Connecticut River Watershed Project Bolter, Keyer and Willard Streams; Canaan, VT

Executive Summary to River Corridor Restoration and Protection Grants Program Submitted by: Essex County Natural Resources Conservation District (ECNRCD) January 2008.

Background

"The Connecticut River drains nearly one sixth of New England and provides 70 percent of the Long Island Sound's fresh water. Its farmland, forests, and waters, as well as its unique communities and rich history, make it one of only fourteen American Heritage Rivers. The journey from source to sound passes through nearly every variant of the New England landscape, combining to form a mosaic that is truly the heart of New England". (The Trust for Public Lands; Connecticut River Program, 2006). The Connecticut River Watershed- from the River's source at the Canadian border to the Long Island Sound- is 7.2 million acres in size, and is drained by the 410-mile Connecticut River mainstem and thousands of miles of tributaries.

Bolter and Keyer Brooks and Willard and Leach Streams, tributaries of the Northern Connecticut River in the Town of Canaan, Vermont, have suffered from long-term human intervention, repeated conflicts with human infrastructure, and in 2004, a stream altering storm event. On the evening of July 13th the Town of Canaan experienced a microburst thunderstorm that sat over its hills for greater than two hours. Estimates of the rainfall were between six and eight inches. The results of the storm were immediate and devastating, including washed out bridges and culverts on VT Route 102 and town roads. Stream channels in the hills were widened and deepened by the extreme runoff, in some cases more than doubling in size. Sediment filled stream channels down in the river valley, causing streams to overflow with resultant damage to houses and farm fields. While much of the immediate damage was easily visible (i.e. - the devastation to roads and bridges), the long term effects of significant sediment movement are not known.

Sediment sources were numerous, with much of it coming from the road wash outs and the blowout of Willard Stream. An alluvial fan, present pre-storm at the stream's emergence onto the floodplain, filled with gravel and cobbles and sent its overflow down through houses along Rte. 102. One farm suffered damage when Keyer Brook's channel filled with gravel, prompting the waters to flow across fields for a 1/2 mile before reentering the main stem of the Connecticut. Two large gullies eroded where the water spilled from the field directly into the river. A substantial amount of sediment was produced that might well have been lessened by different management of the Keyer Brook corridor and an established, forested riparian buffer along the Connecticut. The long term effects are being felt in the mainstem of the Connecticut. Since the microburst, any quantity of precipitation causes the raw tributaries to carry more sediment to the River.

Aquatic weed beds from Stewartstown to Colebrook, New Hampshire have been buried by silt up to six inches in depth, and anecdotal evidence shows severe effects on fishing in the river. Evaluation of the dynamics is a necessary step toward the resolution of the interventions and conflicts the tributaries have endured, with resultant improvement of water quality and in-stream habitat.

Scope of Services

The Essex County Natural Resources Conservation District looked to the New Hampshire Charitable Foundation's Mitigation and Enhancement Fund for support for evaluation and remediation on four effected tributaries of the Northern Connecticut River. Knowing that full remediation of these tributaries could not happen without proper evaluation and assessment, the ECNRCD proposed to use the VT Agency of Natural Resources three-Phase fluvial geomorphic assessment protocol for assessment. It was the District's belief that through the assessment process, we could move towards the correction of the loss of important agricultural land in the tributary's vicinity, resolve issues with the Town of Canaan's pumping station (on Leach Stream), prevent future erosion of State and Municipal highways, and address the relevant concerns of private landowners/homeowners.

-Leach Stream, for which funding was sought and secured through the New Hampshire Charitable Foundation, has not been evaluated at this time (see 'Additional Stream Geomorphic Assessments' comments below). The three Upper Connecticut River tributaries that were evaluated, and for which Phase I and Phase II Assessments were conducted and completed, are as follows:

-Bolter Brook: A classic oxbow avulsion is imminent in the main stem at the mouth of this brook.

-Keyer Brook: a steep brook possessing the capability of damaging nearby roads, as it did during the storm of 2004. This stream also has had an impact on abutting farm land. **-Willard Stream:** a steep stream coming down from the north side of Mt. Monadnock.

Stabilization of these tributaries was, and remains, the goal of this assessment project. The objective of the grant proposal to the New Hampshire Charitable Foundation was to complete an assessment of the full extent of damage, to determine the stream dynamics causing the damage, inventory the erosion sites that continue to contribute sediment to the mainstem, and develop a remediation plan for those sites.

Methodology

Phase 1 of Geomorphic Assessment (following ANR Protocols);

-All maps and aerial photos available were examined to gain an historical perspective of stream dynamics. Landowners and town officials were spoken with in order to gain a full knowledge of damage and threats to human infrastructure and agricultural land.

-Following windshield surveys of the three tributaries, Phase I stream geomorphic assessment data, Steps 1-7, was collected and entered into the VT ANR developed Web Based Data Management System (DMS) to enable evaluation of all reaches and select those necessitating Phase II evaluation. The assessment utilized the most current version of the Stream Geomorphic Assessment Tool GIS Extension and followed protocols (including quality assurance procedures) specified in the most current version of the Vermont Agency of Natural Resources (ANR) Stream Geomorphic Assessment Phase 1 Protocols Handbook.

Phase II of Geomorphic Assessment (following ANR Protocols);

-Field assessment work (Phase II geomorphic and habitat assessment) was conducted in selected reaches on the tributaries, including cross sections, grade measurements, pebble counts, etc. All sketch, photo and geomorphic and habitat assessment data, Steps 1-7, was entered into the ANR DMS. Data has been, and is in the continued process of being evaluated and maps will be developed. Assessment of in-stream habitat for potential restoration projects has begun.

-Field verified Phase I data, and corrected (where necessary) in the ANR Phase I DMS.

-Field sketches (and GPS locations) were used to create GIS coverages and document the location of: reach and segment breaks, photo points, and other definite features located during the field assessment.

Discussion

Overall the reaches assessed on **Bolter Brook** were in fair condition for both geomorphic and habitat. The stream sensitivity is high for both segments of M1, with the stream continuing in adjustment from the flooding of 2004. **M1A**, beginning at the Rte. 102 bridge and winding downstream to the confluence with the Connecticut River, is of a very broad confinement, with decent buffering of crops and pasture on both its banks. A perched culvert at the upper end of the reach, just below the Rte. 102 bridge, could use attention regarding its fish passage limitations. This B4c riffle-pool stream segment lies in great contrast to the M1B segment just upstream of the Rte. 102 bridge. **M1B** (a cobbled, C4 riffle-pool stream) encompasses 1,770 feet of brook riddled with flood chutes (six) and large debris jams (3+), remnants of the flooding event in 2004. At the time of assessment, two years after the flood, the debris jams are continuing to influence the channels movement. Fish habitat was noted as good and substantial buffers and bank vegetative protection along both banks was observed. Channel aggradation and degradation processes were note in reference condition, though the high frequency of debris jams, noted above, made the brook exceptionally difficult to access.

Phase II assessment determined that **Keyer Brook**, as a whole, is recovering well from the flood in most locations. A dirt road, (Canaan Hill Road) does impact the river for a good majority of the reaches assessed, but overall the reaches possess good buffer (between 26 and 50' in most locations). **M1 and M2A** are both C4 riffle-pool segments. An old, 4.8' dam is present in M2A, straightening has occurred in the stream and a large bulldozed berm adjacent to the Richard and Emily Norris farm is effecting flow. The buffer vegetative type found on the left bank of M1 was dominantly herbaceous, but found to be dominantly invasive (namely Japanese knotweed; *Polygonum cuspidatum* Siebold & Zucc)

along the brook's right bank. The riparian corridor on both banks was noted as crop/pasture/hay. In the riparian geomorphic assessment, the adjustment process of 'channel degradation' (incision) in M1 was found in reference condition with low incision and entrenchment ratios, and no known flow alterations present (i.e. increases in flow or decreases in sediment supply). M2A exhibited bolder/cobble texture on both of its steep left and right banks, with a pasture hay riparian corridor present on the left and a forested corridor on the right. The epifaunal substrate and available cover habitat parameter was found to be in reference condition in the rapid habitat assessment, and the reach presented again reference condition with little or no enlargement of islands or point bars and <5% of the brook's bottom affected by sediment deposition. The morphological diversity (in this case the frequency of riffles and steps) was found to be reference in condition, while its worth noting that the riparian vegetative width zone of the left bank was found in poor condition. In rapid geomorphic assessment, the channel aggradation (i.e. 'shallow pool depths, high frequency of debris jams and course gravels, cobbles and boulders embedded with sand/silt and fine gravels') was noted in reference condition. M2B is a F4 riffle pool segment with 100' of development on the left bank but otherwise substantial buffering on both banks. Bank erosion was evident on the often times undercut banks slopes of this segment. For habitat parameters, epifaunal substrate and available cover, channel alteration, frequency of riffles/steps and bank vegetative protection the segment was found in reference condition. Riparian habitat assessment adjustment processes; channel degradation (incision) and aggradation, and a change in planform 'flood chute presence, island formation and/or multiple thread channels' for example), were noted in reference condition also. M3A and M3B are both C4 plane bed stream types, with M3A containing a great deal of ledge, along with a bridge and small culvert and berming (in attempt to block the brook's access to the old channel post flooding. M3B has river corridor encroachment by a dirt road (Canaan Hill Road) for 600'+ on the left bank, and a great deal of deposition acting similar to a potential alluvial fan. Both segments exhibited undercut bank slopes on their banks and riparian corridors of forest. The VT Rte. 102 bridge in segment A proved a channel and floodprone constriction, with deposition evident above. In M3B, riparian habitat assessment's habitat parameters epifaunal substrate and available cover, channel alteration, bank stability and the riparian vegetative zone all were found in reference condition, although heavy deposits of fine materials and increased bar development were present for a 'poor' sediment deposition habitat parameter condition. The step-pool bed features in this segment were found filled with sediment and multiple unvegetated bars were noted in this aggradational zone, lending it for segmentation in this reach. M3C is a B3 planebed stream with ledge present and tributary rejuvenation noted.

M4 functions as a B3 step-pool stream, in a narrowly confined manner with an 18- culvert and several significant areas of ledge. Several outcrops of bedrock are present as part of the valley wall on the right bank, and the road (again Canaan Hill Road) running along the stream's left bank (noted as having a poor riparian vegetative zone width) for 4,810 feet. The undercut slopes of M4 were noted as undercut with boulder/cobble texture and extensive bank erosion. An instream culvert of 18' in width proved a channel and floodprone constriction. Habitat for fish proved reference in many parameters of the riparian habitat assessment.

The twice segmented reach of **Willard Stream** that was assessed had, and continues to have, a lot going on and is continuing in its adjustment post flood. M1A, a C4 riffle-pool segment running from the Rte. 102 bridge to the confluence of the Connecticut River, differs greatly from its upstream presence. Multiple depositional features are present (mid, point, side and diagonal bars and one island), and erosion is present for 862' at between six and seven feet in height on the left bank and 1,165' (six to seven feet in height) on the right. The riparian corridor on both banks was dominated pasture/hay. The riparian habitat assessment determined a reference condition for the frequency of riffles and steps, and the presence of boulders and other large, natural obstructions was noted also. The segment proved in reference condition in regards to channelization, as 'dredging, straightening, berms and streambank armoring' was absent or minimal and the stream exhibited a normal pattern of movement. Many active and large flood chutes were present however, and evidence of 'recent channel avulsions, multiple thread channels, islands, and multiple unvegetated mid channel, delta or diagonal bars' were observed. The influence of two beaver dams was noted, and ice jam damage was evident on several trees along the channel. M1B encompasses the most interesting, and yet alarming, segment that was assessed, with berms on both banks totaling 774' in length and approximately 12' in height and significant windrowing on both banks. Many depositional features are present along with flood chutes carrying huge loads of debris, dropping much of it in the forested edge of the right bank. The channel in this segment is acting like an alluvial fan, with huge amounts of sediment working through the system with steep and diagonal riffles present and extensive braiding. The streams width spanned 104' where the cross section for this segment was conducted. The typical bank slope along this segment was steep, with conifers dominating and a sub-dominant presence of shrubs and saplings. Mass failures were common, particularly along the left bank. Both banks vegetative protection and riparian vegetative zone widths were found to be in reference condition overall however. The VT Rte. 102 bridge, spanning 48' in width, was found to be a floodprone constrictor, resulting in deposition both above and below its span. In the rapid habitat assessment, sediment deposition was found to be poor in condition, with 'heavy deposits of fine materials, increased bar development, >50% of the stream's bottom changing frequently, and pools almost absent due to substantial sediment deposition'.

STREAM	REACH	REACH CONDITION		STREAM
NAME	NUMBER	GEOMORPHIC	HABITAT	SENSITIVITY
Bolter	M1A	Fair	Fair	High
Bolter	M1B	Fair	Fair	High
Keyer	M1	Good	N/E	N/E
Keyer	M2A	Good	Good	High
Keyer	M2B	Fair	Good	Very High
Keyer	M3A	Fair	Good	Very High
Keyer	M3B	Fair	Good	Very High
Keyer	M3C	Fair	Good	High
Keyer	M4	Good	Good	Moderate
Willard	M1A	Fair	Fair	Very High
Willard	M1B	Fair	Fair	Extreme

Additional Stream Geomorphic Assessments

Leach Stream was not evaluated due to much of its length flowing through Quebec, Canada. The ECNRCD in consultation with the River Management Program will be attempting to move forward with this assessment in the coming year, with a final report submitted to the New Hampshire Charitable Foundation and the River Management Program pending assessment.

Bridges and Culverts

Bridge and culvert surveys have not been conducted to date in the Connecticut River Watershed (where it lies in relation to these aforementioned brooks and streams). All three assessessed tributaries flow under VT Rte. 102, with undersized, and in one instance perched, culverts affecting the waters flow on Bolter and Keyer Brooks. All of the bridges and culverts present in the study site should be evaluated in the near future if possible.

Potential Restoration Projects

Willard Stream in Canaan, Vermont has flood damage, depositional issues related to the bridge at VT Rte. 102, and berm height's of 12 feet where an adjacent landowner has attempted to protect a reinstalled snow mobile bridge and adjust the movement of the stream at this location. The channel is acting as an alluvial fan, working large amounts of sediment through its system, causing stream braiding. Windrowing in two locations is significant. Phase I and II assessments have been completed for this stream, with the objectives of this grant to address Category 2, with Project Identification and Development. Essex County NRCD proposes to utilize the most current ANR 'Guide to Identification and Development of River Corridor Protection and Restoration Projects'. The District has worked in collaboration with the RMP on assessments with technical assistance, training and with

data review for project development, and will continue to coordinate activities with them similarly. There is opportunity for corridor easements on the lower reaches of any of these streams (and on Willard above the bridge), planting, keeping livestock out of the stream, etc.

Conclusion

Phase II assessment determined that Keyer Brook, as a whole, is recovering well from the flood in most locations, while Willard and Bolter continue in their adjustment. . In general, while forested riparian buffering and in some instances pasture floodplain is adequate along these three tributaries, the damage we expected to find resulting from the 2004 flood event, was present.

A pre-proposal for River Corridor Restoration along Willard Stream has been submitted to the DEC's River Management Program for consideration. Flood damage and depositional issues related to the bridge at VT Rte. 102, and berm height's of 12 feet where an adjacent landowner has attempted to protect a reinstalled snow mobile bridge and adjust the movement of the stream at this location are cause for attention.