Managing Streams Toward Equilibrium Conditions: A Case Study of the Vermont River Management Program

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http://www.anr.state.vt.us/dec/waterq/rivers.htm

ABSTRACT:

The Vermont Agency of Natural Resources' River Management Program (RMP) promotes the planning, designing, and protecting of river corridors that will accommodate stream meander and floodplain processes as the most economically and environmentally sustainable river management alternative. The RMP is analyzing the reference fluvial processes and geomorphic condition and documenting the current physical condition of rivers throughout the state using a set of three fluvial geomorphic assessment protocols. The RMP is also assessing the erosion hazards and habitat impacts associated with watershed and channel modifications.

Assessment data show that berming, armoring, and dredging have modified the hydraulics of streams and have led to the systemic channelization of stream networks. Channelizing rivers into a straightened condition was to hasten runoff and maximize the use of valley-bottom land for railroad and road networks, agriculture, and development. The systemic channelization and extensive use of structural measures such as rock riprap and other revetments have created the public perception that rivers should not move. Moreover, after a century or more of channelization with structural measures, erosion hazards have increased, aquatic and riparian habitat remain degraded, and nutrient loading from erosion is still increasing. Repeated and costly efforts to control long lengths of rivers as static, straightened channels is proof that channelization with structural measures is unsustainable public policy. This is particularly the case if channelization practices keep rivers in an unstable evolutionary process, such as incision. Some measures of structural control to protect public and private property will be necessary. Nevertheless, by not intervening on every eroding stream bank, discouraging river corridor encroachments, and accommodating stream meander and floodplain processes, the RMP is allowing streams to evolve back to equilibrium conditions.

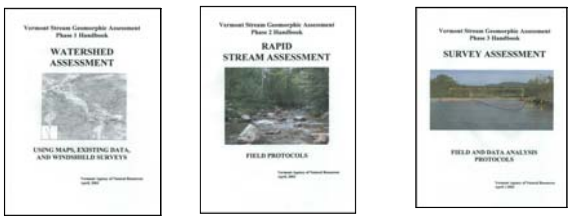


Figure 1:
Vermont Geomorphic Assessment Protocols

Conclusion: The RMP is using the assessment data to identify the watershed and reach-scale stressors which explain the departure (from reference) and sensitivity of existing conditions. Mapping the departure and sensitivity of reaches in the context of vertical and lateral channel constraints throughout the stream network can explain the type and rate of channel evolution processes underway and how adopting certain management practices can accommodate, preserve, or restore equilibrium over time. The RMP is partnering with state and federal resource agencies to provide private landowners and local governments a consistent message about the problems that arise from channelization practices in order to build support for actions that can lead to sustainable and healthy river systems.

Figure 2: Present Day Channel Adjustments Date Back to Watershed Changes Associated with Settlement Patterns and Modification of Channels and Floodplains.

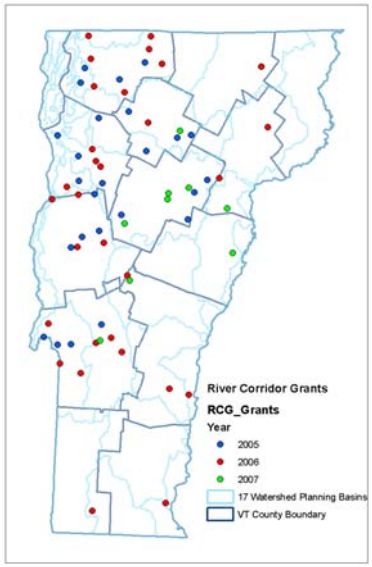


Figure 3. Geomorphic Assessment and Restoration Projects within VT's 17 independent watersheds

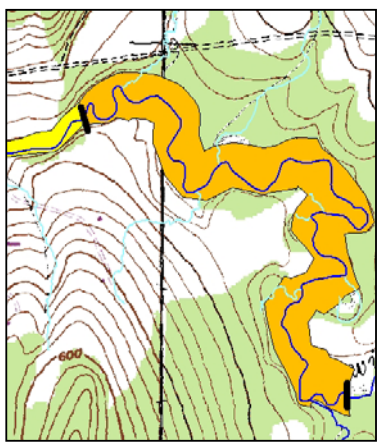
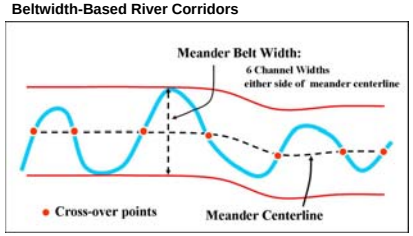


Figure 4: VT Fluvial Erosion Hazard Program: A Geomorphic Approach to Erosion Hazard Assessment to Mitigate Hazards Through Protection of Meander Beltwidth-Based River Corridors



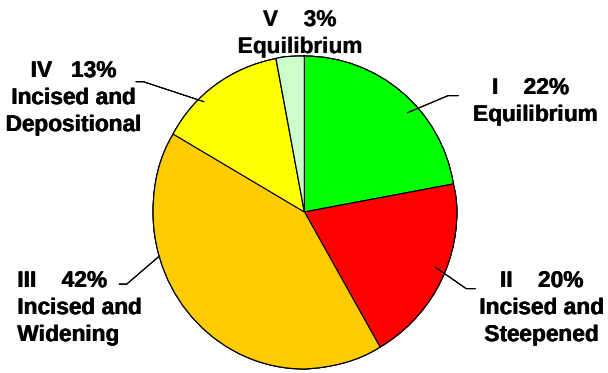
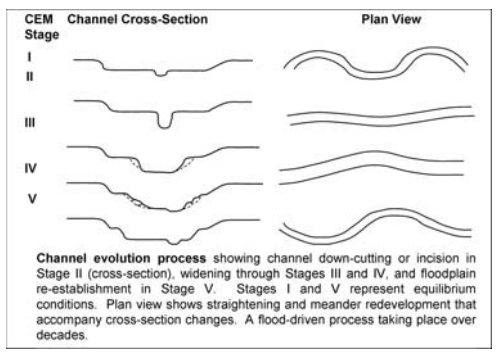


Figure 5. Results of Assessing 757 stream-miles in Vermont

Approximately 75% percent of 760 stream-miles assessed by the Vermont State River Management Program are losing access to floodplains, the direct result of the stream channel instability. The primary concern is the likely increase in erosion and flood hazards due to channel instability.

Evolution Stage	*Number of Segments*	*Percent Segments*	*Number of Miles*	*Percent Length*
I	208	20%	168	22%
II	256	24%	148	19%
III	415	39%	317	42%
IV	139	13%	102	14%
V	40	4%	23	3%
Total	1,058	100%	757	100%

Table 1. Data for the Assessed Stream-Miles in Vermont



Channel evolution process showing channel down-cutting or incision in Stage II (cross-section), widening through Stages III and IV, and floodplain re-establishment in Stage V. Stages I and V represent equilibrium conditions. Plan view shows straightening and meander redevelopment that accompany cross-section changes. A flood-driven process taking place over decades.

References:

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