category mostly due to poor habitat diversity where pools are lacking, moderately unstable banks on the west side, and a narrow riparian buffer on the west side due to the close proximity to Garfield Road. In contrast, the buffer on the east side is greater than 100 feet and the corridor land use is forested.

At the upper end of R18SI.02-A, Rodman Brook becomes even closer to Garfield Road, resulting in dominant buffer widths of less than 25 feet in R18SI.02-B. Forest is still the dominant land use on the east side with buffer widths predominantly greater than 100 feet. Segment R18SI.02-B has been historically straightened along virtually the entire length. Gravels and cobbles from the road base are contributing material to the channel. The bedform is largely plane bed now, deviating from the reference bedform of riffle-pool. Planebed channels lack discrete bed features (such as pools, riffles, and point bars) and may have long stretches of featureless bed.

Segment R18SI.02-B has also deviated from its reference “C” stream type and is now a “B” channel with a narrow floodplain. The geomorphic condition scored in the “fair” category. Channel adjustment processes include extreme historic degradation and minor aggradation, widening and planform adjustment. Minimal channel widening has occurred and the width to depth ratio is low (14.5). The habitat condition was also in the “fair” range. The presence of only two of the four velocity depth patterns and poor habitat spacing

(frequency of riffle/steps) reflect the extensive channel alteration that has occurred in this segment. The close proximity of Rodman Brook to Garfield Road has resulted in narrow buffers and moderately unstable banks on the west side of the channel. These narrow buffers and lack of a vegetated riparian corridor have also contributed to the “fair” habitat conditions. Unfortunately, the channel is so close to the road that a buffer restoration project in this segment is not a possibility.

Reach RI8SI.03

The most upstream reach assessed during the Phase 2 assessment (RI8SI.03) was segmented to account for a change in the reference valley width. Segment B, which starts just below Garfield Road and extends 650 feet upstream, is semi-confined while segment A is broad. RI8SI.03-A has a human caused change in valley width from the encroachment of Garfield Road, yet the Phase 2 valley confinement is still broad. There is a very minor human caused change in the confinement in segment A just upstream of the Garfield Road crossing.

Segment RI8SI.03-A is approximately 1,370 feet in length. Extreme historic incision has led to a stream type departure from a “C” channel to a “B” channel. This means the channel now has a narrow floodprone area rather than a wide floodplain that would be there by reference. The substrate is cobble dominated (Figure 10). The upper portion of RI8SI.03-A is acting as a sediment transport section where it is straightened along Garfield Road. There are more depositional features at the lower end of the segment as the stream moves away from the road.



Figure 10. Cobble dominated substrate in RI8SI.03-A

While the buffer width on the west bank is impacted in the middle of the segment by the close proximity to Garfield Road, the buffer width on the east side is wide (greater than

100 feet) and was noted to have high quality bank vegetation. Dominant land use within the east corridor is forest. The western corridor is dominated by residential land use and forest is subdominant. Spring, seeps, and tributaries were noted to be abundant at the time of the survey in mid-October 2007.

The geomorphic condition of R18SI.03-A was rated as “fair”. Extreme historic degradation, minor widening and major planform change are the primary adjustment processes occurring within this segment. The habitat condition was rated as “good”. All the habitat parameters scored in the good or reference category with the exception of velocity/depth patterns (not much deep water), channel alteration, and riparian buffer width on the west side of the channel.

The valley wall narrows at the upper end of R18SI.03-A near the Garfield Road crossing. The valley confinement becomes semi-confined where R18SI.03-B begins. There are no grade controls in segment B, however, channel spanning ledge was noted at the lower end of R18SI.04 near the reach break. R18SI.03-B is a “B” channel by reference with a riffle-pool bedform and cobble dominated substrate (Figure 11).



Figure 11. Representative cross section in R18SI.03-B

An arch at the Garfield Road crossing is creating a channel and floodprone constriction at the lower end of segment R18SI.03-B (Figure 12). The span of the structure is 18 feet compared with the reference channel width of 23.9 (75 percent of the bankfull channel width). Based on field observations by BCE during the phase 2 assessment in October 2007 and the bridge and culvert assessment conducted by LCPC in 2006, no obvious geomorphic issues were noted as a result of this stream crossing. There is a natural streambed at the arch, which is allowing fish to move through the structure.



Figure 12. Inlet (top left) and outlet (top right) of Garfield Road arch

Both the geomorphic condition and habitat condition for R18SI.03-B scored “good”. Three islands, one mid-channel bar and one flood chute were mapped in R18SI.03-B providing evidence of some planform adjustment. Degradation, aggradation and widening all scored in the reference category. Segment R18SI.03-B is characterized as having high quality buffers (buffer width of greater than 100 feet dominant), good bank stability, and excellent habitat diversity.

5.0 SEDIMENT REGIME AND SENSITIVITY

5.1 Sediment Regime Departure Analysis

River corridor restoration and protection projects that are successful 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 sediment load or finds a way to attenuate the loads upstream. Modifications in watershed inputs in the form of peak flows or increased sediment can result in an imbalance of stream power and sediment in the channel. Changes in the shape of the channel may also lead to disequilibrium. Large channel adjustments, such as severe erosion and excessive deposition, are a result of this imbalance, and often continue until the channel reaches a state of equilibrium. (Vermont Agency of Natural Resources, 2010)

The reference and existing sediment regimes are presented in Figures 13 and 14 as a way to understand if the Rodman Brook watershed has lost flood and sediment attenuation areas. All departures were derived from the DMS according to the sediment regime criteria established by the Vermont Agency of Natural Resources (2010). 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*. The upper most segment (R18SI.03-B) is semi-confined with an existing stream type of B3 and has a *Transport* sediment regime by reference.

Changes in hydrology (such as development and agriculture within the riparian corridor) and/or floodplain encroachments have altered the reference sediment regime types for some segments. Two segments (R18S1.01 and R18S1.02-A) 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 being transported through without being deposited as a result of channel incision and reduced floodplain access. Additionally coarse sediment storage is increased due to increased sediment load along with lower transport capacity. Two segments (R18S1.02-B and R18S1.03-A) that were also *Coarse Equilibrium (in=out) & Fine Deposition* by reference have been converted to an *Unconfined Source and Transport* sediment regime due to entrenchment and incision. These segments are not currently contributing large sources of sediment, but will likely become sources of sediment as the channel starts to widen. R18S1.03-B has an existing sediment regime of *Transport* and does not represent a sediment regime departure.

The existing sediment regimes for the four lowest segments in the Rodman Brook watershed reflect reduced floodplain access, increased stream power, reduced boundary resistance, and lateral constraints. 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, 2010).

5.2 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, 2007).

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, 2007).

There are many variables that are contributing to the sensitivity of the streams in the Rodman Brook watershed. The location and slope of a stream affects its morphology and sensitivity. Streams that are transporting sediment through the channel are less sensitive than streams that are storing and responding to sediment. Additionally, flow regime and floodplain constrictions may be affecting the sensitivity of the study area. 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 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. Garfield Road runs along much of the length of the first three reaches, significantly changing the confinement in many locations. The existing geomorphic condition and stream sensitivity of the Phase 2 assessed reaches are presented in Table 2.

Table 2. Stream Sensitivity for Phase 2 Reaches					
Segment Number	Reference Stream Type	Existing Stream Type	Stream Type Departure	Geomorphic Condition	Sensitivity
R18SI.01	C3b	B3	Yes	Fair	High
R18SI.02-A	C3b	C3b	No	Fair	High
R18SI.02-B	C4b	B4	Yes	Fair	Very High
R18SI.03-A	C3b	B3	Yes	Fair	High
R18SI.03-B	B3	B3	No	Good	Moderate

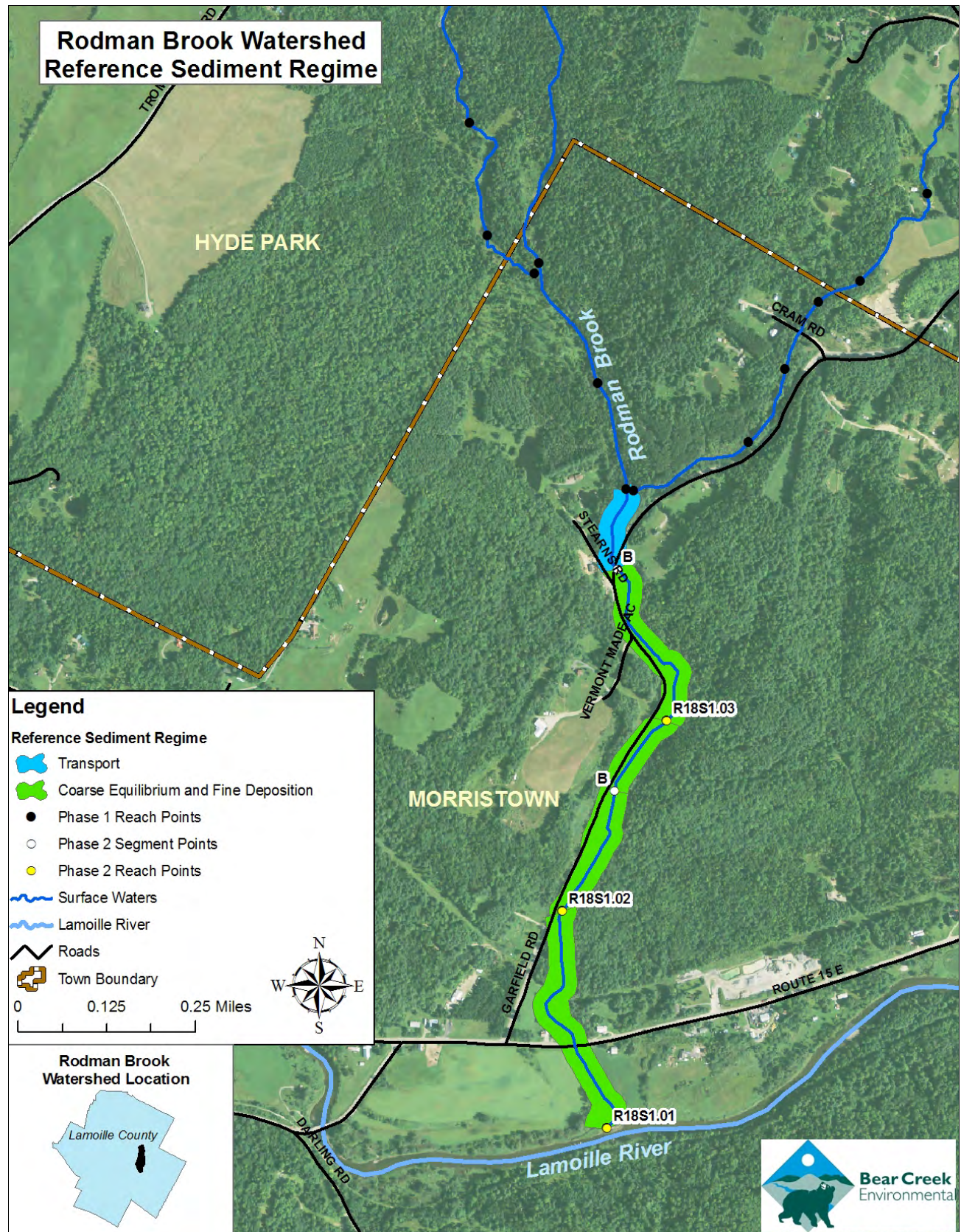


Figure 13. Rodman Brook Reference Sediment Regime

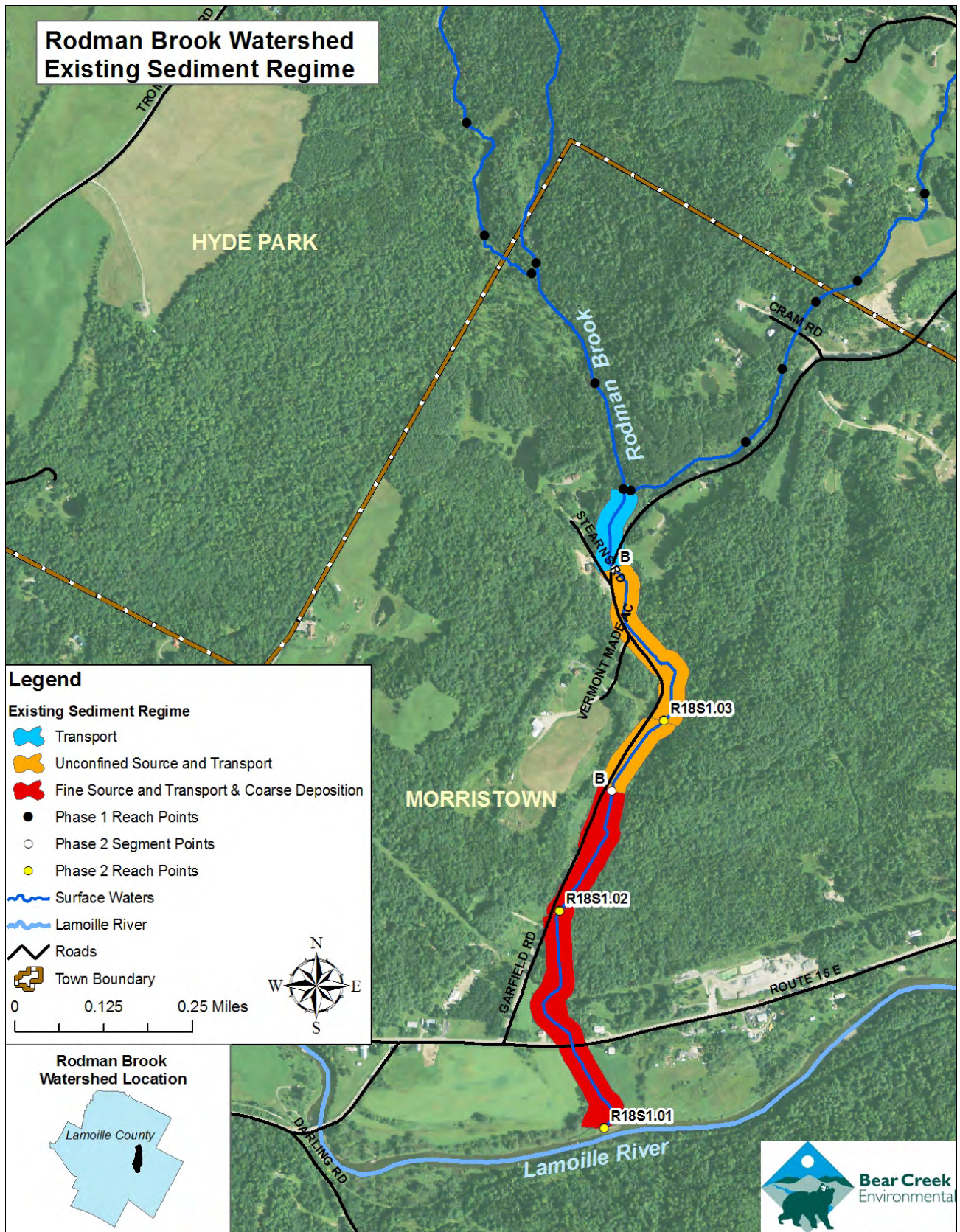


Figure 14. Rodman Brook Existing Sediment Regime

6.0 PRELIMINARY PROJECT IDENTIFICATION AND PRIORITIZATION

The sediment departure and sensitivity analyses presented in Section 5.0 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. One of the primary programs is the River Corridor Easement (RCE). 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. Corridor easements are a high priority for reaches that are not in equilibrium; these channels are experiencing channel adjustments, which are causing conflicts with current/future land-use expectations. Providing an easement on these reaches reduces the conflict and provides a long term solution to sediment storage and flood water attenuation needs. A description of the River Corridor Easement Program (RCE) is provided below.

River Corridor Easement

Easements are in perpetuity, meaning the agreement stays with the land forever.

- A onetime payment is received by the landowner for transferal of channel management rights to a second party (a land trust).

- Transferal of channel management rights means that the landowner would no longer be able to rock line river banks or remove gravel for personal use.
- A RCE requires a minimum 50 foot buffer that floats with the river. No active land use is allowed within the buffer. The buffer can be actively planted or allowed to revegetate passively.
- The easement does not take away the agricultural land use rights, so the landowner could continue to crop or pasture the farm land mapped outside of the buffer, yet within the corridor, for as long as the river allows.

6.1 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 man-made conflicts that can result from development in identified fluvial erosion hazard areas; minimize property loss and damage due to fluvial erosion; and prohibit land uses and development in fluvial erosion hazard areas that pose a danger to health and safety. The basis of a Fluvial Erosion Hazard Zone is a defined river corridor which includes the course of a river and its adjacent lands. The width of the corridor is defined by the lateral extent of the river meanders, called the meander belt width, which is governed by valley landforms, surficial geology, and the length and slope requirements of the river channel. The width of the corridor is also governed by the stream type and sensitivity of the stream. River corridors, as defined by the Vermont Agency of Natural Resources (2008), are intended to provide landowners, land use planners, and river managers with a meander belt width which would accommodate the meanders and slope of a balanced or equilibrium channel, which when achieved, would serve to maximize channel stability and minimize fluvial erosion hazards. Information collected during the Phase 2 Assessment including reach sensitivity, reach condition, and stream type is used to develop these zones. Towns have the opportunity to work with the Vermont River Management Program to develop fluvial erosion hazard zones to reduce conflicts within the river corridor.

STORMWATER

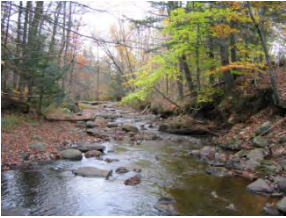

Stormwater runoff rates are of particular concern in urbanized and agricultural watersheds because stormwater runs off from impervious surfaces rather than naturally infiltrating the soil. The cumulative effect of the increased frequency, volume, and rate of stormwater runoff results in increases in wash-off pollutant loading to streams and destabilization of stream channels. Improved stormwater management of Garfield Road is recommended to reduce the amount of sediment that is washing off the road into the brook.

6.2 Proposed Site Level Restoration Opportunities


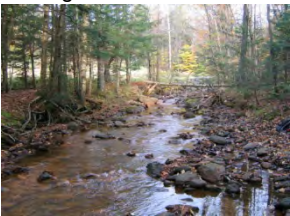
Site specific projects were identified using the criteria outlined by the VANR in Chapter 6 Preliminary Project Identification and Prioritization (Vermont Agency of Natural Resources, 2010). This planning guide is intended to aid in the development of projects that protect and restore river equilibrium. The site level projects that were developed for Rodman Brook within Morrystown are provided below in Table 3. The project strategy, technical feasibility, and priority for each project are listed by project number and reach. A map of the project sites are shown in Figure 15. Projects include river corridor protection to provide attenuation of sediment and floodwaters through corridor easements, the replacement of an undersized stream crossing at Route 15, an alternatives analysis for a berm removal project, a project to remediate a heavy iron seep, and improved stormwater treatment of Garfield Road. No suitable planting locations were identified. Many of the areas with narrow buffers were adjacent to Garfield Road and would not be suitable locations for a planting project. The restoration projects identified in this plan include:

- **Passive Restoration** through corridor easements upstream and downstream of Route 15 to allow Rodman Brook to adjust and reach an equilibrium condition (project #1);
- **Active Restoration** by replacing the Route 15 bridge (project #2);
- **Active Restoration** by removing 250 feet of berms that are on one or both sides of the channel near a former mill dam (project #3); and
- **Passive Restoration** through corridor easements from 1100 feet above the Route 15 crossing upstream to where Rodman Brook is close to Garfield (project #4);
- **Active Restoration** of an iron seep that is altering the food source and reducing the habitat for aquatic insects (project #5).
- **Stormwater** improved treatment of stormwater coming off of Garfield Road (project #6)

**Table 3. Rodman Brook Site Level Opportunities for Restoration and Protection
Morristown, 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 Upstream and downstream of Route 15 (Morristown)  R18S1.01	Passive Restoration	Extreme historic incision has occurred within the lowest reach on Rodman Brook. Upstream and downstream of the Route 15 Bridge there is room for the channel to adjust. The channel is currently widening and there are locations where the stream is starting to regain sinuosity through the formation of bar features.	Protect River Corridor through corridor easement to reduce conflicts and channel armoring	High priority – R18S1.01 is near the mouth and is an important attenuation asset. The stream is far enough from Garfield Road that there is room to adjust.	Flood and sediment attenuation; Provide channel management alternatives	Cost of corridor easements may be high due to wide corridor	Field/yard to floodplain	VANR, LCPC, landowner, land trust, Lamoille Natural Resources Conservation District (LNRCD)
#2 Route 15 crossing (Morristown)  R18S1.01	Active Restoration	The Route 15 Bridge is undersized relative to bankfull (span is 13 feet and is 50 percent of bankfull width) There is scour above and below the structure. The bridge sits on bedrock.	Bridge Replacement	Low priority – although the bridge is undersized, the bedrock bed under the bridge adds to geomorphic stability.	Improved geomorphic stability	High cost for replacement	Unknown	Town of Morristown VANR, LCPC
#3 Upstream of Route 15 crossing in vicinity of bedrock grade controls (Morristown) R18S1.01	Active Restoration	Berms line both sides of the channel in the vicinity of two bedrock grade controls. These berms may have been associated with a former mill.	Alternatives analysis for berm removal project	Low priority - Well established vegetation on berm within the buffer makes this lower priority. The road encroachment in the west corridor also needs to be considered.	Improved floodplain access	High cost for design and removal	Unknown	VANR, LCPC, landowner, LNRCD

**Table 3. Rodman Brook Site Level Opportunities for Restoration and Protection
Morristown, 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
<p>#4 About 1100 feet above Route 15 crossing upstream to where Rodman Brook is close to Garfield Road (Morristown)</p>  <p>R18S1.02-A</p>	Passive Restoration	Stream channel is much more sinuous in this segment than is evident on stream layer. A juvenile floodplain is being created at a lower elevation.	Protect River Corridor through corridor easement to reduce conflicts and channel armoring	High priority – This is an important attenuation segment, which is located downstream of a straightened segment that is severely encroached upon by Garfield Road.	Flood and sediment attenuation; Provide channel management alternatives	Cost of corridor easements may be high due to wide corridor	forest/yard to floodplain	VANR, LCPC, landowner, land trust
<p>#5 Equidistant between Route 15 crossing and Garfield Road crossing</p>  <p>R18S1.02-A</p>	Active Restoration	There is an active iron seep at the upstream end of segment R18S1.02-A. Iron precipitate alters the food source for aquatic insects and also reduces available habitat by filling in the interstitial spaces of the substrate.	Remediate iron seep by using limestone to intercept the groundwater.	Moderate priority- The iron seep is not causing a geomorphic issue, but is likely impacting the available food source for aquatic insects in the immediate vicinity of the iron precipitate.	Improved aquatic habitat	Moderate cost for remediation design and construction	Unknown	VANR, LCPC, landowner, LNRCD
<p>#6 Downstream of intersection of Vermont Made AC and Garfield Road, where Rodman Brook is next to Garfield Road</p> <p>R18S1.02-B and R18S1.03-A</p>	Stormwater management	Rodman Brook runs next to Garfield Road and gravel and cobbles from the road base are falling down the bank into the channel. Stormwater from the road is flowing into road side ditches and directly into the brook.	Stabilize road base and treat stormwater prior to entering Rodman Brook. Possibly grade the road so stormwater flows away from brook.	High- The sediment is contributing to substrate embeddedness and is reducing aquatic habitat.	Improved aquatic habitat	Moderate cost for improved stormwater treatment and maintenance	Unknown	Town of Morrilltown, VANR, LCPC, LNRCD

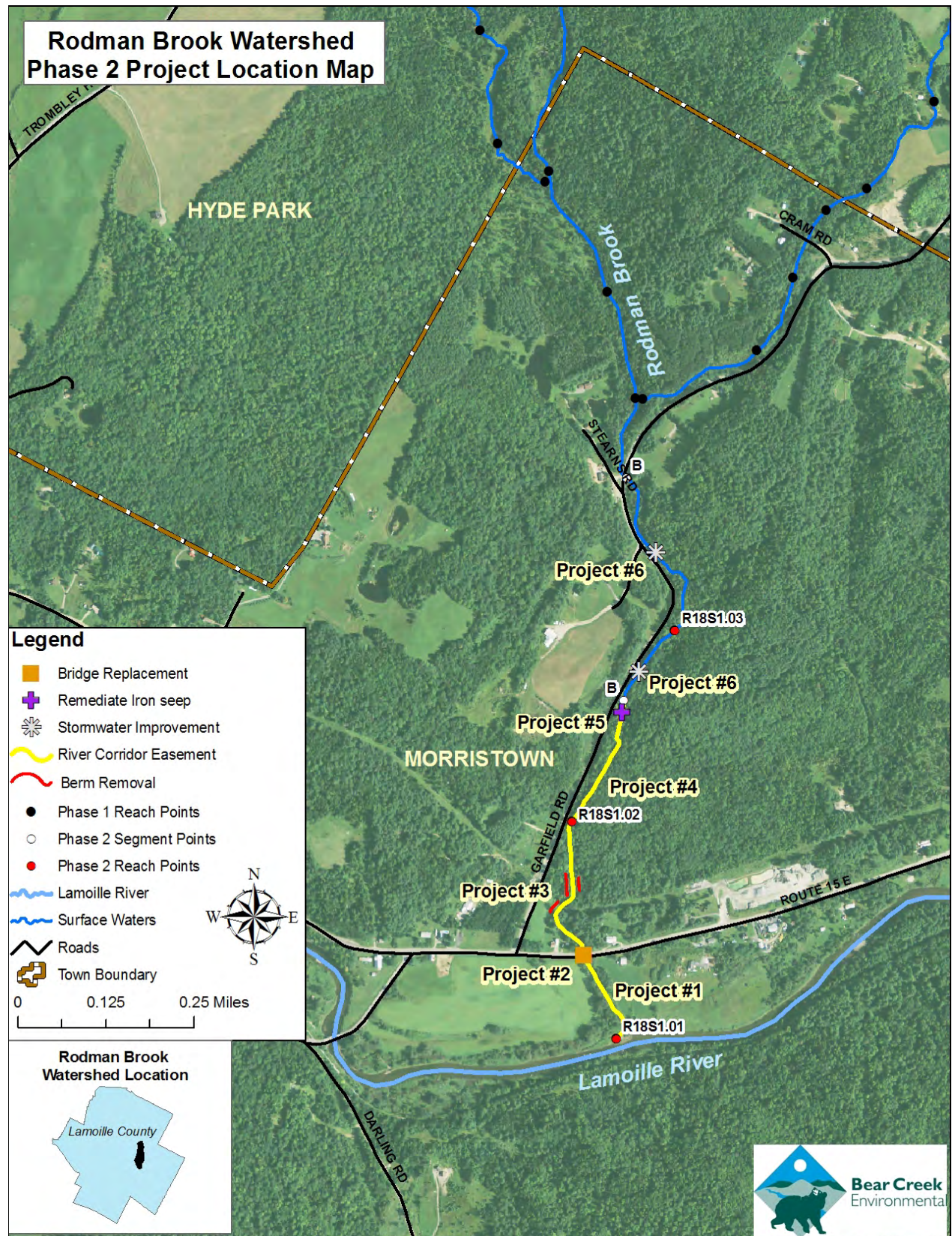


Figure 15. Proposed restoration projects for Rodman Brook

6.3 Next Steps

There are many opportunities to restore the Rodman 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 plantings, and replacement of stream crossings. 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 Towns of Morristown and 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 Rodman Brook. The following are recommendations for next steps:

1. Apply for funding to complete additional Phase 2 stream geomorphic assessments of Rodman Brook. A Phase 2 assessment has been completed on reaches R18S1.01-R18S1.03. However, additional assessment work would provide further information and prediction on how the river will evolve in this area and should be considered as land use decisions are being made within the corridor. Future field studies focusing particularly on high total impact and poor project reach conditions can help area residents and municipal officials craft short-term and long-term management plans.
2. Utilize Phase 2 information and bridge and culvert assessment data to assist with replacing stream crossings. As bridges and culverts are replaced, they should be adequately sized to meet the river's bankfull width. Careful consideration should be given to the design of the structure to reduce geomorphic incompatibility and aquatic organism passage issues.
3. 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.
4. Town, State, and LCPC representatives meet to discuss the various restoration and protection opportunities and set priorities for action. Avoiding encroachments and land uses that conflict with the river's evolution will mitigate the costs of managing the river and decrease the potential for flood damage.
5. 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.
6. Summary and prioritization of potential projects.
7. 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
PO Box 1637
52 Portland Street, Second Floor
Morrisville, VT 05661
(802) 888-4548
lcpc@lcpv.org



7.0 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 over wide channel.

Bifurcation- When a stream has split into two or more active channels.

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.

Channel length - Length of channel, in feet, for the main stem or tributary from the reach point to the next upstream reach point.

Channel slope - Channel slope is the difference in elevation at the upstream end of the channel and the downstream end of the channel divided by the channel length.

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.

Head cut – Sudden change in elevation or knickpoint at the leading edge of a gully

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.

Reach condition (from ANR Phase I Handbook)

- Reference (reach) condition: In equilibrium – no apparent or significant channel, floodplain, or land cover modifications; channel geometry is likely to be in balance with the flow and sediment produced in it watershed.
- Good (reach) condition: In equilibrium but may be in transition into or out of the range of natural variability – minor erosion or lateral adjustment but adequate floodplain function; any adjustment from historic modifications nearly complete.
- Fair (reach) condition: In adjustment - moderate loss of floodplain function and/or moderate to major planform adjustments that could lead to channel avulsions.
- Poor (reach) condition: In adjustment and stream type departure – may have changed to a new stream type or central tendency of fluvial processes – significant channel and floodplain modifications may have altered the channel geometry such that the stream is not in balance with the flow and sediment produced in the watershed.

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.

Sinuosity - The channel length divided by valley length.

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.

Straightening - The removal of meander bends, often done in towns and along roadways, railroads, and agricultural fields.

Stream confinement - The valley width divided by the channel width.

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.

Valley slope - Valley slope is calculated as the difference between the elevation of upstream reach point and the elevation of reach point divided by the valley length.

Windrowing - Pushing gravel up from the stream bed onto the top of either bank as part of the straightening of the river.

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Appendix A. Phase I - Step I. Reach Locations

Basin: **Lamoille** Watershed: **Lamoille River** Sub-watershed: **Lamoille River -- headwaters to Gihon River**

SGAT Version: **4.56** Quality Assurance Status **Step 7 done**

Reach ID	Stream Name	Excluded?	Towns	Description
R18SI.01	Rodman Brook		Morristown	Begins at the confluence with the Lamoille River, and continues for about 2000 feet. This segment continues for about 1100 feet after crossing Route 15.
R18SI.02	Rodman Brook		Morristown	Continues for about 700 feet.
R18SI.03	Rodman Brook		Morristown	Continues for about 2000 feet, and about 560 feet past Garfield Road.
R18SI.04	Rodman Brook		Morristown	Continues for just over 900 feet.
R18SI.05	Rodman Brook		Morristown	Continues for about 925 feet to a tributary entering from the northwest.
R18SI.06	Rodman Brook		Hyde Park, Morristown	Continues for just over a mile, about 675 feet past TH50
R18SI.07	Rodman Brook		Hyde Park	Continues for about 925 feet, about 510 feet after crossing Cleveland Corners Road.
R18SI.08	Rodman Brook		Hyde Park	Continues for about 2800 feet, ending about 125 feet downstream of a tributary entering from the east.
R18SI.09	Rodman Brook		Hyde Park	Continues for about 950 feet, about 350 feet upstream of a small pond.
R18SI.10	Rodman Brook		Hyde Park	Continues for about 1.1 miles to about 835 feet upstream of where the channel crosses Solar Drive.
R18SI.11	Rodman Brook		Hyde Park	Continues for about 1150 feet to a tributary entering from the east. This reach ends about 460 feet downstream of Levesque Road.
R18SI.12	Rodman Brook		Hyde Park	Continues for about 2350 feet, ending about 250 feet downstream of Diggins Road.
R18SI.13	Rodman Brook		Hyde Park	Continues for about 2825 feet, ends at a tributary entering from the north.
R18SI.14	Rodman Brook		Hyde Park	Continues for about 700 feet. There are no significant reference points along this reach.
R18SI.15	Rodman Brook		Hyde Park	Continues for about 1300 feet, into the headwaters of the stream

Appendix B
Phase 2 Stream Geomorphic Assessment Data
Rodman Brook
Morristown, Vermont



Phase 2 Segment Summary Report **Rodman Brook**

Stream:	Rodman Brook	SGAT Version:	4.56
Reach:	R18S1.01-0	Organization:	Bear Creek Environmental
Segment Length(ft):	1,878	Observers:	CS, MA
Rain:	Yes	Completion Date:	10/16/2007
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Begins at the confluence with the Lamoille River, and continues for about 2000 feet. This segment continues for about 1100 feet after crossing Route 15.**

Step 5 - Notes: **Old berms along portion of reach (300-400'). Did not segment due to short length of section and similarity of the reach except for berms. Grade controls, phase 1 valley walls and banks are consistent. Straightened DS of Rt 15 bridge, near confluence w/Lamoille. Possible old mill/dam - old foundation near bedrock section. Before Hyde Park was founded this area was town of Garfield, mill town. Abandoned ~late 1800s. Berms, etc. result of old town.**

Note: We have added a human elevated floodplain and human elevated incision ratio for this reach. These values are only applicable to the bermed portion of the reach.

Step 7 - Narrative: **Extreme historic degradation, minor aggradation, widening, and planform.**

Step 1. Valley and Floodplain

1.1 Segmentation: None	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Hilly	Flat	Valley Width (ft): 645
1.3 Corridor Encroachments:	Continuous w/ Bank:	Never	Never	Width Determination: Estimated
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Never	Never	Confinement Type: VB
Berm: 167 9 90 9	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 214 0 0				Human Caused Change in Valley Width?: Yes
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 63				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	7.0	5.0	Yes	
Ledge	Mid-segment	2.0	1.0	Yes	
Ledge	Mid-segment	4.0	2.0	Yes	



Phase 2 Segment Summary Report

Rodman Brook

Stream: **Rodman Brook** Reach: **R18S1.01-0**

Step 2. Stream Channel

2.1 Bankfull Width (ft.):	24.00	2.11 Riffle/Step Spacing:	250 ft.	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	1.80	2.12 Substrate Composition		Bed:	12 inches
2.3 Mean Depth (ft):	1.40	Bedrock:	0.0 %	Bar:	6 inches
2.4 Floodprone Width (ft.):	39.70	Boulder:	17.0 %	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	2.80	Cobble:	50.0 %	Stream Type:	B
Human Elev FloodPln (ft.):	9.00	Coarse Gravel:	24.0 %	Bed Material:	Cobble
2.6 Width/Depth Ratio:	17.14	Fine Gravel:	8.0 %	Subclass Slope:	None
2.7 Entrenchment Ratio:	1.65	Sand:	1.0 %	Bed Form:	Riffle-Pool
2.8 Incision Ratio:	1.56	Silt and Smaller:	0.0 %	Field Measured Slope:	
Human Elevated Inc. Rat.:	5.00	Silt/Clay Present:	Yes	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	Low	Detritus:	4.0 %	Reference Stream Type:	
2.10 Riffles Type:	Complete	# Large Woody Debris:	13	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	Steep				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	305.0	754.3	Dominant:	Deciduous	Deciduous
Material Type:	Sand	Sand	Erosion Height (ft.):	4.2	5.4	Sub-dominant:	Coniferous	Coniferous
Consistency:	Non-cohesive	Non-cohesive	Revetment Type:	Multiple	Multiple	Bank Canopy		
Lower			Revetment Length:	161.0	123.3	Canopy %:	51-75	51-75
Material Type:	Boulder/Cobbles	Boulder/Cobbles				Mid-Channel Canopy:	Closed	
Consistency:	Non-cohesive	Non-cohesive						

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	>100	51-100	Dominant
Sub-Dominant	26-50	26-50	Sub-dominant
W less than 25	0	144	(Legacy)
Buffer Vegetation Type			Failures
Dominant	Mixed Trees	Mixed Trees	Gullies
Sub-Dominant	None	Herbaceous	

3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	Forest	Residential	Mass Failures		
Sub-Dominant	Hay	None	Height		
W less than 25	Amount	Mean Hieght	Gullies Number		
Buffer Vegetation Type			Gullies Length		
Dominant	None				
Sub-Dominant	None				



Phase 2 Segment Summary Report

Rodman Brook

Stream: Rodman Brook

Reach: R18S1.01-0

Step 4. Flow & Flow Modifiers

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

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	13	Yes	No	Yes	Yes	Scour Above, Scour Below

Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: 0	5.2 Other Features	Neck Cutoff: 0	5.4 Stream Ford or Animal Crossing: No
Mid: 3	Delta: 1	Flood chutes: 1	Avulsion: 0	5.5 Straightening: Straightening
Point: 3	Island: 0	5.3 Steep Riffles and Head Cuts	Head Cuts: 0	Straightening Length (ft.): 1,074
Side: 7	Braiding: 0	Steep Riffles: 0	Trib Rejuv.: No	5.5 Dredging: None

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	15	6.4 Sediment Deposition:	16	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	16	6.5 Channel Flow Status:	15	6.8 Bank Stability:	7	6
6.3 Pool Variability:	15	6.6 Channel Alteration:	8	6.9 Bank Vegetation Protection	8	6
Total Score:	140	6.7 Channel Sinuosity:	13	6.10 Riparian Veg. Zone Width:	10	5
Habitat Rating:	0.70					
Habitat Stream Condition:	Good					

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		5	C to B	Yes	Geomorphic Rating	0.56
7.2 Channel Aggradation		13	None	No	Channel Evolution Model	F
7.3 Widening Channel		14		No	Channel Evolution Stage	III
7.4 Change in Planforml		13		No	Geomorphic Condition	Fair
Total Score		45			Stream Sensitivity	High



Phase 2 Segment Summary Report Rodman Brook

Stream:	Rodman Brook	SGAT Version:	4.56
Reach:	R18S1.02-A	Organization:	Bear Creek Environmental
Segment Length(ft):	1,015	Observers:	CS, MN
Rain:	Yes	Completion Date:	10/18/2007
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Segment begins where stream becomes much closer to the road and continues 1076 feet.**

Step 5 - Notes: **Lots of Fe & silt on substrate. Cross section located on bend. Has good floodplain access. Note: Stream is much more sinuous in this segment than is evident on SGAT stream layer. This segment is farther in evolution than downstream. Rip rap and large trees on outside bend preventing further widening.**

Step 7 - Narrative: **Major historic degradation and planform, minor aggradation, widening. Some widening in middle of segment where floodplain access is limited. Rebuilt floodplain at lower elevation on inside bends.**

Step 1. Valley and Floodplain

1.1 Segmentation: Banks and Buffers	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Steep	Steep	Valley Width (ft): 250
1.3 Corridor Encroachments:	Continuous w/ Bank:	Sometimes	Never	Width Determination: Estimated
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Sometimes	Never	Confinement Type: VB
Berm: 0 0 0	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 863 11 0				Human Caused Change in Valley Width?: Yes
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 0				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	3.0	2.0	Yes	
Ledge	Mid-segment	4.0	3.0	Yes	



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Phase 2 Segment Summary Report

Rodman Brook

Stream: **Rodman Brook** Reach: **R18S1.02-A**

Step 2. Stream Channel

2.1 Bankfull Width (ft.):	26.80	2.11 Riffle/Step Spacing:	188 ft.	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	2.50	2.12 Substrate Composition		Bed:	8 inches
2.3 Mean Depth (ft.):	1.76	Bedrock:	0.0 %	Bar:	6 inches
2.4 Floodprone Width (ft.):	155.20	Boulder:	11.0 %	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	3.80	Cobble:	56.0 %	Stream Type:	C
Human Elev FloodPln (ft.):		Coarse Gravel:	24.0 %	Bed Material:	Cobble
2.6 Width/Depth Ratio:	15.23	Fine Gravel:	8.0 %	Subclass Slope:	b
2.7 Entrenchment Ratio:	5.79	Sand:	1.0 %	Bed Form:	Riffle-Pool
2.8 Incision Ratio:	1.52	Silt and Smaller:	0.0 %	Field Measured Slope:	
Human Elevated Inc. Rat.:	0.00	Silt/Clay Present:	No	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	Moderate	Detritus:	3.0 %	Reference Stream Type:	
2.10 Riffles Type:	Complete	# Large Woody Debris:	6	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	Steep		
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	102.9	218.6	Dominant:	Coniferous Coniferous
Material Type:	Sand	Sand	Erosion Height (ft.):	5.0	5.1	Sub-dominant:	Deciduous Deciduous
Consistency:	Non-cohesive	Non-cohesive	Revetment Type:	Rip-Rap	None	Bank Canopy	
Lower			Revetment Length:	81.4	0.0	Canopy %:	76-100 51-75
Material Type:	Boulder/Cobbles	Boulder/Cobbles				Mid-Channel Canopy:	Closed
Consistency:	Non-cohesive	Non-cohesive					

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	>100	26-50	Dominant
Sub-Dominant	None	0-25	Sub-dominant
W less than 25	0	100	(Legacy)
Buffer Vegetation Type			Failures
Dominant	Coniferous	Mixed Trees	Gullies
Sub-Dominant	Deciduous	Herbaceous	

3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	Forest	Residential	Mass Failures	
Sub-Dominant	None	None	Height	
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Buffer Vegetation Type			Gullies Length	
Dominant	None			
Sub-Dominant	None			



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Phase 2 Segment Summary Report

Rodman Brook

Stream: Rodman Brook

Reach: R18S1.02-A

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

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

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	12	6.4 Sediment Deposition:	14	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	15	6.5 Channel Flow Status:	11	6.8 Bank Stability:	8	5
6.3 Pool Variability:	9	6.6 Channel Alteration:	17	6.9 Bank Vegetation Protection	9	6
Total Score:	134	6.7 Channel Sinuosity:	15	6.10 Riparian Veg. Zone Width:	10	3
Habitat Rating:	0.67					
Habitat Stream Condition:	Fair					

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		10	None	Yes	Geomorphic Rating	0.59
7.2 Channel Aggradation		13	None	No	Channel Evolution Model	F
7.3 Widening Channel		14		No	Channel Evolution Stage	IV
7.4 Change in Planform		10		No	Geomorphic Condition	Fair
Total Score		47			Stream Sensitivity	High



Phase 2 Segment Summary Report Rodman Brook

Stream:	Rodman Brook	SGAT Version:	4.56
Reach:	R18S1.02-B	Organization:	Bear Creek Environmental
Segment Length(ft):	661	Observers:	CS, MA
Rain:	Yes	Completion Date:	10/16/2007
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Segment begins where floodplain access becomes more limited about 600 feet downstream of the end of reach.**

Step 5 - Notes: **Segment was straightened, largely plane bed now. Road runs along right bank. Gravel and cobbles from road base falling down bank (not riprapped). Fairly high incision. Old terrace at LTOB may be just barely accessible in very high flows.**

Step 7 - Narrative: **Extreme historic degradation, minor aggradation, widening and planform.**

Step 1. Valley and Floodplain

1.1 Segmentation: Banks and Buffers	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Steep	Steep	Valley Width (ft): 111
1.3 Corridor Encroachments:	Continuous w/ Bank:	Never	Never	Width Determination: Measured
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Never	Never	Confinement Type: NW
Berm: 0 0 0	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 660 15 0				Human Caused Change in Valley Width?: Yes
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 0				
1.6 Grade Controls: None				



Phase 2 Segment Summary Report

Rodman Brook

Stream: **Rodman Brook** Reach: **R18S1.02-B**

Step 2. Stream Channel

2.1 Bankfull Width (ft.):	23.00	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	2.20	2.12 Substrate Composition	Bed: 8 inches
2.3 Mean Depth (ft.):	1.58	Bedrock:	Bar: N/A inches
2.4 Floodprone Width (ft.):	34.70	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	4.70	Cobble:	Stream Type: B
Human Elev FloodPIn (ft.):		Coarse Gravel:	Bed Material: Gravel
2.6 Width/Depth Ratio:	14.56	Fine Gravel:	Subclass Slope: None
2.7 Entrenchment Ratio:	1.51	Sand:	Bed Form: Plane Bed
2.8 Incision Ratio:	2.14	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	0.00	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	Low	Detritus:	Reference Stream Type:
2.10 Riffles Type:	Eroded	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: Steep					
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	0.0	226.5	Dominant:	Deciduous	Herbaceous
Material Type:	Gravel	Gravel	Erosion Height (ft.):	0.0	6.1	Sub-dominant:	Herbaceous	Bare
Consistency:	Non-cohesive	Non-cohesive	Revetment Type:	None	Rip-Rap	Bank Canopy		
Lower			Revetment Length:	0.0	133.7	Canopy %:	51-75	1-25
Material Type:	Gravel	Gravel			Mid-Channel Canopy:		Open	
Consistency:	Non-cohesive	Non-cohesive						

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	0-25
Sub-Dominant	None	26-50
W less than 25	0	482
Buffer Vegetation Type		
Dominant	Mixed Trees	Herbaceous
Sub-Dominant	None	Deciduous

3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	Forest	Residential	Mass Failures	
Sub-dominant	None	None	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	None		Gullies Length	
Gullies	None			



Phase 2 Segment Summary Report

Rodman Brook

Stream: Rodman Brook

Reach: R18S1.02-B

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: 0	5.2 Other Features	Neck Cutoff: 0	5.4 Stream Ford or Animal Crossing:	No
Mid:	1	Flood chutes:	0	5.5 Straightening:	Straightening
Point:	0	5.3 Steep Riffles and Head Cuts	Head Cuts: 0	Straightening Length (ft.):	467
Side:	3	Steep Riffles:	0	5.5 Dredging:	None

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	11	6.4 Sediment Deposition:	13	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	13	6.5 Channel Flow Status:	15	6.8 Bank Stability:	9	4
6.3 Pool Variability:	10	6.6 Channel Alteration:	3	6.9 Bank Vegetation Protection	9	3
Total Score:	104	6.7 Channel Sinuosity:	3	6.10 Riparian Veg. Zone Width:	10	1
Habitat Rating:	0.52					
Habitat Stream Condition:	Fair					

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		3	C to B	Yes	Geomorphic Rating	0.56
7.2 Channel Aggradation		14	None	No	Channel Evolution Model	F
7.3 Widening Channel		14		No	Channel Evolution Stage	II
7.4 Change in Planform		14		No	Geomorphic Condition	Fair
Total Score		45			Stream Sensitivity	Very High



Phase 2 Segment Summary Report Rodman Brook

Stream:	Rodman Brook	SGAT Version:	4.56
Reach:	R18S1.03-A	Organization:	Bear Creek Environmental
Segment Length(ft):	1,371	Observers:	MN, CS
Rain:	No	Completion Date:	10/18/2007
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Segment begins about 1400 feet downstream of bridge at Garfield Road and ends at bridge.**

Step 5 - Notes: **Road in corridor (RB) most of length. The upper portion of R18S1.03A is acting as a sediment transport section where it is straightened along the road. There are more depositional features at the lower end of the segment as the stream moves away from the road.**

Step 7 - Narrative: **Extreme historic degradation, minor aggradation and planform. Good bank vegetation on LB.**

Step 1. Valley and Floodplain

1.1 Segmentation: Valley Width	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Very Steep	Steep	Valley Width (ft): 173
1.3 Corridor Encroachments:	Continuous w/ Bank:	Never	Never	Width Determination: Measured
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Never	Never	Confinement Type: BD
Berm: 0 0	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 1,247 0 0				Human Caused Change in Valley Width?: Yes
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 0				
1.6 Grade Controls: None				



Phase 2 Segment Summary Report

Rodman Brook

Stream: **Rodman Brook** Reach: **R18S1.03-A**

Step 2. Stream Channel

2.1 Bankfull Width (ft.):	22.80	2.11 Riffle/Step Spacing:	109 ft.	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	2.30	2.12 Substrate Composition		Bed:	9 inches
2.3 Mean Depth (ft.):	1.48	Bedrock:	0.0 %	Bar:	8 inches
2.4 Floodprone Width (ft.):	31.00	Boulder:	7.0 %	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	4.90	Cobble:	50.0 %	Stream Type:	B
Human Elev FloodPln (ft.):		Coarse Gravel:	22.0 %	Bed Material:	Cobble
2.6 Width/Depth Ratio:	15.41	Fine Gravel:	19.0 %	Subclass Slope:	None
2.7 Entrenchment Ratio:	1.36	Sand:	2.0 %	Bed Form:	Riffle-Pool
2.8 Incision Ratio:	2.13	Silt and Smaller:	0.0 %	Field Measured Slope:	
Human Elevated Inc. Rat.:	0.00	Silt/Clay Present:	No	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	Low	Detritus:	2.0 %	Reference Stream Type:	
2.10 Riffles Type:	Complete	# Large Woody Debris:	34	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	Steep	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	37.0	117.9	
Material Type:	Sand	Sand	Erosion Height (ft.):	4.0	5.3	
Consistency:	Non-cohesive	Non-cohesive	Revetment Type:	None	Rip-Rap	
Lower			Revetment Length:	0.0	151.2	
Material Type:	Boulder/Cobbles	Boulder/Cobbles				
Consistency:	Non-cohesive	Non-cohesive				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	Deciduous	Shrubs/Sapling
				Sub-dominant:	Shrubs/Sapling	Deciduous
				Bank Canopy		
				Canopy %:	76-100	26-50
				Mid-Channel Canopy:	Open	

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	>100	51-100	Dominant
Sub-Dominant	None	26-50	Sub-dominant
W less than 25	0	134	(Legacy)
Buffer Vegetation Type			Failures
Dominant	Mixed Trees	Mixed Trees	Gullies
Sub-Dominant	None	Shrubs/Sapling	

3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	Forest	Residential	Mass Failures		
Sub-Dominant	None	Forest	Height		
W less than 25	Amount	Mean Hieght	Gullies Number		
Buffer Vegetation Type			Gullies Length		
Dominant	None				
Sub-Dominant					



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Phase 2 Segment Summary Report

Rodman Brook

Stream: Rodman Brook

Reach: R18S1.03-A

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: 0	5.2 Other Features	Neck Cutoff: 0	5.4 Stream Ford or Animal Crossing:	No
Mid:	2 Delta: 0	Flood chutes: 2	Avulsion: 0	5.5 Straightening:	Straightening
Point:	3 Island: 1	5.3 Steep Riffles and Head Cuts	Head Cuts: 0	Straightening Length (ft.):	511
Side:	2 Braiding: 0	Steep Riffles: 1	Trib Rejuv.: Yes	5.5 Dredging:	None

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	14	6.4 Sediment Deposition:	15	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	14	6.5 Channel Flow Status:	14	6.8 Bank Stability:	10	8
6.3 Pool Variability:	10	6.6 Channel Alteration:	9	6.9 Bank Vegetation Protection	9	8
Total Score:	142	6.7 Channel Sinuosity:	16	6.10 Riparian Veg. Zone Width:	10	5
Habitat Rating:	0.71					
Habitat Stream Condition:	Good					

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		5	C to B	Yes	Geomorphic Rating	0.57
7.2 Channel Aggradation		14	None	No	Channel Evolution Model	F
7.3 Widening Channel		17		No	Channel Evolution Stage	II
7.4 Change in Planform		10		No	Geomorphic Condition	Fair
Total Score		46			Stream Sensitivity	High



Phase 2 Segment Summary Report Rodman Brook

Stream:	Rodman Brook	SGAT Version:	4.56
Reach:	R18S1.03-B	Organization:	Bear Creek Environmental
Segment Length(ft):	647	Observers:	MN, CS
Rain:	Yes	Completion Date:	10/22/2007
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Segment begins just downstream of Garfield Rd bridge and continues for 600 feet until the end of reach.**

Step 5 - Notes: **Bedrock grade control just upstream of the top of the segment (in R18S1.04). Overall semi-confined, some areas slightly wider. Good habitat quality. Two islands indicating some planform adjustment. Cross section at location where valley wall starts to widen.**

Step 7 - Narrative: **Minor planform.**

Step 1. Valley and Floodplain

1.1 Segmentation: Valley Width	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Very Steep	Steep	Valley Width (ft): 85
1.3 Corridor Encroachments:	Continuous w/ Bank:	Sometimes	Sometimes	Width Determination: Measured
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Sometimes	Sometimes	Confinement Type: SC
Berm: 0 0	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 0 0				Human Caused Change in Valley Width?: Yes
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 73				
1.6 Grade Controls: None				



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Phase 2 Segment Summary Report

Rodman Brook

Stream: **Rodman Brook** Reach: **R18S1.03-B**

Step 2. Stream Channel

2.1 Bankfull Width (ft.):	28.50	2.11 Riffle/Step Spacing:	132 ft.	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	2.30	2.12 Substrate Composition		Bed:	11 inches
2.3 Mean Depth (ft):	1.45	Bedrock:	0.0 %	Bar:	4 inches
2.4 Floodprone Width (ft.):	39.90	Boulder:	19.0 %	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	2.30	Cobble:	48.0 %	Stream Type:	B
Human Elev FloodPln (ft.):		Coarse Gravel:	19.0 %	Bed Material:	Cobble
2.6 Width/Depth Ratio:	19.66	Fine Gravel:	12.0 %	Subclass Slope:	None
2.7 Entrenchment Ratio:	1.40	Sand:	2.0 %	Bed Form:	Riffle-Pool
2.8 Incision Ratio:	1.00	Silt and Smaller:	0.0 %	Field Measured Slope:	
Human Elevated Inc. Rat.:	0.00	Silt/Clay Present:	No	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	Low	Detritus:	3.0 %	Reference Stream Type:	B
2.10 Riffles Type:	Complete	# Large Woody Debris:	25	Reference Bed Material:	Cobble
				Reference Subclass Slope:	None
				Reference Bedform:	Riffle-Pool

Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	Steep	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	30.8	17.7	
Material Type:	Sand	Sand	Erosion Height (ft.):	8.0	9.0	
Consistency:	Non-cohesive	Non-cohesive	Revetment Type:	Rip-Rap	Rip-Rap	
Lower			Revetment Length:	121.0	129.4	
Material Type:	Boulder/Cobbles	Boulder/Cobbles				
Consistency:	Non-cohesive	Non-cohesive				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	Deciduous	Deciduous
				Sub-dominant:	Coniferous	None
				Bank Canopy		
				Canopy %:	76-100	76-100
				Mid-Channel Canopy:	Open	

3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	>100	>100	Dominant	Forest	Forest	Mass Failures	
Sub-Dominant	51-100	51-100	Sub-dominant	Residential	Residential	Height	
W less than 25	0	0	(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Buffer Vegetation Type			Failures	None		Gullies Length	
Dominant	Deciduous	Deciduous	Gullies	None			
Sub-Dominant	Coniferous	Coniferous					

3.3 Riparian Corridor



Phase 2 Segment Summary Report

Rodman Brook

Stream: Rodman Brook

Reach: R18S1.03-B

Step 4. Flow & Flow Modifiers

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

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	18	Yes	No	Yes	Yes	None

Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: 0	5.2 Other Features	Neck Cutoff: 0	5.4 Stream Ford or Animal Crossing: No
Mid: 1	Delta: 0	Flood chutes: 1	Avulsion: 0	5.5 Straightening: Straightening
Point: 0	Island: 3	5.3 Steep Riffles and Head Cuts	Head Cuts: 0	Straightening Length (ft.): 87
Side: 3	Braiding: 0	Steep Riffles: 1	Trib Rejuv.: No	5.5 Dredging: None

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.: 16	6.4 Sediment Deposition: 16	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate: 16	6.5 Channel Flow Status: 15	6.8 Bank Stability:	8	9
6.3 Pool Variability: 16	6.6 Channel Alteration: 14	6.9 Bank Vegetation Protection	8	8
Total Score: 159	6.7 Channel Sinuosity: 18	6.10 Riparian Veg. Zone Width:	7	8
Habitat Rating: 0.80				
Habitat Stream Condition: Good				

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic		
7.1 Channel Degradation		16	None	No	Geomorphic Rating	0.76
7.2 Channel Aggradation		18	None	No	Channel Evolution Model	F
7.3 Widening Channel		16		No	Channel Evolution Stage	I
7.4 Change in Planforml		11		No	Geomorphic Condition	Good
Total Score		61			Stream Sensitivity	Moderate



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Phase 2 - Stream Geometry Data

Rodman Brook

Reach	Phase 2 Stream Type						Phase 1 Data			Phase 2 Channel Data												
	Seg-ment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel Width	Bankfull Width	Max Depth	Mean Depth	Floodpr Width	Recnt Abandn Fldpin	Width Depth Ratio	Entrenchment Ratio	Incision Ratio	Channel Evolution Stage	Channel Evolution Model	Geo Assess Condition	Hab Assess Condition	QC Staff	QC Auto
R18S1.01	0	B	Cobble	Riffle-Pool	None	No	2.08		24	1.8	1.4	39.7	2.8	17.14	1.65	1.56	III	F	Fair	Good	F	P
R18S1.02	A	C	Cobble	Riffle-Pool	b	No	2.15		26.8	2.5	1.76	155.2	3.8	15.23	5.79	1.52	IV	F	Fair	Fair	F	P
R18S1.02	B	B	Gravel	Plane Bed	None	No	2.15		23	2.2	1.58	34.7	4.7	14.56	1.51	2.14	II	F	Fair	Fair	F	P
R18S1.03	A	B	Cobble	Riffle-Pool	None	No	2.43		22.8	2.3	1.48	31	4.9	15.41	1.36	2.13	II	F	Fair	Good	F	P
R18S1.03	B	B	Cobble	Riffle-Pool	None	Yes	2.43		28.5	2.3	1.45	39.9	2.3	19.66	1.40	1.00	I	F	Good	Good	F	P



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Phase 2 - Rapid Geomorphic Assessment

Rodman Brook

Reach	Seg- ment	Sub Rch?	Degradation			Aggradation			Widening		Planform		Geo Score	Geo Condition	Evol. Stage	Confin. Type	Sensitivity	QC Staff	QC Auto
			Score	STD	Historic	Score	STD	Historic	Score	Historic	Score	Historic							
R18S1.01	0	No	5	C to B	Yes	13	None	No	14	No	13	No	0.56	Fair	III	VB	High	F	P
R18S1.02	A	No	10	None	Yes	13	None	No	14	No	10	No	0.59	Fair	IV	VB	High	F	P
R18S1.02	B	No	3	C to B	Yes	14	None	No	14	No	14	No	0.56	Fair	II	NW	Very High	F	P
R18S1.03	A	No	5	C to B	Yes	14	None	No	17	No	10	No	0.58	Fair	II	BD	High	F	P
R18S1.03	B	Yes	16	None	No	18	None	No	16	No	11	No	0.76	Good	I	SC	Moderate	F	P