Notes from Draft Tactical Basin Plan:

Hardwick is mainly in the Upper Lamoille sub-basin which includes the headwaters of the Lamoille mainstem, originating in the northwest corner of Wheelock, along the east side of Vermont Route 16 at the outlet of Horse Pond and flows in a southwesterly direction to Hardwick, ending at the outlet of Hardwick Lake. This area is primarily forested and valued for its timber harvest, active pastoral landscape and small productive town centers. Alder Brook supports a large riparian wetland complex from Greensboro to Hardwick where it flows into Hardwick Lake, a waterbody historically dammed for hydroelectric, but never utilized for that purpose. East of Hardwick, the Lamoille river flows in a westerly direction where Route 15 now follows the course of the river. In Hardwick Village, the river flows westerly and then northerly. The river has been armored and channelized through Hardwick Village in an effort to protect Route 15 and existing infrastructure in the floodplain.

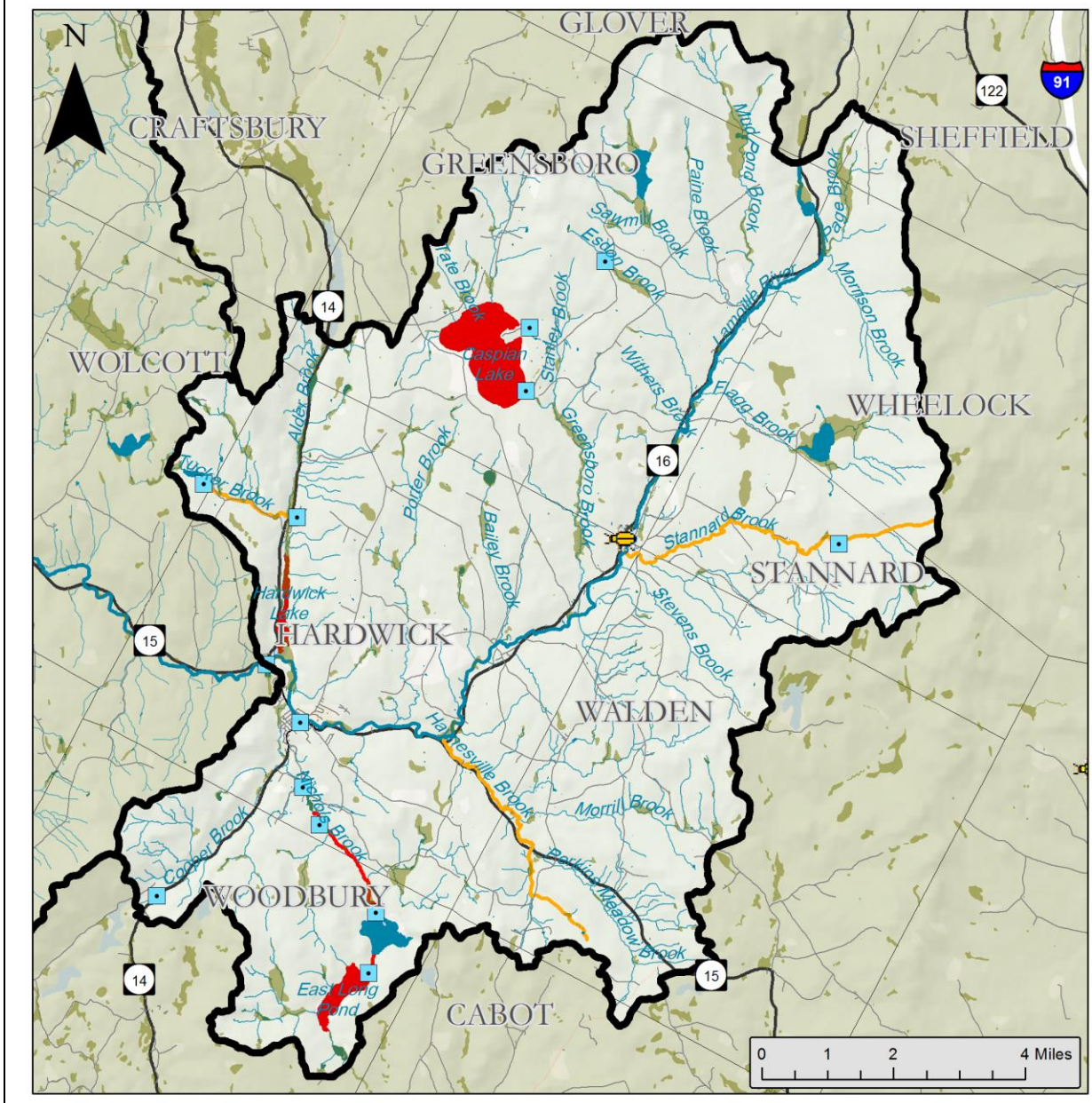
TBP notes significant wetlands in the upper Lamoille sub-basin, including, white cedar Hardbury Swamp in Hardwick (22 acres) surveyed by the Vermont Nongame and Natural Heritage Program in 1996.

Table 1. Status of rivers, streams, lakes, and ponds in Upper Lamoille (Hardwick only).

Stream or lake segment	Town	Mileage & status	Pollutant(s)	Primary Stressor	Use Impairment	Problem/Source
UPPER LAMOILLE						
Altered						
VT07-21L05 Hardwick Lake	Hardwick	145 acres ***Altered*** Part F list	Flow alteration	Flow alteration	Aesthetics, aquatic life support	Water level fluctuation
Stressed						
Haynesville Brook	Walden, Hardwick	***Stressed***	Physical alteration, sediment	Channel erosion	Aesthetics, aquatic life support Secondary contact recreation	Post-flood work, streambank erosion
Tucker Brook	Hardwick	***Stressed***	Physical alteration, turbidity, siltation	Channel erosion	Aesthetics, aquatic life support Secondary contact recreation	Post-flood work, streambank erosion
Stannard Brook	Wheelock, Stannard, Walden, Hardwick	***Stressed***	Sediment	Channel erosion	aquatic life support	Floods and post-flood work (1973, 95, 97); bank erosion; macroinvertebrates in fair condition 2002

Stressed waters support designated uses, but the water quality and/or aquatic biota/ habitat have been disturbed to some degree by point or by nonpoint sources of human origin and the water may require some attention to maintain or restore its high quality. In some instances, stressed waters may have documented disturbances or impacts and the water needs further assessment to confirm impairment.

Altered waters are affected by lack of flow, water level or flow fluctuations, modified hydrology, physical channel alterations, documented channel degradation or stream type change is occurring and arises from some human activity, OR where the occurrence of exotic species has had negative impacts on designated uses. These aquatic communities are altered from their expected ecological state.


N
GLOVER
CRAFTSBURY
GREENSBORO
SHEFFIELD
WOLCOTT
WHEELOCK
STANNARD
HARDWICK
WALDEN
WOODBURY
CABOT
14
15
16
122
91
Caspian Lake
Hardwick Lake
East Long Pond
Mud Pond Brook
Paine Brook
Sawmill Brook
Eaton Brook
Late Brook
Stanley Brook
Lamoille River
Sage Brook
Morrison Brook
Withers Brook
Flagg Brook
Alder Brook
Turkey Brook
Poder Brook
Greensboro Brook
Bailey Brook
Stannard Brook
Stevens Brook
Hardwick Brook
Morrill Brook
Copper Brook
Meadow Brook
0 1 2 4 Miles
Part F (altered flow regulation)
Stressed Stream/River
Part F (altered flow regulation)
Dam
Wetland
Bug Assessment
Fair
Good-Fair
Good

Types of monitoring and assessments that have been completed, or are ongoing or planned in the Lamoille watershed are:

- Stream geomorphic assessments
- Water quality monitoring
- Biological monitoring
- Agricultural Assessment and Planning
- Better Back Roads/Road erosion inventories
- Stormwater master planning and Illicit Discharge Detection and Elimination (IDDE) infrastructure mapping

Table 4. Status of assessments for the Lamoille River Basin

Sub-Basin	Geomorphic Assessment	Water Quality Monitoring	Biomonitoring	Agricultural Assessment and Planning	Better Backroads/ Road Erosion Inventory	Stormwater master plan or Illicit Discharge Detection
Upper Lamoille	PC, X	O, X	O, X	X	X	PC
Middle Lamoille	PC, X	O, X	O, X	X	PC	X, PC
Lower Lamoille	PC, N	O, X	O, X	X	X	X, PC

X= proposed in plan C= Completed PC= Partial Completed O= On-going U= Underway N= not proposed at this time

Stream Geomorphic Assessments:

The major commonalities across **all** reports was the importance of **riparian buffers with woody vegetation, river corridor protection**, and adequate sizing and placement of structures (bridges and culverts). The application of these three strategies would largely negate the need for high cost projects to protect and restore infrastructure. A combination of proactive measures (i.e. local zoning, **building outside the river corridor protection zone**, and sizing structures adequately) and implementation of priority projects will result in local economic benefits, public safety, clean water, and wildlife habitat protection. Protecting floodplains and wetlands upstream and downstream of developed town centers and villages is an important tool for protecting water quality as well.

The Upper Lamoille SGA was completed in 2009

Upper Lamoille

Preliminary management strategies were identified for each reach assessed for the Upper Lamoille. These management strategies should be reviewed and those strategies that are still priorities should be scoped and implemented. The main concerns were sediment inputs from Hardwick Village and flood

storage capacities upstream. Ensuring floodplain access, reducing stormwater inputs, and restoring Alder Brook at the Hardwick Dam are high priorities.

Surface waters recommended for SGA and river corridor planning are Kate Brook, Tucker Brook, Bunker Brook, Stannard Brook, and Haynesville Brook.

C. Actions to encourage stream equilibrium and wetland and river corridor protection							
BASINWIDE							
C1	Basinwide with a focus on target towns	Protect river corridors to support flood resiliency and river equilibrium in target areas	Hardwick, Wolcott, Johnson, Cambridge, Jeffersonville, Westford		Land erosion, encroachment, channel erosion	VDEC SGA and River Corridor Mapping, RPC Flood Resiliency Program	VDEC - Rivers, LCPC, CNRCD,
C2	Lamoille River	Assess and catalogue VFWD riparian/streambank parcels for streambank protection and potential easement opportunities	Multiple	Lamoille mainstem	Recreation, protection	VFWD, VDEC, Existing Uses, Appendix F	VDEC, VFWD
UPPER LAMOILLE							
C3	Hardwick Lake and Lamoille River	Propose and complete alternatives analysis for Jackson Dam	Hardwick	Hardwick Lake	Flood resiliency, channel erosion, flow alteration	Dam safety report	Town of Hardwick, Hardwick Electric, VDEC, CCNRCD, USFW, Army Corps of Engineers
C5	Haynesville Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Walden, Hardwick	Entire stressed segment ***Stressed***	Encroachment, flood resiliency, channel erosion, land erosion	VDEC Water Quality Assessment Report, 2016 Stressed Waters	VDEC – Rivers, CCNRCD, NVDA

						List	
C6	Tucker Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Hardwick	Entire stressed segment ***Stressed***	Encroachment, flood resiliency, channel erosion, land erosion	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC – Rivers, CCNRCD, NVDA
C7	Stannard Brook	SGA and river corridor plan to identify stressors and priority projects to address stressors	Wheelock, Stannard, Walden, Hardwick	Entire stressed segment ***Stressed***	Encroachment, flood resiliency, channel erosion, land erosion	VDEC Water Quality Assessment Report, 2016 Stressed Waters List	VDEC – Rivers, CCNRCD, NVDA
C8	Upper Lamoille Mainstem	Follow up on preliminary management strategies identified in the Upper Lamoille River Phase 2 SGA	Greensboro, Hardwick		Reach 25A to 30B	Upper Lamoille River Phase 2 SGA	
C10	Upper Lamoille waters	Work with towns to adopt river corridor protection	Hardwick, Stannard, Wheelock, Walden, Greensboro, Craftsbury, Woodbury		Channel erosion, encroachment, flood resiliency, nutrients	Municipal Protection Matrix, ERAF database	NVDA, CVRPC, municipalities, VDEC – Rivers

Conditions and recommendations noted from Upper Lamoille SGA (2009)

Reach 25A begins at a railroad bridge behind the Grand Union on Route 15 in Hardwick and ends just upstream of Jackson Dam. This segment is impounded and was not assessed. The impoundment causes the Lamoille River at this location to overflow, which has created a wetland area surrounding the river, and a nearby lake known as Hardwick Lake. Jackson Dam is a store and release dam and the waters are drained annually.

The dam was originally built around 1914 for the purpose of storing water for the downstream hydroelectric generating facility at Wolcott. Due to this annual drainage the wetland and lake environment that has been created is not high quality because the habitat cannot be sustained throughout the year. The drainage is done to help protect Hardwick village from flooding and ice jamming. A consideration of the removal of Jackson Dam is recommended as it affects additional segments upstream towards Route 16, and is at the downstream end of Hardwick village. The recommendation of the removal of Jackson Dam is also noted in the Lamoille River Basin Plan, authored by the Vermont Department of Environmental Conservation (http://www.anr.state.vt.us/dec/waterq/planning/htm/pl_lamoille.htm).

Reach 25B begins at the bridge on Main Street in Hardwick village and ends at the railroad bridge. It is characterized by significant armoring as it turns through Hardwick village. There is a berm along the left bank for more than half the segment protecting Route 15. Development is also significant, particularly on the left bank, with multiple urban stormwater inputs. The stream bed features bedrock at the upstream end of the segment and slightly steeper gradient, which then slows to gravel dominated, featureless "plane bed" stream for the majority of the segment. The confinement is narrow due to streamside encroachments, however floodplain is still accessed along the right bank. The geomorphic condition for this segment is recorded as "good" with channel degradation as the limiting factor.

- Ice jamming mitigation should be considered through this segment and in conjunction with
- the upstream reach data.
- The **open, undeveloped area along the lower right bank of this segment has potential for long term conservation**, as well as possibly expanding floodwater storage. Long term planning with the town to protect this area could be highly beneficial to the village of Hardwick to protect it from ice jam and flood event inundation. Additional measurements should be taken to assess floodplain access along the right bank of this undeveloped area. If the access becomes challenged by bank and floodplain height, excavation of the floodprone area may be recommended to achieve additional floodwater storage, if necessary.
- Long term monitoring of the existing bank armoring will be necessary as the stream bed is degrading and the armoring is showing evidence of being undermined.

Reach R26 begins at the confluence of Haynesville Brook near the junction of Routes 15 and 16 and continues until it reaches Hardwick village at the Main Street bridge. Porter Brook enters

this reach about midway. Intermittent armoring noted. Potential for smaller buffer projects noted (like tree plantings).

- Haynesville Brook and Porter Brook are the two main tributaries on this reach that should be monitored for sediment input. Haynesville's sediment source is largely due to erosion, planform change and lack of buffers. Porter Brook is steeper, and its sediment inputs are largely due to upstream inadequate road infrastructure, undersized culverts and land use. Continued work with the town of Hardwick is recommended to address road and structures along Porter Brook. Buffer opportunities along Haynesville Brook should also be considered.

Reach 27A begins at the Riverside farm bridge off Route 16 and continues downstream to the Haynesville Brook confluence at the junction of Routes 15 and 16. Erosion is prevalent on meander bends and two mass failures are noted. Erosion where the river abuts Route 16. This stream segment lies in the first broad valley upstream of Hardwick village. It may provide critical floodwater storage. The development is relatively minimal and there are only 3-4 main landowners from this lower segment break and upstream to the falls in Hardwick village.

Reach 27B begins at the downstream end of the falls in Hardwick village and ends at the Riverside Farm Bridge. This reach is flanked on its left corridor by cropland (vegetable farm) and the valley wall on its immediate right. There are minimal depositional features, showing minor evidence that the stream channel is attempting to pull away from the valley wall on its right. The landowner has noted erosion problems but has not installed any armoring or revetments along the fields.

- Conservation easement consideration for the agriculture fields would be recommended, which would allow for agricultural use, but consider river restoration in the long term. Reach 27A and 27B should be considered as critical floodwater storage upstream of the village of Hardwick. It is important to monitor incision ratios along both segments to ensure floodplain access in the long term.

Reach 28B lies in the open area just upstream of the falls in East Hardwick village. The bridge and weir are channel constrictions, and there is deposition noted upstream. There is good floodplain access along the right bank, with an incision ratio of 1.0 and evident historic channels in the floodplain.

- The floodplain area along the right bank upstream from the village is currently undeveloped and is providing critical floodwater storage for East Hardwick. Consideration of a conservation easement on this floodplain is recommended, both to protect the floodplain and to allow channel planform adjustment to

continue to take place. Long term planning with the town to look at current and future zoning options may be another way to help protect this resource.

Reach 28C begins at the lower end of Michaud Farm's fields, follows along the railroad and ends at the open fields upstream of East Hardwick village. The river is reasonably stable through this section. The geomorphic and habitat conditions are both recorded as "good" for this segment, with moderate stream sensitivity. The bridge on Route 16 is the most prominent area of conflict, but it's not likely to modified.