Fluvial Geomorphology Assessment of the Poultney River and Hubbardton River, Vermont

Prepared for

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Hubbardton River (looking upstream)

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EXECUTIVE SUMMARY

A Phase 1 and Phase 2 geomorphic assessment of the Poultney River mainstem and the Hubbardton River, a major tributary of the Poultney River, were completed in Summer 2005. The Poultney River is characterized by alternating confined and unconfined sections that represent source and response reaches, respectively. The reaches between Poultney and Fair Haven are natural depositional areas where the river leaves steeper mountainous terrain and flows onto a broad flat valley. Current rates of channel migration and bar growth may be higher than before European contact as land clearance in the upper watershed is resulting in greater sediment production. Furthermore, channel straightening and bank armoring within the broad valley is leading to increased rates of deposition in less managed areas. Downstream of Fair Haven the river flows within a narrow valley confined by glacial lake clays and bedrock. Where the river first emerges into the Champlain Valley and once again becomes unconfined, 14 feet of channel aggradation occurred in response to extensive post-European settlement land clearance that left the adjacent sandy glacial lake terraces prone to erosion and downslope sediment transport. As forests became reestablished in the watershed during the 20th Century, the sediment load to the river declined and the river incised back through the 14 feet of sediment deposited only a century or two earlier.

The morphology of the Hubbardton River channel varies markedly upstream and downstream of Mill Pond near the midpoint of the river. The channel is incised on the lower Hubbardton River but good floodplain access is present on the upper Hubbardton River. While sediment trapped behind the dam impounding Mill Dam may be partially responsible for channel incision on the lower Hubbardton River, the extent and pattern of incision appears related to the removal of wood from the channel decades ago. Wood removal likely occurred on the upper Hubbardton River as well, but beaver dams and log jams have reformed with recent wood added to the channel. In contrast, wood remains scarce on the lower Hubbardton River. The incision on the lower Hubbardton River is characterized by widespread continuous bank erosion on both banks of the channel, high banks (i.e., incision ratios > 1.7), and reduced access to the floodplain and side channels.

Four restoration alternatives were considered during a Phase 3 assessment on the lower Hubbardton River at the Hubbardton River Clayplain Preserve owned by The Nature Conservancy. Each alternative was compared with respect to their potential to address bank erosion, downstream sediment transport, and habitat degradation caused by the channel incision. If no action was taken at the site, the channel would slowly evolve by widening the banks through erosion until flows were spread out sufficiently to begin a process of aggradation that would lead to the development of a new floodplain or reconnection to the former floodplain surface. Constructing rock revetments to stop the bank erosion would inhibit this natural channel evolution and lead to bank instabilities elsewhere that might increase the amount of sediment moving downstream. Restoring riparian vegetation along the river banks has the potential to create near bank habitat over the short term while over longer periods of time supply wood to the channel that could fully reconnect the channel to the floodplain. Constructing engineered log jams in the channel would mimic these natural processes and speed up channel evolution by several

decades, if not centuries. Within only a few years log jams would trap and store sediment, reduce bank heights and erosion, and reconnect the channel to the floodplain. More frequent inundation of the floodplain surface would reactivate former channels and create a patchwork of habitats that would support a diverse range of plant and animal species. Increased flooding, however, may be unacceptable for many current landowners trying to farm on the floodplain. Consequently, restoration projects entailing the construction of log jams in the river will need to be implemented in the future when appropriate opportunities arise and public education efforts succeed in demonstrating the benefits of achieving equilibrium conditions along the river.

1.0 INTRODUCTION

This report describes the results and recommendations of a fluvial geomorphology assessment of the Poultney River mainstem and the Hubbardton River, a major tributary of the Poultney River (Figure 1). The watershed area of the Poultney River is 262 mi^2 with the Hubbardton River contributing 44 mi^2, or 17 percent of the total. The Nature Conservancy is involved in ongoing Clayplain Forest restoration of the Hubbardton River watershed. The geomorphic assessment discussed below provides an opportunity to link upland restoration with streambank stabilization efforts that could serve as a model for reducing sediment production and nutrient loading in Lake Champlain. Towards this end, the purpose of this geomorphology assessment was three fold: 1) complete a Phase 1 assessment of all reaches on the main stems of the Poultney and Hubbardton Rivers; 2) complete a Phase 2 assessment of 10 reaches representative of conditions on the two rivers; and 3) complete a Phase 3 assessment and alternatives analysis for a portion of one reach on the Hubbardton River to determine the best approach for improving bank stability and reducing sediment inputs to Lake Champlain. Data collected during an earlier assessment of the Poultney River watershed completed by The Nature Conservancy were incorporated into the current assessment (Field et al., 2001).

Recognizing the value of fluvial geomorphology to improve bank stability and reduce sediment production, the State of Vermont has developed a three phase Stream Geomorphic Assessment Handbook to reveal the underlying causes for erosion and channel instability (Vermont Agency of Natural Resources, 2003). The assessment of the Poultney River and Hubbardton River employed the three phase handbook. Phase 1 of Vermont's Stream Geomorphic Assessment Handbook utilizes topographic maps, aerial photographs, and archival records to characterize natural conditions and human land uses in the watershed. Surveying and other fieldwork during Phase 2 of the assessment provides information on the existing morphology of the channel and how the channel is responding to natural conditions and human land uses identified in Phase 1. Alternatives analyses of different management strategies can be completed with the results of more detailed Phase 3 surveying conducted on unstable reaches prioritized for restoration. The Phase 1 and Phase 2 results were entered into a web-based data management system administered by Vermont's River Management Program with summary tables of the results provided in Appendix 1. A number of channel features, including sites of bank erosion and armoring, were mapped continuously along the length of the Poultney, Hubbardton, and Castleton Rivers as part of an earlier assessment (Field et al., 2001) and were entered into a GIS database in order to supplement additional GIS data created as part of the Phase 1 and Phase 2 assessment (Appendix 2).

2.0 PHASE 1 ASSESSMENT

2.1 Subdividing Reaches

Since different portions of a river might respond differently to the same natural and human factors, the first assessment task is to subdivide the river into distinct reaches. Within a given reach, the river is assumed to respond similarly to changing watershed conditions while adjacent reaches may respond differently. Reaches that share similar traits are referred to as "like-reaches" and an understanding of channel response or effective restoration techniques gained in one reach may apply to other "like-reaches". Break points between different reaches are made on the presence of one or more of the following conditions: natural change in valley slope; constriction of valley width; expansion of valley width; or confluence of a major tributary comprising more than 10 percent of the watershed upstream of the reach break. Human factors are generally ignored in the identification of reach breaks except where large dams serve as a grade control that prevent the upstream or downstream migration of morphological adjustments to the channel. Seventeen reach breaks of uneven length were identified on the Poultney River using topographic maps with the reaches numbered consecutively from the downstream end of the river and designated M1, M2, etc. to indicate that the reaches are located on the mainstem of the river (Figure 1 and Table 1). One of the reach breaks occur at a valley constriction, five at expansions in the valley, six at the confluence of major tributaries, and four at significant natural changes in valley slope (Table 1). The Carver Falls Dam is built on top of a waterfall where a natural change in valley slope occurs.

An additional 10 reaches were subdivided on the Hubbardton River with the reaches numbered consecutively from the downstream end of the tributary and designated T1.01, T1.02, etc. to indicate that the reaches are located on the first major tributary of the Poultney River upstream of Lake Champlain (Figure 1 and Table 1). Two of the reach breaks occur at valley constrictions, four at expansions in the valley, two at the confluence of major tributaries, and one at a significant change in valley slope created by Mill Pond Dam (Figure 1 and Table 1). Of the 27 identified reaches on both rivers, a Phase 2 assessment was completed on only ten, four on the Poultney River and six on the Hubbardton River (Table 2). The Hubbardton River was a greater focus of the Phase 2 Assessment because of The Nature Conservancy's interest in linking Clayplain Forest restoration in the upper watershed with streambank stabilization efforts.

Reaches downstream of constrictions tend to occupy more confined valleys where the river channel has a greater likelihood of flowing against glacial sediments exposed along the high valley walls. The potential for high rates of sediment production in these locations can affect channel morphology differently than reaches occupying wide valleys where the channel encounters floodplain sediments only. Reaches M11-M17 occupy narrower portions of the valley near the headwaters of the Poultney River. Reaches M5-M6 also occupy a more confined valley with much broader valley segments occurring upstream and downstream. Sediment production in these narrower valleys leads to greater channel response and adjustments in less confined reaches downstream. Although valley confinement is generally greater throughout the Hubbardton River watershed, similar trends are present with headwater reaches T1.08-T1.10 generally more confined before spreading out onto a wider valley in reaches T1.03-T1.06. Valley constrictions are also present lower in the Hubbardton watershed (T1.02) and may influence channel morphology in the wider reach (T1.01) downstream.

Reaches downstream of tributary confluences will generally have a morphology different than reaches immediately upstream of the confluence because of the introduction of sediment at the confluence. The morphological impacts of tributary confluences, as well as valley constrictions and expansions, are generally most noticeable at or near the reach break. Consequently, the locations of the reach breaks themselves are likely points of channel instability with active bar formation, bank erosion, and channel migration possible. Delineating the reach breaks and understanding the morphological conditions present in each reach are critical for identifying the natural and human conditions leading to erosion and channel instability.

2.2 Natural Conditions

An analysis of valley confinement, valley slope, and other natural conditions help establish the reference channel condition that would be expected to develop in each reach in the absence of human influence. (Departures from this reference condition can later be identified during the Phase 2 assessment to determine how the stream is responding to human land use and management practices). The Poultney River can be subdivided into four distinct sections based on variations in valley confinement with the upper Poultney River (Reaches M11-M17) characterized by more confined valleys and steeper valley slopes as the river flows through low lying areas of the Taconic Mountains (Table 1 and Appendix 1). As a consequence, sinuosity and channel migration are low. Consistent with the steeper slopes and valley confinements, Reaches M16-M17 are a “B” stream type by reference. While the other four reaches on the upper Poultney River (M11-M15) are “C” type streams by reference due to less valley confinement, portions of these reaches are constrained by bedrock and the channel frequently impinges on the narrow valley margins. Erosion of glacial deposits often results where the channel approaches steep valley walls (Figure 2).

The valley becomes very broad in East Poultney as the river flows into a north-south oriented depression related to an underlying geological structure at the edge of the Taconic Mountains. With the loss of valley confinement and accompanying drop in valley slope, the sediment carrying capacity of the river is reduced. Consequently, sediment produced from the erosion of glacial deposits in the more confined portions of the river upstream (Figure 2) are deposited in Reaches M7-M10, leading to greater bar development, channel migration, and sinuosity (Figure 3 and Table 1). The reference stream type within the broad valley is a “C” stream at the upstream end (Reaches M8-M10) transitioning to an “E” type stream at the downstream end (Reach M7) where the valley slope is lowest and sinuosity highest.

Between Low Hampton, NY and Carver Falls Dam (Reaches M4-M6), the river becomes confined once again with the lowest confinement ratios along the river seen in this area. The channel impinges on high banks of glacial lake clays throughout Reaches M4-M6 but the presence of ledge, including the waterfall on top of which Carver Falls Dam is built, suggest that underlying bedrock constraints are responsible for the narrow and semi-confined valleys (Table 1). Reflective of the valley confinement, Reaches M4-M5 are “B” type streams by reference, but Reach M6 is a “C” stream by reference as some floodplain is present in this reach before becoming completely confined downstream of the broad structural depression (Reaches M7-M10).

The lower Poultney River (Reaches M1-M3) flows in the Champlain Basin with the river's floodplain inset below a glacial lake terrace more than 100 feet high. While the floodplain is broad enough to classify the reaches as a "C" stream by reference, the river impinges on the high nonalluvial terrace slopes in several locations. Consequently, channel sinuosity values are generally lower than in undisturbed sections of the broad valley between Fair Haven and Poultney (Reaches M7-M9). Erosion of the high terrace slopes is not observed on the lower Poultney River, but bank armoring has been placed on the valley side slopes in a couple of locations in Reach M2 (Appendix 2).

The Hubbardton River flows entirely within the Champlain Basin. The lowest reaches of the Hubbardton River (Reaches T1.01-T1.02) are incised over 100 feet into the glacial lake terrace. Channel sinuosity and channel migration values are low as the river is narrowly confined within nonalluvial slopes. Reach T1.02 is a "B" type stream by reference where the confinement is greatest. Although Reach T1.01 is a "C" stream by reference because valley widening has progressed sufficiently to create a narrow floodplain, the river frequently flows against the high banks, destabilizing the nonalluvial slopes (Figure 4). The Hubbardton River flows almost exclusively over clay soils deposited in a glacial lake or Champlain Sea that filled the Champlain Basin near the end of the last Ice Age (Figure 5). Both the low slopes and clay soils along the Hubbardton River promote the development of the highly sinuous channels and erodible banks observed in the middle reaches of the Hubbardton River (Reaches T1.03-T1.04)(Table 1). The occurrence of clay soils within the broad valley of the middle Poultney River (Reaches M7-M9) may also lead to the high channel sinuosity values observed in this area.

2.3 Human Land Use and Constraints

Superimposed on the natural watershed characteristics that are controlling channel morphology are numerous human land uses that can potentially alter the natural reference channel morphology. The Phase 1 assessment assigns an impact rating (e.g., not significant, low, and high) for several human activities and morphological conditions that are possibly indicative of a channel response to human impacts (Table 2). A higher impact score indicates a greater likelihood that the channel is responding to human land use in the watershed. While the impact rating scores are based on all of the human activities and morphological parameters (Table 2 and Appendix 1), the following summary focuses only on those considered to have the greatest influence on the Poultney and Hubbardton Rivers.

In the 19th Century most of the watershed was cleared of its forest cover for agriculture (Figure 6). Although hillslopes in the watershed are now largely tree covered, the river may still be responding to the extensive land clearance over 100 years ago and subsequent reforestation. Presently, agricultural and urban land uses are restricted to the valley bottoms, so the watershed land cover impact is not significant for the lower Poultney River (Reaches M1-M9) and low for the upper Poultney River and Hubbardton River where the more heavily used valley bottoms comprise a greater percentage of the smaller watersheds (Appendix 1). The same trend holds for land use within the corridor adjacent to the river channel with insignificant impacts recorded along the lower Poultney River where the corridor is largely forested or hayfields. High impacts are recorded for reaches on the upper Poultney River and Hubbardton River where much of the river corridor has been cleared for agriculture and limited urban development. A riparian buffer is found along at least portions of all the reaches on the Poultney River such that the impact rating is either not significant or low for the entire river. More intensive agriculture in the Hubbardton watershed, including cattle grazing to the river's edge, results in low to high impact scores for riparian buffer condition on most reaches of the Hubbardton River. Reach T1.01 and T1.03 are more remote and less heavily used so the riparian buffer width impact rating is not significant in these two reaches.

Human activities directly within the river channel can have a significant impact on channel morphology. One dam is present on the Poultney River at Carver Falls (Reach M5) and one is present on the Hubbardton River at Mill Pond (Reach T1.05). Both dams are presently operated as run-of-the-river facilities, so no flow regulation occurs but sediment transport is probably disrupted. Therefore, a high impact score is assigned for flow regulation in those two reaches where a dam is present. No other flow regulations or impoundments occur within the watershed, so a "not significant" impact rating is assigned to all of the other reaches.

Channel straightening occurred along more than 20 percent of the total length of at least five reaches on the Poultney River (Table 1). The straightening occurred prior to 1900 as indicated on topographic maps surveyed in the 1890's. Some currently meandering sections of Reaches M7-M9 may have been more extensively straightened in the past but have reestablished a meandering pattern in the more than 100 years since they were straightened (Figure 7). Those reaches where more than 20 percent of the total length was straightened were assigned a high impact rating. A low impact rating was assigned to Reaches M7-M9, although more than 20 percent of these reaches may have been originally straightened in the 18th or 19th Century.

Channel straightening was conducted for a number of reasons including improving drainage and increasing arable land in floodprone areas. While significant straightening is present in only one reach along the Hubbardton River (T1.09), other channelization practices were encouraged in the past to improve drainage. Federal programs encouraged the removal of wood from rivers and streams prior to the 1970's and, despite limited straightening, the lower Hubbardton River (Reaches T1.01-T1.04) is largely devoid of wood (Figure 8a). Wood was probably removed from the upper Hubbardton River (Reaches T1.05-T1.10) as well but has been reintroduced naturally as beavers build dams and streamside trees fall into the river (Figure 8b). Dredging of sediment from the river channel accompanied straightening in the Town of Poultney (Reaches M9-M10) and near Middletown Springs (Reaches M14-M15) through at least the 1980's.

An analysis of depositional features, channel migration, and meander parameters can identify potential human influences on channel morphology. Multiple mid-channel bars are present in most unconfined reaches of the upper Poultney River, especially near upstream eroding banks or where flow initially becomes unconfined (Figures 2-3, Table 1, and Appendix 1). Reach M3 on the lower Poultney River, the first unconfined reach below several confined reaches (M4-M6), also has abundant depositional features. Channel migration in the past 30 years has occurred only in the broad valley between Poultney and Fair Haven (Reaches M7-M10). Sediment from the upper Poultney River (Reaches M11-M17) is deposited in the broad valley, creating gravel bars that deflect flow and result in channel migration. Sediment deposition elsewhere in the watershed is insufficient to result in extensive channel changes. Channel straightening results in a reduction in meander width and meander wavelength such that straightened or previously straightened segments tend to also have high impact scores related to these two meander parameters (e.g., Reach M9). Extensive deposition can lead to rapid formation of meanders with short wavelengths and high widths as is seen in Reaches M7-M9.

Bridges, culverts, and roads cross and parallel the Poultney and Hubbardton Rivers in several places but their impact is localized and not considered responsible for reach-wide channel instabilities. Bank armoring is also localized around roads and homes. In order to account for the local instabilities that might result, a low impact rating score is assigned to reaches where these human constraints exist. Roads parallel almost the entire length of Reaches M2, M11, M13, and T1.08 and a high impact rating for this variable is assigned to these reaches. However, the roads in these locations are not elevated above the natural ground surface and are thus not artificially constraining the valley width.

Accounting for all of the human activities and morphological parameters for which an impact rating is assigned (Table 2), Reach M14 near Middletown Springs has the highest impact score (Score = 17) on the Poultney River, reflecting the heavy land use, sediment deposition in the broad valley, and associated dredging and changes to meander parameters. The four reaches in the broad valley between Poultney and Fair Haven (M7-M10) also have high impact scores (Scores > 13) related to the extensive straightening and dredging that previously occurred in order to manage the bar growth and channel migration that continues today. The lower Poultney River (Reaches M1-M3) has lower impact scores (Scores < 11) owing to less human disturbance, particularly in the marshy areas adjacent to the channel in Reach M1. The lowest impact scores on the Poultney River (Scores < 7) occur in more confined reaches (Reaches M4-M6 and M17) where channel migration and meander growth are naturally limited. Confined areas are also less attractive for human land use, so tend to be less disturbed.

The high sinuosity of the Hubbardton River leads to higher impact scores than might be expected for the degree of human land use. High meander width and wavelength ratios are a natural consequence of the clay soils, not a consequence of human interference. Extensive use of the river corridor and watershed for agricultural purposes does contribute to the impact scores and along with wood removal from the channel are conditions that might lead to a channel response.

3.0 PHASE 2 ASSESSMENT

The Phase 1 assessment identifies human land uses and constraints that might engender a channel response. The Phase 2 assessment is designed to identify if and how the channel is responding to these human activities. Phase 2 assessments on the Poultney River were limited to only those four reaches where survey data was collected during an earlier study of the watershed (Table 1; Field et al., 2001). More effort was focused on the Hubbardton River, a total of six Phase 2 reaches were assessed, because of The Nature Conservancy's interest in linking Clayplain Forest restoration to streambank stabilization. The Phase 2 results for the Poultney River and Hubbardton River are discussed separately below with related cross sectional data presented in Appendix 3.

3.1 Poultney River

The four Phase 2 reaches on the Poultney River represent three separate sections of the river. Channel dimensions (Width:depth ratio = 16) and floodplain access (Entrenchment ratio = 3.5) in Reach M15 on the upper Poultney River are consistent with the "C" type reference stream designated in Phase 1 and suggest the river is not responding to human land use. Although dredging has occurred within the reach, the lack of channel response is consistent with the absence of any other in-stream modifications such as flow regulation, channel straightening, or bank armoring. The moderate levels of bank erosion (Table 1) are more symptomatic of an absence of riparian buffer over portions of the reach rather than widespread instabilities related to watershed land use. Cattle were observed trampling the banks to access the river water. Improvements to the riparian buffer in impacted areas would ultimately improve bank stability.

Reach M9 was divided into a meandering segment (Segment A) and an upstream straightened segment (Segment B). Differences between the segments are reflective of past human management practices and the channel's response to those activities. Repeated gravel mining and channel straightening occurred through the Town of Poultney until the 1980's in an effort to reduce the flooding and erosion caused by gravel deposition. The areas impacted included portions of Reach M10 and at least the upstream end of Reach M9 (Segment B). Reach M10 and M9 are situated where the river first emerges on to the broad flat valley between Poultney and Fair Haven. The consequent loss in stream power makes this area naturally susceptible to gravel deposition. Rates of gravel accumulation in these response reaches (Reaches M9-M10) likely increase when upstream land use leads to increased sediment production and delivery. In addition to straightening, Reach M9-B is confined by a railroad grade on the left bank and berm on the right bank (Figure 9a and Appendix 1). The segment is further constrained by rock armoring on both banks. As a result of these human manipulations of the channel and floodplain, the channel has a low sinuosity, high incision ratio, and low width:depth ratio (Figure 9a). While the river is still able to access its floodplain over the low berm, bank armoring prevents lateral channel adjustments and the channel is locked into Stage II of Schumm's Channel Evolutionary Model (CEM).

Sediment transport efficiency is increased by the human constraints imposed on the channel, so excess sediment is delivered to the meandering segment downstream (Reach M9-A). High meander width and meander wavelength ratios in Reach M9-A are indicative of rapid sedimentation. The high width:depth ratio, rapid channel migration, and growth of large unvegetated gravel bars are further indications that Reach M9-A is responding to excess sediment delivery from the straightened segment immediately upstream and from the more mountainous upper reaches (Reaches M11-M17)(Figure 9b). Although the channel is still undergoing lateral channel adjustments (Stage IV of the CEM) that form large poorly shaded gravel bars (Figure 3), the habitat quality in Segment A is higher (RHA score = 119) than the straightened Segment B (RHA score = 96) due to better pool-riffle development, particle size segregation, wood cover, and floodplain/side channel access (Appendix 1). The conditions and channel adjustments observed in Reach M9 are representative of straightened and meandering segments throughout the broad valley between Fair Haven and East Poultney (Reaches M7-M10).

A width:depth ratio of 14.6 and entrenchment ratio of 4.2 in Reach M3 are consistent with the "C" type reference stream identified in Phase 1. However, an incision ratio of 1.5 indicates the channel has undergone a period of incision. The current floodplain is inset into the older valley bottom and indicates the channel has reached a new equilibrium level and is approaching Stage V of the CEM (Figure 10). Erosion of the high banks is still active on the outside bends of meanders but is not continuous along both banks as would be expected during earlier stages of channel evolution (Figure 11). Although Carver Falls Dam, only 1.5 miles upstream, may have contributed to the incision, the channel response was largely driven by deforestation and subsequent reforestation. Reach M3 underwent 14 feet of aggradation in response to land clearance by early European settlers to the region (Figure 11; Field, 2002). The sandy sediment in the terrace deposits along the valley margins and from upstream were easily washed downslope into the valley once the tree cover on the hillsides was removed. Within the relatively narrow valley of Reach M3, the sediment could not spread out across a wide floodplain so the sediment aggraded 14 feet. Sediment retention on the hillsides accompanying reforestation of the watershed in the latter 19th and 20th Century led to a reduction in sediment supply to the river. The river responded by incising through the 14 feet of sediment deposited only a century or two earlier.

Reach M1 is in a broader valley and much further from upland sediment sources than Reach M3. Consequently, 18th and 19th Century deforestation resulted in little if any aggradation. Banks are low and fully connected to marshlands along the river corridor. The channel has a relatively high width:depth ratio of 21.3 reflecting the natural adjustments accompanying the river's transition to Lake Champlain. Fluctuating lake levels lead to minor tributary rejuvenation as marshlands supply flow to the river during dryer periods. The rejuvenation is not symptomatic of reach-wide instabilities.

3.2 Hubbardton River

The morphology of the Phase 2 reaches above Mill Pond (Reaches T1.06-T1.07) is distinctly different than reaches below Mill Pond (Reaches T1.01-T1.04). Much of the lower Hubbardton River is slightly incised as reflected in higher incision ratios compared to above Mill Pond (Figure 12 and Appendix 1). Periodic inundation of the floodplain still occurs throughout the lower Hubbardton River (Reaches T1.01-T1.04) but portions of Reach T1.03 have an entrenchment ratio of only 1.8 indicating some loss of floodplain access as a result of the incision (Appendix 1). Although entrenchment ratios are above 2.2 in the other reaches, a lack of channel migration (Appendix 1) over 60 years (i.e., the length of the map record) is also indicative of a minor loss of floodplain connection. Abundant abandoned channels on the floodplain provide a record of an earlier time when the river was prone to periodically shifting its position across the floodplain (Figure 13). The current staticness in channel position and, in places, the accompanying incision could be caused by sediment retention behind Mill Pond Dam upstream (Figure 1). However, channel incision is more pronounced in Reach T1.03 than Reach T1.04 closer to the dam. Given the uniform erodibility of the clay comprising the bank sediments along the Hubbardton River (Figure 5), greater incision would be expected closer to the dam. Minor incision on the most downstream reach (Reach T1.01) is likely related to tributary rejuvenation along the Hubbardton River in response to the deep incision on the lower Poultney River (Reach M3; Figure 11). However, deeper incision further upstream on the Hubbardton River (Reach T1.03), as reflected in a higher incision ratio (Appendix 1), must be the result of another cause, because incision due solely to tributary rejuvenation would be greater closer to the confluence. The removal of wood from the river channel (Figure 8a) could lead to the patterns of channel incision (Figure 12) and lack of channel migration (Figure 13) observed on the lower Hubbardton River. Wood serves as an important roughness element in channels and, when removed, the power of the stream to transport sediment is increased, leading to incision of the channel bed.

With greater amounts of wood present in the channel above Mill Pond (Appendix 1), the channel is fully connected to the floodplain with an incision ratio of 1.0 (Figures 8b and 12b). A lack of incision may also be related to the impoundment behind Mill Pond Dam, but these effects are probably limited to the downstream end of Reach T1.06. The absence of channel migration in the past 60 years suggests wood has only recently been reintroduced to the channel when large riparian trees fell into the river (Figure 8b) and beaver dams reemerged. Channel migration and avulsions most likely occur when numerous closely spaced debris jams (Figure 8b) and/or beaver dams are present on the river – a threshold level that has apparently not yet been reached on the upper Hubbardton River (Reaches T1.06-T1.10).

4.0 PHASE 3 ASSESSMENT

Clay soils lead to a greater incidence of bank erosion on the Hubbardton River compared to the Poultney River (Figure 5 and Appendix 2; Field et al., 2001)). Where incision occurs on the lower Hubbardton River, the erosion is characterized by long continuous shallow planar slips (Figure 14). The occurrence of erosion along both banks is also suggestive of channel adjustments to incision. The Nature Conservancy is particularly interested in how the erosion might affect continuing efforts at restoring Clayplain Forest in the riparian corridor and elsewhere in the watershed. Sediment produced from the erosion might also impact aquatic ecosystems and result in increased nutrient levels in Lake Champlain.

To better understand the causes of erosion and select strategies for best managing the channel incision, a Phase 3 assessment was conducted at the Hubbardton River Clayplain Preserve in Reach T1.03 where The Nature Conservancy owns land on the east side of the Hubbardton River (Figure 1). The Phase 3 assessment site is located 4,000 feet upstream of the beginning of Reach T1.03 and is reflective of erosion and incision problems observed downstream of Mill Pond Dam (Reaches T1.01-T1.04). Conducting the Phase 3 assessment on land owned by The Nature Conservancy provides a better chance that the preferred management activity selected by the alternatives analysis will be implemented. A small tributary entering the Hubbardton River at the Phase 3 site flows completely on The Nature Conservancy land, offering an opportunity to model restoration activities that might later be scaled up on the lower Hubbardton River (Figure 15).

Detailed topographic surveying as part of the Phase 3 assessment resulted in plan view maps and several cross sections along the Hubbardton River and small tributary (Figure 15 and Appendix 4). Incision ratios of 1.7 on the Hubbardton River are recorded while other cross sections have an incision ratio of 1.0. These discrepancies reflect the difficulties in accurately identifying bankfull features in an actively incising channel. Given local accounts that the floodplain is still periodically inundated, the bankfull level was placed at the top of the bank (thus resulting in incision ratios of 1.0) unless definite bankfull features were found below the bank. Regardless of incision ratios, the conclusion that the channel is incising is further supported by continuous erosion along both banks (Figure 14), tributary rejuvenation, and what appear to be relatively high banks (Figure 8a) for a small river. Bank heights are much lower on unincised portions of the upper Hubbardton River (Figure 8b). Rejuvenation on the lower end of the tributary is observed and ends at a knickpoint about 150 feet upstream of the confluence with the Hubbardton River. Incision ratios on the tributary channel are 1.8 downstream of the knickpoint.

Incised portions of the tributary and Hubbardton River at the Phase 3 site are in Stage II of the CEM. While bank erosion on the Hubbardton River suggests early Stage III bank widening may have begun, width:depth ratios of less than 20 are inconsistent with significant widening. Consequently, if the channel were to evolve naturally, a period of extensive channel widening and continued bank erosion would be expected (Stage III) before aggradation ensues to establish a new floodplain level (Stage IV). Given the likelihood that channel incision began several decades ago, the widening and aggradation would likely take over a century to complete under current conditions. The competent clay soils that predominate in the watershed (Figure 5) tend to resist bank widening, thereby lengthening the evolutionary process that might typically take only a few decades in an area with sandier soils.

5.0 ALTERNATIVES ANALYSIS

With an understanding of the ongoing evolutionary development of the incised channel, four restoration alternatives were considered for addressing the bank erosion and channel incision observed at the Phase 3 site: do nothing, rock revetment, riparian buffer plantings, and engineered log jams (Appendix 5). A short description of each alternative is provided below with a list of pros and cons for each in order to identify the most effective and practical restoration option to implement. The efficacy of each alternative is judged on its ability to restore floodplain access, limit sediment delivery downstream towards Lake Champlain, arrest channel incision, improve bank stability, and promote the evolution of an equilibrium channel condition.

5.1 Do Nothing Alternative

Comparisons of the 1942 and 2003 aerial photographs show streamside riparian zones becoming increasingly revegetated along the lower Hubbardton River, particularly around the Phase 3 site. If this trend were to continue, wood should eventually begin to fall into the stream as the riparian forest matures and the oldest trees begin to die or are undermined by bank erosion. The channel incision that accompanied wood removal will be reversed when log jams form in the river as observed on the upper Hubbardton River (Figure 8b). Reference equilibrium conditions, present before European settlement of the region, depend on the presence of wood in the channel. This natural recovery process would likely take decades, if not centuries, as the riparian forest matures, sediment builds up behind the log jams, and flow becomes reconnected to the floodplain.

Pros:
- No implementation costs
- No adverse impacts downstream as a result of restoration activities at the site
- No infrastructure at risk

Cons:
- Continued sediment production from slumping banks for several decades
- Recovery time very slow
- Continued incision may complicate restoration of Clayplain Forest, especially near stream banks

5.2 Rock Revetment: Channelization Alternative

Bank erosion and incision problems would traditionally be dealt with by using channelization techniques such as the construction of a rock revetment (i.e., riprap). Rock revetments lining the most unstable portions of the bank at the Phase 3 site could arrest the bank erosion (Appendix 5). The rock revetments would have to be keyed in at the base of the bank to prevent undermining the toe of the rock structures.

Within the context of channel evolution, the use of rock revetments to stop the bank erosion would prevent the channel from progressing through Stage III and IV of the

CEM, thereby locking the channel in an unstable configuration. While bank erosion at the site would temporarily be stopped, the instabilities created and maintained by the riprap would be transferred downstream where bank erosion would be accelerated. If channel evolution and bank widening were to continue unabated upstream of the treated area, a constriction would develop where the channel transitions into the treated area. Flow would be partially impounded behind the constriction, leading to deposition of sediment just upstream of the treated area. Flow passing through the treated reach would then be deficient in sediment; unable to erode the banks within the treated area, severe erosion would likely result at the terminus of the rock revetments. Consequently, while sediment production from the treated area would decline, the overall amount of sediment moving to the lake might actually increase because of the additional instabilities created by the rock revetments.

In addition to transferring instabilities upstream and downstream, locking the channel into Stage II of the CEM with large rocks on the bank would result in continued incision of the channel, because the flow would be capable of eroding only the bed of the channel. Eventually, the rock revetment would be undermined and collapse. The rock revetment alternative, therefore, would be a temporary solution that would prevent the channel from reconnecting to the floodplain and achieving a sustainable equilibrium condition.

Pros:
- Eliminate sediment production from treated banks
- Prevent land loss within treated area
- Provide time for riparian plantings within treated area to mature

Cons:
- Promotes further incision
- Potential for increased erosion downstream
- Expensive if properly keyed in below the bed of the channel
- Weight of rocks on top of bank may promote further bank failure
- Inconsistent with equilibrium tendencies of stream
- No infrastructure in immediate need of protection

5.3 Riparian Buffer Plantings: Passive Geomorphic Alternative

Passive geomorphic management alternatives are ones which move the stream toward a sustainable equilibrium condition without directly altering the channel's form. Planting the riparian zone with fast rooting native trees and shrubs would speed up the natural process of revegetation in the riparian zone that has been occurring slowly over the past several decades (Appendix 5). As the trees mature, the roots would increase the soil binding strength and decrease bank erosion. Eventually, mature trees would be undermined and provide a source of wood in the channel. Shrubs planted close together on the bank would baffle strong currents and reduce near bank shear stress. Bank vegetation would also help trap debris to further protect the bank and create cover habitat.

Bank erosion is currently fastest where no riparian buffer exists such that bank widening progresses unevenly – fastest in areas with no riparian buffer and slower in areas with a buffer. Over time, planting a riparian buffer where none currently exists would even the rates of bank widening over a greater distance along the channel, thereby limiting instabilities that naturally develop at transition points between resistant and less resistant banks. If a riparian buffer were to be established throughout the Phase 3 site (Appendix 5), bank widening could progress evenly and slowly. Eventually, as trees became undermined and fell into the channel, the resulting added roughness in the channel would promote aggradation. With increases in the channel bed elevation, flows would begin to spread out on a newly established floodplain or, with sufficient aggradation, become reconnected to the former floodplain. Decreases in sediment transport capacity accompanying floodplain reconnection would lead to increased floodplain storage of sediment and a decrease in sediment delivery downstream towards Lake Champlain.

Pros:
- Improve aquatic habitat – shading, cover, substrate for insect colonization
- Reduce bank erosion
- Minimize instabilities at transition points at upstream and downstream ends of project site
- Low cost
- Consistent with natural evolution of channel

Cons:
- Initial high mortality rates of plantings
- Concerted maintenance efforts needed to succeed
- No immediate impact – several decades needed for vegetation to mature
- Continued bank slumping may cause loss of vegetation before maturation

5.4 Engineered Log Jams: Active Geomorphic Alternative

The ultimate success of riparian buffer restoration depends on the planted trees growing to maturity – a process that takes several decades. With no active efforts to reduce erosion prior to the trees maturing, much of the vegetation may fail to reach maturity before being washed away as the banks recede. Therefore, attempts to reduce erosion and achieve an equilibrium condition more quickly may require active manipulation of the channel. The construction of engineered log jams across the channel could speed up the natural recovery process at the Phase 3 site by several decades (Appendix 5). The log jams would need to be cabled together and anchored in place with large rocks or by another means to prevent the transport of individual logs downstream where they might cause damage to human infrastructure. The log jams should be constructed in concert with buffer plantings, so as the log jams decompose the wood will be replaced by recruitment from the maturing riparian vegetation. Local scour below the debris jams might improve overhanging bank cover but could also cause localized bank instabilities if riparian vegetation is not well established.

Sediment would be trapped behind log jams placed in the channel, promoting aggradation and reconnection to the former floodplain. This would mimic natural processes that are observed on the small tributary at the Phase 3 site (Figure 16). Log jams can rapidly return a stream to a natural equilibrium condition without a long period of bank widening and sediment generation – the channel would pass directly from Stage II of the CEM to Stage IV. Consequently, long term sediment delivery to Lake Champlain could be greatly reduced if engineered log jams were placed in incised portions of the lower Hubbardton River. Not only would log jams store sediment within the channel as the bed aggrades, but reconnection to the floodplain would allow sediment to be stored on the floodplain as well. Decreases in bank heights associated with channel aggradation would also increase bank stability and reduce erosion.

Local scour downstream of log jams is caused by a sediment deficiency resulting from the trapping of sediment upstream of the jam (Figure 16). If log jams are spaced closely together the aggradation occurring behind a downstream jam could effectively inhibit the tendency for scour downstream of the upstream log jam. The potential for scour at the furthest downstream log jam will remain, however, as the project site transitions into an untreated area.

Placement of numerous jams in the river will increase the frequency, depth, and duration of flooding on the reconnected floodplain. Given that the purposeful removal of wood was undertaken decades ago to alleviate flooding and drainage problems, the artificial restoration of log jams in the river might be unpalatable to many landowners living along the river or trying to farm on the floodplain. However, where opportunities exist or present themselves in the future, the creation of log jams could restore natural hydrological processes and maximize the ecological potential of the watershed. Increased inundation of the floodplain will potentially reactivate former channels seen on the lower Hubbardton River (Figure 13). As the position of the main channel shifts between different channels on the floodplain over several decades, abandoned channels in different stages of infilling and vegetation growth develop on the floodplain. This allows for a patchwork of different habitats to form that attract a diverse range of plant and animal species. This habitat complexity is lost with channel incision because the channel position remains static and all of the abandoned channels ultimately reach a uniform climax stage of vegetation growth. The potential benefit of flood disturbance in restoring natural geomorphic processes and recreating a complex ecosystem could be tested on the small tributary at the Phase 3 site without endangering agricultural land or human infrastructure because The Nature Conservancy owns all of the land along the tributary. Successful and carefully monitored results of engineered log jams on the tributary could then provide a model for constructing larger log jams on the lower Hubbardton River and other incised rivers in the Champlain Valley.

Pros:
- Reference equilibrium conditions could be reestablished rapidly
- Improve aquatic and riparian habitat
- Reconnection to floodplain consistent with Clayplain Forest restoration
- Trap and store sediment before transported to Lake Champlain
- Reduce bank erosion

Cons:
- Scour below debris jams could destabilize banks locally
- Increased overbank flooding
- Potential landowner resistance
- High implementation costs

6.0 CONCLUSIONS

A fluvial geomorphic assessment of the Poultney and Hubbardton Rivers has identified river reaches continuing to respond to past land use and river management practices. The Poultney River is characterized by alternating confined source reaches and unconfined response reaches. In the Town of Poultney (Reach M9-B), where the river emerges from mountainous areas onto a broad flat valley, channel straightening and bank armoring was used in the past to alleviate flooding and bank erosion by altering the river's natural tendency for sediment deposition. Downstream the channel continues to build large gravel bars (Figure 3), shift channel positions, and attack the river's banks in response to the human manipulations and natural loss of sediment transport efficiency (Reach M9-A). On the lower Poultney River (Reach M3), where the channel emerges from a narrow valley around Fair Haven, the channel experienced 14 feet of aggradation as a result of deforestation by early European settlers that increased sediment production from the surrounding sandy glacial lake terraces (Figure 11). Reforestation of the watershed in the past century has decreased sediment delivery to the river and has caused 14 feet of incision through the European settlement deposits. The river continues to erode the resulting high river banks (Figure 11) as a new floodplain level and equilibrium condition is achieved (Figure 10).

Differences in channel morphology between the lower and upper Hubbardton River reflect the river's response to the 20th Century (and earlier) removal of wood from the channel. The wood removal was done to reduce flooding and improve drainage for agriculture but the resulting reduction in channel roughness caused channel incision. Incision on the lower Hubbardton River might be locally enhanced by the presence of Mill Pond Dam upstream (Reach T1.04) and tributary rejuvenation (Reach T1.01) in response to channel incision of the lower Poultney River. While wood has naturally reaccumulated along portions of the upper Hubbardton River (Figure 8b), the lower Hubbardton River is still largely devoid of wood (Figure 8a). Consequently, the upper Hubbardton River is reconnected to its floodplain (Figure 12b) and is no longer incised, as may have been the case several decades ago. An incised condition still persists on the lower Hubbardton River with widespread continuous bank erosion (Figure 14 and Appendix 2), high incision ratios (Figure 12a and Appendix 1), and reduced access to the floodplain and former channels (Figure 13).

Restoration of an unincised condition on the lower Hubbardton River would be consistent with The Nature Conservancy's goals of facilitating habitat improvements in the watershed and reducing sediment delivery downstream towards Lake Champlain. While the river would naturally repair itself as wood is recruited into the channel from the riparian corridor, this process is likely to take a century or longer, especially where no riparian forest currently exists. Attempts to reduce bank erosion by constructing rock revetments (Appendix 5) should be limited to areas where human infrastructure is imminently threatened because bank armoring will inhibit the evolution of a stable channel configuration, enhance channel incision, and destabilize banks elsewhere such that overall sediment transport downstream will remain unchanged, if not increase. The planting of trees and shrubs in the riparian corridor will speed up the natural recovery process, but several decades will still be needed for trees to mature. Continued bank erosion in the interim may render many such planting efforts unsuccessful. Riparian buffer restoration will, however, lead to improved riparian and aquatic habitat long before full channel recovery occurs, so opportunities for restoration should be actively pursued.

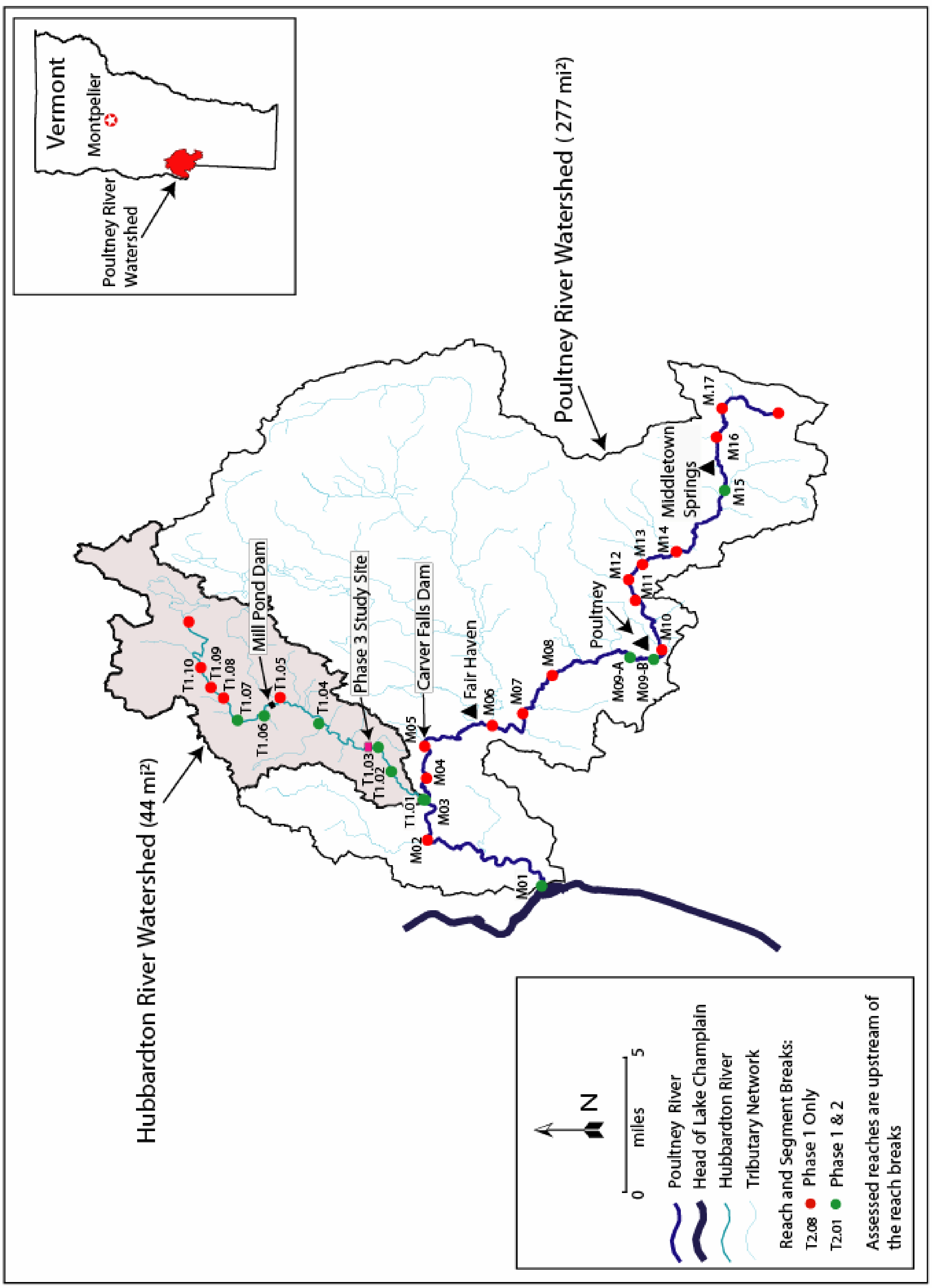
Constructing engineered log jams in the channel will mimic natural processes (Figure 16) and result in a more immediate channel response that will lead to sustainable long-term improvements in channel equilibrium and aquatic habitat. Sediment storage behind the log jams will reduce sediment delivery towards Lake Champlain, increase bank stability, create better access to the floodplain and side channels, and enhance habitat complexity. Local bank scour and increased overbank flooding that will accompany the construction of engineered log jams may cause significant landowner resistance, making this restoration alternative difficult to implement in the near term. Installing log jams on the small tributary owned exclusively by The Nature Conservancy (Figure 15) may prove useful for demonstrating this restoration strategy, so landowners and other interested parties will have a clearer understanding of how log jams can lead to improved channel stability and ecosystem health. Such a demonstration project could facilitate public education efforts that will ultimately increase the likelihood of constructing log jams on the lower Hubbardton River or other incised rivers in the Champlain Valley when future restoration opportunities arise.

7.0 REFERENCES

Field, J., Graves, J., and Doyle, K., 2001, A wetland and riparian habitat assessment of the Poultney River Watershed in NY and VT: Unpublished report submitted to The Nature Conservancy Southern Lake Champlain Valley Program, 73 p.

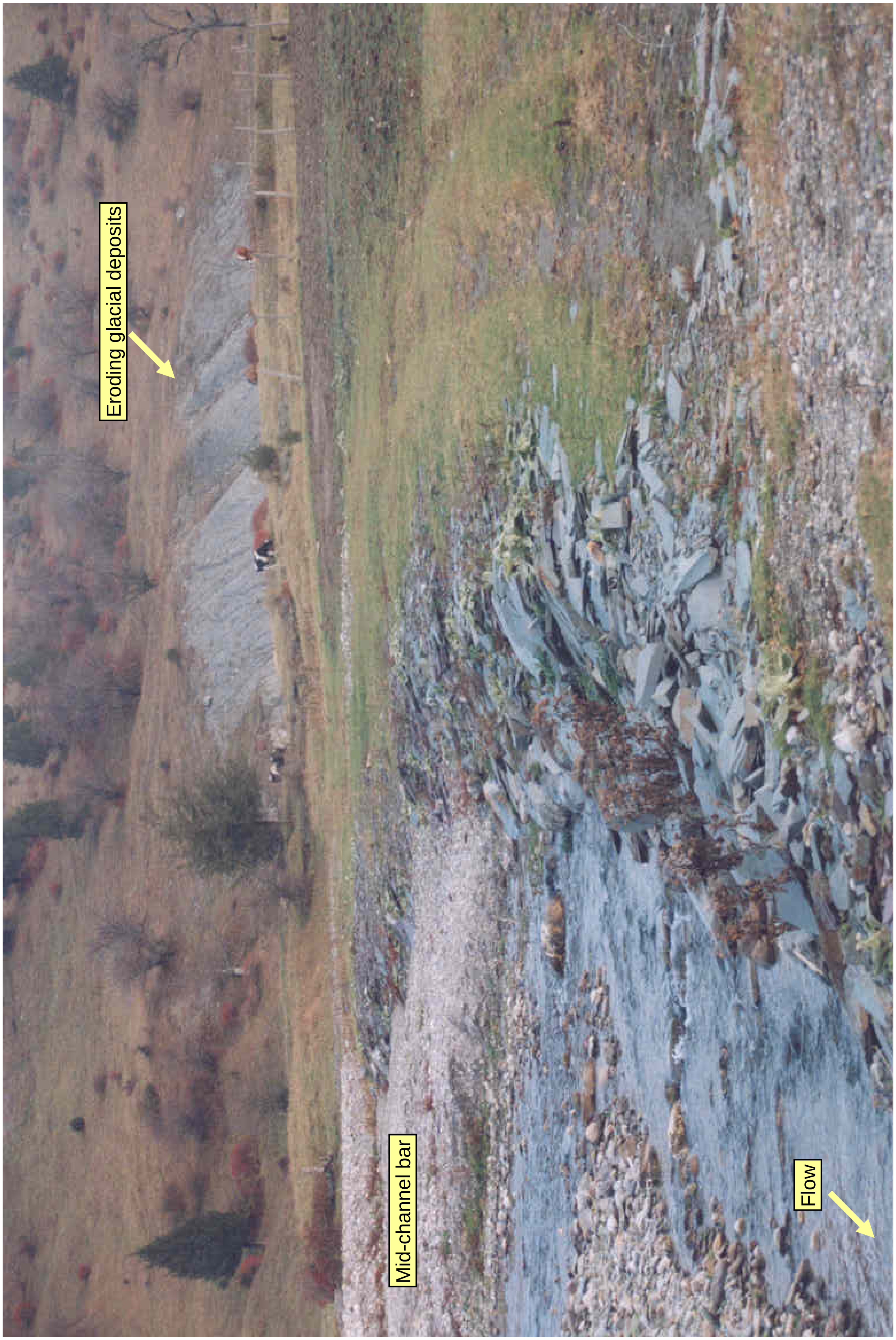
Field, J., 2002, Floodplain history and associated impacts on channel morphology at the Lower Poultney River Preserve (Harrison Tract), VT and NY: Unpublished report submitted to The Nature Conservancy Southern Lake Champlain Valley Program, 31 p.

Vermont Agency of Natural Resources, 2003, Vermont Stream Geomorphic Assessment Handbook: Unpublished report available at http://www.anr.state.vt.us/dec/waterq/rv_geoassesspro.htm.



Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Figure 1

Erosion of Glacial Deposits on the Upper Poultney River



Note: Located at confluence of Morse Hollow (Reach M14)

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Large Unvegetated Gravel Bar on the Poultney River

Note: Located at Green Mountain College (Reach M9-A)

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Poultney River and Hubbardton River Fluvial Geomorphology Assessment – Figure 3

Erosion of Glacial Lake Deposits on the Lower Hubbardton River

Note: Located downstream of West Haven Road (Reach T1.02)

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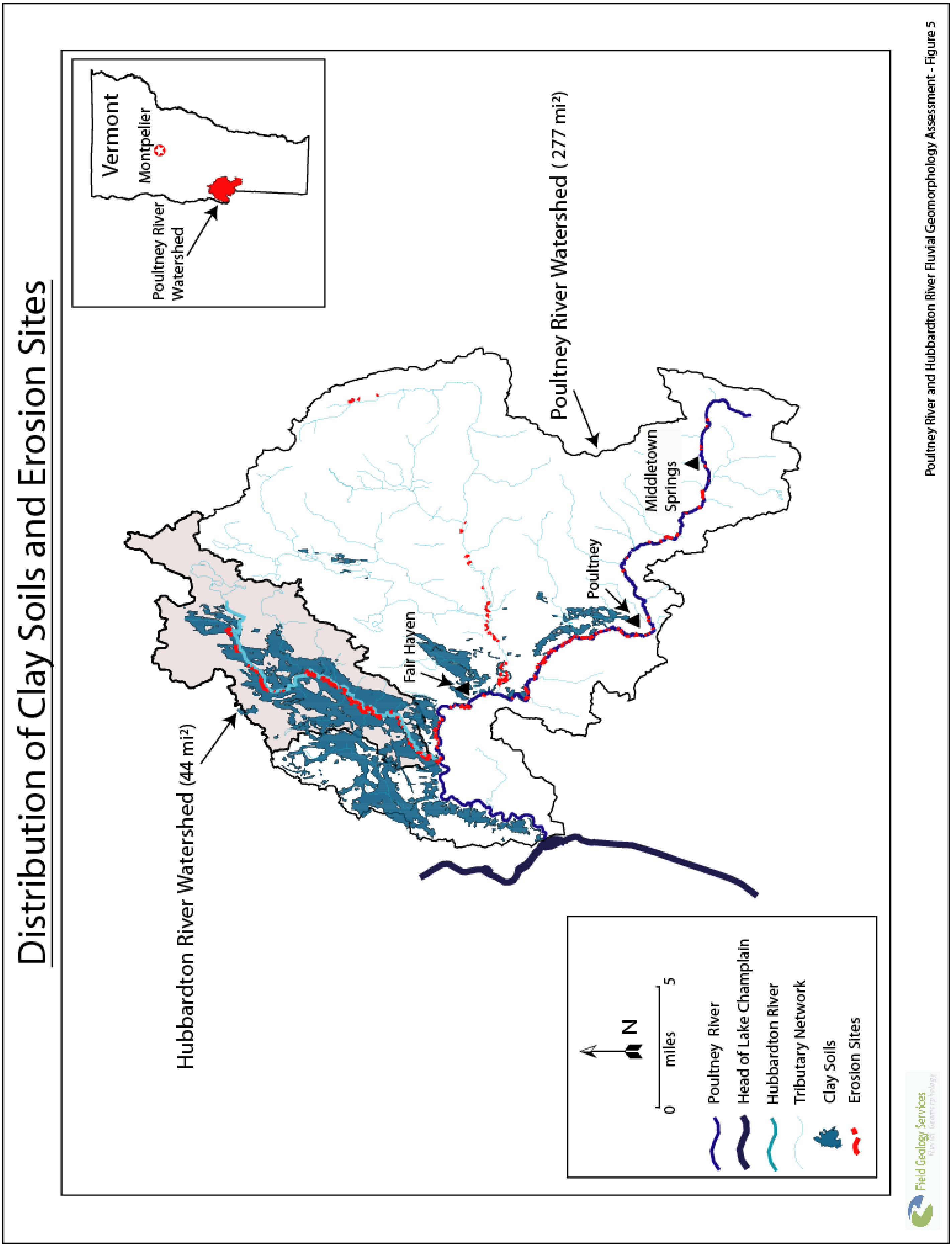
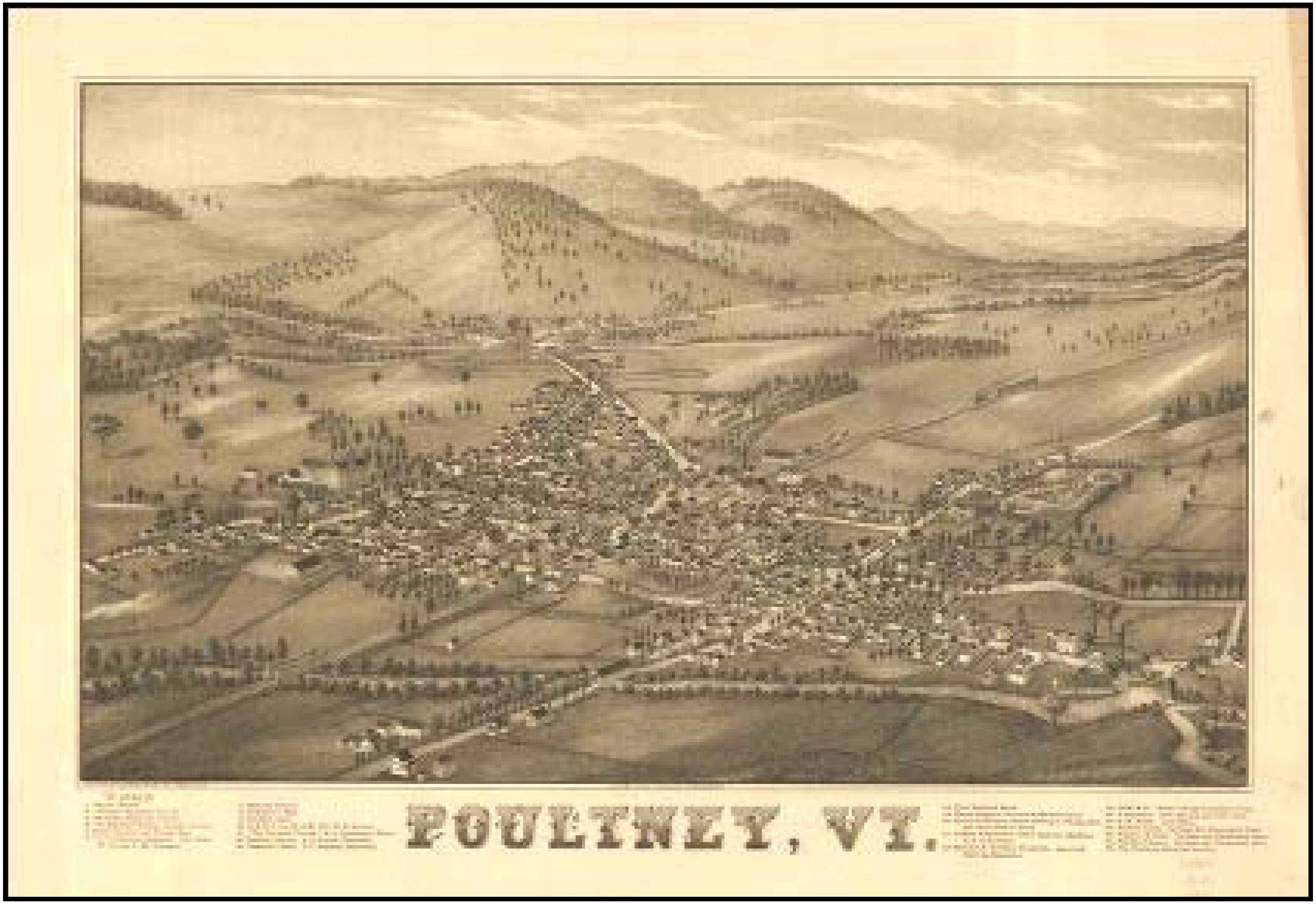
Fluvial Geomorphology


Distribution of Clay Soils and Erosion Sites
Vermont
Montpelier
Poultney River Watershed
Poultney River Watershed (277 mi²)
Hubbardton River Watershed (44 mi²)
Middletown Springs
Poultney
Fair Haven
N
0 miles 5
Poultney River
Head of Lake Champlain
Hubbardton River
Tributary Network
Clay Soils
Erosion Sites
Field Geology Services
Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Figure 5

Land Clearance Around Poultney in 1886

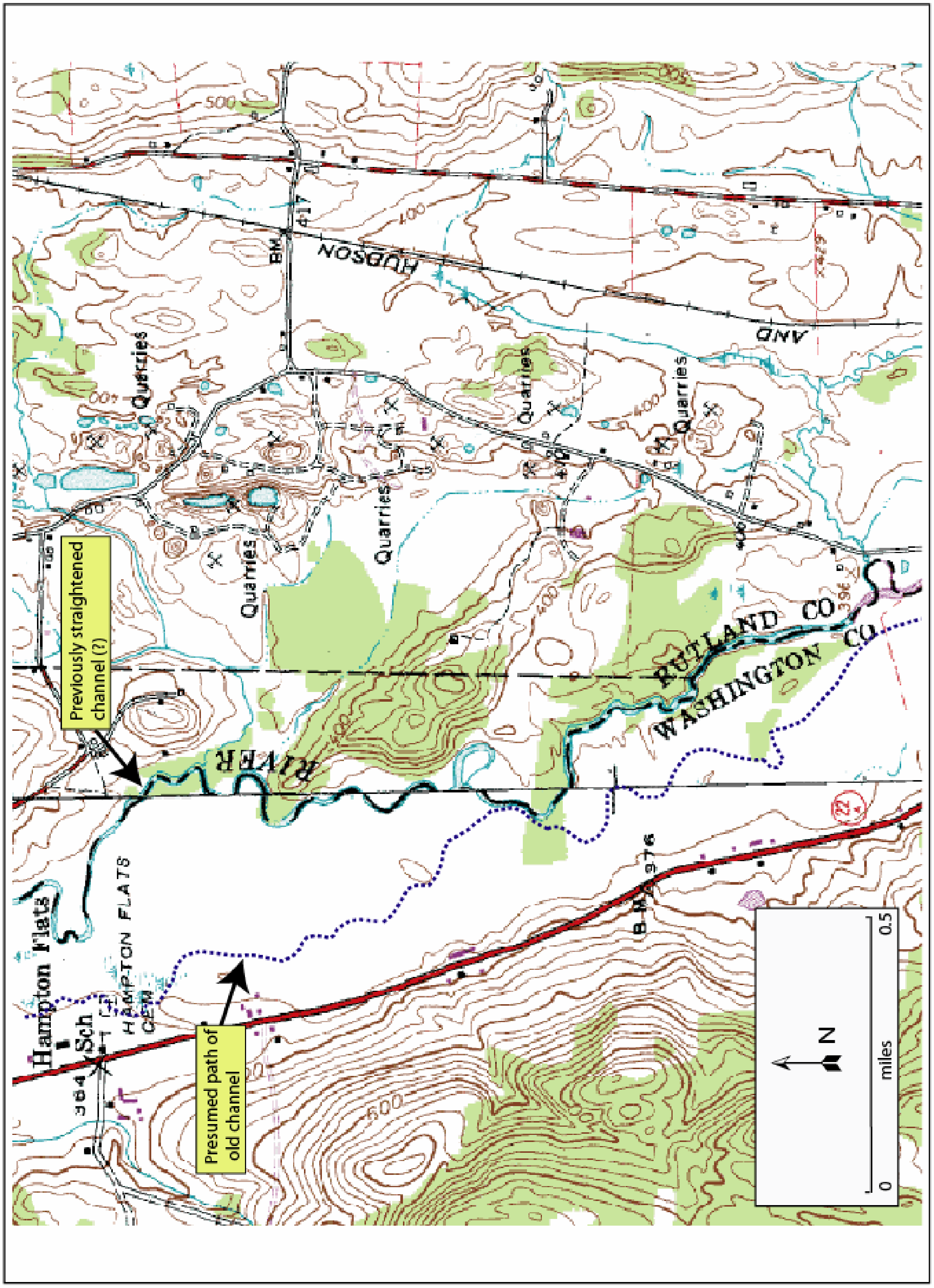


Drawn by L. R. Burleigh. C.H. Vogt & Son, lith. 1886

Field Geology Services
Fluvial Geomorphology

Poultney River and Hubbardton River Fluvial Geomorphology Assessment – Figure 6

Recreation of Meanders Along Previously Straightened Channel



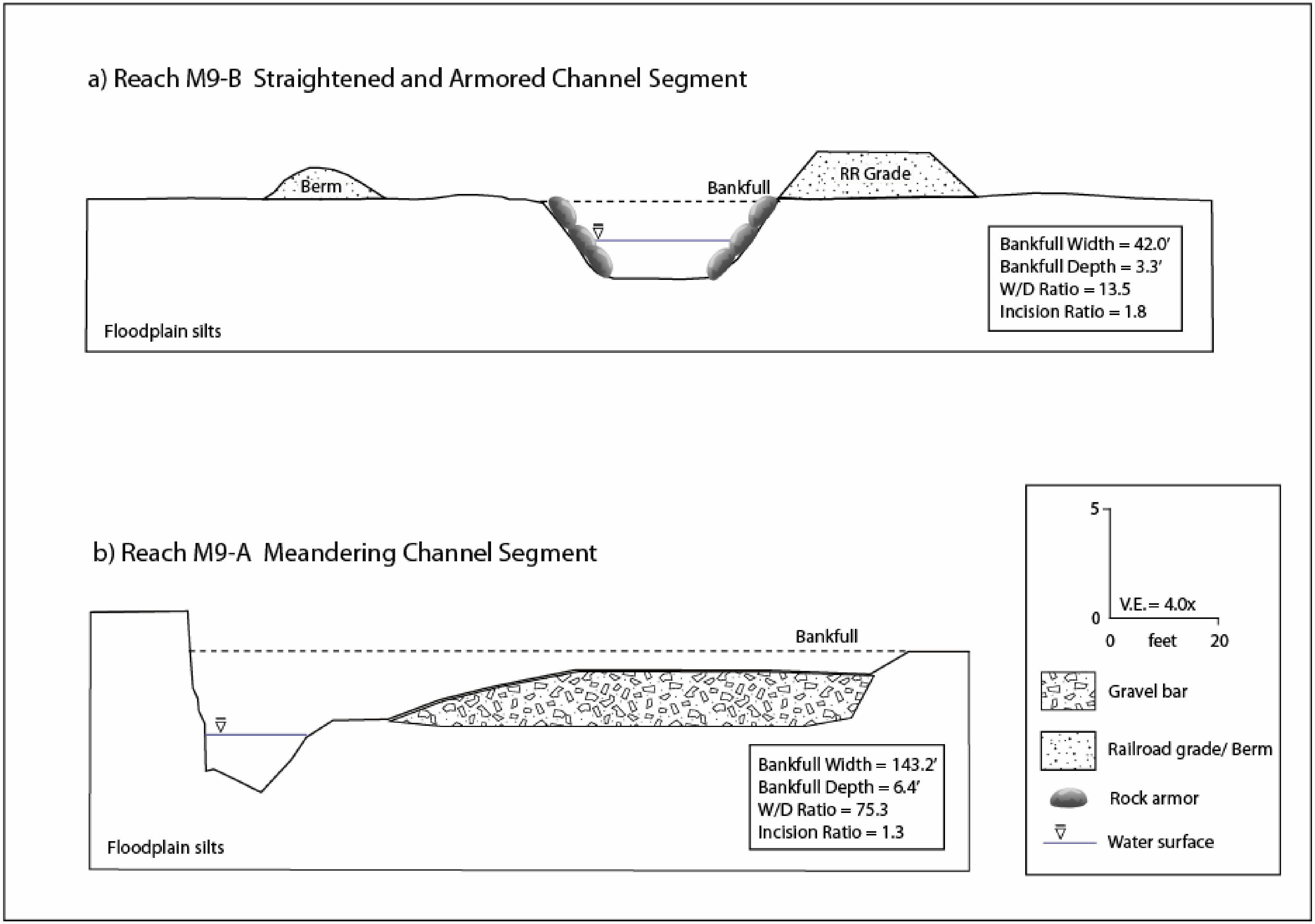
Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Figure 7

Differences in Wood Loading on the Hubbardton River

a) Lower Hubbardton

b) Upper Hubbardton

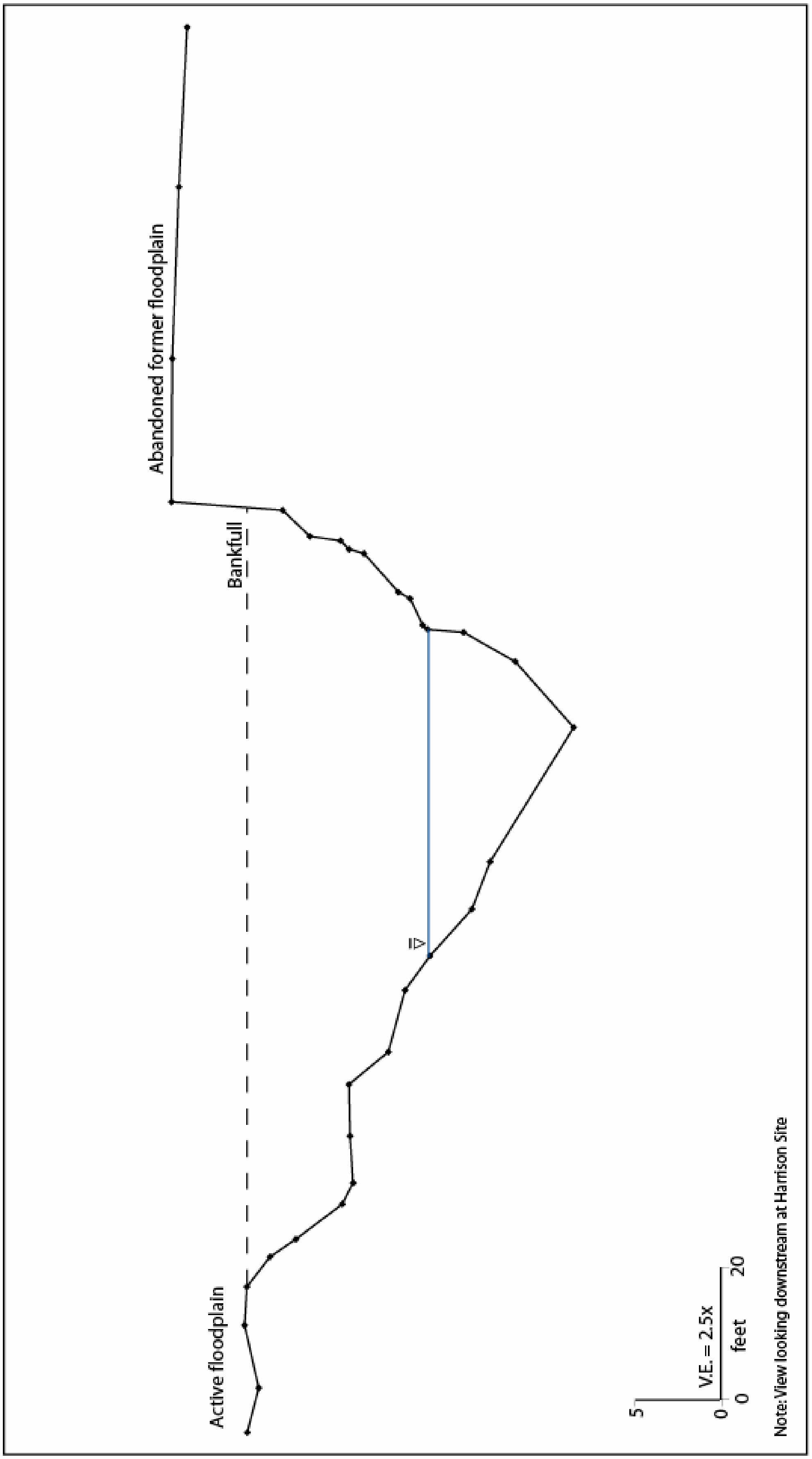
Comparison of Straightened and Meandering Channel Segments



Field Geology Services Fluvial Geomorphology

Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Figure 9

Cross Section of Lower Poultney River (Reach M3)



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Poultney River and Hubbardton River Geomorphology Assessment - Figure 10

Erosion of Post-European Settlement Deposits on Lower Poultney River

Poultney River and Hubbardton River Fluvial Geomorphology Assessment – Figure 11

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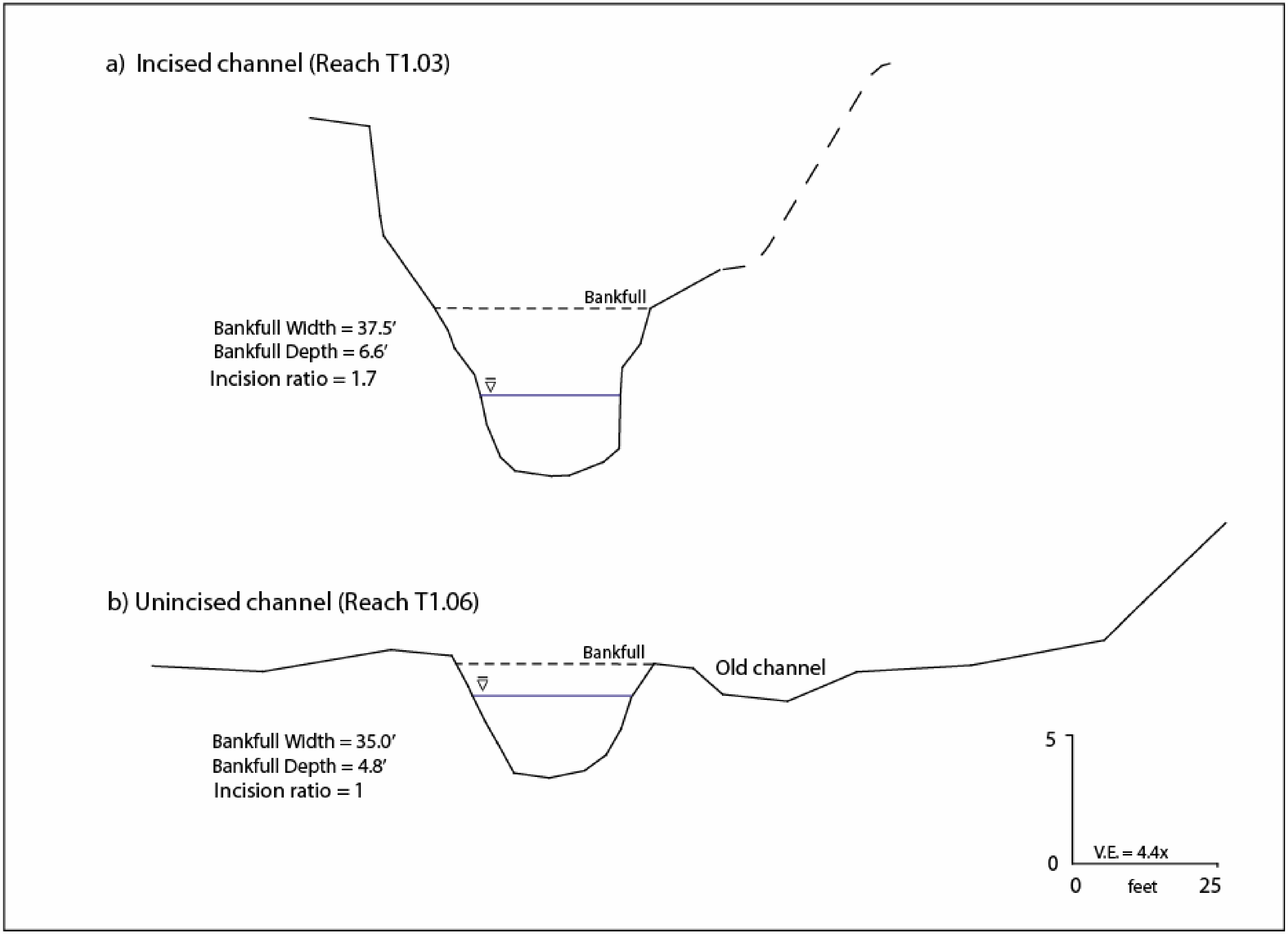
Comparison of Hubbardton River Cross Sections



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Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Figure 12

Former Channel Positions on the Lower Hubbardton River (Reach T1.04)

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Poultney River and Hubbardton River Fluvial Geomorphology Assessment – Figure 13

Continuous Planar Slip Bank Erosion on the Lower Hubbardton River

Note: In Reach T1.03

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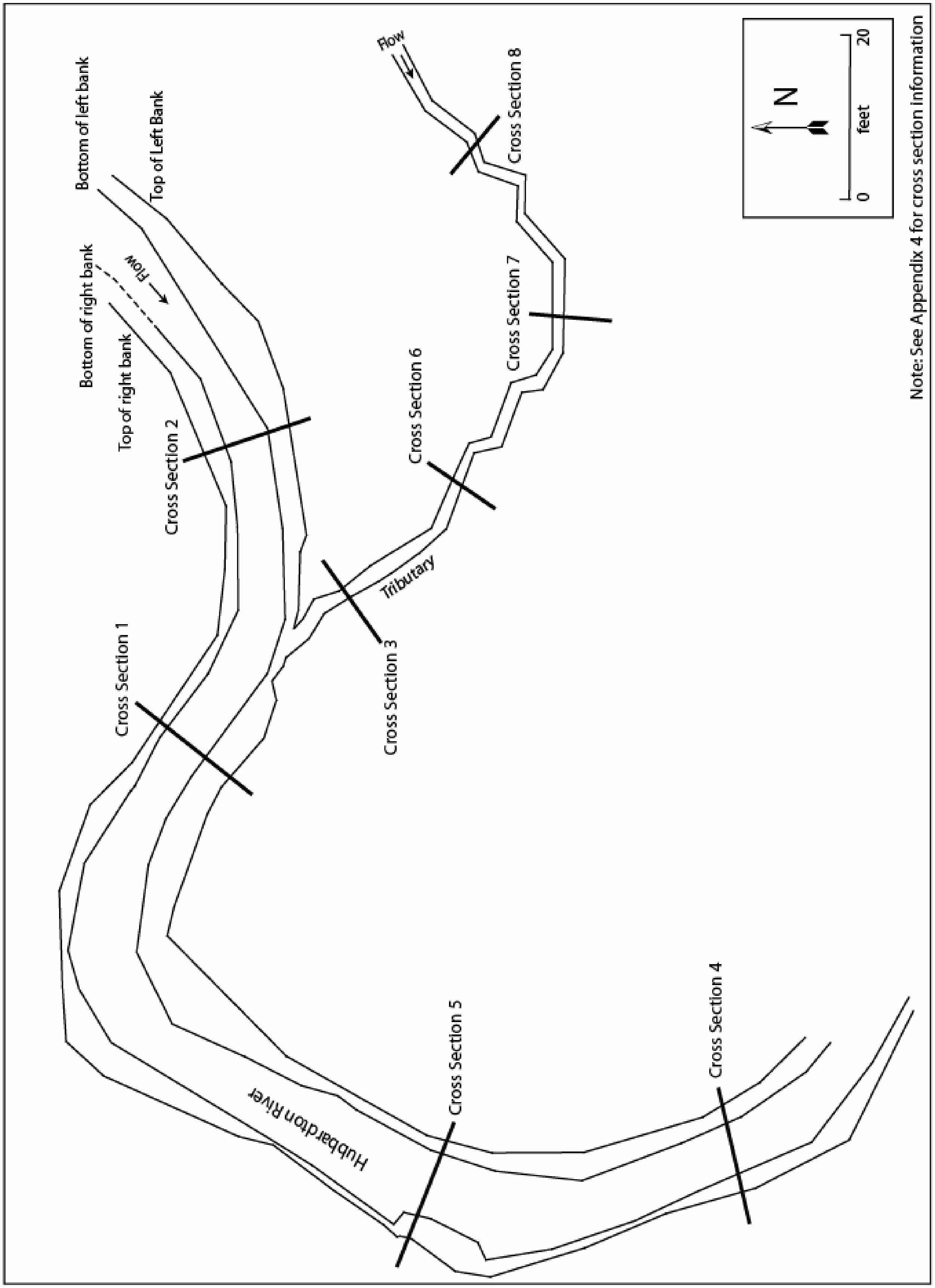
Hubbardton River Clayplain Preserve Phase 3 Assessment Site



Note: See Appendix 4 for cross section information

Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Figure 15

Natural Log Jam on Unnamed Tributary at the Phase 3 Site

View looking upstream. Note aggradation occurring upstream of log jam.

Morphological Parameters of Reaches

Reach #	Cause of Reach Break	Phase 2 Assessment Completed?	Valley Confinement	Channel Gradient (%)	Sinuosity	Amount of Bar Development	Amount of Channel Migration	% Channelized	% Bank Erosion
M1	Lake Champlain	Yes	Very broad	0.02	1.27	Low	Not significant	10	7
M2	Expansion	No	Narrow	0.06	1.19	Low	Not significant	34	7
M3	Hubbardton River	Yes	Narrow	0.1	1.12	High	Not significant	42	37
M4	Expansion	No	Semi-confined	0.15	1.16	Not significant	Not significant	0	35
M5	Slope break	No	Semi-confined	1.04	2.52	Low	Not significant	0	43
M6	Castleton River	No	Narrow	0.54	1.59	Not significant	Not significant	20	41
M7	Constriction	No	Very broad	0.04	1.18	Low	High	12	32
M8	Expansion	No	Very broad	0.32	1.41	Low	High	11	24
M9	Slope break	Yes	Very broad	0.37	1.56	High	High	9	13
M10	Expansion	No	Very broad	0.6	1.05	High	High	23	19
M11	Slope break	No	Broad	1.18	1.23	Not significant	Not significant	0	41
M12	Finel Hollow	No	Broad	0.98	1.09	Not significant	Not significant	0	26
M13	Hampshire Hollow	No	Very broad	0.75	1.11	High	Not significant	12	29
M14	Morse Hollow	No	Very broad	0.99	1.02	High	Not significant	25	24
M15	South Brook	Yes	Very broad	1.9	1.15	High	Not significant	0	9
M16	Expansion	No	Very broad	2.19	1.09	Low	Not significant	0	5
M17	Slope break	No	Broad	2.88	1.37	Not significant	Not significant	15	11
T1.01	Poultney River	Yes	Broad	0.35	1.22	Low	Not significant	9	1
T1.02	Expansion	Yes	Semi-confined	0.71	1.24	Low	Not significant	0	0
T1.03	Constriction	Yes	Narrow	0.14	2.09	High	Not significant	6	28
T1.04	Strong Swamp trib.	Yes	Broad	0.34	1.73	Low	Not significant	6	46
T1.05	Black Pond trib.	No	Very broad	0	1.23	Low	Not significant	0	1
T1.06	Mill Pond Reservoir	Yes	Broad	0.21	1.45	Low	Not significant	0	38
T1.07	Expansion	Yes	Very broad	0.3	1.15	Low	Not significant	0	43
T1.08	Expansion	No	Narrow	0.97	1.04	Not significant	Not significant	0	16
T1.09	Constriction	No	Very broad	0.33	1.19	Not significant	Not significant	42	16
T1.10	Expansion	No	Very broad	0.59	1.14	Not significant	Not significant	18	1

Human Activities and Morphological Parameters Used for Determining an Impact Rating

Human Activities
Watershed land cover
Corridor land cover
Riparian buffer width
Flow regulation
Bridges and culverts
Bank armoring
Straightening
Dredging
Berms and roads
River corridor development

Morphological Parameters
Depositional features
Meander migration
Meander width ratio
Wavelength ratio
Bank erosion
Ice/debris jam potential

Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Table 2

Appendix 1

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Phase 1 Project Metadata

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Parameter	Metadata
Alluvial fan	1:24K topos, field obs.
Bank armoring and revetments	1:24K topos, 1:5K orthos, files, field obs.
Bank erosion - relative magnitude	Field obs. along entire reach
Dominant bed form and material	Preliminary estimate
Belt width	1:5K NHD, 1:5K orthos
Berms and roads	1:24K topos, 1:5K orthos
Bridges and culverts	1:24K topos, 1:5K NHD & orthos, files, field obs.
Channel length	SGAT automated
Channel straightening	1:24K topos, 1:5K NHD & orthos
Confinement type	1:24K topos
Corridor land use - land cover data	Land use - land cover (1990s statewide)
Corridor soil data	NRCS soil survey maps
Debris and ice jam potential	Field obs. along entire reach
Depositional features	1:5K orthos, field obs.
Dredging and gravel mining history	Interviews - DEC, NRCS, Towns, others
Downstream and upstream elevations	1:24K topos
Flow regulations and water withdrawals	1:24K topos, 1:5K NHD & orthos, files, field obs.
Grade controls	1:24K topos, field obs.
Latitude and Longitude	SGAT automated
Meander centerline	1:24K topos, 1:5K NHD
Meander migration and channel avulsion	1:5K orthos (1990s & 1970s), field obs.
Historic corridor land use - land cover	1:5K orthos (1970s), old aerial photos, topos
Historic watershed land use - land cover	1:5K orthos (1970s), old aerial photos, topos
Reach breaks	1:24K topos, 1:5K NHD
Riparian buffer width	1:5K orthos
River corridor development	1:24K topos, 1:5K orthos
Stream type	1:24K topos
Towns that reaches are in	1:24K topos
Valley length	SGAT automated
Valley side slopes	1:24K topos, field obs.
Valley walls	1:24K topos, surficial geology (SG) data
Valley width	SGAT automated
Groundwater and small tributary inputs	1:5K NHD, NWI maps, field obs.
Wavelength	1:5K NHD, 1:5K orthos
Watershed delineations	1:24K topos, 1:5K NHD
Watershed land use - land cover data	Land use - land cover (1990s statewide)

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Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Phase 1 - Step 1. Reach Locations

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Reach ID	Excluded?	Stream Name	Towns	Description
M01		Poultney	West Haven	Flows through Ward Marsh area; Left bank on New York side
M02		Poultney	West Haven	Between Coggman Creek and Hubbardton River; Left bank on New York side
M03		Poultney	West Haven	Upstream of Hubbardton confluence to valley confinement through old Sod Farm now Conservancy; Left bank on New York side
M04		Poultney	West Haven	Below Carver Falls Dam; Left bank on New York side; Floodplain is wide enough in m stream but valley is confined between lake terrace on both sides
M05		Poultney	Fair Haven, West Haven	Upstream of Carver Falls Dam to Castleton river confluence; Left bank on New York s through glacial lake clay deposits
M06		Poultney	Fair Haven	Upstream of Castleton River to Cedar Swamp; Left bank on New York side; lower port reflected in confinment type in Step 2.10
M07		Poultney	Fair Haven	Crosses Route 22A; Left bank on New York side; abundant abandoned meanders pre change of all reaches
M08		Poultney	Fair Haven, Poultney	Upstream end at Hampton, NY ; Left bank on New York side; Right bank frequently im deposits
M09		Poultney	Poultney	Green Mountain College land on right bank for portion of reach; Left bank on New Yor present, and well developed side channel habitat
M10		Poultney	Poultney	Upstream end in East Poultney; first, or most downstream, reach entirely in Vermont; sides of channel confine channel more than reflected in Step 2.10
M11		Poultney	Poultney	Downstream end at falls in East Poultney; Bedrock segments at lower end produce de swimming hole
M12		Poultney	Poultney	Between Finel Hollow and Hampshire Hollow
M13		Poultney	Middletown Springs, Poultney	Between Hampshire Hollow and Morse Hollow
M14		Poultney	Middletown Springs, Poultney	Between Morse Hollow and South Brook; High eroding bank near downstream end co Morse Brook has led to development of large midchannel bars that are occasionally s
M15		Poultney	Middletown Springs	Flows through town of Middletown Springs; Wide valley with low river terrace on edge
M16		Poultney	Middletown Springs, Tinmouth	Upstream of Middletown Springs to Junction of 133 and 140
M17		Poultney	Middletown Springs, Tinmouth	Steep headwaters area east of Spoon Mountain
T01.01		Hubbardton	West Haven	Downstream end at confluence with Poultney; Floodplain confined within glacial lake t where river impinges against terrace
T01.02		Hubbardton	West Haven	West Haven Road crosses channel about half way along the reach; Reach is more na terrace
T01.03		Hubbardton	Benson, West Haven	Upstream end is just downstream of Route 22A; Confined within lake terrace with sor
T01.04		Hubbardton	Benson	Mostly upstream of Route 22A; Floodplain confined within lake terrace despite broad v
T01.05		Hubbardton	Benson	Mill Pond; almost entire reach is still water area behind Mill Pond Dam
T01.06		Hubbardton	Benson	Upstream of Mill Pond; includes marshy areas with abundant abandoned meanders pr
T01.07		Hubbardton	Benson	Parallels Sunset Lake Road; Confined within narrowed valley
T01.08		Hubbardton	Benson	Confined within glacial lake terrace on either side of valley
T01.09		Hubbardton	Benson	Valley is more broad but floodplain still confined within terrace
T01.10		Hubbardton	Benson	Upstream most reach on Hubbardton River

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Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Phase 1 - Step 2. Preliminary Reference Stream Type

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	2.1		2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	2.
Reach ID	Elevation Up (ft.)	Down (ft.)	Valley Length (ft.)	Valley Slope (%)	Channel Length (ft.)	Channel Slope (%)	Sinuosity	Watershed Area (sq. mi.)	Channel Width (ft.)	Valley Width (ft.)	Confir Ratio
M01	100	95	24852	0.02	31583	0.02	1.27	262.41	164.9	2263	13.7
M02	105	100	8073	0.06	9612	0.05	1.19	236.80	156.7	797	5.1
M03	110	105	4976	0.10	5566	0.09	1.12	190.38	140.5	771	5.5
M04	120	110	6824	0.15	7903	0.13	1.16	189.86	140.3	334	2.4
M05	290	220	6722	1.04	16965	0.41	2.52	187.64	139.4	353	2.5
M06	330	290	7469	0.54	11847	0.34	1.59	75.50	88.5	401	4.5
M07	335	330	12710	0.04	14939	0.03	1.18	71.18	85.9	1993	23.2
M08	380	335	14162	0.32	20020	0.22	1.41	65.88	82.6	1611	19.5
M09	400	380	5374	0.37	8406	0.24	1.56	53.58	74.5	3967	53.2
M10	470	400	11662	0.60	12234	0.57	1.05	49.08	71.3	3116	43.7
M11	520	480	3388	1.18	4161	0.96	1.23	44.55	67.9	500	7.4
M12	560	520	4086	0.98	4459	0.90	1.09	37.27	62.1	517	8.3
M13	610	560	6664	0.75	7379	0.68	1.11	33.28	58.7	1128	19.2
M14	785	610	17698	0.99	18033	0.97	1.02	28.07	53.9	668	12.4
M15	965	785	9481	1.90	10904	1.65	1.15	12.78	36.4	1069	29.4
M16	1110	965	6633	2.19	7205	2.01	1.09	7.24	27.4	404	14.7
M17	1400	1110	10084	2.88	13786	2.10	1.37	4.53	21.7	136	6.3
T01.01	140	110	8513	0.35	10419	0.29	1.22	44.38	67.8	539	7.9
T01.02	175	140	4900	0.71	6080	0.58	1.24	42.31	66.2	235	3.5
T01.03	190	175	10893	0.14	22769	0.07	2.09	40.62	64.9	299	4.6
T01.04	220	190	8940	0.34	15473	0.19	1.73	33.30	58.7	369	6.3
T01.05	220	220	4786	0.00	5881	0.00	1.23	21.83	47.6	1045	22.0
T01.06	235	225	4812	0.21	6981	0.14	1.45	19.94	45.5	380	8.4
T01.07	250	235	5072	0.30	5832	0.26	1.15	18.07	43.3	534	12.3
T01.08	280	250	3095	0.97	3219	0.93	1.04	16.82	41.8	220	5.3
T01.09	295	280	4534	0.33	5390	0.28	1.19	16.24	41.0	796	19.4
T01.10	380	295	14416	0.59	16384	0.52	1.14	11.87	35.1	440	12.5

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Poultney - Hubbardton River

Phase 1 - Step 3. Basin Characteristics: Geology

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	3.1	3.2	3.3 Geologic Materials			3.4 Valley Side
Reach ID	Alluvial Fan	Grade Control	Dominant	%	Sub-Dominant	Left
M01	No	None			---	Extremely Steep
M02	No	None			---	Steep
M03	No	None			---	Very Steep
M04	No	Multiple			---	Very Steep
M05	No	Ledge			---	Hilly
M06	No	Ledge			---	Flat
M07	No	None			---	Hilly
M08	No	Ledge			---	Steep
M09	No	Ledge			---	Hilly
M10	Yes	Ledge	Alluvial	58.1	Ice-Contact	Steep
M11	No	Ledge	Till	49.5	Ice-Contact	Steep
M12	No	Ledge	Alluvial	47.4	Till	Steep
M13	No	Ledge	Other	30.0	Ice-Contact	Hilly
M14	No	Ledge	Ice-Contact	45.4	Alluvial	Steep
M15	No	Ledge	Ice-Contact	56.7	Alluvial	Steep
M16	No	Ledge	Ice-Contact	55.0	Till	Steep
M17	No	Ledge	Ice-Contact	66.0	Till	Extremely Steep
T01.01	No	None	Glacial Lake	52.5	Alluvial	Steep
T01.02	No	None	Glacial Lake	87.4	Ice-Contact	Hilly
T01.03	No	None	Glacial Lake	99.7	Till	Hilly
T01.04	No	None	Glacial Lake	87.3	Alluvial	Hilly
T01.05	No	Dam	Glacial Lake	78.4	Till	Hilly
T01.06	No	None	Glacial Lake	100.0	---	Hilly
T01.07	No	None	Glacial Lake	64.2	Alluvial	Hilly
T01.08	No	None	Glacial Lake	82.0	Alluvial	Steep
T01.09	No	None	Glacial Lake	100.0	---	Hilly
T01.10	No	None	Glacial Lake	69.7	Other	Hilly

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Poultney - Hubbardton River

Phase 1 - Step 3. Basin Characteristics: Soils

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

	3.5 Soil Properties								
	Hydrologic				Water Table				
Reach ID	Group	%	Flooding	%	Deep	%	Shallow	%	Erodibility
M01									
M02									
M03									
M04									
M05									
M06									
M07									
M08									
M09									
M10	B	61.6	Occasional	51.1	2.0	50.8	1.5	58.5	Slight
M11	A	42.5	None/Rare	92.0	6.0	92.0	6.0	92.0	Severe
M12	B	52.1	None/Rare	50.1	5.0	30.0	1.5	39.7	Moderate
M13	Not Rated	30.0	None/Rare	52.9	6.0	24.5	1.5	32.6	Moderate
M14	A	39.0	None/Rare	64.7	6.0	53.5	6.0	53.5	Moderate
M15	A	56.7	None/Rare	62.8	6.0	59.7	6.0	59.7	Moderate
M16	A	53.4	None/Rare	93.6	6.0	74.7	6.0	74.7	Very Severe
M17	A	46.9	None/Rare	99.5	6.0	46.9	1.5	53.1	Severe
T01.01	D	52.5	None/Rare	53.0	2.0	46.6	0.5	37.4	Moderate
T01.02	D	89.7	None/Rare	100.0	3.0	64.8	1.0	64.8	Very Severe
T01.03	D	100.0	None/Rare	100.0	1.5	47.8	0.5	47.8	Moderate
T01.04	D	87.3	None/Rare	87.3	1.0	48.2	0.0	60.9	Slight
T01.05	D	98.6	None/Rare	98.6	1.5	62.7	0.5	61.3	Very Severe
T01.06	D	100.0	None/Rare	85.3	1.5	52.5	0.5	52.5	Moderate
T01.07	D	64.2	None/Rare	64.2	1.5	82.1	0.5	46.3	Moderate
T01.08	D	85.0	None/Rare	80.4	3.0	77.4	1.0	77.4	Very Severe
T01.09	D	100.0	Frequent	79.1	1.0	79.1	0.0	79.1	Slight
T01.10	D	96.4	None/Rare	96.0	1.5	43.0	0.5	43.0	Moderate

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Poultney - Hubbardton River

Phase 1 - Step 3. Soils Data

Soil Parent Material

Reach ID	Alluvial	Glacial Lake	Ice-contact	Other	Till	Total
M10	58.1	7.7	32.4		1.7	100.0
M11	0.6		42.5	7.4	49.5	100.0
M12	47.4		17.4	2.5	32.7	100.0
M13	17.1	0.1	29.3	30.0	23.5	100.0
M14	24.3		45.4	11.0	19.3	100.0
M15	32.2		56.7	5.0	6.1	100.0
M16	6.4		55.0		38.6	100.0
M17	0.5		66.0		33.5	100.0
T01.01	46.6	52.5		0.5		99.7
T01.02		87.4	5.7	4.6	2.3	100.0
T01.03		99.7			0.3	100.0
T01.04	12.7	87.3				100.0
T01.05	1.4	78.4			20.2	100.0
T01.06		100.0				100.0
T01.07	35.8	64.2				100.0
T01.08	15.0	82.0			3.1	100.0
T01.09		100.0				100.0
T01.10		69.7	0.7	23.7	6.0	100.0

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Poultney - Hubbardton River

Phase 1 - Step 4. Land Cover - Reach Hydrology

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	4.1 Watershed Land Cover - Land Use							4.2 Corridor Land Cover - Land Use							4.3 Riparian Buffer		
		Current							Current						Width (ft.)		
Reach ID	**Historic**	**Dom.**	**%**	**Sub-D.**	**Urban**	**Crop**	**Impact**	**Historic**	**Dom.**	**%**	**Sub-D.**	**Urban**	**Crop**	**Impact**	**L Bank**	**R Bank**	**Impact**
M01	Forest			---			N.D.	Wetland			---			N.D.	26-50	26-50	N.S.
M02	Forest			---			N.D.	Wetland			---			N.D.	>100	>100	N.S.
M03	Forest			---			N.D.	Crop			---			N.D.	>100	26-50	Low
M04	Forest			---			N.D.	Forest			---			N.D.	>100	>100	N.S.
M05	Forest			---			N.D.	Forest			---			N.D.	>100	>100	N.S.
M06	Forest			---			N.D.	Crop			---			N.D.	0-25	0-25	Low
M07	Forest			---			N.D.	Crop			---			N.D.	0-25	51-100	Low
M08	Forest			---			N.D.	Crop			---			N.D.	51-100	>100	N.S.
M09	Forest			---			N.D.	Crop			---			N.D.	26-50	26-50	N.S.
M10	Forest	Forest	76.8	Field	3.7	3.1	Low	Crop	Forest	26.1	Crop	11.5	17.3	High	51-100	51-100	N.S.
M11	Forest	Forest	78.9	Field	3.2	2.6	Low	Crop	Urban	36.1	Forest	36.1	1.9	High	>100	>100	N.S.
M12	Forest	Forest	78.5	Field	3.2	2.8	Low	Crop	Forest	28.3	Field	12.0	1.6	High	>100	>100	Low
M13	Forest	Forest	78.6	Field	3.2	2.7	Low	Crop	Forest	44.4	Urban	13.9	4.9	High	>100	>100	Low
M14	Forest	Forest	78.1	Field	3.4	2.8	Low	Crop	Forest	26.2	Field	18.4	6.0	High	>100	0-25	Low
M15	Forest	Forest	78.6	Field	3.5	2.8	Low	Crop	Forest	36.1	Field	4.9	4.5	Low	0-25	>100	Low
M16	Forest	Forest	83.8	Field	3.1	3.1	Low	Crop	Forest	49.3	Urban	9.3	2.0	High	>100	>100	Low
M17	Forest	Forest	82.4	Field	3.4	3.8	Low	Crop	Forest	43.8	Urban	7.9	1.5	Low	>100	>100	N.S.
T01.01	Forest	Forest	60.4	Field	4.1	5.4	Low	Crop	Forest	43.0	Crop		23.5	High	>100	>100	N.S.
T01.02	Forest	Forest	60.4	Field	4.2	5.2	Low	Crop	Forest	25.4	Field	14.1	10.0	High	>100	>100	Low
T01.03	Forest	Forest	60.6	Field	4.1	5.1	Low	Crop	Forest	43.8	Crop		11.9	High	>100	>100	N.S.
T01.04	Forest	Forest	63.7	Field	3.8	3.9	Low	Crop	Forest	30.3	Field	2.6	12.7	High	0-25	>100	Low
T01.05	Forest	Forest	63.0	Field	4.3	3.9	Low	Wetland	Field	9.4	Forest	5.2	1.8	Low	0-25	26-50	Low
T01.06	Forest	Forest	66.4	Field	3.9	3.7	Low	Crop	Crop	15.8	Forest	3.9	15.8	High	0-25	0-25	High
T01.07	Forest	Forest	67.9	Field	3.7	3.6	Low	Crop	Field	25.9	Forest		10.2	High	0-25	0-25	High
T01.08	Forest	Forest	68.8	Field	3.9	3.5	Low	Crop	Urban	26.1	Forest	26.1	7.2	High	>100	>100	Low
T01.09	Forest	Forest	68.9	Field	3.8	3.6	Low	Crop	Forest	34.0	Crop		14.2	High	0-25	0-25	High
T01.10	Forest	Forest	69.8	Field	4.2	3.9	Low	Crop	Forest	34.7	Crop	2.7	8.9	High	0-25	0-25	Low

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Poultney - Hubbardton River

Phase 1 - Step 4. Land Cover - Land Use Data

Watershed Land Cover - Land Use

Reach ID	Commercial	Crop	Field	Forest	Residential	Shrub	Water	Wetland	Total
M10	0.0	3.1	10.6	76.8	3.7	0.5	4.9	0.3	99.9
M11		2.6	9.9	78.9	3.2	0.4	4.7	0.2	99.9
M12		2.8	10.1	78.5	3.2	0.4	4.8	0.2	99.9
M13		2.7	9.9	78.6	3.2	0.4	4.7	0.2	99.9
M14		2.8	10.3	78.1	3.4	0.5	4.7	0.2	99.9
M15		2.8	9.3	78.6	3.5	0.5	5.0	0.0	99.8
M16		3.1	5.2	83.8	3.1	0.4	4.2	0.0	99.8
M17		3.8	5.9	82.4	3.4	0.4	3.8	0.1	99.8
T01.01	0.0	5.4	20.0	60.4	4.1	0.4	9.3	0.3	99.9
T01.02	0.0	5.2	19.9	60.4	4.2	0.4	9.5	0.3	99.9
T01.03	0.0	5.1	19.8	60.6	4.1	0.4	9.7	0.4	99.9
T01.04	0.0	3.9	17.3	63.7	3.8	0.3	10.4	0.4	99.9
T01.05	0.0	3.9	15.4	63.0	4.3	0.3	12.1	0.6	99.8
T01.06	0.0	3.7	12.5	66.4	3.9	0.2	12.4	0.7	99.8
T01.07	0.0	3.6	10.4	67.9	3.7	0.2	13.1	0.8	99.8
T01.08	0.0	3.5	9.0	68.8	3.9	0.2	13.5	0.8	99.8
T01.09	0.0	3.6	8.6	68.9	3.8	0.2	13.8	0.8	99.8
T01.10	0.0	3.9	8.5	69.8	4.2	0.2	12.1	1.2	99.8

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Poultney - Hubbardton River

Phase 1 - Step 4. Land Cover - Land Use Data

Corridor Land Cover - Land Use

Reach ID	Commercial	Crop	Field	Forest	Residential	Shrub	Water	Wetland	Total
M10	0.2	17.3	11.0	26.1	11.3	0.4	33.1	0.7	100.0
M11		1.9	14.6	23.4	36.1	0.7	23.4		100.0
M12		1.6	22.9	28.3	12.0	0.4	34.8		100.0
M13	0.4	4.9	8.6	44.4	13.5		20.1	8.1	100.0
M14	0.1	6.0	21.8	26.2	18.3	1.5	24.1	1.9	100.0
M15		4.5	17.3	36.1	4.9	0.9	36.3		100.0
M16		2.0	2.3	49.3	9.3		37.1		100.0
M17		1.5	3.8	43.8	7.9	0.4	42.7		100.0
T01.01		23.5	1.1	43.0		0.2	32.2		100.0
T01.02		10.0	18.6	25.4	14.1		31.9		100.0
T01.03		11.9	7.6	43.8			36.7		100.0
T01.04		12.7	12.7	30.3	2.6	0.6	41.0		100.0
T01.05		1.8	9.4	8.8	5.2	0.8	74.0		100.0
T01.06		15.8	15.1	15.3	3.9		50.0		100.0
T01.07		10.2	25.9	22.3		0.2	41.4		100.0
T01.08		7.2	14.0	18.7	26.1	1.8	32.2		100.0
T01.09		14.2	8.4	34.0			43.4		100.0
T01.10		8.9	4.6	34.7	2.7		43.2	6.0	100.0

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Poultney - Hubbardton River

Phase 1 - Step 4. Riparian Condition Summary

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

	Riparian Corridor				Riparian Buffer								
					Left Bank					Right Bank			
	Dominant Corridor Land Cover	Urban	Crop	Corridor Land Cover Impact	Buffer	Percent of each Buffer Width				Buffer	Percent of each Buffer Width		
Reach ID		%	%		Width	0-25	26-50	51-100	>100	Width	0-25	26-50	51-100
M01				N.D.	26-50	10	40	20	30	26-50	20	50	20
M02				N.D.	>100	10	25	0	65	>100	20	20	0
M03				N.D.	>100	0	0	0	100	26-50	30	65	0
M04				N.D.	>100	10	0	0	90	>100	0	5	0
M05				N.D.	>100	10	0	0	90	>100	10	0	0
M06				N.D.	0-25	60	0	0	40	0-25	50	10	0
M07				N.D.	0-25	70	0	10	20	51-100	30	0	60
M08				N.D.	51-100	20	25	35	20	>100	10	25	10
M09				N.D.	26-50	0	40	35	25	26-50	15	50	15
M10	Forest	11.5	17.3	High	51-100	10	10	60	20	51-100	20	20	30
M11	Urban	36.1	1.9	High	>100	5	10	0	85	>100	10	30	0
M12	Forest	12.0	1.6	High	>100	40	0	0	60	>100	30	0	30
M13	Forest	13.9	4.9	High	>100	5	0	5	90	>100	30	20	0
M14	Forest	18.4	6.0	High	>100	25	15	20	40	0-25	50	20	10
M15	Forest	4.9	4.5	Low	0-25	60	0	0	40	>100	25	10	0
M16	Forest	9.3	2.0	High	>100	0	0	0	100	>100	30	0	0
M17	Forest	7.9	1.5	Low	>100	15	0	0	85	>100	20	30	0
T01.01	Forest		23.5	High	>100	20	30	0	50	>100	10	0	0
T01.02	Forest	14.1	10.0	High	>100	10	0	0	90	>100	40	0	0
T01.03	Forest		11.9	High	>100	15	5	0	80	>100	15	0	5
T01.04	Forest	2.6	12.7	High	0-25	60	0	0	40	>100	30	0	0
T01.05	Field	5.2	1.8	Low	0-25	25	25	25	25	26-50	20	60	0
T01.06	Crop	3.9	15.8	High	0-25	70	0	0	30	0-25	80	10	0
T01.07	Field		10.2	High	0-25	80	0	0	20	0-25	90	0	0
T01.08	Urban	26.1	7.2	High	>100	40	10	0	50	>100	20	0	0
T01.09	Forest		14.2	High	0-25	80	10	0	10	0-25	100	0	0
T01.10	Forest	2.7	8.9	High	0-25	50	0	0	50	0-25	50	0	0

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Poultney - Hubbardton River

Phase 1 - Step 5. Instream Channel Modification

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	5.1 Flow Regulation		5.2 Bridges - Culverts				5.3 Bank Armoring			5.4 Channel Straightening			5.5 Dred
Reach ID	Type	Impact	Number	Length	Percent	Impact	Length	Percent	Impact	Length	Percent	Impact	Type
M01	None	N.S.	1	100	0.3	Low	577	1.8	N.S.	3175	10.1	Low	Not Evaluated
M02	None	N.S.	1	20	0.2	Low	464	4.8	N.S.	3240	33.7	High	Not Evaluated
M03	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	2328	41.8	High	Not Evaluated
M04	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	None	----	N.E.	None
M05	Impoundment	High	1	20	0.1	Low	None	----	N.E.	None	----	N.E.	None
M06	None	N.S.	2	60	0.5	Low	None	----	N.E.	2346	19.8	Low	None
M07	None	N.S.	2	60	0.4	Low	323	2.2	N.S.	1726	11.6	Low	Dredging
M08	None	N.D.	0	0	0.0	N.S.	300	1.5	N.S.	2224	11.1	Low	Dredging
M09	None	N.S.	2	60	0.7	Low	219	2.6	N.S.	786	9.4	Low	Dredging
M10	None	N.S.	3	175	1.4	Low	219	1.8	N.S.	2784	22.8	High	Dredging
M11	None	N.S.	1	20	0.5	Low	258	6.2	N.S.	None	----	N.E.	None
M12	None	N.S.	1			Unk.	224	5.0	N.S.	None	----	N.E.	Not Evaluated
M13	None	N.S.	1	20	0.3	Low	247	3.3	N.S.	892	12.1	Low	Not Evaluated
M14	None	N.S.	2	50	0.3	Low	338	1.9	N.S.	4440	24.6	High	Gravel Mining
M15	None	N.S.	2	40	0.4	Low	None	----	N.E.	None	----	N.E.	Dredging
M16	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	None	----	N.E.	Not Evaluated
M17	None	N.S.	4			Unk.	None	----	N.E.	2017	14.6	Low	Not Evaluated
T01.01	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	968	9.3	Low	Not Evaluated
T01.02	None	N.S.	1	30	0.5	Low	203	3.3	N.S.	None	----	N.E.	Not Evaluated
T01.03	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	1447	6.4	Low	Not Evaluated
T01.04	None	N.S.	2	550	3.6	Low	623	4.0	N.S.	872	5.6	Low	Dredging
T01.05	Impoundment	High	2	40	0.7	Low	None	----	N.E.	None	----	N.E.	None
T01.06	None	N.S.	1			Unk.	None	----	N.E.	None	----	N.E.	Not Evaluated
T01.07	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	None	----	N.E.	Not Evaluated
T01.08	None	N.S.	1			Unk.	139	4.3	N.S.	None	----	N.E.	Not Evaluated
T01.09	None	N.S.	0	0	0.0	N.S.	None	----	N.E.	2239	41.5	High	Not Evaluated
T01.10	None	N.S.	1			Unk.	195	1.2	N.S.	3005	18.3	Low	Not Evaluated

Poultney River and Hubbardton River Fluvial Geomorphology Assessment - Appendix 1 (Phase1)

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Poultney - Hubbardton River

Phase 1 - Step 5. Bank Armoring And Straightening

Lengths summed for each Reach, Type, and Category

Reach ID	Type	Category	Total Length
M01	Straightening	Straightened	3175
M01	Armoring	Rip-rap	577
M02	Armoring	Rip-rap	464
M02	Straightening	Straightened	3240
M03	Straightening	Straightened	2328
M06	Straightening	Straightened	2346
M07	Armoring	Rip-rap	323
M07	Straightening	Straightened	1726
M08	Armoring	Rip-rap	300
M08	Straightening	Straightened	2224
M09	Armoring	Rip-rap	219
M09	Straightening	Straightened	786
M10	Straightening	Straightened	2784
M10	Armoring	Rip-rap	219
M11	Armoring	Rip-rap	258
M12	Armoring	Rip-rap	224
M13	Armoring	Rip-rap	247
M13	Straightening	Straightened	892
M14	Armoring	Rip-rap	338
M14	Straightening	Straightened	4440
M17	Straightening	Straightened	2017
T01.01	Straightening	Straightened	968
T01.02	Armoring	Rip-rap	203
T01.03	Straightening	Straightened	1447
T01.04	Armoring	Rip-rap	623
T01.04	Straightening	Straightened	872
T01.08	Armoring	Rip-rap	139
T01.09	Straightening	Straightened	2239
T01.10	Straightening	Straightened	3005
T01.10	Armoring	Rip-rap	195

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Poultney - Hubbardton River

Phase 1 - Step 6. Floodplain Modification and Planform Changes

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	6.1 Berms & Roads			6.2 Corridor Development			6.3 Depositional Features		6.4 Meander Migration		6.5 Meander Width Ratio			6.6 Wa
Reach ID	**Length**	**Percent**	**Impact**	**Length**	**Percent**	**Impact**	**Type**	**Impact**	**Type**	**Impact**	**Width**	**Ratio**	**Impact**	**Length**
M01	228	0.7	N.S.	0.0	0.0	N.S.	Mid-channel	Low	None	N.S.	1118	6.8	N.S.	1625
M02	5839	60.7	High	0.0	0.0	N.S.	Mid-channel	Low	Migration	N.S.	288	1.8	High	1486
M03	None	----	N.E.	0.0	0.0	N.S.	Point	High	None	N.S.	314	2.2	High	880
M04	None	----	N.E.	0.0	0.0	N.S.	None	N.S.	None	N.S.			Unk.	
M05	215	1.3	N.S.	0.0	0.0	N.S.	Multiple	Low	None	N.S.			Unk.	
M06	217	1.8	N.S.	613.0	5.2	Low	None	N.S.	None	N.S.	432	4.9	Low	804
M07	648	4.3	N.S.	1653.0	11.1	Low	Point	Low	Migration	High	305	3.6	Low	460
M08	1243	6.2	Low	1666.0	8.3	Low	Point	Low	Migration	High	324	3.9	Low	490
M09	278	3.3	N.S.	1245.0	14.8	Low	Multiple	High	Migration	High	162	2.2	High	938
M10	297	2.4	N.S.			Unk.	Multiple	High	Migration	High	381	5.3	N.S.	1029
M11	1825	43.9	High	450.0	10.8	Low	None	N.S.	None	N.S.	91	1.3	High	477
M12	864	19.4	Low	0.0	0.0	N.S.	None	N.S.	None	N.S.	289	4.7	Low	1030
M13	3146	42.6	High	0.0	0.0	N.S.	Multiple	High	None	N.S.	154	2.6	High	535
M14	2015	11.2	Low			Unk.	Multiple	High	None	N.S.	275	5.1	N.S.	1314
M15	524	4.8	N.S.	450.0	4.1	N.S.	Mid-channel	High	None	N.S.	231	6.3	N.S.	902
M16	463	6.4	Low	220.0	3.1	N.S.	Point	Low	None	N.S.			Unk.	
M17	1469	10.7	Low	580.0	4.2	N.S.	None	N.S.	None	N.S.			Unk.	
T01.01	None	----	N.E.	0.0	0.0	N.S.	Point	Low	None	N.S.	143	2.1	High	439
T01.02	531	8.7	Low	0.0	0.0	N.S.	Point	Low	None	N.S.			Unk.	
T01.03	None	----	N.E.	0.0	0.0	N.S.	Multiple	High	None	N.S.	301	4.6	Low	407
T01.04	249	1.6	N.S.	0.0	0.0	N.S.	Point	Low	None	N.S.	202	3.4	Low	311
T01.05	None	----	N.E.	0.0	0.0	N.S.	Multiple	Low	None	N.S.	44	0.9	High	573
T01.06	None	----	N.E.	0.0	0.0	N.S.	Multiple	Low	None	N.S.	171	3.8	Low	388
T01.07	None	----	N.E.	0.0	0.0	N.S.	Point	Low	None	N.S.	79	1.8	High	253
T01.08	2815	87.4	High	0.0	0.0	N.S.	None	N.S.	None	N.S.			Unk.	
T01.09	None	----	N.E.	0.0	0.0	N.S.	None	N.S.	None	N.S.	137	3.3	Low	233
T01.10	283	1.7	N.S.	0.0	0.0	N.S.	None	N.S.	None	N.S.	175	5.0	Low	280

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Poultney - Hubbardton River

Phase 1 - Step 6. Berms and Roads

Lengths summed for each Reach, Type, and Category

Reach ID	Type	Category	Total Length
M01	Berms and Roads	One Side	228
M02	Berms and Roads	One Side	5839
M05	Berms and Roads	Both Sides	215
M06	Berms and Roads	Both Sides	217
M07	Berms and Roads	Both Sides	228
M07	Berms and Roads	One Side	420
M08	Berms and Roads	One Side	1243
M09	Berms and Roads	Both Sides	278
M10	Berms and Roads	Both Sides	297
M11	Berms and Roads	One Side	1553
M11	Berms and Roads	Both Sides	272
M12	Berms and Roads	One Side	864
M13	Berms and Roads	One Side	1470
M13	Berms and Roads	Both Sides	1676
M14	Berms and Roads	One Side	2015
M15	Berms and Roads	Both Sides	156
M15	Berms and Roads	One Side	368
M16	Berms and Roads	One Side	463
M17	Berms and Roads	Both Sides	228
M17	Berms and Roads	One Side	1241
T01.02	Berms and Roads	One Side	531
T01.04	Berms and Roads	Both Sides	249
T01.08	Berms and Roads	One Side	2815
T01.10	Berms and Roads	Both Sides	283

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Poultney - Hubbardton River

Phase 1 - Step 7. Bed and Bank Windshield Survey

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	7.1 Stream Type					7.2 Bank Erosion - Bank Height			7.3 Ice & Debris Jam Potential	
Reach ID	Reference Stream Type	Mod. Ref. Stream Type	Dominant Bedform	Subclass Slope	Dominant Bed Material	Bank Erosion	Bank Height	Impact	Type	Impact
M01	C	No	Dune-Ripple	None	Sand	Low	Low	Low	None	N.S.
M02	C	No	Dune-Ripple	None	Not Evaluated	Low	Medium	Low	Multiple	Low
M03	C	No	Riffle-Pool	None	Sand	High	High	High	Bend	Low
M04	B	No	Riffle-Pool	c	Gravel	Low	High	Low	None	N.S.
M05	B	No	Riffle-Pool	c	Cobble	Low	Low	Low	Multiple	N.S.
M06	C	No	Riffle-Pool	None	Gravel	Low	High	High	Not Evaluated	N.D.
M07	E	No	Dune-Ripple	None	Sand	Low	Low	Low	Multiple	Low
M08	C	No	Riffle-Pool	None	Gravel	High	Low	Low	Bend	Low
M09	C	No	Riffle-Pool	None	Cobble	Low	Low	Low	Multiple	Low
M10	C	No	Riffle-Pool	None	Cobble	Low	Low	Low	Bridge	Low
M11	C	No	Riffle-Pool	None	Cobble	Low	Low	Low	Bridge	Low
M12	C	No	Riffle-Pool	None	Cobble	Low	Low	Low	Shallow	Low
M13	C	No	Riffle-Pool	None	Cobble	Low	Low	Low	Multiple	Low
M14	C	No	Riffle-Pool	None	Cobble	Low	High	High	Bridge	Low
M15	C	No	Riffle-Pool	None	Cobble	Low	Low	Low	Bridge	Low
M16	B	No	Step-Pool	b	Cobble	Low	Low	Low	Bend	Low
M17	B	No	Step-Pool	b	Cobble	None	Low	N.S.	Multiple	Low
T01.01	C	No	Dune-Ripple	None	Sand	Low	High	Low	None	N.S.
T01.02	B	No	Dune-Ripple	c	Sand	Low	Low	Low	Bridge	Low
T01.03	E	No	Dune-Ripple	None	Sand	High	Low	Low	Bend	N.S.
T01.04	E	No	Riffle-Pool	None	Sand	High	Low	Low	Multiple	Low
T01.05	C	No	Riffle-Pool	None	Sand	Low	Low	Low	Bridge	Low
T01.06	E	No	Dune-Ripple	None	Sand	Low	Low	Low	None	N.D.
T01.07	E	No	Riffle-Pool	None	Sand	High	Low	Low	None	N.S.
T01.08	B	No	Plane Bed	c	Sand	Low	Low	Low	None	N.S.
T01.09	E	No	Dune-Ripple	None	Sand	Low	Low	Low	Bend	Low
T01.10	C	No	Riffle-Pool	None	Gravel	High	Low	Low	Bend	Low

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Poultney - Hubbardton River

Phase 1 - Step 7. Comments

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Reach ID	7.4 Comments
M01	Unknown if ice jams have occurred but this area does experience backwater from Lake Champlain which could potentially slow ice n
M02	Bridge and sharp bends
M03	Tight meanders
M04	
M05	Sharp bends, shallow, and valley constrictions present
M06	
M07	
M08	
M09	Bridge and shallow
M10	
M11	
M12	Mid-channel bars present
M13	Bridge and sharp bend
M14	Shallow and bridge
M15	
M16	
M17	Bends and bridges
T01.01	Backwater from Poultney at high flow might cause problems
T01.02	
T01.03	Many tight meanders present
T01.04	Tight meanders, culvert, and bridge
T01.05	Most of reach is pond behind Mill Dam
T01.06	
T01.07	
T01.08	
T01.09	Ice jam potential also possible as a result of constriction downstream at reach break
T01.10	

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Poultney - Hubbardton River

Phase 1 - Step 7. Channelization Report

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Step	2.5	2.11 (also 7.1) Stream Type				5.4 Channel Straightening			6.5 Meander Width Ratio			6.6 Wavelength Ratio		
	Channel Slope	Reference Stream Type	Dominant Bedform	Subclass Slope	Dominant Bed Material	Length	Percent	Impact	Width	Ratio	Impact	Length	Ratio	Impact
M01	0.02	C	Dune-Ripple	None	Sand	3175	10.1	Low	1118	6.8	N.S.	1625	9.9	N.S.
M02	0.05	C	Dune-Ripple	None	Not Evaluated	3240	33.7	High	288	1.8	High	1486	9.5	N.S.
M03	0.09	C	Riffle-Pool	None	Sand	2328	41.8	High	314	2.2	High	880	6.3	Low
M04	0.13	B	Riffle-Pool	c	Gravel	None	----	N.E.			Unk.			Unk.
M05	0.41	B	Riffle-Pool	c	Cobble	None	----	N.E.			Unk.			Unk.
M06	0.34	C	Riffle-Pool	None	Gravel	2346	19.8	Low	432	4.9	Low	804	9.1	N.S.
M07	0.03	E	Dune-Ripple	None	Sand	1726	11.6	Low	305	3.6	Low	460	5.4	High
M08	0.22	C	Riffle-Pool	None	Gravel	2224	11.1	Low	324	3.9	Low	490	5.9	High
M09	0.24	C	Riffle-Pool	None	Cobble	786	9.4	Low	162	2.2	High	938	12.6	N.S.
M10	0.57	C	Riffle-Pool	None	Cobble	2784	22.8	High	381	5.3	N.S.	1029	14.4	Low
M11	0.96	C	Riffle-Pool	None	Cobble	None	----	N.E.	91	1.3	High	477	7.0	Low
M12	0.90	C	Riffle-Pool	None	Cobble	None	----	N.E.	289	4.7	Low	1030	16.6	High
M13	0.68	C	Riffle-Pool	None	Cobble	892	12.1	Low	154	2.6	High	535	9.1	N.S.
M14	0.97	C	Riffle-Pool	None	Cobble	4440	24.6	High	275	5.1	N.S.	1314	24.4	High
M15	1.65	C	Riffle-Pool	None	Cobble	None	----	N.E.	231	6.3	N.S.	902	24.8	High
M16	2.01	B	Step-Pool	b	Cobble	None	----	N.E.			Unk.			Unk.
M17	2.10	B	Step-Pool	b	Cobble	2017	14.6	Low			Unk.			Unk.
T01.01	0.29	C	Dune-Ripple	None	Sand	968	9.3	Low	143	2.1	High	439	6.5	Low
T01.02	0.58	B	Dune-Ripple	c	Sand	None	----	N.E.			Unk.			Unk.
T01.03	0.07	E	Dune-Ripple	None	Sand	1447	6.4	Low	301	4.6	Low	407	6.3	Low
T01.04	0.19	E	Riffle-Pool	None	Sand	872	5.6	Low	202	3.4	Low	311	5.3	High
T01.05	0.00	C	Riffle-Pool	None	Sand	None	----	N.E.	44	0.9	High	573	12.0	N.S.
T01.06	0.14	E	Dune-Ripple	None	Sand	None	----	N.E.	171	3.8	Low	388	8.5	N.S.
T01.07	0.26	E	Riffle-Pool	None	Sand	None	----	N.E.	79	1.8	High	253	5.8	High
T01.08	0.93	B	Plane Bed	c	Sand	None	----	N.E.			Unk.			Unk.
T01.09	0.28	E	Dune-Ripple	None	Sand	2239	41.5	High	137	3.3	Low	233	5.7	High
T01.10	0.52	C	Riffle-Pool	None	Gravel	3005	18.3	Low	175	5.0	Low	280	8.0	Low

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Poultney - Hubbardton River

Phase 1 - Step 8. Stream and Watershed Impact Rating

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Reach ID	Stream Type	Bed Material	Stream Type Subclass Slope	Bed Feature	Confinement Type	Watershed Area	Step Number with Impact Score | 0 = Not Significant or No Data | 1 = Low | 2 = High | 4.1	4.2	4.3	5.1	5.2	5.3	5.4	5.5	6.1	6.2	6.3	6.4	6.5	6.6	7.2	7.3	To Sc
M01	C	Sand	None	Dune-Ripple	VB	262.4	0	0	0	0	1	0	1	0	0	0	1	0	0	0	1	0	
M02	C	Not Evaluated	None	Dune-Ripple	NW	236.8	0	0	0	0	1	0	2	0	2	0	1	0	2	0	1	1	
M03	C	Sand	None	Riffle-Pool	NW	190.4	0	0	1	0	0	0	2	0	0	0	2	0	2	1	2	1	
M04	B	Gravel	c	Riffle-Pool	SC	189.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
M05	B	Cobble	c	Riffle-Pool	SC	187.6	0	0	0	2	1	0	0	0	0	0	1	0	0	0	1	0	
M06	C	Gravel	None	Riffle-Pool	NW	75.5	0	0	1	0	1	0	1	0	0	1	0	0	1	0	2	0	
M07	E	Sand	None	Dune-Ripple	VB	71.2	0	0	1	0	1	0	1	2	0	1	1	2	1	2	1	1	
M08	C	Gravel	None	Riffle-Pool	VB	65.9	0	0	0	0	0	0	1	2	1	1	1	2	1	2	1	1	
M09	C	Cobble	None	Riffle-Pool	VB	53.6	0	0	0	0	1	0	1	2	0	1	2	2	2	0	1	1	
M10	C	Cobble	None	Riffle-Pool	VB	49.1	1	2	0	0	1	0	2	2	0	0	2	2	0	1	1	1	
M11	C	Cobble	None	Riffle-Pool	BD	44.5	1	2	0	0	1	0	0	0	2	1	0	0	2	1	1	1	
M12	C	Cobble	None	Riffle-Pool	BD	37.3	1	2	1	0	0	0	0	0	1	0	0	0	1	2	1	1	
M13	C	Cobble	None	Riffle-Pool	VB	33.3	1	2	1	0	1	0	1	0	2	0	2	0	2	0	1	1	
M14	C	Cobble	None	Riffle-Pool	VB	28.1	1	2	1	0	1	0	2	2	1	0	2	0	0	2	2	1	
M15	C	Cobble	None	Riffle-Pool	VB	12.8	1	1	1	0	1	0	0	2	0	0	2	0	0	2	1	1	
M16	B	Cobble	b	Step-Pool	VB	7.2	1	2	1	0	0	0	0	0	1	0	1	0	0	0	1	1	
M17	B	Cobble	b	Step-Pool	BD	4.5	1	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	
T01.01	C	Sand	None	Dune-Ripple	BD	44.4	1	2	0	0	0	0	1	0	0	0	1	0	2	1	1	0	
T01.02	B	Sand	c	Dune-Ripple	SC	42.3	1	2	1	0	1	0	0	0	1	0	1	0	0	0	1	1	
T01.03	E	Sand	None	Dune-Ripple	NW	40.6	1	2	0	0	0	0	1	0	0	0	2	0	1	1	1	0	
T01.04	E	Sand	None	Riffle-Pool	BD	33.3	1	2	1	0	1	0	1	1	0	0	1	0	1	2	1	1	
T01.05	C	Sand	None	Riffle-Pool	VB	21.8	1	1	1	2	1	0	0	0	0	0	1	0	2	0	1	1	
T01.06	E	Sand	None	Dune-Ripple	BD	19.9	1	2	2	0	0	0	0	0	0	0	1	0	1	0	1	0	
T01.07	E	Sand	None	Riffle-Pool	VB	18.1	1	2	2	0	0	0	0	0	0	0	1	0	2	2	1	0	
T01.08	B	Sand	c	Plane Bed	NW	16.8	1	2	1	0	0	0	0	0	2	0	0	0	0	0	1	0	
T01.09	E	Sand	None	Dune-Ripple	VB	16.2	1	2	2	0	0	0	2	0	0	0	0	0	1	2	1	1	
T01.10	C	Gravel	None	Riffle-Pool	VB	11.9	1	2	1	0	0	0	1	0	0	0	0	0	1	1	1	1	

Poultney - Hubbardton River

Phase 1 - Step 8. Summary of Categorical Impacts

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

		Stream Type					Step 4	Step 5	Step 6
Reach ID	**Stream or Tributary**	**Stream Type**	**Bed Material**	**Subclass Slope**	**Bedform**	**Total (out of 32)**	**Land Use (out of 6)**	**Instream Modification (out of 10)**	**Floodplain Modification (out of 12)**
M01	Poultney	C	Sand	None	Dune-Ripple	4	0	2	1
M02	Poultney	C	Not Evaluated	None	Dune-Ripple	10	0	3	5
M03	Poultney	C	Sand	None	Riffle-Pool	11	1	2	5
M04	Poultney	B	Gravel	c	Riffle-Pool	1	0	0	0
M05	Poultney	B	Cobble	c	Riffle-Pool	5	0	3	1
M06	Poultney	C	Gravel	None	Riffle-Pool	7	1	2	2
M07	Poultney	E	Sand	None	Dune-Ripple	14	1	4	7
M08	Poultney	C	Gravel	None	Riffle-Pool	13	0	3	8
M09	Poultney	C	Cobble	None	Riffle-Pool	13	0	4	7
M10	Poultney	C	Cobble	None	Riffle-Pool	15	3	5	5
M11	Poultney	C	Cobble	None	Riffle-Pool	12	3	1	6
M12	Poultney	C	Cobble	None	Riffle-Pool	10	4	0	4
M13	Poultney	C	Cobble	None	Riffle-Pool	14	4	2	6
M14	Poultney	C	Cobble	None	Riffle-Pool	17	4	5	5
M15	Poultney	C	Cobble	None	Riffle-Pool	12	3	3	4
M16	Poultney	B	Cobble	b	Step-Pool	8	4	0	2
M17	Poultney	B	Cobble	b	Step-Pool	5	2	1	1
T01.01	Hubbardton	C	Sand	None	Dune-Ripple	9	3	1	4
T01.02	Hubbardton	B	Sand	c	Dune-Ripple	9	4	1	2
T01.03	Hubbardton	E	Sand	None	Dune-Ripple	9	3	1	4
T01.04	Hubbardton	E	Sand	None	Riffle-Pool	13	4	3	4
T01.05	Hubbardton	C	Sand	None	Riffle-Pool	11	3	3	3
T01.06	Hubbardton	E	Sand	None	Dune-Ripple	8	5	0	2
T01.07	Hubbardton	E	Sand	None	Riffle-Pool	11	5	0	5
T01.08	Hubbardton	B	Sand	c	Plane Bed	7	4	0	2
T01.09	Hubbardton	E	Sand	None	Dune-Ripple	12	5	2	3
T01.10	Hubbardton	C	Gravel	None	Riffle-Pool	9	4	1	2
					Total Scores	269	70	52	100
					Percent of Each Impact Category		26.0 %	19.3 %	37.2 %

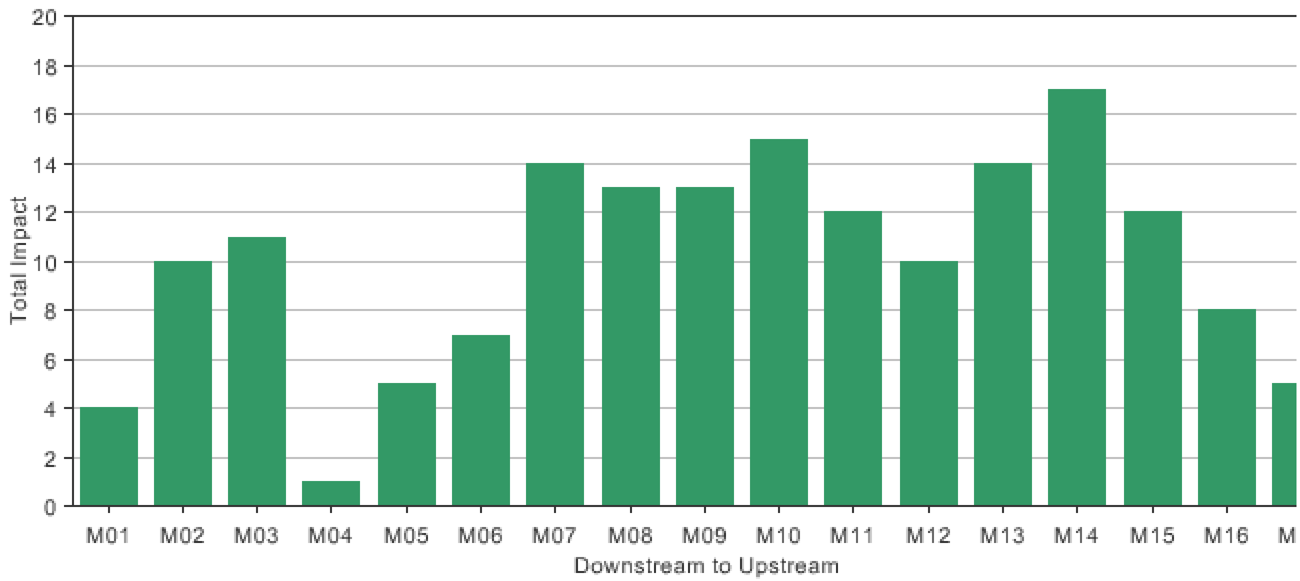
Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Phase1 - Step 8. Downstream to Upstream Impact Scores

Poultney

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**



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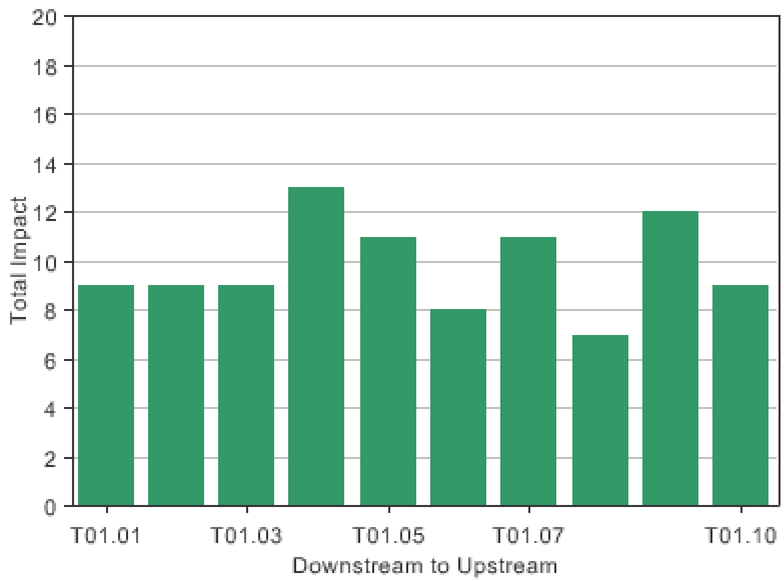
Poultney - Hubbardton River

Phase1 - Step 8. Downstream to Upstream Impact Scores

Hubbardton

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**



Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M01**

Stream Name: **Poultney**

Topo Maps: **Whitehall; Thornhill; Benson**

Step 1. Reach Location

1.1 Reach Description: Flows through Ward Marsh area; Left bank on New York side

1.2 Towns: **West Haven**

1.3 Downstream Latitude: **43.57**

1.3 Downstream Longitude: **-73.40**

Step 2. Stream Type

2.1 Elevation Upstream: **100**

2.1 Elevation Downstream: **95**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(24852) (4.71)**

2.3 Valley Slope (%): **0.02**

2.4 Channel Length (ft.)(mi.): **(31583) (5.98)**

2.5 Channel Slope (%): **0.02**

2.6 Sinuosity: **1.27**

2.7 Watershed Area (sq. mi.): **262.41**

2.8 Channel Width (ft.): **164.9**

2.9 Valley Width (ft.): **2263**

2.10 Confinement Ratio: **13.7**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Extremely Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Wetland**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **26-50**

4.3 Riparian Buffer - Right Bank: **26-50**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.3 (1)**

5.3 Bank Armoring %: **1.8**

5.4 Channel Straightening %: **10.1**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0.7**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Mid-channel**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **1118 (6.8)**

6.6 Wavelength (Ratio): **1625 (9.9)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **None**

7.4 Comments:

Step 8. Impact Rating

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

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M02**

Stream Name: **Poultney**

Topo Maps: **Thornhill; Benson**

Step 1. Reach Location

1.1 Reach Description: Between Coggman Creek and Hubbardton River; Left bank on New York side

1.2 Towns: **West Haven**

1.3 Downstream Latitude: **43.63**

1.3 Downstream Longitude: **-73.37**

Step 2. Stream Type

2.1 Elevation Upstream: **105**

2.1 Elevation Downstream: **100**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(8073) (1.53)**

2.3 Valley Slope (%): **0.06**

2.4 Channel Length (ft.)(mi.): **(9612) (1.82)**

2.5 Channel Slope (%): **0.05**

2.6 Sinuosity: **1.19**

2.7 Watershed Area (sq. mi.): **236.80**

2.8 Channel Width (ft.): **156.7**

2.9 Valley Width (ft.): **797**

2.10 Confinement Ratio: **5.1**

2.10 Confinement Type: **Narrow**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Wetland**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.2 (1)**

5.3 Bank Armoring %: **4.8**

5.4 Channel Straightening %: **33.7**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **60.7**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Mid-channel**

6.4 Meander Migration: **Migration**

6.5 Meander Width (Ratio): **288 (1.8)**

6.6 Wavelength (Ratio): **1486 (9.5)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Not Evaluated**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Medium**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M03**

Stream Name: **Poultney**

Topo Maps: **Benson; Thorn Hill**

Step 1. Reach Location

1.1 Reach Description: Upstream of Hubbardton confluence to valley confinement through old Sod Farm now owned by The N Conservancy; Left bank on New York side

1.2 Towns: **West Haven**

1.3 Downstream Latitude: **43.63**

1.3 Downstream Longitude: **-73.34**

Step 2. Stream Type

2.1 Elevation Upstream: **110**

2.1 Elevation Downstream: **105**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(4976) (0.94)**

2.3 Valley Slope (%): **0.10**

2.4 Channel Length (ft.)(mi.): **(5566) (1.05)**

2.5 Channel Slope (%): **0.09**

2.6 Sinuosity: **1.12**

2.7 Watershed Area (sq. mi.): **190.38**

2.8 Channel Width (ft.): **140.5**

2.9 Valley Width (ft.): **771**

2.10 Confinement Ratio: **5.5**

2.10 Confinement Type: **Narrow**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Very Steep**

3.4 Right Valley Side Slope: **Very Steep**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **26-50**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **41.8**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **314 (2.2)**

6.6 Wavelength (Ratio): **880 (6.3)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **High**

7.2 Bank Height: **High**

7.3 Ice/Debris Jam Potential: **Bend**

7.4 Comments:

Step 8. Impact Rating

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

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M04**

Stream Name: **Poultney**

Topo Maps: **Benson; Thorn Hill**

Step 1. Reach Location

1.1 Reach Description: Below Carver Falls Dam; Left bank on New York side; Floodplain is wide enough in most locations to cl as a C stream but valley is confined between lake terrace on both sides

1.2 Towns: **West Haven**

1.3 Downstream Latitude: **43.63**

1.3 Downstream Longitude: **-73.33**

Step 2. Stream Type

2.1 Elevation Upstream: **120**

2.1 Elevation Downstream: **110**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(6824) (1.29)**

2.3 Valley Slope (%): **0.15**

2.4 Channel Length (ft.)(mi.): **(7903) (1.50)**

2.5 Channel Slope (%): **0.13**

2.6 Sinuosity: **1.16**

2.7 Watershed Area (sq. mi.): **189.86**

2.8 Channel Width (ft.): **140.3**

2.9 Valley Width (ft.): **334**

2.10 Confinement Ratio: **2.4**

2.10 Confinement Type: **Semi-confined**

2.11 Reference Stream Type: **B**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Multiple**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Very Steep**

3.4 Right Valley Side Slope: **Very Steep**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Forest**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **( )**

6.6 Wavelength (Ratio): **( )**

Step 7. Windshield Survey

7.1 Reference Stream Type: **B**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **c**

7.1 Bed Material: **Gravel**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **High**

7.3 Ice/Debris Jam Potential: **None**

7.4 Comments:

Step 8. Impact Rating

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

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M05**

Stream Name: **Poultney**

Topo Maps: **Benson; Thorn Hill**

Step 1. Reach Location

1.1 Reach Description: Upstream of Carver Falls Dam to Castleton river confluence; Left bank on New York side; channel natu incised through glacial lake clay deposits

1.2 Towns: **Fair Haven, West Haven**

1.3 Downstream Latitude: **43.63**

1.3 Downstream Longitude: **-73.31**

Step 2. Stream Type

2.1 Elevation Upstream: **290**

2.1 Elevation Downstream: **220**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(6722) (1.27)**

2.3 Valley Slope (%): **1.04**

2.4 Channel Length (ft.)(mi.): **(16965) (3.21)**

2.5 Channel Slope (%): **0.41**

2.6 Sinuosity: **2.52**

2.7 Watershed Area (sq. mi.): **187.64**

2.8 Channel Width (ft.): **139.4**

2.9 Valley Width (ft.): **353**

2.10 Confinement Ratio: **2.5**

2.10 Confinement Type: **Semi-confined**

2.11 Reference Stream Type: **B**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Forest**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **Impoundment**

5.2 Bridges and Culverts % (Number): **0.1 (1)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **1.3**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **( )**

6.6 Wavelength (Ratio): **( )**

Step 7. Windshield Survey

7.1 Reference Stream Type: **B**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **c**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M06**

Stream Name: **Poultney**

Topo Maps: **Thorn Hill**

Step 1. Reach Location

1.1 Reach Description: Upstream of Castleton River to Cedar Swamp; Left bank on New York side; lower portion far more conf than reflected in confinement type in Step 2.10

1.2 Towns: **Fair Haven**

1.3 Downstream Latitude: **43.59**

1.3 Downstream Longitude: **-73.29**

Step 2. Stream Type

2.1 Elevation Upstream: **330**

2.1 Elevation Downstream: **290**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(7469) (1.41)**

2.3 Valley Slope (%): **0.54**

2.4 Channel Length (ft.)(mi.): **(11847) (2.24)**

2.5 Channel Slope (%): **0.34**

2.6 Sinuosity: **1.59**

2.7 Watershed Area (sq. mi.): **75.50**

2.8 Channel Width (ft.): **88.5**

2.9 Valley Width (ft.): **401**

2.10 Confinement Ratio: **4.5**

2.10 Confinement Type: **Narrow**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Flat**

3.4 Right Valley Side Slope: **Flat**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **0-25**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.5 (2)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **19.8**

5.5 Dredging History **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **1.8**

6.2 Floodplain Development %: **5.2**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **432 (4.9)**

6.6 Wavelength (Ratio): **804 (9.1)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Gravel**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **High**

7.3 Ice/Debris Jam Potential: **Not Evaluated**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M07**

Stream Name: **Poultney**

Topo Maps: **Thorn Hill**

Step 1. Reach Location

1.1 Reach Description: Crosses Route 22A; Left bank on New York side; abundant abandoned meanders present and most dy channel change of all reaches

1.2 Towns: **Fair Haven**

1.3 Downstream Latitude: **43.58**

1.3 Downstream Longitude: **-73.28**

Step 2. Stream Type

2.1 Elevation Upstream: **335**

2.1 Elevation Downstream: **330**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(12710) (2.41)**

2.3 Valley Slope (%): **0.04**

2.4 Channel Length (ft.)(mi.): **(14939) (2.83)**

2.5 Channel Slope (%): **0.03**

2.6 Sinuosity: **1.18**

2.7 Watershed Area (sq. mi.): **71.18**

2.8 Channel Width (ft.): **85.9**

2.9 Valley Width (ft.): **1993**

2.10 Confinement Ratio: **23.2**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **E**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Flat**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **51-100**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.4 (2)**

5.3 Bank Armoring %: **2.2**

5.4 Channel Straightening %: **11.6**

5.5 Dredging History **Dredging**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **4.3**

6.2 Floodplain Development %: **11.1**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **Migration**

6.5 Meander Width (Ratio): **305 (3.6)**

6.6 Wavelength (Ratio): **460 (5.4)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **E**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M08**

Stream Name: **Poultney**

Topo Maps: **Thorn Hill; Poultney**

Step 1. Reach Location

1.1 Reach Description: Upstream end at Hampton, NY ; Left bank on New York side; Right bank frequently impinges on high b glacial deposits

1.2 Towns: **Fair Haven, Poultney**

1.3 Downstream Latitude: **43.56**

1.3 Downstream Longitude: **-73.26**

Step 2. Stream Type

2.1 Elevation Upstream: **380**

2.1 Elevation Downstream: **335**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(14162) (2.68)**

2.3 Valley Slope (%): **0.32**

2.4 Channel Length (ft.)(mi.): **(20020) (3.79)**

2.5 Channel Slope (%): **0.22**

2.6 Sinuosity: **1.41**

2.7 Watershed Area (sq. mi.): **65.88**

2.8 Channel Width (ft.): **82.6**

2.9 Valley Width (ft.): **1611**

2.10 Confinement Ratio: **19.5**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **51-100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **1.5**

5.4 Channel Straightening %: **11.1**

5.5 Dredging History **Dredging**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **6.2**

6.2 Floodplain Development %: **8.3**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **Migration**

6.5 Meander Width (Ratio): **324 (3.9)**

6.6 Wavelength (Ratio): **490 (5.9)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Gravel**

7.2 Bank Erosion: **High**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bend**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M09**

Stream Name: **Poultney**

Topo Maps: **Thorn Hill; Poultney**

Step 1. Reach Location

1.1 Reach Description: Green Mountain College land on right bank for portion of reach; Left bank on New York side; avulsions, bars present, and well developed side channel habitat

1.2 Towns: **Poultney**

1.3 Downstream Latitude: **43.53**

1.3 Downstream Longitude: **-73.25**

Step 2. Stream Type

2.1 Elevation Upstream: **400**

2.1 Elevation Downstream: **380**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(5374) (1.02)**

2.3 Valley Slope (%): **0.37**

2.4 Channel Length (ft.)(mi.): **(8406) (1.59)**

2.5 Channel Slope (%): **0.24**

2.6 Sinuosity: **1.56**

2.7 Watershed Area (sq. mi.): **53.58**

2.8 Channel Width (ft.): **74.5**

2.9 Valley Width (ft.): **3967**

2.10 Confinement Ratio: **53.2**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **( )**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **( )**

3.5 Soils - Flooding (%): **( )**

3.5 Soils - Water Table Deep (%): **( )**

3.5 Soils - Water Table Shallow (%): **( )**

3.5 Soils - Erodibility (%): **( )**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **( )**

4.1 Current Watershed Sub-Dominant Land Cover: **---**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **( )**

4.2 Current Corridor Sub-Dominant Land Cover: **---**

4.3 Riparian Buffer - Left Bank: **26-50**

4.3 Riparian Buffer - Right Bank: **26-50**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.7 (2)**

5.3 Bank Armoring %: **2.6**

5.4 Channel Straightening %: **9.4**

5.5 Dredging History **Dredging**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **3.3**

6.2 Floodplain Development %: **14.8**

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **Migration**

6.5 Meander Width (Ratio): **162 (2.2)**

6.6 Wavelength (Ratio): **938 (12.6)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M10**

Stream Name: **Poultney**

Topo Maps: **Poultney**

Step 1. Reach Location

1.1 Reach Description: Upstream end in East Poultney; first, or most downstream, reach entirely in Vermont; well developed te on both sides of channel confine channel more than reflected in Step 2.10

1.2 Towns: **Poultney**

1.3 Downstream Latitude: **43.51**

1.3 Downstream Longitude: **-73.24**

Step 2. Stream Type

2.1 Elevation Upstream: **470**

2.1 Elevation Downstream: **400**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(11662) (2.21)**

2.3 Valley Slope (%): **0.60**

2.4 Channel Length (ft.)(mi.): **(12234) (2.32)**

2.5 Channel Slope (%): **0.57**

2.6 Sinuosity: **1.05**

2.7 Watershed Area (sq. mi.): **49.08**

2.8 Channel Width (ft.): **71.3**

2.9 Valley Width (ft.): **3116**

2.10 Confinement Ratio: **43.7**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **Yes**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Alluvial (58.1)**

3.3 Sub-dominant Geologic Material: **Ice-Contact**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **B (61.6)**

3.5 Soils - Flooding (%): **Occasional (51.1)**

3.5 Soils - Water Table Deep (%): **2.0 (50.8)**

3.5 Soils - Water Table Shallow (%): **1.5 (58.5)**

3.5 Soils - Erodibility (%): **Slight (8.2)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (76.8)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (26.1)**

4.2 Current Corridor Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer - Left Bank: **51-100**

4.3 Riparian Buffer - Right Bank: **51-100**

4.4 Ground Water Inputs:

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **1.4 (3)**

5.3 Bank Armoring %: **1.8**

5.4 Channel Straightening %: **22.8**

5.5 Dredging History **Dredging**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **2.4**

6.2 Floodplain Development %:

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **Migration**

6.5 Meander Width (Ratio): **381 (5.3)**

6.6 Wavelength (Ratio): **1029 (14.4)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bridge**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M11**

Stream Name: **Poultney**

Topo Maps: **Poultney; Wells**

Step 1. Reach Location

1.1 Reach Description: Downstream end at falls in East Poultney; Bedrock segments at lower end produce deep pools and a fa local swimming hole

1.2 Towns: **Poultney**

1.3 Downstream Latitude: **43.52**

1.3 Downstream Longitude: **-73.21**

Step 2. Stream Type

2.1 Elevation Upstream: **520**

2.1 Elevation Downstream: **480**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(3388) (0.64)**

2.3 Valley Slope (%): **1.18**

2.4 Channel Length (ft.)(mi.): **(4161) (0.79)**

2.5 Channel Slope (%): **0.96**

2.6 Sinuosity: **1.23**

2.7 Watershed Area (sq. mi.): **44.55**

2.8 Channel Width (ft.): **67.9**

2.9 Valley Width (ft.): **500**

2.10 Confinement Ratio: **7.4**

2.10 Confinement Type: **Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Till (49.5)**

3.3 Sub-dominant Geologic Material: **Ice-Contact**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **A (42.5)**

3.5 Soils - Flooding (%): **None/Rare (92.0)**

3.5 Soils - Water Table Deep (%): **6.0 (92.0)**

3.5 Soils - Water Table Shallow (%): **6.0 (92.0)**

3.5 Soils - Erodibility (%): **Severe (52.7)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (78.9)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Urban (36.1)**

4.2 Current Corridor Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.5 (1)**

5.3 Bank Armoring %: **6.2**

5.4 Channel Straightening %: **0**

5.5 Dredging History **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **43.9**

6.2 Floodplain Development %: **10.8**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **91 (1.3)**

6.6 Wavelength (Ratio): **477 (7.0)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bridge**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M12**

Stream Name: **Poultney**

Topo Maps: **Poultney; Wells**

Step 1. Reach Location

1.1 Reach Description: Between Finel Hollow and Hampshire Hollow

1.2 Towns: **Poultney**

1.3 Downstream Latitude: **43.53**

1.3 Downstream Longitude: **-73.19**

Step 2. Stream Type

2.1 Elevation Upstream: **560**

2.1 Elevation Downstream: **520**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(4086) (0.77)**

2.3 Valley Slope (%): **0.98**

2.4 Channel Length (ft.)(mi.): **(4459) (0.84)**

2.5 Channel Slope (%): **0.90**

2.6 Sinuosity: **1.09**

2.7 Watershed Area (sq. mi.): **37.27**

2.8 Channel Width (ft.): **62.1**

2.9 Valley Width (ft.): **517**

2.10 Confinement Ratio: **8.3**

2.10 Confinement Type: **Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Alluvial (47.4)**

3.3 Sub-dominant Geologic Material: **Till**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **B (52.1)**

3.5 Soils - Flooding (%): **None/Rare (50.1)**

3.5 Soils - Water Table Deep (%): **5.0 (30.0)**

3.5 Soils - Water Table Shallow (%): **1.5 (39.7)**

3.5 Soils - Erodibility (%): **Moderate (36.0)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (78.5)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (28.3)**

4.2 Current Corridor Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **(1)**

5.3 Bank Armoring %: **5.0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **19.4**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **289 (4.7)**

6.6 Wavelength (Ratio): **1030 (16.6)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Shallow**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M13**

Stream Name: **Poultney**

Topo Maps: **Wells**

Step 1. Reach Location

1.1 Reach Description: Between Hampshire Hollow and Morse Hollow

1.2 Towns: **Middletown Springs, Poultney**

1.3 Downstream Latitude: **43.52**

1.3 Downstream Longitude: **-73.18**

Step 2. Stream Type

2.1 Elevation Upstream: **610**

2.1 Elevation Downstream: **560**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(6664) (1.26)**

2.3 Valley Slope (%): **0.75**

2.4 Channel Length (ft.)(mi.): **(7379) (1.40)**

2.5 Channel Slope (%): **0.68**

2.6 Sinuosity: **1.11**

2.7 Watershed Area (sq. mi.): **33.28**

2.8 Channel Width (ft.): **58.7**

2.9 Valley Width (ft.): **1128**

2.10 Confinement Ratio: **19.2**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Other (30.0)**

3.3 Sub-dominant Geologic Material: **Ice-Contact**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **Not Rated (30.0)**

3.5 Soils - Flooding (%): **None/Rare (52.9)**

3.5 Soils - Water Table Deep (%): **6.0 (24.5)**

3.5 Soils - Water Table Shallow (%): **1.5 (32.6)**

3.5 Soils - Erodibility (%): **Moderate (31.3)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (78.6)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (44.4)**

4.2 Current Corridor Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs:

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.3 (1)**

5.3 Bank Armoring %: **3.3**

5.4 Channel Straightening %: **12.1**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **42.6**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **154 (2.6)**

6.6 Wavelength (Ratio): **535 (9.1)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M14**

Stream Name: **Poultney**

Topo Maps: **Wells; Middletown Springs**

Step 1. Reach Location

1.1 Reach Description: Between Morse Hollow and South Brook; High eroding bank near downstream end combined with conf of Morse Brook has led to development of large midchannel bars that are occasionally scalped for gravel

1.2 Towns: **Middletown Springs, Poultney**

1.3 Downstream Latitude: **43.50**

1.3 Downstream Longitude: **-73.17**

Step 2. Stream Type

2.1 Elevation Upstream: **785**

2.1 Elevation Downstream: **610**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(17698) (3.35)**

2.3 Valley Slope (%): **0.99**

2.4 Channel Length (ft.)(mi.): **(18033) (3.42)**

2.5 Channel Slope (%): **0.97**

2.6 Sinuosity: **1.02**

2.7 Watershed Area (sq. mi.): **28.07**

2.8 Channel Width (ft.): **53.9**

2.9 Valley Width (ft.): **668**

2.10 Confinement Ratio: **12.4**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Ice-Contact (45.4)**

3.3 Sub-dominant Geologic Material: **Alluvial**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **A (39.0)**

3.5 Soils - Flooding (%): **None/Rare (64.7)**

3.5 Soils - Water Table Deep (%): **6.0 (53.5)**

3.5 Soils - Water Table Shallow (%): **6.0 (53.5)**

3.5 Soils - Erodibility (%): **Moderate (43.8)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (78.1)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (26.2)**

4.2 Current Corridor Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **0-25**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.3 (2)**

5.3 Bank Armoring %: **1.9**

5.4 Channel Straightening %: **24.6**

5.5 Dredging History **Gravel Mining**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **11.2**

6.2 Floodplain Development %:

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **275 (5.1)**

6.6 Wavelength (Ratio): **1314 (24.4)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **High**

7.3 Ice/Debris Jam Potential: **Bridge**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M15**

Stream Name: **Poultney**

Topo Maps: **Middletown Springs**

Step 1. Reach Location

1.1 Reach Description: Flows through town of Middletown Springs; Wide valley with low river terrace on edge of left bank flood

1.2 Towns: **Middletown Springs**

1.3 Downstream Latitude: **43.48**

1.3 Downstream Longitude: **-73.13**

Step 2. Stream Type

2.1 Elevation Upstream: **965**

2.1 Elevation Downstream: **785**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(9481) (1.80)**

2.3 Valley Slope (%): **1.90**

2.4 Channel Length (ft.)(mi.): **(10904) (2.07)**

2.5 Channel Slope (%): **1.65**

2.6 Sinuosity: **1.15**

2.7 Watershed Area (sq. mi.): **12.78**

2.8 Channel Width (ft.): **36.4**

2.9 Valley Width (ft.): **1069**

2.10 Confinement Ratio: **29.4**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Ice-Contact (56.7)**

3.3 Sub-dominant Geologic Material: **Alluvial**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **A (56.7)**

3.5 Soils - Flooding (%): **None/Rare (62.8)**

3.5 Soils - Water Table Deep (%): **6.0 (59.7)**

3.5 Soils - Water Table Shallow (%): **6.0 (59.7)**

3.5 Soils - Erodibility (%): **Moderate (46.2)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (78.6)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (36.1)**

4.2 Current Corridor Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Abundant**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.4 (2)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Dredging**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **4.8**

6.2 Floodplain Development %: **4.1**

6.3 Channel Bars: **Mid-channel**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **231 (6.3)**

6.6 Wavelength (Ratio): **902 (24.8)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bridge**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M16**

Stream Name: **Poultney**

Topo Maps: **Middletown Springs**

Step 1. Reach Location

1.1 Reach Description: Upstream of Middletown Springs to Junction of 133 and 140

1.2 Towns: **Middletown Springs, Tinmouth**

1.3 Downstream Latitude: **43.49**

1.3 Downstream Longitude: **-73.10**

Step 2. Stream Type

2.1 Elevation Upstream: **1110**

2.1 Elevation Downstream: **965**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(6633) (1.26)**

2.3 Valley Slope (%): **2.19**

2.4 Channel Length (ft.)(mi.): **(7205) (1.36)**

2.5 Channel Slope (%): **2.01**

2.6 Sinuosity: **1.09**

2.7 Watershed Area (sq. mi.): **7.24**

2.8 Channel Width (ft.): **27.4**

2.9 Valley Width (ft.): **404**

2.10 Confinement Ratio: **14.7**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **B**

2.12 Bedform: **Step-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Ice-Contact (55.0)**

3.3 Sub-dominant Geologic Material: **Till**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **A (53.4)**

3.5 Soils - Flooding (%): **None/Rare (93.6)**

3.5 Soils - Water Table Deep (%): **6.0 (74.7)**

3.5 Soils - Water Table Shallow (%): **6.0 (74.7)**

3.5 Soils - Erodibility (%): **Very Severe (91.9)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (83.8)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (49.3)**

4.2 Current Corridor Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **6.4**

6.2 Floodplain Development %: **3.1**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **( )**

6.6 Wavelength (Ratio): **( )**

Step 7. Windshield Survey

7.1 Reference Stream Type: **B**

7.1 Dominant Bed Form: **Step-Pool**

7.1 Sub-class Slope: **b**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bend**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **M17**

Stream Name: **Poultney**

Topo Maps: **Middletown Springs**

Step 1. Reach Location

1.1 Reach Description: Steep headwaters area east of Spoon Mountain

1.2 Towns: **Middletown Springs, Tinmouth**

1.3 Downstream Latitude: **43.48**

1.3 Downstream Longitude: **-73.08**

Step 2. Stream Type

2.1 Elevation Upstream: **1400**

2.1 Elevation Downstream: **1110**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(10084) (1.91)**

2.3 Valley Slope (%): **2.88**

2.4 Channel Length (ft.)(mi.): **(13786) (2.61)**

2.5 Channel Slope (%): **2.10**

2.6 Sinuosity: **1.37**

2.7 Watershed Area (sq. mi.): **4.53**

2.8 Channel Width (ft.): **21.7**

2.9 Valley Width (ft.): **136**

2.10 Confinement Ratio: **6.3**

2.10 Confinement Type: **Broad**

2.11 Reference Stream Type: **B**

2.12 Bedform: **Step-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Ledge**

3.3 Dominant Geologic Material (%): **Ice-Contact (66.0)**

3.3 Sub-dominant Geologic Material: **Till**

3.4 Left Valley Side Slope: **Extremely Steep**

3.4 Right Valley Side Slope: **Very Steep**

3.5 Soils - Hydrologic Group (%): **A (46.9)**

3.5 Soils - Flooding (%): **None/Rare (99.5)**

3.5 Soils - Water Table Deep (%): **6.0 (46.9)**

3.5 Soils - Water Table Shallow (%): **1.5 (53.1)**

3.5 Soils - Erodibility (%): **Severe (73.7)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (82.4)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (43.8)**

4.2 Current Corridor Sub-Dominant Land Cover: **Urban**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **(4)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **14.6**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **10.7**

6.2 Floodplain Development %: **4.2**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **( )**

6.6 Wavelength (Ratio): **( )**

Step 7. Windshield Survey

7.1 Reference Stream Type: **B**

7.1 Dominant Bed Form: **Step-Pool**

7.1 Sub-class Slope: **b**

7.1 Bed Material: **Cobble**

7.2 Bank Erosion: **None**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.01**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Downstream end at confluence with Poultney; Floodplain confined within glacial lake terrace; Large slu present where river impinges against terrace

1.2 Towns: **West Haven**

1.3 Downstream Latitude: **43.63**

1.3 Downstream Longitude: **-73.34**

Step 2. Stream Type

2.1 Elevation Upstream: **140**

2.1 Elevation Downstream: **110**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(8513) (1.61)**

2.3 Valley Slope (%): **0.35**

2.4 Channel Length (ft.)(mi.): **(10419) (1.97)**

2.5 Channel Slope (%): **0.29**

2.6 Sinuosity: **1.22**

2.7 Watershed Area (sq. mi.): **44.38**

2.8 Channel Width (ft.): **67.8**

2.9 Valley Width (ft.): **539**

2.10 Confinement Ratio: **7.9**

2.10 Confinement Type: **Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (52.5)**

3.3 Sub-dominant Geologic Material: **Alluvial**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **D (52.5)**

3.5 Soils - Flooding (%): **None/Rare (53.0)**

3.5 Soils - Water Table Deep (%): **2.0 (46.6)**

3.5 Soils - Water Table Shallow (%): **0.5 (37.4)**

3.5 Soils - Erodibility (%): **Moderate (31.2)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (60.4)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (43.0)**

4.2 Current Corridor Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **9.3**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **143 (2.1)**

6.6 Wavelength (Ratio): **439 (6.5)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **High**

7.3 Ice/Debris Jam Potential: **None**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.02**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: West Haven Road crosses channel about half way along the reach; Reach is more narrowly confined w lake terrace

1.2 Towns: **West Haven**

1.3 Downstream Latitude: **43.64**

1.3 Downstream Longitude: **-73.32**

Step 2. Stream Type

2.1 Elevation Upstream: **175**

2.1 Elevation Downstream: **140**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(4900) (0.93)**

2.3 Valley Slope (%): **0.71**

2.4 Channel Length (ft.)(mi.): **(6080) (1.15)**

2.5 Channel Slope (%): **0.58**

2.6 Sinuosity: **1.24**

2.7 Watershed Area (sq. mi.): **42.31**

2.8 Channel Width (ft.): **66.2**

2.9 Valley Width (ft.): **235**

2.10 Confinement Ratio: **3.5**

2.10 Confinement Type: **Semi-confined**

2.11 Reference Stream Type: **B**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (87.4)**

3.3 Sub-dominant Geologic Material: **Ice-Contact**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (89.7)**

3.5 Soils - Flooding (%): **None/Rare (100.0)**

3.5 Soils - Water Table Deep (%): **3.0 (64.8)**

3.5 Soils - Water Table Shallow (%): **1.0 (64.8)**

3.5 Soils - Erodibility (%): **Very Severe (78.7)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (60.4)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (25.4)**

4.2 Current Corridor Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.5 (1)**

5.3 Bank Armoring %: **3.3**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **8.7**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **( )**

6.6 Wavelength (Ratio): **( )**

Step 7. Windshield Survey

7.1 Reference Stream Type: **B**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **c**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bridge**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.03**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Upstream end is just downstream of Route 22A; Confined within lake terrace with some floodplain form

1.2 Towns: **Benson, West Haven**

1.3 Downstream Latitude: **43.65**

1.3 Downstream Longitude: **-73.31**

Step 2. Stream Type

2.1 Elevation Upstream: **190**

2.1 Elevation Downstream: **175**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(10893) (2.06)**

2.3 Valley Slope (%): **0.14**

2.4 Channel Length (ft.)(mi.): **(22769) (4.31)**

2.5 Channel Slope (%): **0.07**

2.6 Sinuosity: **2.09**

2.7 Watershed Area (sq. mi.): **40.62**

2.8 Channel Width (ft.): **64.9**

2.9 Valley Width (ft.): **299**

2.10 Confinement Ratio: **4.6**

2.10 Confinement Type: **Narrow**

2.11 Reference Stream Type: **E**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (99.7)**

3.3 Sub-dominant Geologic Material: **Till**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (100.0)**

3.5 Soils - Flooding (%): **None/Rare (100.0)**

3.5 Soils - Water Table Deep (%): **1.5 (47.8)**

3.5 Soils - Water Table Shallow (%): **0.5 (47.8)**

3.5 Soils - Erodibility (%): **Moderate (49.7)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (60.6)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (43.8)**

4.2 Current Corridor Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs:

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **6.4**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **301 (4.6)**

6.6 Wavelength (Ratio): **407 (6.3)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **E**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **High**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bend**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.04**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Mostly upstream of Route 22A; Floodplain confined within lake terrace despite broad valley

1.2 Towns: **Benson**

1.3 Downstream Latitude: **43.68**

1.3 Downstream Longitude: **-73.29**

Step 2. Stream Type

2.1 Elevation Upstream: **220**

2.1 Elevation Downstream: **190**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(8940) (1.69)**

2.3 Valley Slope (%): **0.34**

2.4 Channel Length (ft.)(mi.): **(15473) (2.93)**

2.5 Channel Slope (%): **0.19**

2.6 Sinuosity: **1.73**

2.7 Watershed Area (sq. mi.): **33.30**

2.8 Channel Width (ft.): **58.7**

2.9 Valley Width (ft.): **369**

2.10 Confinement Ratio: **6.3**

2.10 Confinement Type: **Broad**

2.11 Reference Stream Type: **E**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (87.3)**

3.3 Sub-dominant Geologic Material: **Alluvial**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (87.3)**

3.5 Soils - Flooding (%): **None/Rare (87.3)**

3.5 Soils - Water Table Deep (%): **1.0 (48.2)**

3.5 Soils - Water Table Shallow (%): **0.0 (60.9)**

3.5 Soils - Erodibility (%): **Slight (19.6)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (63.7)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (30.3)**

4.2 Current Corridor Sub-Dominant Land Cover: **Field**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **3.6 (2)**

5.3 Bank Armoring %: **4.0**

5.4 Channel Straightening %: **5.6**

5.5 Dredging History **Dredging**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **1.6**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **202 (3.4)**

6.6 Wavelength (Ratio): **311 (5.3)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **E**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **High**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Multiple**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.05**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Mill Pond; almost entire reach is still water area behind Mill Pond Dam

1.2 Towns: **Benson**

1.3 Downstream Latitude: **43.70**

1.3 Downstream Longitude: **-73.28**

Step 2. Stream Type

2.1 Elevation Upstream: **220**

2.1 Elevation Downstream: **220**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(4786) (0.91)**

2.3 Valley Slope (%): **0.00**

2.4 Channel Length (ft.)(mi.): **(5881) (1.11)**

2.5 Channel Slope (%): **0.00**

2.6 Sinuosity: **1.23**

2.7 Watershed Area (sq. mi.): **21.83**

2.8 Channel Width (ft.): **47.6**

2.9 Valley Width (ft.): **1045**

2.10 Confinement Ratio: **22.0**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **C**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **Dam**

3.3 Dominant Geologic Material (%): **Glacial Lake (78.4)**

3.3 Sub-dominant Geologic Material: **Till**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (98.6)**

3.5 Soils - Flooding (%): **None/Rare (98.6)**

3.5 Soils - Water Table Deep (%): **1.5 (62.7)**

3.5 Soils - Water Table Shallow (%): **0.5 (61.3)**

3.5 Soils - Erodibility (%): **Very Severe (90.4)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (63.0)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Wetland**

4.2 Current Corridor Dominant Land Cover: **Field (9.4)**

4.2 Current Corridor Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **26-50**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **Impoundment**

5.2 Bridges and Culverts % (Number): **0.7 (2)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **None**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **44 (0.9)**

6.6 Wavelength (Ratio): **573 (12.0)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bridge**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.06**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Upstream of Mill Pond; includes marshy areas with abundant abandoned meanders present

1.2 Towns: **Benson**

1.3 Downstream Latitude: **43.71**

1.3 Downstream Longitude: **-73.29**

Step 2. Stream Type

2.1 Elevation Upstream: **235**

2.1 Elevation Downstream: **225**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(4812) (0.91)**

2.3 Valley Slope (%): **0.21**

2.4 Channel Length (ft.)(mi.): **(6981) (1.32)**

2.5 Channel Slope (%): **0.14**

2.6 Sinuosity: **1.45**

2.7 Watershed Area (sq. mi.): **19.94**

2.8 Channel Width (ft.): **45.5**

2.9 Valley Width (ft.): **380**

2.10 Confinement Ratio: **8.4**

2.10 Confinement Type: **Broad**

2.11 Reference Stream Type: **E**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (100.0)**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (100.0)**

3.5 Soils - Flooding (%): **None/Rare (85.3)**

3.5 Soils - Water Table Deep (%): **1.5 (52.5)**

3.5 Soils - Water Table Shallow (%): **0.5 (52.5)**

3.5 Soils - Erodibility (%): **Moderate (44.1)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (66.4)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Crop (15.8)**

4.2 Current Corridor Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **0-25**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **(1)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Multiple**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **171 (3.8)**

6.6 Wavelength (Ratio): **388 (8.5)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **E**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **None**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.07**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Parallels Sunset Lake Road; Confined within narrowed valley

1.2 Towns: **Benson**

1.3 Downstream Latitude: **43.72**

1.3 Downstream Longitude: **-73.29**

Step 2. Stream Type

2.1 Elevation Upstream: **250**

2.1 Elevation Downstream: **235**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(5072) (0.96)**

2.3 Valley Slope (%): **0.30**

2.4 Channel Length (ft.)(mi.): **(5832) (1.10)**

2.5 Channel Slope (%): **0.26**

2.6 Sinuosity: **1.15**

2.7 Watershed Area (sq. mi.): **18.07**

2.8 Channel Width (ft.): **43.3**

2.9 Valley Width (ft.): **534**

2.10 Confinement Ratio: **12.3**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **E**

2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (64.2)**

3.3 Sub-dominant Geologic Material: **Alluvial**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (64.2)**

3.5 Soils - Flooding (%): **None/Rare (64.2)**

3.5 Soils - Water Table Deep (%): **1.5 (82.1)**

3.5 Soils - Water Table Shallow (%): **0.5 (46.3)**

3.5 Soils - Erodibility (%): **Moderate (48.0)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (67.9)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Field (25.9)**

4.2 Current Corridor Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **0-25**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **Point**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **79 (1.8)**

6.6 Wavelength (Ratio): **253 (5.8)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **E**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **High**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **None**

7.4 Comments:

Step 8. Impact Rating

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

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Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.08**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Confined within glacial lake terrace on either side of valley

1.2 Towns: **Benson**

1.3 Downstream Latitude: **43.73**

1.3 Downstream Longitude: **-73.28**

Step 2. Stream Type

2.1 Elevation Upstream: **280**

2.1 Elevation Downstream: **250**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(3095) (0.59)**

2.3 Valley Slope (%): **0.97**

2.4 Channel Length (ft.)(mi.): **(3219) (0.61)**

2.5 Channel Slope (%): **0.93**

2.6 Sinuosity: **1.04**

2.7 Watershed Area (sq. mi.): **16.82**

2.8 Channel Width (ft.): **41.8**

2.9 Valley Width (ft.): **220**

2.10 Confinement Ratio: **5.3**

2.10 Confinement Type: **Narrow**

2.11 Reference Stream Type: **B**

2.12 Bedform: **Plane Bed**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (82.0)**

3.3 Sub-dominant Geologic Material: **Alluvial**

3.4 Left Valley Side Slope: **Steep**

3.4 Right Valley Side Slope: **Steep**

3.5 Soils - Hydrologic Group (%): **D (85.0)**

3.5 Soils - Flooding (%): **None/Rare (80.4)**

3.5 Soils - Water Table Deep (%): **3.0 (77.4)**

3.5 Soils - Water Table Shallow (%): **1.0 (77.4)**

3.5 Soils - Erodibility (%): **Very Severe (80.4)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (68.8)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Urban (26.1)**

4.2 Current Corridor Sub-Dominant Land Cover: **Forest**

4.3 Riparian Buffer - Left Bank: **>100**

4.3 Riparian Buffer - Right Bank: **>100**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **(1)**

5.3 Bank Armoring %: **4.3**

5.4 Channel Straightening %: **0**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **87.4**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **( )**

6.6 Wavelength (Ratio): **( )**

Step 7. Windshield Survey

7.1 Reference Stream Type: **B**

7.1 Dominant Bed Form: **Plane Bed**

7.1 Sub-class Slope: **c**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **None**

7.4 Comments:

Step 8. Impact Rating

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

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.09**

Stream Name: **Hubbardton**

Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Valley is more broad but floodplain still confined within terrace

1.2 Towns: **Benson**

1.3 Downstream Latitude: **43.73**

1.3 Downstream Longitude: **-73.27**

Step 2. Stream Type

2.1 Elevation Upstream: **295**

2.1 Elevation Downstream: **280**

2.1 Gentle Gradient:

2.2 Valley Length (ft.)(mi.): **(4534) (0.86)**

2.3 Valley Slope (%): **0.33**

2.4 Channel Length (ft.)(mi.): **(5390) (1.02)**

2.5 Channel Slope (%): **0.28**

2.6 Sinuosity: **1.19**

2.7 Watershed Area (sq. mi.): **16.24**

2.8 Channel Width (ft.): **41.0**

2.9 Valley Width (ft.): **796**

2.10 Confinement Ratio: **19.4**

2.10 Confinement Type: **Very Broad**

2.11 Reference Stream Type: **E**

2.12 Bedform: **Dune-Ripple**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**

3.2 Grade Control: **None**

3.3 Dominant Geologic Material (%): **Glacial Lake (100.0)**

3.3 Sub-dominant Geologic Material: **---**

3.4 Left Valley Side Slope: **Hilly**

3.4 Right Valley Side Slope: **Hilly**

3.5 Soils - Hydrologic Group (%): **D (100.0)**

3.5 Soils - Flooding (%): **Frequent (79.1)**

3.5 Soils - Water Table Deep (%): **1.0 (79.1)**

3.5 Soils - Water Table Shallow (%): **0.0 (79.1)**

3.5 Soils - Erodibility (%): **Slight (20.8)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (68.9)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (34.0)**

4.2 Current Corridor Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **0-25**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **0.0 (0)**

5.3 Bank Armoring %: **0**

5.4 Channel Straightening %: **41.5**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **0**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **137 (3.3)**

6.6 Wavelength (Ratio): **233 (5.7)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **E**

7.1 Dominant Bed Form: **Dune-Ripple**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Sand**

7.2 Bank Erosion: **Low**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bend**

7.4 Comments:

Step 8. Impact Rating

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

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Phase 1 - Reach Summary Report

Reach ID: **T01.10**
Stream Name: **Hubbardton**
Topo Maps: **Benson**

Step 1. Reach Location

1.1 Reach Description: Upstream most reach on Hubbardton River
1.2 Towns: **Benson**
1.3 Downstream Latitude: **43.74**
1.3 Downstream Longitude: **-73.26**

Step 2. Stream Type

2.1 Elevation Upstream: **380**
2.1 Elevation Downstream: **295**
2.1 Gentle Gradient:
2.2 Valley Length (ft.)(mi.): **(14416) (2.73)**
2.3 Valley Slope (%): **0.59**
2.4 Channel Length (ft.)(mi.): **(16384) (3.10)**
2.5 Channel Slope (%): **0.52**
2.6 Sinuosity: **1.14**
2.7 Watershed Area (sq. mi.): **11.87**
2.8 Channel Width (ft.): **35.1**
2.9 Valley Width (ft.): **440**
2.10 Confinement Ratio: **12.5**
2.10 Confinement Type: **Very Broad**
2.11 Reference Stream Type: **C**
2.12 Bedform: **Riffle-Pool**

Step 3. Basin Characteristics: Geology and Soils

3.1 Alluvial Fan: **No**
3.2 Grade Control: **None**
3.3 Dominant Geologic Material (%): **Glacial Lake (69.7)**
3.3 Sub-dominant Geologic Material: **Other**
3.4 Left Valley Side Slope: **Hilly**
3.4 Right Valley Side Slope: **Hilly**
3.5 Soils - Hydrologic Group (%): **D (96.4)**
3.5 Soils - Flooding (%): **None/Rare (96.0)**
3.5 Soils - Water Table Deep (%): **1.5 (43.0)**
3.5 Soils - Water Table Shallow (%): **0.5 (43.0)**

3.5 Soils - Erodibility (%): **Moderate (34.1)**

Step 4. Land Cover - Reach Hydrology

4.1 Historic Watershed Land Cover: **Forest**

4.1 Current Watershed Dominant Land Cover (%): **Forest (69.8)**

4.1 Current Watershed Sub-Dominant Land Cover: **Field**

4.2 Historic Corridor Land Cover: **Crop**

4.2 Current Corridor Dominant Land Cover: **Forest (34.7)**

4.2 Current Corridor Sub-Dominant Land Cover: **Crop**

4.3 Riparian Buffer - Left Bank: **0-25**

4.3 Riparian Buffer - Right Bank: **0-25**

4.4 Ground Water Inputs: **Minimal**

Step 5. Instream Channel Modifications

5.1 Flow Regulation: **None**

5.2 Bridges and Culverts % (Number): **(1)**

5.3 Bank Armoring %: **1.2**

5.4 Channel Straightening %: **18.3**

5.5 Dredging History **Not Evaluated**

Step 6. Floodplain Modifications

6.1 Berms and Roads %: **1.7**

6.2 Floodplain Development %: **0.0**

6.3 Channel Bars: **None**

6.4 Meander Migration: **None**

6.5 Meander Width (Ratio): **175 (5.0)**

6.6 Wavelength (Ratio): **280 (8.0)**

Step 7. Windshield Survey

7.1 Reference Stream Type: **C**

7.1 Dominant Bed Form: **Riffle-Pool**

7.1 Sub-class Slope: **None**

7.1 Bed Material: **Gravel**

7.2 Bank Erosion: **High**

7.2 Bank Height: **Low**

7.3 Ice/Debris Jam Potential: **Bend**

7.4 Comments:

Step 8. Impact Rating

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

Poultney - Hubbardton River

Phase 1 - Step 9. Adjustment Process and Reach Condition

Rough Draft

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

		Stream Type						9.1 Predicted Adjustment Scores				9.2 Reach Condition	
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.	Project	Statewide
M01	VB	C	Sand	None	Dune-Ripple	262.41	4	2	0	0	2	Reference	Reference
M02	NW	C	Not Evaluated	None	Dune-Ripple	236.80	10	7	2	2	5	Fair	Good
M03	NW	C	Sand	None	Riffle-Pool	190.38	11	6	5	7	6	Fair	Good
M04	SC	B	Gravel	c	Riffle-Pool	189.86	1	2	0	0	0	Reference	Reference
M05	SC	B	Cobble	c	Riffle-Pool	187.64	5	5	4	4	2	Good	Good
M06	NW	C	Gravel	None	Riffle-Pool	75.50	7	4	3	2	2	Good	Reference
M07	VB	E	Sand	None	Dune-Ripple	71.18	14	6	3	2	8	Fair	Good
M08	VB	C	Gravel	None	Riffle-Pool	65.88	13	5	2	2	7	Fair	Good
M09	VB	C	Cobble	None	Riffle-Pool	53.58	13	6	2	4	8	Fair	Good
M10	VB	C	Cobble	None	Riffle-Pool	49.08	15	6	5	5	11	Fair	Good
M11	BD	C	Cobble	None	Riffle-Pool	44.55	12	5	5	3	4	Fair	Good
M12	BD	C	Cobble	None	Riffle-Pool	37.27	10	2	4	0	0	Reference	Reference
M13	VB	C	Cobble	None	Riffle-Pool	33.28	14	6	6	5	6	Fair	Good
M14	VB	C	Cobble	None	Riffle-Pool	28.07	17	9	8	7	9	Poor	Fair
M15	VB	C	Cobble	None	Riffle-Pool	12.78	12	5	5	5	7	Fair	Good
M16	VB	B	Cobble	b	Step-Pool	7.24	8	2	4	0	0	Reference	Reference
M17	BD	B	Cobble	b	Step-Pool	4.53	5	3	2	0	1	Reference	Reference
T01.01	BD	C	Sand	None	Dune-Ripple	44.38	9	3	3	0	1	Good	Reference
T01.02	SC	B	Sand	c	Dune-Ripple	42.31	9	3	4	0	0	Good	Reference
T01.03	NW	E	Sand	None	Dune-Ripple	40.62	9	1	3	2	1	Good	Reference
T01.04	BD	E	Sand	None	Riffle-Pool	33.30	13	5	6	3	6	Fair	Good
T01.05	VB	C	Sand	None	Riffle-Pool	21.83	11	5	7	5	7	Fair	Good
T01.06	BD	E	Sand	None	Dune-Ripple	19.94	8	2	5	4	4	Good	Good
T01.07	VB	E	Sand	None	Riffle-Pool	18.07	11	2	5	4	4	Good	Good
T01.08	NW	B	Sand	c	Plane Bed	16.82	7	4	4	0	0	Good	Reference
T01.09	VB	E	Sand	None	Dune-Ripple	16.24	12	4	5	4	6	Fair	Good
T01.10	VB	C	Gravel	None	Riffle-Pool	11.87	9	1	4	0	1	Reference	Reference

Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Phase 1 - Step 10. Like Reach Evaluation

Rough Draft

Sorted by Stream Type , Watershed Area

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Stream Type - C

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M01	VB	C	Sand	None	Dune-Ripple	262.41	4	2	0	0	2
M02	NW	C	Not Evaluated	None	Dune-Ripple	236.80	10	7	2	2	5
M03	NW	C	Sand	None	Riffle-Pool	190.38	11	6	5	7	6

Stream Type - B

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M04	SC	B	Gravel	c	Riffle-Pool	189.86	1	2	0	0	0
M05	SC	B	Cobble	c	Riffle-Pool	187.64	5	5	4	4	2

Stream Type - C

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M06	NW	C	Gravel	None	Riffle-Pool	75.50	7	4	3	2	2

Stream Type - E

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M07	VB	E	Sand	None	Dune-Ripple	71.18	14	6	3	2	8

Stream Type - C

Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
		Stream Type						Predicted Adjustment Scores			
M08	VB	C	Gravel	None	Riffle-Pool	65.88	13	5	2	2	7
M09	VB	C	Cobble	None	Riffle-Pool	53.58	13	6	2	4	8
M10	VB	C	Cobble	None	Riffle-Pool	49.08	15	6	5	5	11
M11	BD	C	Cobble	None	Riffle-Pool	44.55	12	5	5	3	4
M12	BD	C	Cobble	None	Riffle-Pool	37.27	10	2	4	0	0
M13	VB	C	Cobble	None	Riffle-Pool	33.28	14	6	6	5	6
M14	VB	C	Cobble	None	Riffle-Pool	28.07	17	9	8	7	9
M15	VB	C	Cobble	None	Riffle-Pool	12.78	12	5	5	5	7

Stream Type - B

Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
		Stream Type						Predicted Adjustment Scores			
M16	VB	B	Cobble	b	Step-Pool	7.24	8	2	4	0	0
M17	BD	B	Cobble	b	Step-Pool	4.53	5	3	2	0	1

Stream Type - C

Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
		Stream Type						Predicted Adjustment Scores			
T01.01	BD	C	Sand	None	Dune-Ripple	44.38	9	3	3	0	1

Stream Type - B

Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
		Stream Type						Predicted Adjustment Scores			
T01.02	SC	B	Sand	c	Dune-Ripple	42.31	9	3	4	0	0

Stream Type - E

Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
		Stream Type						Predicted Adjustment Scores			
T01.03	NW	E	Sand	None	Dune-Ripple	40.62	9	1	3	2	1
T01.04	BD	E	Sand	None	Riffle-Pool	33.30	13	5	6	3	6

Stream Type - C

	Confinement	Stream	Bed	Subclass		Watershed	Total				
		Stream Type						Predicted Adjustment Scores			

Reach ID	Type	Type	Material	Slope	Bedform	Area	Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.05	VB	C	Sand	None	Riffle-Pool	21.83	11	5	7	5	7

Stream Type - E

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.06	BD	E	Sand	None	Dune-Ripple	19.94	8	2	5	4	4
T01.07	VB	E	Sand	None	Riffle-Pool	18.07	11	2	5	4	4

Stream Type - B

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.08	NW	B	Sand	c	Plane Bed	16.82	7	4	4	0	0

Stream Type - E

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.09	VB	E	Sand	None	Dune-Ripple	16.24	12	4	5	4	6

Stream Type - C

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.10	VB	C	Gravel	None	Riffle-Pool	11.87	9	1	4	0	1

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Stream Geomorphic Assessment VT DEC

Poultney - Hubbardton River

Phase 1 - Step 10. Like Reach Evaluation

Rough Draft

Sorted by Confinement Type , Watershed Area

Basin: **Poultney, Mettawee** Watershed: **Lake George** Sub-watershed: **Poultney River**

Confinement Type - VB

		Stream Type						Predicted Adjustment Scores			
Reach ID	**Confinement Type**	**Stream Type**	**Bed Material**	**Subclass Slope**	**Bedform**	**Watershed Area**	**Total Impact**	**Degrad.**	**Aggrad.**	**Widen.**	**Planf.**
M01	VB	C	Sand	None	Dune-Ripple	262.41	4	2	0	0	2

Confinement Type - NW

		Stream Type						Predicted Adjustment Scores			
Reach ID	**Confinement Type**	**Stream Type**	**Bed Material**	**Subclass Slope**	**Bedform**	**Watershed Area**	**Total Impact**	**Degrad.**	**Aggrad.**	**Widen.**	**Planf.**
M02	NW	C	Not Evaluated	None	Dune-Ripple	236.80	10	7	2	2	5
M03	NW	C	Sand	None	Riffle-Pool	190.38	11	6	5	7	6

Confinement Type - SC

		Stream Type						Predicted Adjustment Scores			
Reach ID	**Confinement Type**	**Stream Type**	**Bed Material**	**Subclass Slope**	**Bedform**	**Watershed Area**	**Total Impact**	**Degrad.**	**Aggrad.**	**Widen.**	**Planf.**
M04	SC	B	Gravel	c	Riffle-Pool	189.86	1	2	0	0	0
M05	SC	B	Cobble	c	Riffle-Pool	187.64	5	5	4	4	2

Confinement Type - NW

		Stream Type						Predicted Adjustment Scores			
Reach ID	**Confinement Type**	**Stream Type**	**Bed Material**	**Subclass Slope**	**Bedform**	**Watershed Area**	**Total Impact**	**Degrad.**	**Aggrad.**	**Widen.**	**Planf.**
M06	NW	C	Gravel	None	Riffle-Pool	75.50	7	4	3	2	2

Confinement Type - VB

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M07	VB	E	Sand	None	Dune-Ripple	71.18	14	6	3	2	8
M08	VB	C	Gravel	None	Riffle-Pool	65.88	13	5	2	2	7
M09	VB	C	Cobble	None	Riffle-Pool	53.58	13	6	2	4	8
M10	VB	C	Cobble	None	Riffle-Pool	49.08	15	6	5	5	11

Confinement Type - BD

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M11	BD	C	Cobble	None	Riffle-Pool	44.55	12	5	5	3	4
M12	BD	C	Cobble	None	Riffle-Pool	37.27	10	2	4	0	0

Confinement Type - VB

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M13	VB	C	Cobble	None	Riffle-Pool	33.28	14	6	6	5	6
M14	VB	C	Cobble	None	Riffle-Pool	28.07	17	9	8	7	9
M15	VB	C	Cobble	None	Riffle-Pool	12.78	12	5	5	5	7
M16	VB	B	Cobble	b	Step-Pool	7.24	8	2	4	0	0

Confinement Type - BD

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
M17	BD	B	Cobble	b	Step-Pool	4.53	5	3	2	0	1
T01.01	BD	C	Sand	None	Dune-Ripple	44.38	9	3	3	0	1

Confinement Type - SC

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.02	SC	B	Sand	c	Dune-Ripple	42.31	9	3	4	0	0

Confinement Type - NW

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.03	NW	E	Sand	None	Dune-Ripple	40.62	9	1	3	2	1

Confinement Type - BD

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.04	BD	E	Sand	None	Riffle-Pool	33.30	13	5	6	3	6

Confinement Type - VB

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.05	VB	C	Sand	None	Riffle-Pool	21.83	11	5	7	5	7

Confinement Type - BD

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.06	BD	E	Sand	None	Dune-Ripple	19.94	8	2	5	4	4

Confinement Type - VB

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.07	VB	E	Sand	None	Riffle-Pool	18.07	11	2	5	4	4

Confinement Type - NW

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.08	NW	B	Sand	c	Plane Bed	16.82	7	4	4	0	0

Confinement Type - VB

		Stream Type						Predicted Adjustment Scores			
Reach ID	Confinement Type	Stream Type	Bed Material	Subclass Slope	Bedform	Watershed Area	Total Impact	Degrad.	Aggrad.	Widen.	Planf.
T01.09	VB	E	Sand	None	Dune-Ripple	16.24	12	4	5	4	6
T01.10	VB	C	Gravel	None	Riffle-Pool	11.87	9	1	4	0	1

Appendix 2

Appendix 3

Summary of Cross Section Data at Selected Reaches*

Study Site	Reach	Bankfull Width (ft)	Bankfull Area (ft^2)	Maximum Depth (ft)	Mean Depth (ft)	Flood Prone Width (ft)	W/D Ratio	Entren. Ratio	Channel Slope	Valley Slope	D50 (mm)	Stream Type
Middletown	M15	31.50	51.88	2.72	1.90	108.27	11.6	3.4	0.0223	0.0239	32-45	B4
GMC	M9-B	43.31	111.73	3.71	3.08	500.00	11.7	>5	0.0045	0.0061	16	C4
Middle Hubbardton	T1.04	27.23	110.22	5.51	4.82	500.00	4.9	>5	0.0013	0.0036	5.7	E4
Harrison	M03	83.33	475.43	7.87	5.68	500.00	10.6	>5	0.0015	0.0024	5.7-8	C4
Ward Marsh	M01	114.83	565.09	7.94	5.45	500.00	14.5	>5	0.0018	0.0026	<1	C5

* The data summarized here was collected in Summer 2000 as part of another project (Field et al., 2001). The original survey data is no longer available.

Reach Information	Hints
Stream Name	Hubbardtor
Location	Reach T1.03 on Hubbardton River - on TNC property
Observers	John Field
Agency	#N/A
Local Organization	Field Geology Services/The Nature Conservancy
HUC 10	0201000103
Plus Four	
Date	10/14/05
Town	BENSON

Riffle Dimension and Hydraulics Summation

	mean dimension calc.?	reference? (yes/no)	Bed Feature	Abkf (sq.ft.)	Wbkf (ft.)	Dmax (ft.)	Bank Ht. (ft.)	FPW (ft.)	Dbkf (ft.)	velocity (ft./sec.)	Q Manning's	shear stress (lbs/ft sq)	shear velocity (ft/sec)	stream power (lbs/ft/sec)	relative roughness	friction factor u/u*	threshold grain size (mm)		
Cross Section-1	y	n	Riffle	108.63	20.47	6.56	6.56	300.00	5.3	1.64	178.2	0.04	0.15	0.00	3614.0	11.15	4.80	###	14.65
Cross Section-2	y	n	Riffle	83.64	26.03	4.36	7.47	46.20	3.2	1.25	104.8	0.02	0.12	0.00	2188.5	10.42	3.00	###	1.77
Cross Section-3	n	n	Riffle	127.05	48.43	6.49	6.49	300.00	2.6	1.12	142.1	0.02	0.11	0.00	1786.8	10.12	2.5	###	6.19
Cross Section-4	y	n	Riffle	246.67	42.88	8.22	8.22	500.00	5.7	1.83	451.1	0.05	0.16	0.00	3917.7	11.48	5.7	###	11.66
Cross Section-5	y	n	Riffle	122.52	45.96	3.09	3.09	500.00	2.6	1.15	141.28	0.02	0.11	0.00	1815.47	10.25	2.70	###	10.88
Cross Section-6	y	n	Riffle	9.18	9.93	2.16	3.80	31.00	0.9	0.52	4.82	0.01	0.06	0.00	629.3	8.36	0.7	###	3.12
Cross Section-7	n	n	Riffle	13.43	9.00	2.60	3.39	36.00	1.4	0.71	9.50	0.01	0.08	0.00	1017.0	9.06	1.2	###	4.00
Cross Section-8	n	n	Riffle	17.24	34.05	2.40	2.40	50.00	0.5	0.38	6.54	0.00	0.05	0.00	344.70	7.74	0.3	###	1.47
Cross Section-9	n	y	Riffle	23.88	33.24	2.70	2.70	48.00	0.7	0.47	11.17	0.01	0.06	0.00	489.2	8.16	0.6	###	1.44
Cross Section-10	n	y	Riffle	20.50	15.56	1.92	1.92	55.00	1.3	0.71	14.64	0.01	0.08	0.00	896.9	9.06	1.2	###	3.53
Cross Section-11																			
Cross Section-12																			

Riffle Dimensions	mean	min	max
x-area bankfull	114.1	9.18	246.67
width bankfull	29.05	9.93	45.96
max depth	4.88	2.16	8.22
bank ht	5.83	3.09	8.22
width flood prone area	275.4	31.00	500.00
mean depth	3.57	0.92	5.75
width depth ratio	9.48	3.86	17.24
Entrenchment Ratio	8.42	1.77	14.65

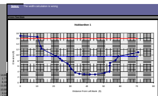
Riffle Hydraulics	mean		mean
velocity	1.28	stream power (lbs/ft/sec)	0.00
Q Manning's	176.06	relative roughness	2433.03
shear stress (lbs/ft sq)	0.03	friction factor u/u*	10.33
shear velocity (ft/sec)	0.12	threshold grain size (mm)	3.41

Pool Dimensions	mean	min	max
x-area bankfull	#DIV/0	0.00	0.00
width bankfull	#DIV/0	0.00	0.00
max depth	#DIV/0!	0.00	0.00
bank ht	#DIV/0!	0.00	0.00
width flood prone area	#DIV/0!	0.00	0.00
mean depth	#DIV/0!	0.00	0.00
width depth ratio	#DIV/0!	0.00	0.00

Pool Hydraulics	mean		mean
velocity	#DIV/0	stream power (lbs/ft/sec)	#DIV/0
Q Manning's	#DIV/0	relative roughness	#DIV/0
shear stress (lbs/ft sq)	#DIV/0!	friction factor u/u*	#DIV/0!
shear velocity (ft/sec)	#DIV/0!	threshold grain size (mm)	#DIV/0!

Notes: The width calculation is wrong

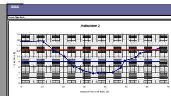
Cross Section

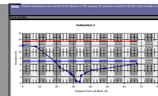


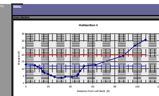
Stream Name	Hubbardton
Location	Reach T1.03 on Hubbardton River - on Th
Observers	John Field
Agency	#N/A
Org	Field Geology Servi
HUC 10	0201000103
Date	10/14/05
Town	BENSON

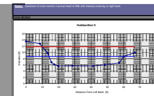
Dimensions			
108.63	x-section area	5.31	d mean
20.47	width	24.98	wet P
6.56	d max	4.35	hyd radi
6.56	bank ht	3.86	w/d ratio
300.00	W flood prone area	14.65	ent ratio

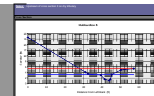
Hydraulics	
1.64	velocity (ft/sec)
178.24	Q Manning's (cfs)
0.04	shear stress (lbs/ft sq)
0.15	shear velocity (ft/sec)
0.00	stream power (lbs/ft/sec)
11.15	friction factor u/u*
4.80	threshold grain size (mm)

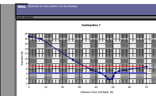


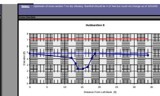


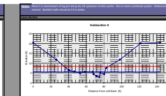






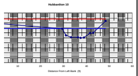






pstream of cross section 9. Depositional area behind log jam - higher width:depth ratio compared to downstream as
d log jam. Represents reference condition upstream of log j

Hubbardton 10



Hubbardton		HUC 10:	02010001	Plus Four	
Reach T1.03 on Hubbardton River - on TN		Date:	10/14/05		
John Field		Town:	BENSON		
#N/A	Org: Field Geology Services	Cross Section No.	10	Include XS in mean dimension calculations?	
Riffle		Location in Bed Feature	Mid		
	Heading Rmon.	Reference? (y/n)	y	(y/n):	n
	Heading Lmon.				

Elevation (ft.)
7.959220
6.866714
5.508463
5.104924
5.111486
4.947446
5.045870
5.925124
5.974336
8.402128

Elevation Bankfull	Elevation top of ban	W fpa (ft)	Channel Slope (%)	Manning's "n"
6.866714	6.866714	55	0.02	0.03

Dimensions

20.50	x-section area	1.32	d mean
15.56	width	16.43	wet P
1.92	d max	1.25	hyd radi
1.92	bank ht	11.82	w/d ratio
55.00	W flood prone are	3.53	ent ratio

Hydraulics

0.71	velocity (ft/sec)
14.64	Q Manning's (cfs)
0.01	shear stress ((lbs/ft sq)
0.08	shear velocity (ft/sec)
0.00	stream power (lbs/ft/sec)
9.06	friction factor u/u*
1.23	threshold grain size (mm

Check from channel materi

0.45	measured D_{84} (mm)		
896.90	relative roughness	19.66	fric. factor
0.014	Manning's n from channel materi		

#N/A	Height of bankfull above current water surf

Left Bank Near Bank Vegetaion

	Composition	Density (%
Overstory		
Understory		
Floor		

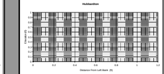
Right Bank Near Bank Vegetaion

	Composition	Density (%
Overstory		
Understory		
Floor		

Notes:

Cross Section

Hubbardton



Stream Name	Hubbardton	HUC 10:	02010001	Plus Four	
Location	Reach T1.03 on Hubbardton River - on	Date:	10/14/05		
Observers	John Field	Town:	BENSON		
Agency	#N/A Org: Field Geology Servic	Cross Section No.		Include XS in mean dimension calculations?	
Bed Feature		Location in Bed Feature			
Lat/Long. Rmon.		Heading Rmon.		Reference? (y/n)	(y/n):
Lat/Long Lmon.		Heading Lmon.			

Floodplain Edits	Notes	Distance (ft)	Elevation (ft.)

Elevation Bankfull	Elevation top of ban	W fpa (ft)	Channel Slope (%)	Manning's "n"
			0.02	

Dimensions

	x-section area		d mean
	width		wet P
	d max		hyd radi
	bank ht		w/d ratio
	W flood prone are		ent ratio

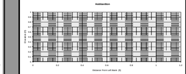
Hydraulics

	velocity (ft/sec)
	Q Manning's (cfs)
	shear stress ((lbs/ft sq)
	shear velocity (ft/sec)
	stream power (lbs/ft/sec)
	friction factor u/u*
	threshold grain size (mm

Check from channel materi

Notes:

Cross Section



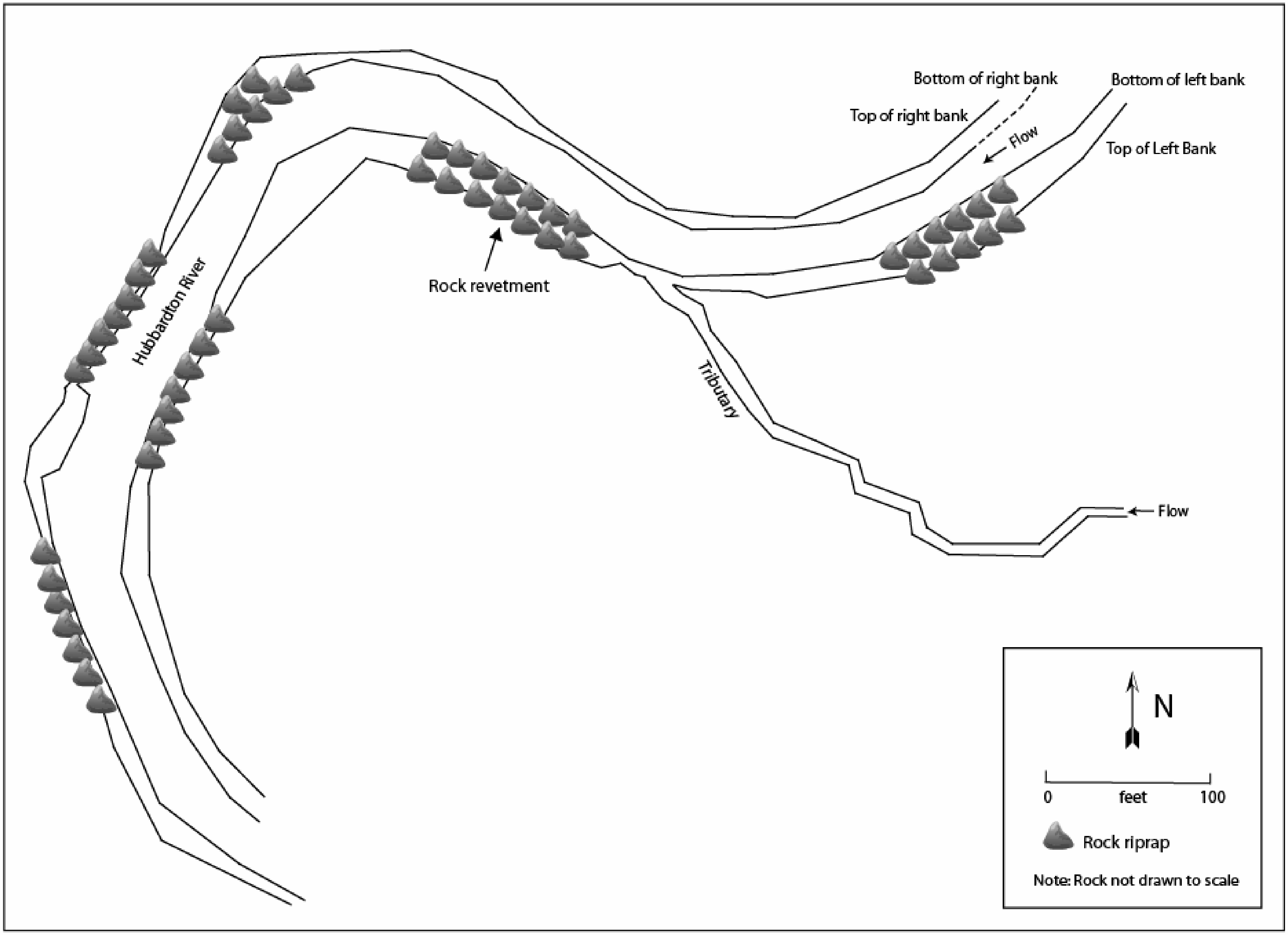
Stream Name
Location
Observers
Agency
Bed Feature
Lat/Long. Rmon.
Lat/Long Lmon.

Floodplain Edits	Notes	Distance (ft)

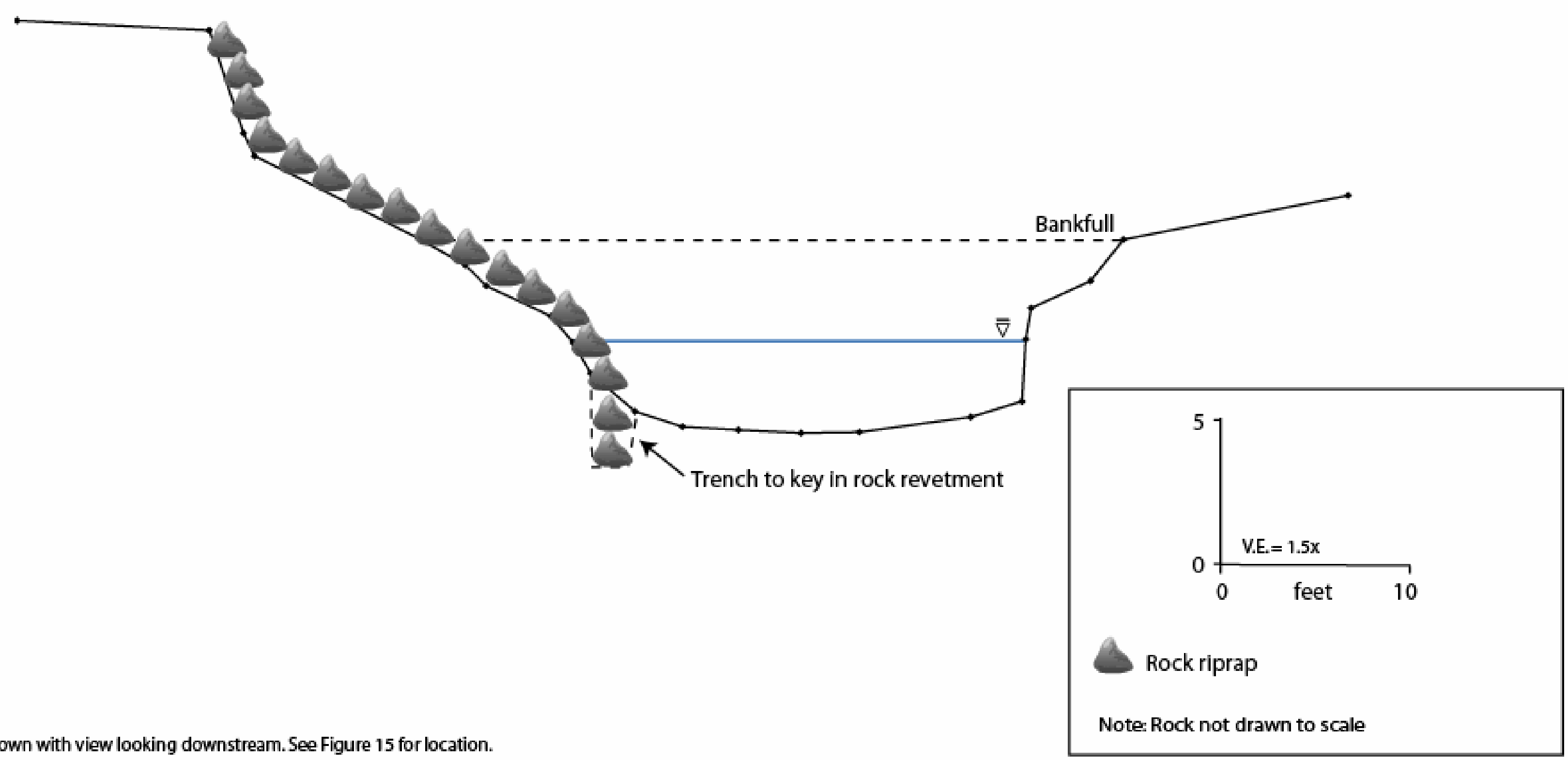
Appendix 4

Appendix 5

Hubbardton River Phase 3 - Channelization Alternative

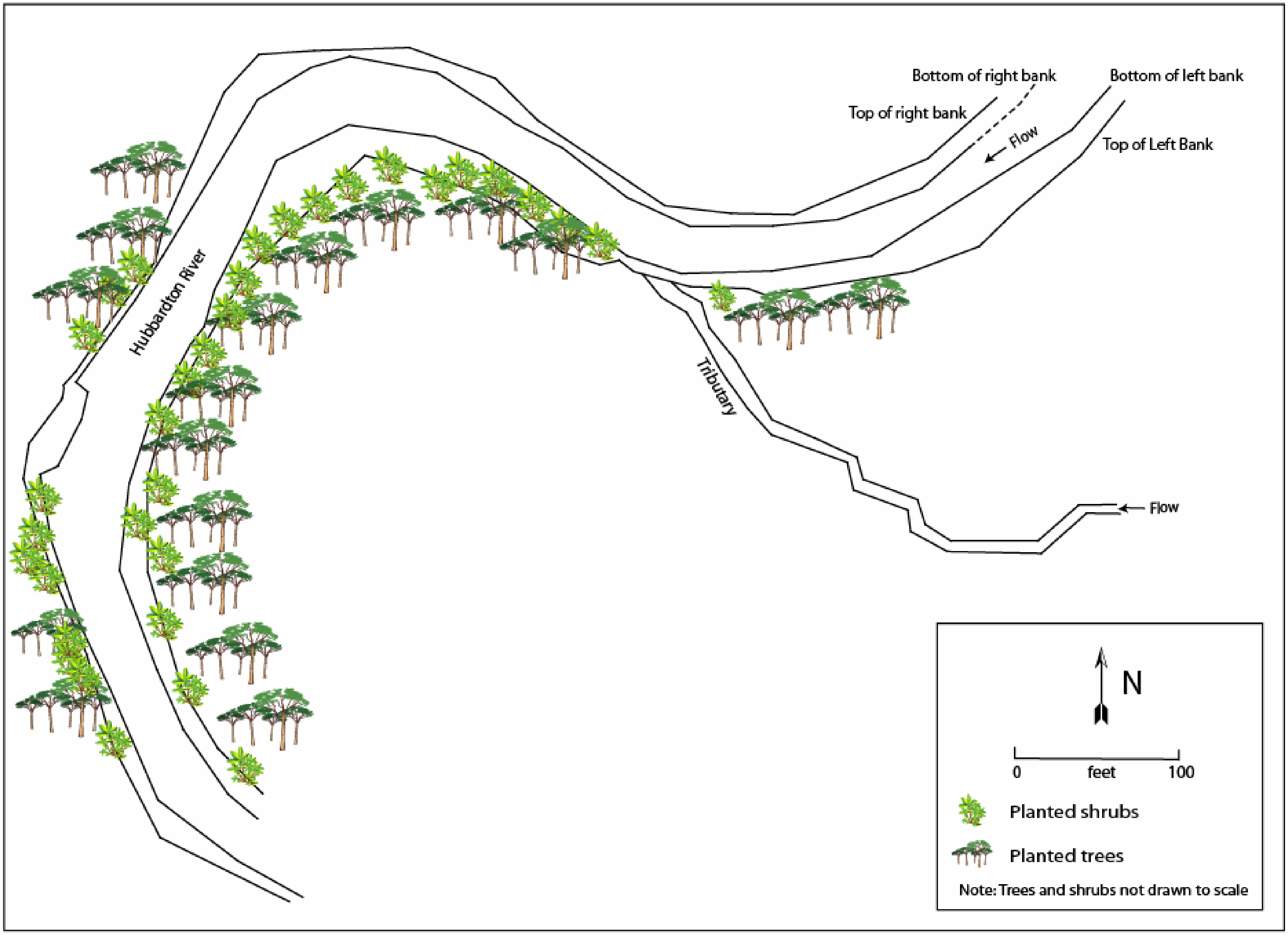


Hubbardton River Phase 3 - Channelization Alternative (Cross Section)



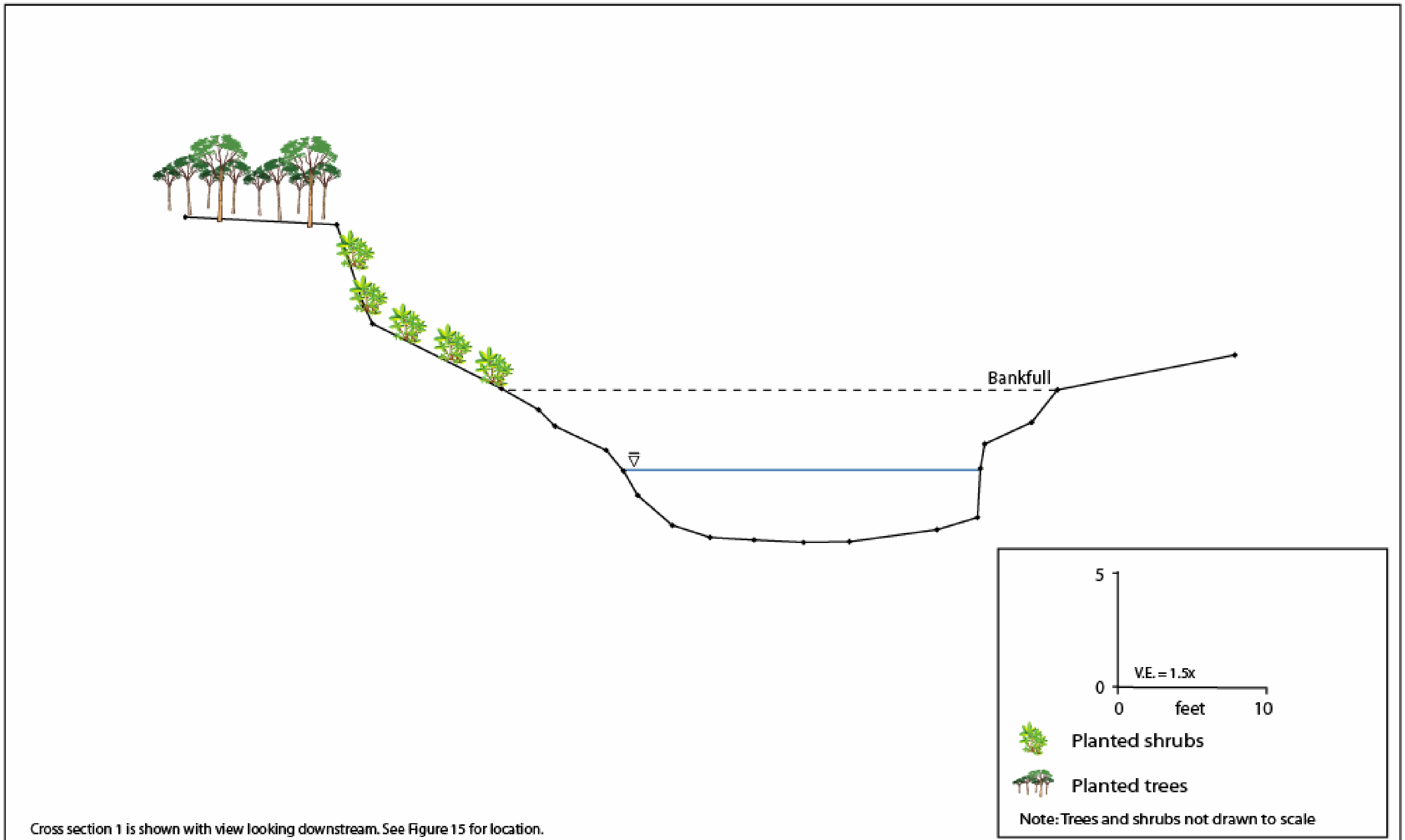
Cross section 1 is shown with view looking downstream. See Figure 15 for location.

Hubbardton River Phase 3 - Passive Geomorphic Alternative



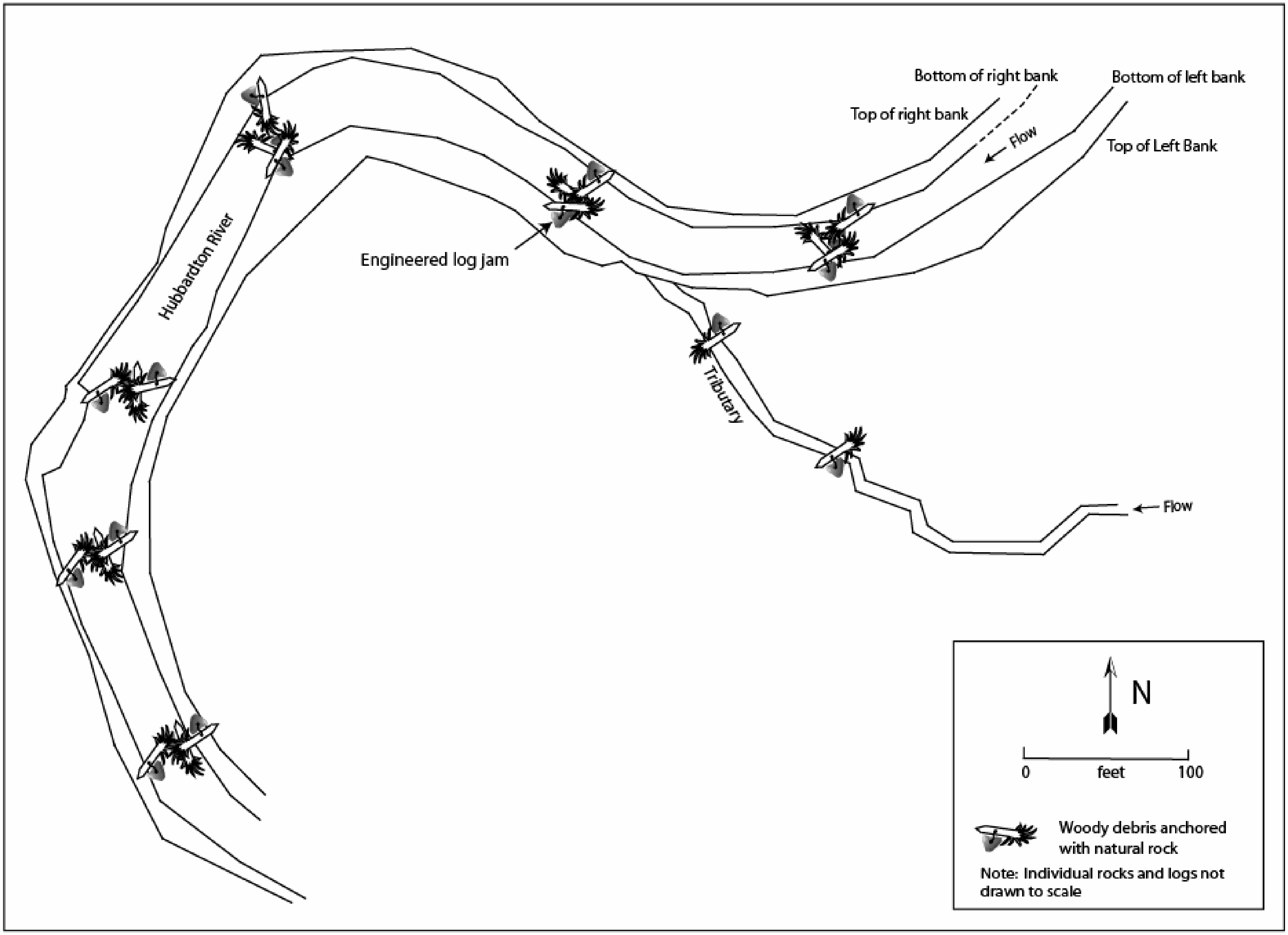
Field Geology Services
Fluvial Geomorphology

Hubbardton River Phase 3 - Passive Geomorphic Alternative (Cross Section)

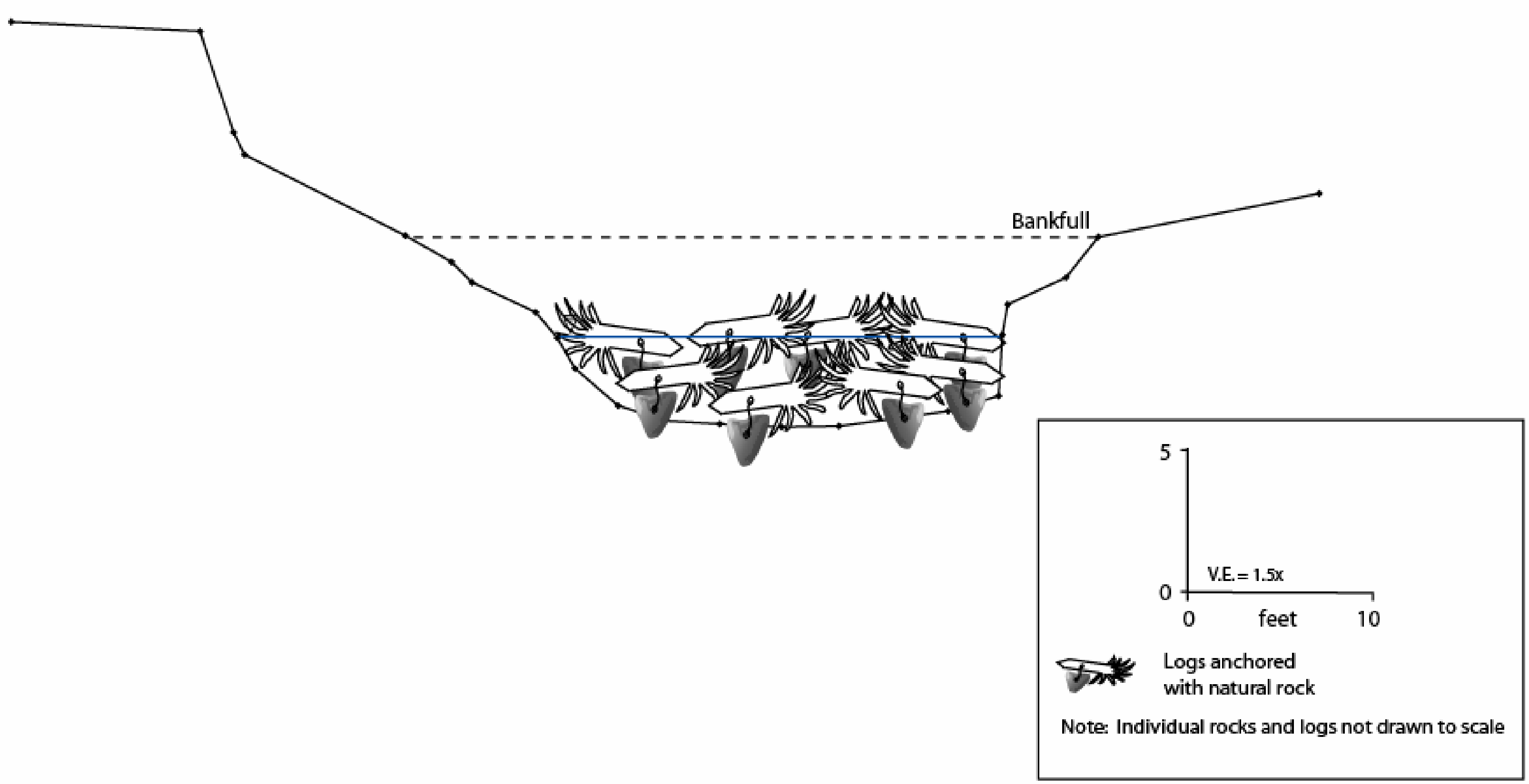


Cross section 1 is shown with view looking downstream. See Figure 15 for location.

Hubbardton River Phase 3 - Active Geomorphic Alternative



Hubbardton River Phase 3 - Active Geomorphic Alternative (Cross Section)



Cross section 1 is shown with view looking downstream. See Figure 15 for location.