Mill Brook Geomorphic Assessment

Southern Windsor County
Regional Planning Commission
2002-2003

Introduction

The Mill Brook is a fifteen-mile stream with headwaters in the towns of Reading and West Windsor VT. The mouth empties into the Connecticut River in Windsor VT just under the historic Windsor/Cornish Covered Bridge. Most of Mount Ascutney is contained in the watershed. For approximately one hundred years, the Mill Brook has been restricted by a dam creating Mill Pond (also known as Kennedy pond) in downtown Windsor. The damn is located about a mile from the confluence with the Connecticut River.

This assessment originated from concerns raised by citizens in and around the watershed who saw sediment accumulating within Mill Pond and filling in favorite boating, swimming and fishing areas. These citizens, with help from the Southern Windsor Country Regional Planning Commission, formed the Mill Brook Watershed Association (MBWA). In addition to this assessment, the MBWA holds regular educational meetings in Brownsville and conducts water quality sampling throughout the watershed in cooperation with local schools, conservation commissions, and other local interests.

In conducting this assessment, the MBWA hopes to better understand the processes currently underway in the Mill Brook so that strategies for reducing the sedimentation in Mill Pond can be developed in context of the entire watershed. By understanding the structure and movement of the Brook we hope to develop responses to the sedimentation problem that will not be short-term "band-aid" fixes, but rather long-term solutions.

As outlined in the initial agreement with ANR, this assessment focuses on two "problem" segments in the watershed. Although the Phase I assessment begins with reach definition for the entire watershed, this assessment began by focusing directly on these problem segments and defined reaches only immediately adjacent.

Problem Reaches

The two problem reaches that were identified pre-assessment are the West Windsor Flats in West Windsor and the Narrows in Windsor. The West Windsor Flats are located just West of Brownsville on VT 44 (see Figure 1). The area has historically been used as a farm fields and pastures with little or no protective buffer of the stream. Currently, the fields are still hayed during the summer months although a few houses have been built taking up some acreage. There have also been efforts to grow a considerable buffer in riparian zones.

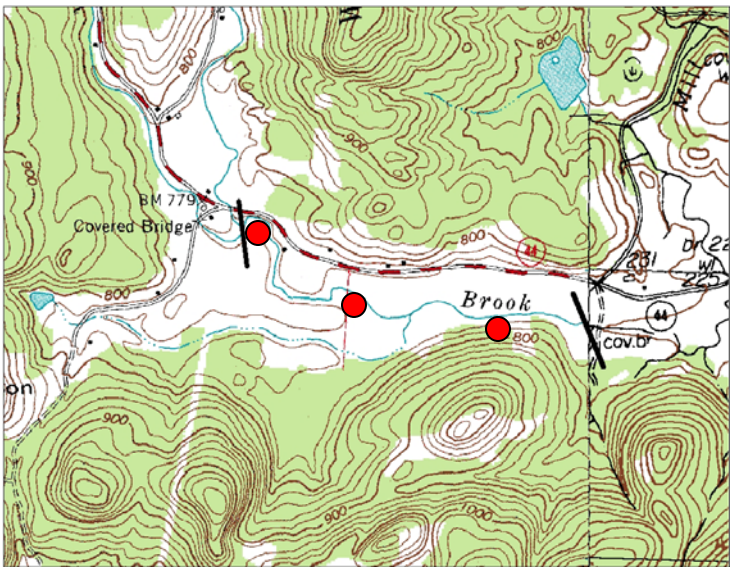

Figure 1: West Windsor Flats

The Narrows begin at the intersection of the Mill Brook and Interstate 91 and extend downstream until the confluence with Mill Pond. This area has been heavily disturbed in the past due to the narrow valley constraints and the presence of VT 44 (see Figure 2). In order to allow passage of the road and reduce flooding of the road the Brook has been altered and armored in many places. Fortunately, the current land owner south of the Brook is letting much the property grow in and allowing the stream to meander as needed. Although this is promising for the future, the current state of the Brook is quite unstable.

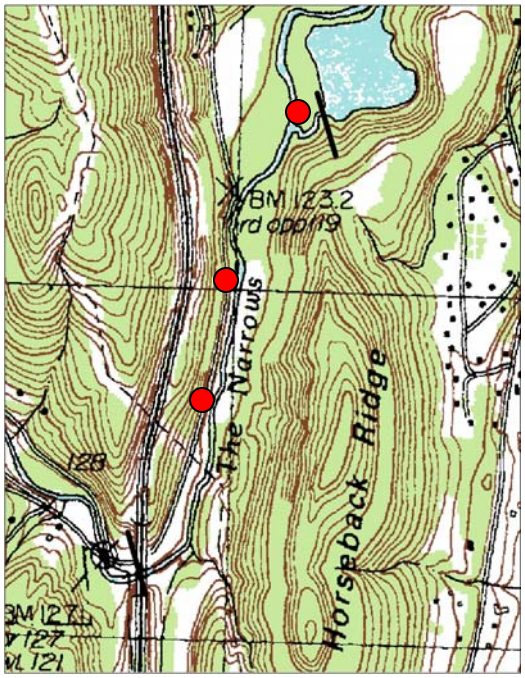

Figure 2: The Narrows

For each reach we chose sites representative of the entire reach. Each site is indicated with a red dot on Figures 1 and 2. All watershed characterizations were done at the middle site of

each reach. However, detailed measurements were taken at each of the six sites to accurately portray the dimensions of the stream channel (see Appendix A: Cross Sections).

Valley and Floodplain Corridor

Both reaches assessed are found in the response zone of the Mill Brook Watershed. It is important to note, however, that the Narrows is far from an "unconstrained valley" although it is in fact within the response zone. Neither of these reaches are on alluvial fans.

Significant floodplain encroachments are found on both reaches. On the West Windsor Flats (the Flats) there are roads and fill associated with those roads that have encroached on the floodplain. The movement of the stream, particularly at bridge locations, is heavily impaired. In addition to the roads, there are two snowmobile bridges whose locations are being vigorously "defended" by landowners. This is restricting the natural meandering of the river. There are two houses and out buildings located within the floodplain although set back from the Brook.

On the Narrows there is much more encroachment. As mentioned before, VT 44 has altered the location of the Brook throughout most of the Narrows. Road fill and armor prevent the Brook from accessing a large portion of the already narrow valley. Again, the landowner on the south side of the Brook has been letting the Brook meander as necessary although this is not guaranteed in perpetuity.

Adjacent side slopes change drastically between the Flats and the Narrows. On the Flats, adjacent side slopes are shallow, continuous with the bank and sandy in texture. The confinement falls directly within the "broad" category although there are a few grade controls, such as ledge and the occasional box culvert (under bridges). The side slopes on Narrows in contrast are steep and extra-steep within one bank-full-width of the bank and sandy to cobble in texture although much bedrock persists. The confinement here is between narrowly and semi-confined and there are a relatively few grade controls such as ledge. Neither reach seem to have any barriers to fish on the main channel.

Stream Channel

Bankfull width calculations were not completed but should be easily obtained from the cross sections in Appendix A. The stream type at the Flats is Riffle-Pool as is the case at the Narrows. We determined that both reaches are of stream type C4 riffle-pool.

Riparian Banks, Buffer and Corridors

Typical bank slope on the Flats is steep and on the Narrows in moderate. Lower bank material is gravel for both reaches and upper bank material at the Flats is silt while at the Narrows in sand. Vegetation type at the Flats is dominated by deciduous trees and shrubs, although there are sections only buffered by pasture-lawn. The vegetation at the Narrows in also dominated by deciduous trees and shrubs although there are sections where there is no buffer but instead VT 44 is present. See Appendix B (field sheets) for more detailed information on buffer composition and width.

Flow and Flow Modifiers

Springs or seeps are not present on either reach. Wetlands are not found adjacent to either reach either except for upper sections of the Mill Pond. Both reaches have uniform flows. It is important to note however, that on the Narrows at the confluence with Mill Pond, the Brook has abandoned its old channel and forged a new route into the upper portion of the Pond. Debris jams are very common on the Flats and intermittent on the Narrows. Stormwater inputs are rare on both reaches although there are a few culverts flowing directly off VT 44 which provide some input. Flow regulation, besides alterations imposed by the road, are non-existent. There is one in stream culvert located under Yale Heights Rd on the Flats. There is a deep pool directly upstream from this box culvert which could signify a conflict with the culvert width. As mentioned before, snowmobile bridges restrict meander and channel width. In addition, the bridge located on VT 44 at the downstream end of the Flats reach is too narrow. There is significant narrowing and entrenchment as a result.

Channel Bed and Planform Changes

Both reaches have significant evidence of planform changes and unbalanced forces at play. Both segments have multiple point bars present and the Narrows has two mid-channel bars at the time of assessment. The Flats, however, has multiple mid-channel bars and the point bars present are very large. At the Narrows there has been significant straightening of the channel as VT 44 was constructed and re-built.

Rapid Habitat Assessment (Low Gradient)

The following are the scores for each reach segment as assessed using the Rapid Habitat Assesment:

The Narrows:

- Epifaunal Substrate and Available Cover – **Good**; 50% of stream bed and lower banks covered with a mix of substrates favorable for epifaunal colonization and fish cover. (13)
- Pool Substrate Characterization – **Fair**; mostly sand/silt bottoms and little to no vegetation present. (7)
- Pool Variability – **Fair**; throughout the whole section only 3 large pools; shallow pools are much more prevalent. (8)
- Sediment Deposition – **Fair**; moderate deposition of new gravel, sand and fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. (10)
- Channel Flow Status – **Good**; water fills >75% of the available channel although for much of summer 2002, water levels were fair/poor due to low precipitation. (14)
- Channel Alteration – **Good**; some channelization present along 15% of the segment, usually in areas of bridge abutments; evidence of past channelization is present along with some rip-rap. (11)
- Channel Sinuosity – **Fair**; the bends in the stream increase the stream length 1.02 times longer than the straight down-valley length. (6)

Bank Stability (Right Bank) – **Fair**; moderately unstable; 60% of bank segment has areas of erosion; high erosion potential from crumbling, unvegetated banks during flood events. (6)

(Left Bank) – **Fair**, moderately unstable; 30% of bank segment has areas of erosion; high erosion potential from crumbling, unvegetated banks during flood events. (10) Overall (8)

Bank Vegetation Protection (Right Bank) – **Good**; 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represents; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. (7)

(Left Bank) – **Good**; 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represents; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. (8) Overall (7.5)

Riparian Vegetative Zone Width (Right Bank) – **Reference**; except right near the road, the width of the riparian zone > 100ft; human activities have not impacted the zone. (9)

(Left Bank) – **Good**; well vegetated zone although only 20ft wide for a long way along the road. (6) Overall (7.5)

Final Score: **0.46** Condition: **Fair**

The West Windsor Flats:

Epifaunal Substrate and Available Cover – **Fair**; 20% of stream bed and lower banks covered with substrates favorable for epifaunal colonization and fish cover; few substrate types present. (8)

Pool Substrate Characterization – **Fair**; mostly sand/silt bottoms and little to no vegetation present. (8)

Pool Variability – **Fair**; throughout the whole section only 3 large pools; shallow pools are much more prevalent. (7)

Sediment Deposition – **Poor**; heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. (5)

Channel Flow Status – **Fair**; water fills 25 - 75% of the available channel although for much of summer 2002, water levels were poor due to low precipitation. (8)

Channel Alteration – **Fair**; channelization present along 50% of the segment rip-rap and armor present on both banks. (7)

Channel Sinuosity – **Fair**; the bends in the stream increase the stream length 1.298 times longer than the straight down-valley length. (8)

Bank Stability (Right Bank) – **Fair**; moderately unstable; 60% of bank segment has areas of erosion; high erosion potential from crumbling, unvegetated banks during flood events. (6)

(Left Bank) – **Fair**, moderately unstable; 30% of bank segment has areas of erosion; high erosion potential from crumbling, unvegetated banks during flood events. (10) Overall (8)

Bank Vegetation Protection (Right Bank) – **Good**; 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represents; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. (6)
(Left Bank) – **Fair**; 50-70% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represents; disruption obvious; patches of bare soil and closely cropped vegetation common; less than on-half of the potential plant stubble height remaining. (4) Overall (5)

Riparian Vegetative Zone Width (Right Bank) – **Good**; except right near the road, the width of the riparian zone > 100ft; human activities have not impacted the zone. (6)
(Left Bank) – **Fair**; width of riparian zone 25-50ft; human activities have impacted zone a great deal (4) Overall (5)

Final Score: **0.345** Condition: **Poor/Fair**

Rapid Geomorphic Assessment

The following are the scores for each reach segment as assessed using the Rapid Geomorphic Assesment:

The Narrows:

Degree of Channel Degradation (Incision) – **Reference**; little to no incision; vertical eroded banks are very low (<5ft); limited potential for future incision due to watershed, floodplain, or channel modifications. (18)

Degree of Channel Aggradation – **Good**; unvegetated bars present; 5-30% of the stream bottom is affected by the accumulation of gravel, sand or fine sediment; minor filling of fine sediments in pools; larger sediments ~50% embedded; bars with coarser particles at upstream end and fines at downstream end. (11)

Over-Widened Channel – **Fair**; trees are overhanging; scour, where occurring, happends on both sides; channelization seems to compound this problem; mid channel bars. (8)

Change in Planform – **Good**; not a lot of migration; channelization affects this as well; mid channel bars. (12)

Dominant Channel Adjustment Process: III Widening
Total Score: 0.6
Condition: Fair

The West Windsor Flats:

Degree of Channel Degradation (Incision) – **Fair**; Moderate incision and/or impending incision; higher terraces adjacent to low bank; nick points or steep riffles may be present; undermining of infrastructure; future incision likely (6)

Degree of Channel Aggradation – **Fair**; Moderate deposition of new gravel, sand or fine sediment on old and new bars; 40% of the bottom affected; Larger sediments are 60% embedded; moderate filling of pools; bars with similar sized materials on both up and downstream ends; point bars are different sizes and heights relative to water surface; some steep bar faces; fine sediment feels soft underfoot. (7)

Over-Widened Channel – **Fair**; trees are overhanging; scour, where occurring, happens on both sides; channelization seems to compound this problem; mid channel bars. (6)

Change in Planform – **Fair**; Evidence of incipient or recent flood chutes, and channel avulsions; mid channel bars are present; thalweg not lines up with planform. (12)

Dominant Channel Adjustment Process: III Widening
Total Score: 0.35
Condition: Poor

Conclusion

From our observations, three problems stand out that contribute to erosion throughout the watershed. First, adequate buffers must continue to be encouraged throughout the watershed. Although is many places buffers are good, if not of reference quality, there are a number of reaches where a diverse and wide buffer would reduce erosion significantly.

Secondly, throughout the past year we have noticed a few practices by road crews in the watershed which may be introducing unnecessary amounts of sediment. For example, there is a large sand pile just west of Brownsville which could be eroding rapidly into the Mill Brook. Similarly, in Reading we witnessed large amounts of sand being dumped into or directly next to stream beds; one just near the end of Bailey's Mill Road and one further up the same road. If this is a common practice, vast amounts of sediment could be being introduced and compounding the erosion and sedimentation problems.

Finally, many bridges in the watershed are of inadequate size to accommodate bank-full conditions. Some of these bridges are small recreational bridges such as the snowmobile bridges on the West Windsor Flats but some are VTrans structures on VT 44. It is our opinion that whenever it is possible these bridges should be located to a more naturally constricted place on the Brook or reconstructed to provide an adequate span.

From this assessment it is clear that there are some geomorphologic and some human reasons for the sedimentation and erosion witnessed in the Mill Brook watershed. It is our hope that with the information collected here the Agency of Natural Resources will be better able to provide us with prescriptive measures to reduce erosion along the banks and sedimentation in the Mill Pond.