Vermont Agency of Natural Resources

Watershed Management Division

2018 White River Basin – Basin 9

TACTICAL BASIN PLAN

DRAFT

The White River Mainstem below the confluence of the Tweed River in Stockbridge.

Approved:

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Emily Boedecker, Commissioner Date

Department of Environmental Conservation

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Julie Moore, Secretary Date

Agency of Natural Resources

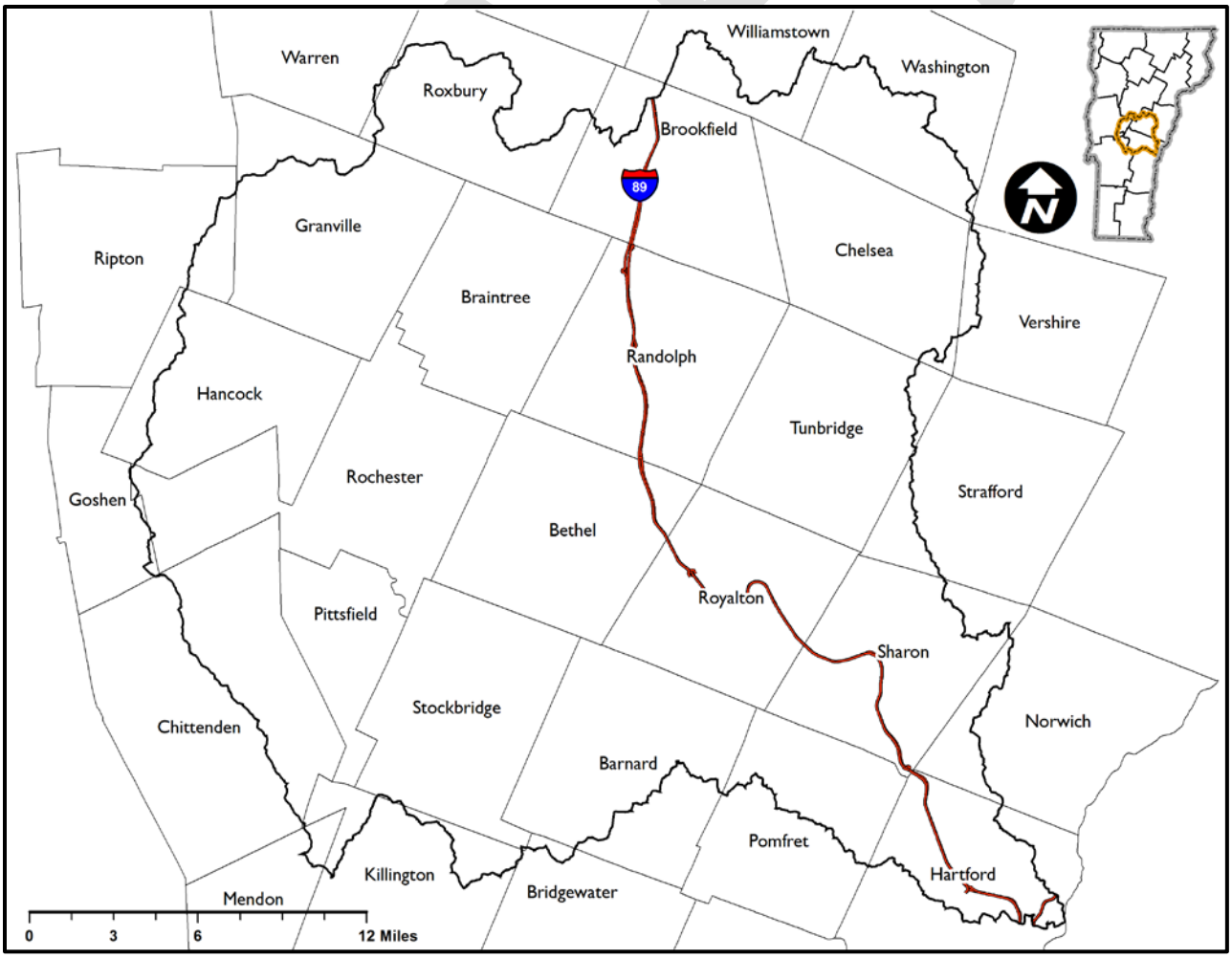
Photo credit: Jim Deshler

All Towns Basin 9

Barnard	Goshen*	Pittsfield	Sharon
Bethel	Granville	Pomfret	Stockbridge
Braintree	Hancock	Ripton*	Strafford*
Bridgewater*	Hartford	Randolph	Tunbridge
Brookfield	Killington*	Rochester	Vershire*
Chelsea	Mendon*	Roxbury	Warren*
Chittenden	Norwich	Royalton	Washington
			Williamstown

**Only a very small area of the town is in the watershed and is covered in more detail in a corresponding basin plan.*

Basin 9



White River Basin Tactical Plan Overview

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Executive Summary

The White River Tactical Basin Plan (TBP) provides an assessment of watershed health and defines on-going and future strategies to address high-priority surface water stressors and opportunities for protecting high quality waters (see Surface Water Management Strategy.)

The five chapters in this plan provide a framework to understand the White River basin, its unique values and challenges related to water quality, and the where and how to carry out priority actions to protect, maintain, enhance and restore water quality in the basin.

Chapter 1	Chapter 2	Chapter 3	Chapter 4	Chapter 5
•Overview of the watershed •Tactical basin planning and implementation process	•Priority waters for remediation and protection •TMDL information	•Monitoring and assessment information •Water quality conditions in the basin	•Regulations and initiatives for protecting and maintaining water quality	•Implementation actions and strategies •Monitoring recommendations

The White River Basin encompasses 710 square miles in Vermont, draining portions of Addison, Orange, Rutland, Washington, and Windsor Counties. The basin covers significant portions of 20 individual towns. The White River mainstem is approximately 56 miles long and is the longest free-flowing large river in Vermont and the longest undammed tributary to the Connecticut River. An emerging network of designated recreational access sites, the White River Water Trail, showcases the basin's overall good water quality and provides opportunities for water-based recreation such as fishing, swimming, boating and related recreational uses. The mainstem of the White River is recommended as an Outstanding Resource Water for recreation and 42 waters have been identified for protection. In 2016, five waters were protected at the highest classification level (Figure 1).

Despite strong efforts to maintain existing conditions, some areas of the basin are experiencing a decline in water quality. **Four primary stressors** in the watershed that affect water quality are:

1. **Encroachment** of unpermitted stream alterations, non-buffered agricultural fields, and development within river corridors, floodplains, wetlands, and lake shores;
2. **Stream channel erosion** due to undersized crossing structures, lack of riparian vegetation for bank stabilization, and unmitigated increases in stormwater flow and volume;
3. **Land erosion** due to unmanaged stormwater runoff from roads, developed lands, and agricultural lands; and
4. **Pathogens** from sources that likely stem from bacterial communities in soils, waste runoff from domesticated animals and livestock, and out-of-date and failed septic systems.

Eleven priority waters are identified for remediation in Basin 9 (Figures 2 and 3). The priority actions described for each water are in process or will be carried out during the implementation phase of the 2018 White River TBP by watershed partners and stakeholders. A summary of implementation actions to address protection and restoration priorities, and a list of water quality monitoring recommendations is provided in Chapter 5, Table 20 and Table 21, respectively.

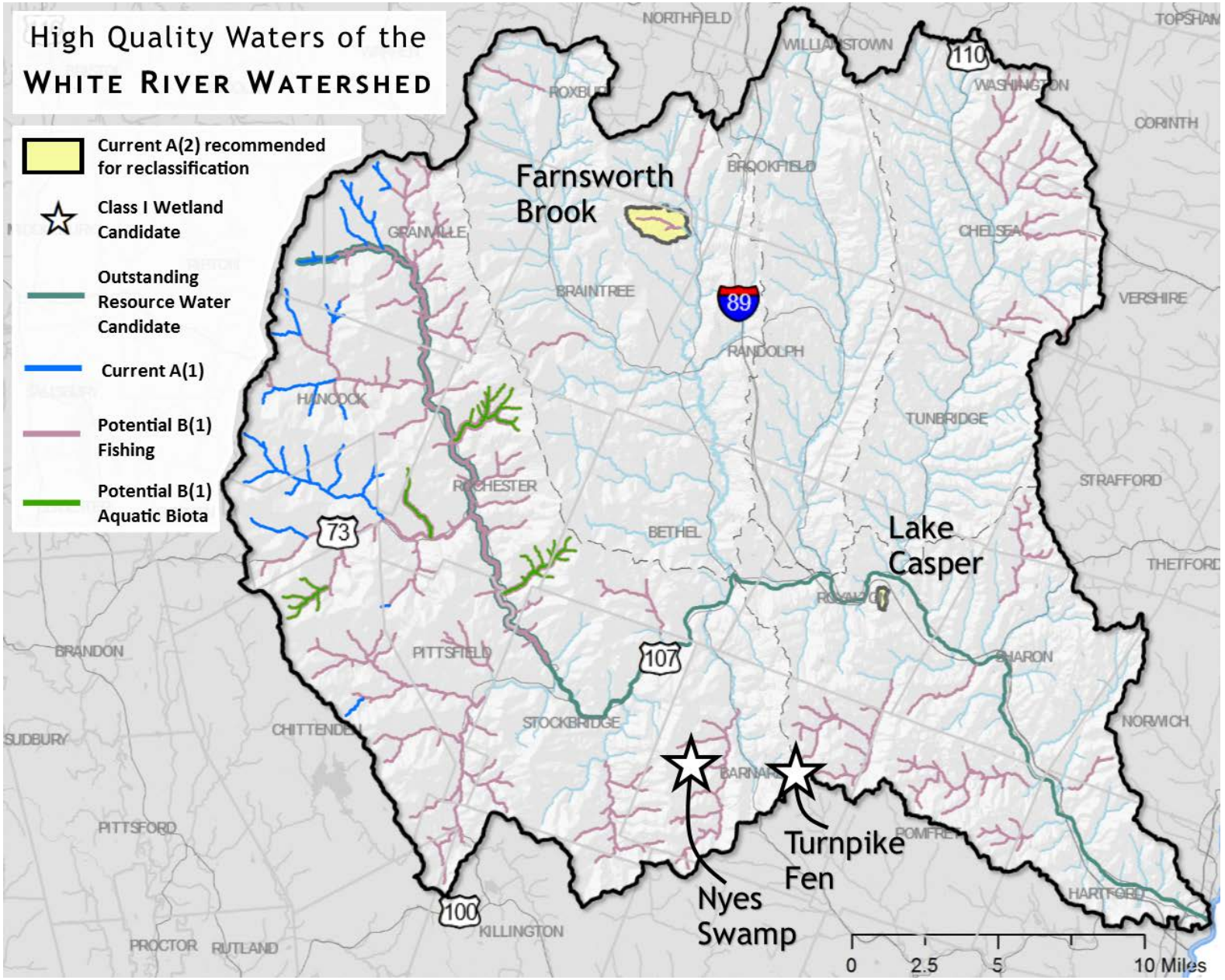


Figure 1. High quality waters of the White River basin

Priorities for Water Quality Remediation in the White River Basin

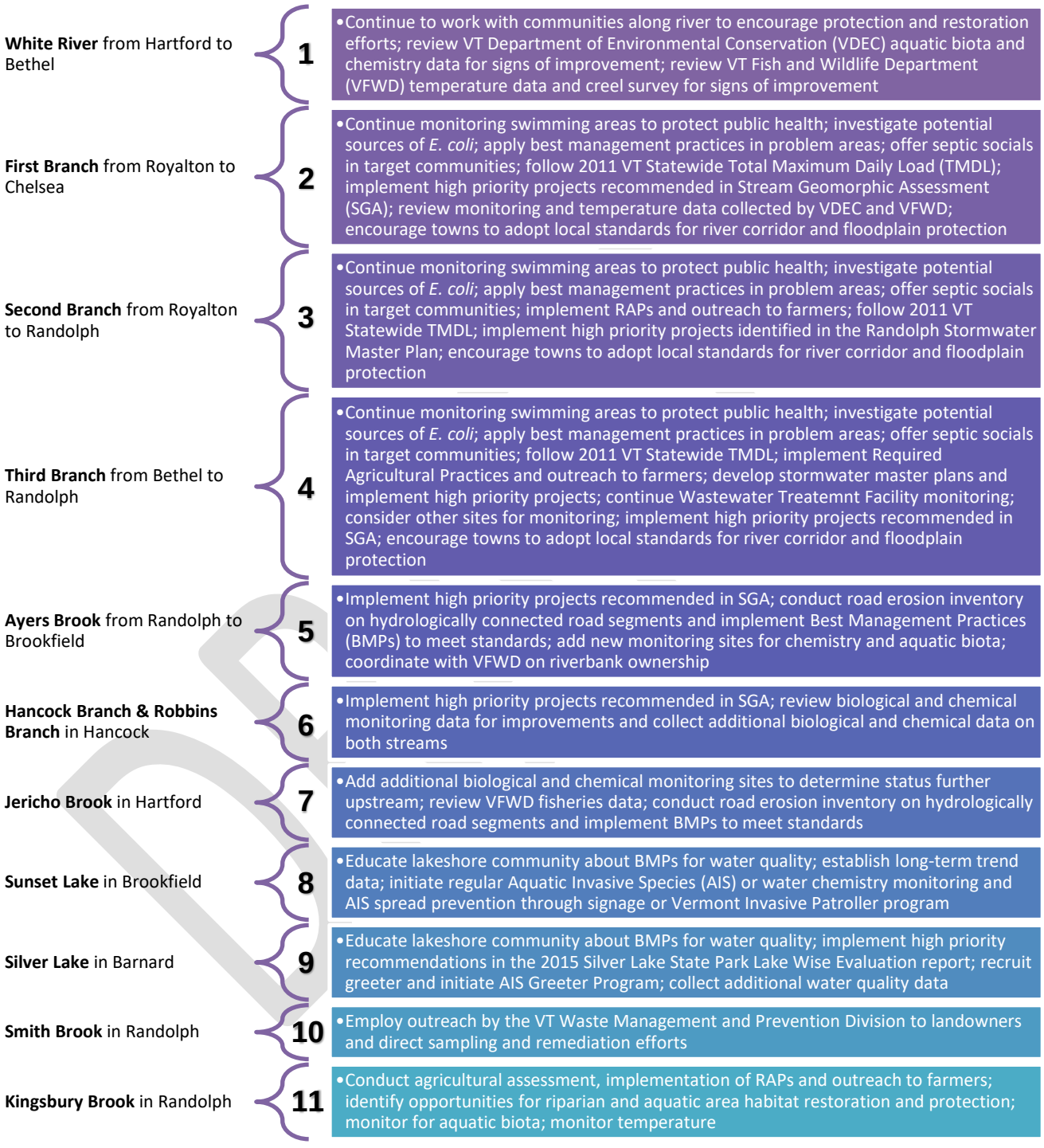


Figure 2. Priority waters and actions for remediation in the White River basin. See corresponding map in Figure 3.

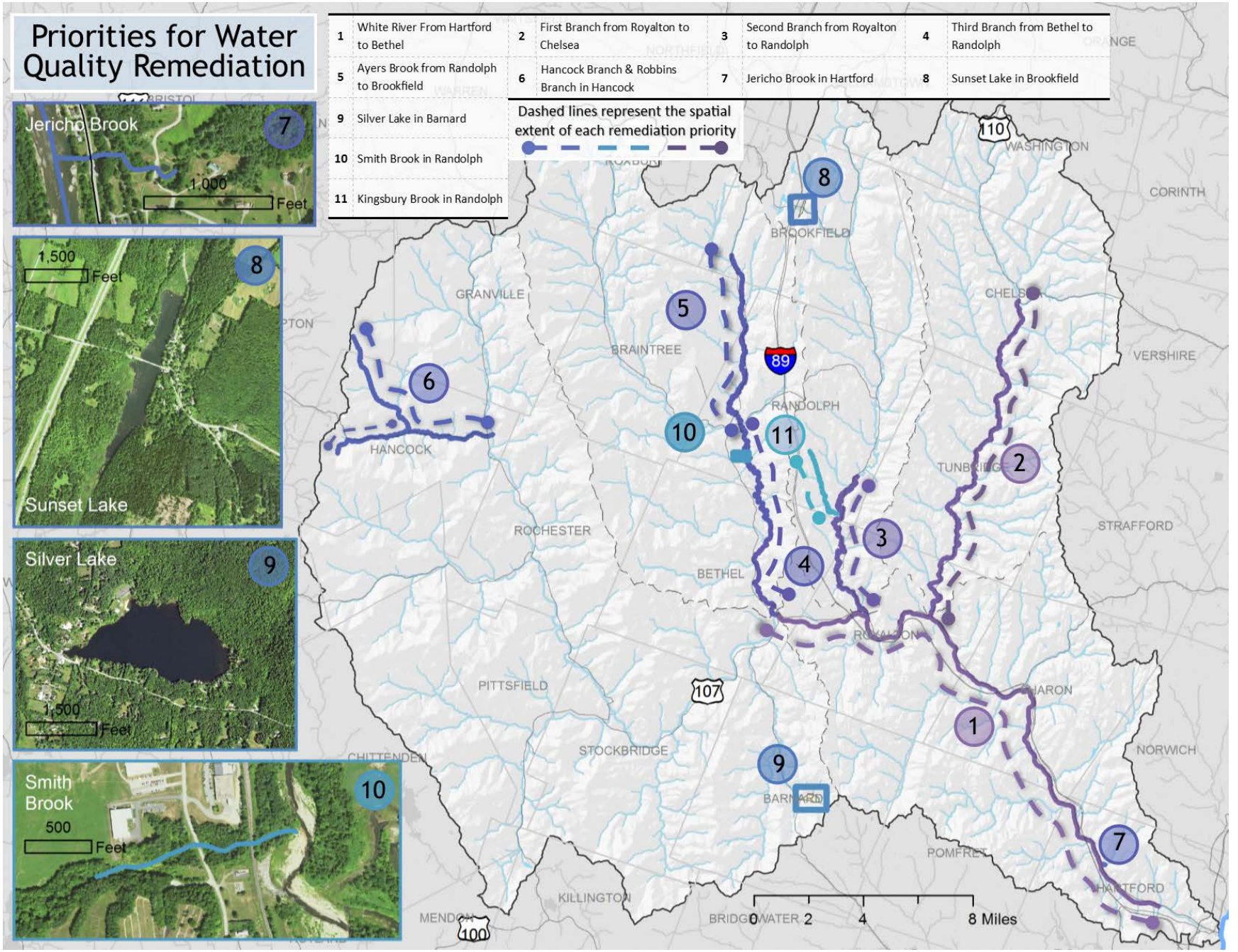


Figure 3. Targeted waters for remediation in the White River basin. Map corresponds with list in Figure 2. Detail boxes on left correspond with numbers on the map.

Chapter 1 – Watershed Description and Tactical Basin Planning Process

A. White River Watershed Overview

The White River Basin encompasses 710 square miles in Vermont, draining portions of Addison, Orange, Rutland, Washington, and Windsor Counties. The White River mainstem is approximately 56 miles long and is the longest free-flowing large river in Vermont and the longest undammed tributary to the Connecticut River. It originates in the town of Ripton on the slope of Battell Mountain and then flows southerly and easterly before emptying into the Connecticut River at White River Junction in the town of Hartford. The White River has five major tributaries including the First Branch, Second Branch, Third Branch, Tweed River and West Branch (Figure 4).

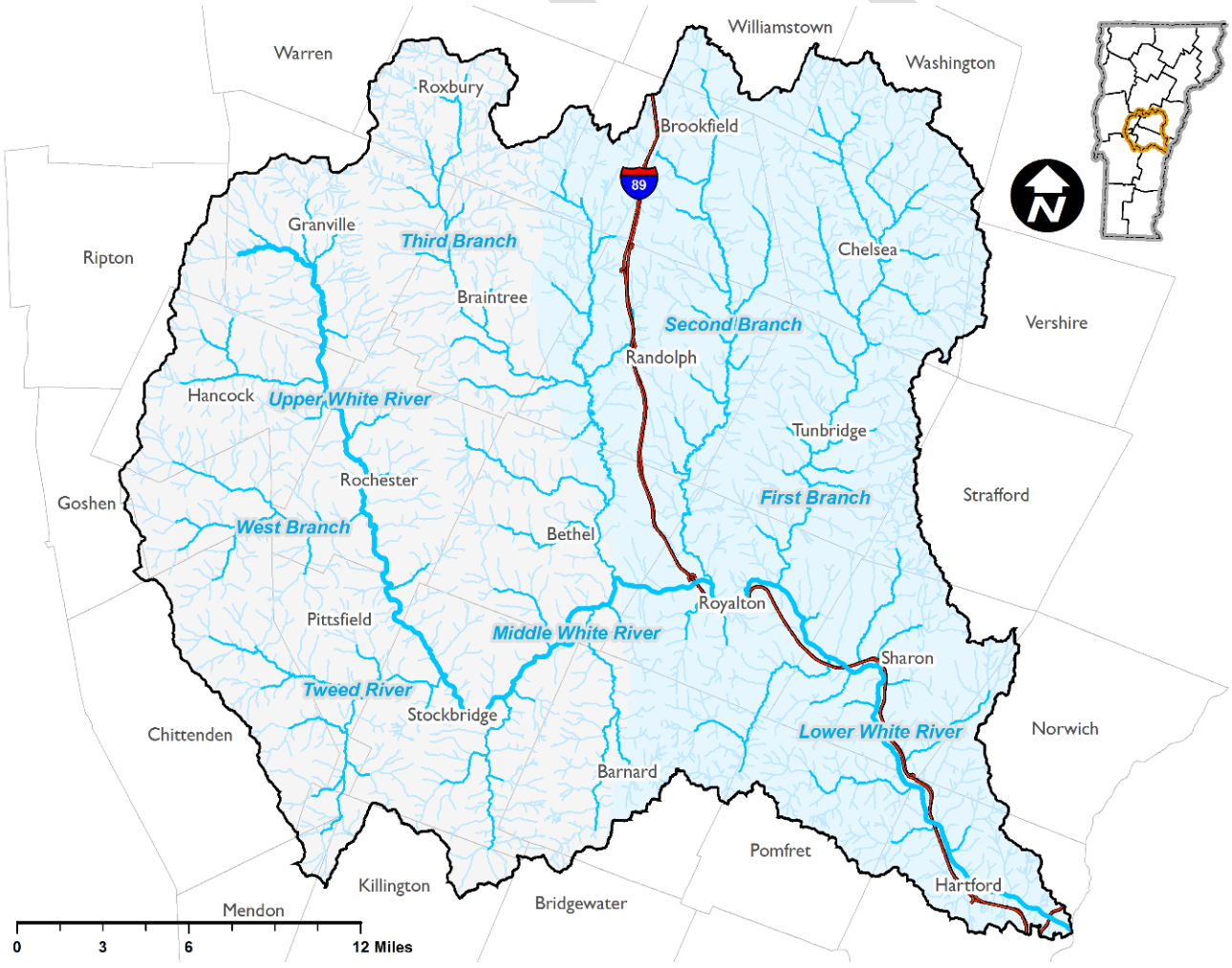


Figure 4. Rivers and streams in the White River basin. The boundary between the blue and grey shaded areas marks the Richardson Memorial Contact.

Geologically, the watershed is sliced in half by the geological formation known as the Richardson Memorial Contact, which runs north to south, roughly from the eastern edge of Roxbury to central Barnard (Figure 4). This contact point separates the post-Taconian carbonate rich rocks to the east from the older quartz-rich rocks to the west. This split in bedrock is relevant as it represents an underlying structure that affects the chemistry of ground and surface waters. The younger rocks to the east are less tightly formed and more porous than those of the west, therefore allowing water to penetrate more quickly, which recharges groundwater at higher rates than the west. Waters east of the split also have a greater buffering capacity, mitigating impacts from acid rain. Geologic resources along the contact in Basin 9 include chromium, iron, arsenic, copper, zinc and lead. To the east, quarried resources include white granite in Bethel, and talc, soapstone, serpentinite, and verde antique (Gale, 2018).

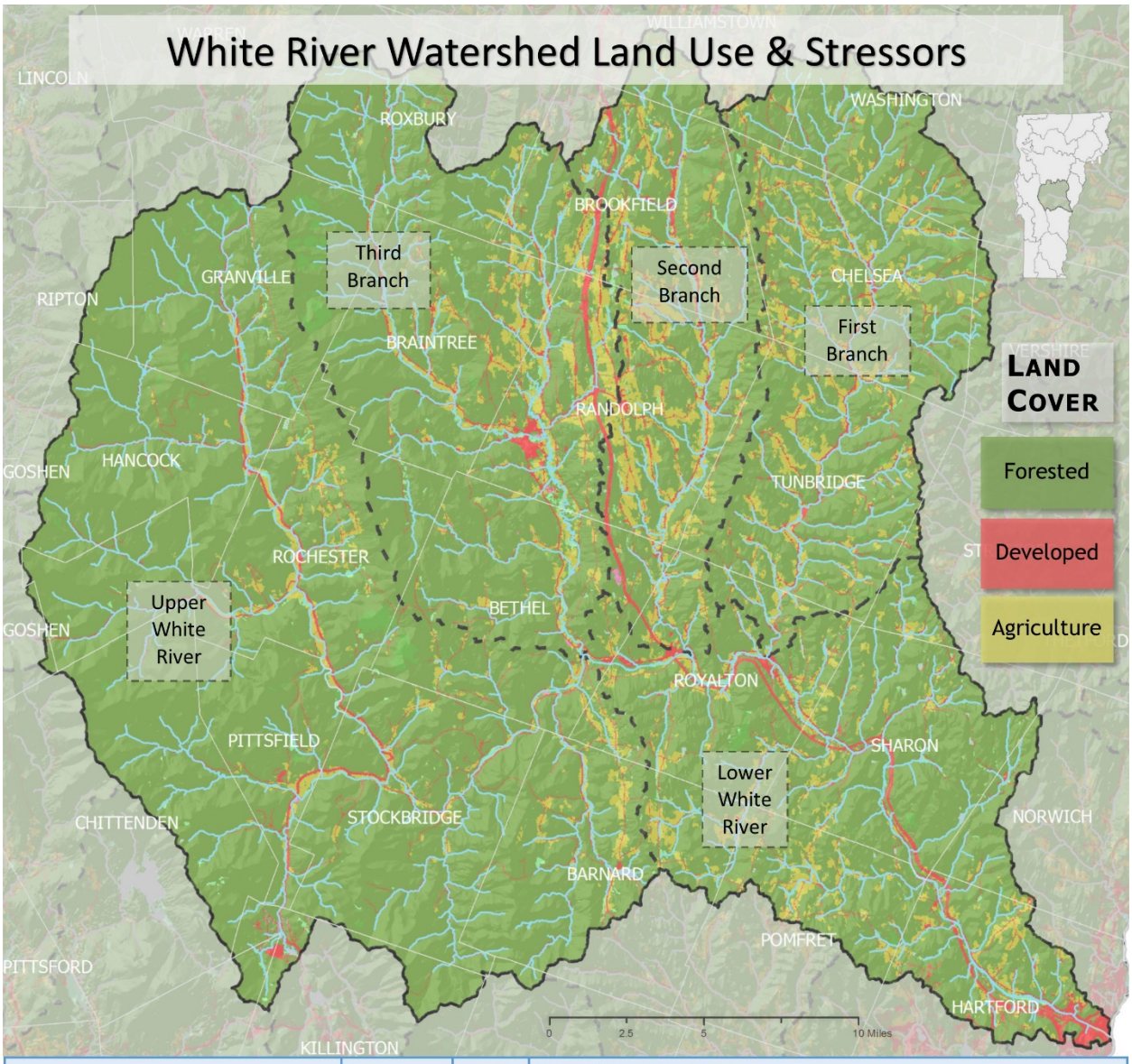
Background levels of naturally occurring minerals can be found in ground and surface waters throughout the basin and drive the species and natural community composition. Fens and the very rare Calcareous Riverside Seep and River Cobble Shore communities, as found in the White Ledges Natural Area, are located in the basin and support highly diverse plant communities. River Cobble Shore communities support the rare cobblestone tiger beetle and boulder beach tiger beetles (Thompson & Sorenson, 2000).

The rich sediments deposited by Lake Hitchcock after glaciation and alluvial sedimentation from historic flooding have created river valleys with rich soil better suited for agriculture than the steep hillsides. Because most of the river valleys throughout the basin are narrow, much development and agriculture are located along the rivers where soil is rich and deep, and the topography is flat. Unfortunately, this land use pattern also leads to surface water pollution from stormwater runoff and inherently higher flood damage risks from encroachment into the river corridors and floodplains.

B. Land Use and Water Quality

The basin[1] can be divided into five major sub-basins – the First Branch, Second Branch, Third Branch, Upper White and Lower White (Figure 5). Overall land use in the White River basin is 1.3% open water and wetlands, 4.6% developed (including the interstate and roads), 8.4% agriculture, and 82.7% forests (Figure 5). The forested landscape is largely responsible for the good water quality in the basin. Many of the areas in the White River basin that are experiencing degraded water quality trends are adjacent to dense road and residential development (Jericho Brook, Third Branch, Ayers Brook, Sunset Lake and Silver Lake) and agricultural lands (Kingsbury Brook, Second Branch and First Branch). Managing land use to reduce discharge of polluted runoff and allowing adequate space for treatment can both improve and protect water quality.

[1] A river basin is an area of land drained by a river and its tributaries. The terms 'basin' and 'watershed' are synonymous. The White River basin or watershed is also referred to as Basin 9.



Major Sub-basin & Top 3 Stressors	Drainage Area (mile^2)	Total River Miles	Percent Land Use Area			
			Wetlands & Open Water	Developed	Agriculture	Forested
Entire White River Basin	***712***	***1898***	***1.3***	***4.6***	***8.4***	***82.7***
Upper White - Encroachment, Channel Erosion, Acidity	271	661	1.1	3.0	3.5	90.6
Lower White - Encroachment, Land Erosion, Pathogens	125	342	2.7	6.5	9.2	79.0
First Branch - Encroachment, Nutrient Loading, Pathogens	105	316	0.8	4.6	12.0	79.5
Second Branch - Encroachment, Nutrient Loading, Pathogens	74	188	2.3	7.0	18.8	69.2
Third Branch - Encroachment, Land Erosion, Pathogens	137	391	1.8	4.8	9.0	80.3

Figure 5. Land cover estimates for the five major sub-basins of the White River watershed. (Source: 2011 LULC data)

Also related to the health of rivers and streams is the infrastructure – bridges and culverts – built to relay the flow of water under transportation corridors. Transportation corridors include state, local, and private roads, large interstates, logging roads, private driveways and railroads. Most of this infrastructure was built before engineers and scientists fully understood the balance required for managing sediment and flow to protect stream channels (and adjacent developed lands). The correct sizing and placement of structures plays a significant role in protecting water quality in the White River basin. Correctly sized structures prevent erosion and scouring upstream and downstream, allow for the passage of fish and wildlife, and reduce impacts from flooding.

Terrestrial invasive plant species also play a role in water quality that may not be immediately evident. Species introduced for use as ornamentals (wild chervil, buckthorn, goutweed, purple loosestrife, and common reed), wildlife forage (multiflora rose), agricultural crop (reed canary grass), and erosion control (Japanese knotweed and honeysuckle) have invaded wetlands, lakeshores, and river corridors making restoration of these areas challenging, while also decreasing species diversity that supports healthy aquatic habitats. Many invasive plants are brought in with fill during road and development projects. Early detection and prevention are the best strategies to combat invasives. Aquatic invasives species are addressed in the lakes and ponds section of this plan. Aquatic invasives can also be found in rivers.

C. Tactical Basin Planning Process

Tactical basin plans (TBPs) are developed, according to the goals and objectives of the Vermont Surface Water Management Strategy (VSWMS) and the Vermont Water Quality Standards (VWQS), to protect, maintain, enhance, and restore the biological, chemical, and physical integrity of Vermont's water resources. Accomplishing these goals and objectives protects public health and safety, and public use and enjoyment of these waters. The tactical basin planning process allows for the completion of TBPs for all of Vermont's fifteen basins every five years, as required by statute.

The process for issuing TBPs includes a review of water quality data and assessments to target strategies and prioritization of resources to those projects that will have the greatest impact on surface water protection or remediation. In short, tactical basin plans are an instruction booklet for protecting and restoring surface waters in Vermont.

The VSWMS lays out the goals and objectives of Vermont Department of Environmental Conservation's (VDEC) Watershed Management Division (WSMD) for addressing pollutants and stressors that can negatively affect the designated uses of Vermont surface waters. The strategy discusses 10 major stressors (Figure 6) and was updated in early 2017 to reflect new provisions of Act 64 (Vermont Clean Water Act) and the Lake Champlain and Lake Memphremagog Total Maximum Daily Loads (TMDLs).

The TBPs are also consistent with the U.S Environmental Protection Agency's (EPA) framework for developing watershed-based plans (Environmental Protection Agency, 2008). EPA's framework consists of nine key elements that ensure that the contributing causes and sources of nonpoint

source pollution are identified, key stakeholders are involved in the planning process, and that restoration and protection strategies addressing water quality concerns are identified. The tactical basin plan uses adaptive management, has a strong implementation sections, is an effective plan for

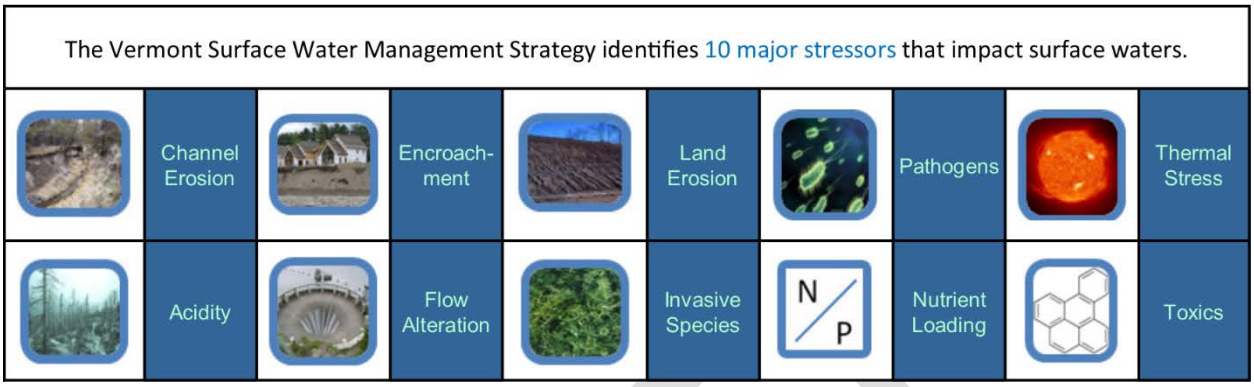


Figure 6. The ten major stressors used to develop remediation actions for surface waters.

restoration and protection, and identifies projects that are eligible for federal and state funding.

To implement the high priority actions required to protect, enhance, maintain and restore water quality, the TBP spells out clear attainable goals and targeted strategies to meet obligations laid out in the Vermont Clean Water Act and EPA's nine elements. The online Watershed Projects Database is a tool by which progress can be tracked regarding measurable indicators of each major goal. The 2013 Basin 9 Report Card located in Appendix A provides status and update information on each of the objectives identified in the previous basin plan.

The Summary Implementation Table in Chapter 5 will be revisited during each plan update and be modified accordingly to best address newly emerging information, unanticipated events, and new requirements by legislative acts such as Act 110, Act 16, and Act 64, now generally referred to as the Vermont Clean Water Act. For more information about the Vermont Clean Water Act, readers should review the content of the Vermont Clean Water Initiative website at: http://dec.vermont.gov/watershed/cwi.

Chapter 2 – Priority Areas for Restoration and Protection

The following sections in Chapter 2 describe priority waters for remediation and protection. Included in the following tables are actions to remediate and protect the priority waters. Priority actions are further characterized in Chapter 5 and the Watershed Projects Database.

A. Priority Waters for Restoration

Based on monitoring and assessment results, priority waterbodies are identified for remediation in Table 1. Priority actions have also been identified in Table 1 and are listed in more detail in the implementation and monitoring tables (Tables 20 & 21) in Chapter 5.

Table 1. Eleven priority waterbodies for restoration, their primary stressors and priority actions for remediation. More detail on these actions can be found in Chapter 5 in the Implementation Table Summary.

Priority Waterbodies and Sub-basins	Stressor	Issues leading to water quality problem	Target Sector	Priority actions*
White River from Hartford to Bethel	Encroachment	Loss of riparian vegetation, road runoff, floodplain encroachments, post-Irene dredging and berming	Rivers	Continue to work with Vtrans and communities along the river to encourage protection and restoration efforts; review VDEC aquatic biota and chemistry data; review VFWD temperature data and creel survey for signs of improvement
First Branch Sub-basin from Royalton to Chelsea	Pathogens, channel erosion, land erosion, encroachment	Unknown *E. coli* sources, dams preventing natural sediment regime and aquatic organism passage (AOP), soil and streambank erosion, loss of riparian vegetation	Rivers, agriculture, stormwater (roads)	Continue monitoring swimming areas to protect public health; investigate potential sources of *E. coli*; apply best management practices in problem areas; offer septic socials in target communities; follow 2011 VT Statewide TMDL; implement high priority projects recommended in Stream Geomorphic Assessment (SGA); review monitoring and temperature data collected by VDEC and VFWD for improvement; encourage towns to adopt local standards for river corridor and floodplain protection
Second Branch Sub-basin from Royalton to Randolph	Pathogens, channel erosion, land erosion	Unknown *E. coli* sources, dams preventing natural sediment regime and AOP, loss of riparian vegetation, streambank erosion, untreated runoff from developed and ag land	Rivers, agriculture, stormwater	Continue monitoring swimming areas to protect public health; investigate potential sources of *E. coli*; apply best management practices in problem areas; offer septic socials in target communities; implement Best Management Practices (BMPs) and outreach to farmers; follow 2011 VT Statewide TMDL; implement high priority projects identified in the Randolph Stormwater Master Plan; encourage towns to adopt local standards for river corridor and floodplain protection
Third Branch Sub-basin from Bethel to Randolph	Pathogens, channel erosion, land erosion, nutrient loading, encroachment	Unknown *E. coli* sources, dams preventing natural sediment regime and AOP, stormwater and agricultural runoff, livestock access, loss of riparian vegetation, bank erosion	Rivers, agriculture, stormwater	Continue monitoring swimming areas to protect public health; investigate potential sources of *E. coli*; apply best management practices in problem areas; offer septic socials in target communities; follow 2011 VT Statewide TMDL; implement BMPs and outreach to farmers; implement and develop projects in stormwater master plans; continue Waste Water Treatment Facility monitoring; consider other sites for monitoring; implement high priority projects recommended in SGA; encourage towns to adopt local standards

Priority Waterbodies and Sub-basins	Stressor	Issues leading to water quality problem	Target Sector	Priority actions*
				for river corridor and floodplain protection
Ayers Brook Sub-basin from Randolph to Brookfield	Encroachment, channel erosion, land erosion	Morphological instability	Stormwater, agriculture, rivers	Implement high priority projects recommended in SGA; implement high priority projects recommended in SGA; conduct road erosion inventory on hydrologically connected road segments and implement BMPs to meet standards; add new monitoring sites for chemistry and aquatic biota; coordinate with VFWD on riverbank ownership
Hancock Branch & Robbins Branch in Hancock	Acidity, land erosion, channel erosion, encroachment	Acid precipitation, streambank erosion and scouring	Stormwater (roads), rivers	Implement high priority projects recommended in SGA; review monitoring data and collect additional data on both streams
Jericho Brook Sub-basin in Hartford	Channel erosion, land erosion, encroachment	Eroding streambanks, road close to brook	Stormwater (roads), rivers	Add additional monitoring site to determine status further upstream; review VFWD fisheries data; conduct road erosion inventory on hydrologically connected road segments and implement BMPs to meet standards
Sunset Lake Watershed in Brookfield	Encroachment, land erosion, toxics	High conductivity levels from unknown sources and fair condition for water quality status, fair shore and lake habitat score	Stormwater	Educate lakeshore community about BMPs for water quality; establish monitoring to evaluate long-term trends; initiate regular AIS monitoring and AIS spread prevention through signage or VIP program
Silver Lake Watershed in Barnard	Land erosion	Negative nutrient trend due to decreasing secchi clarity, fair shore and lake habitat score	Stormwater	Educate lakeshore community about BMPs for water quality; implement high priority recommendations in the 2015 Silver Lake State Park Lake Wise Evaluation report; recruit greeter and initiate AIS Greeter Program; collect additional water quality data
Smith Brook in Randolph	Toxics	Old landfill leachate	Hazardous Waste	Employ outreach by the VT Waste Management and Prevention Division to landowners and direct sampling and remediation efforts
Kingsbury Brook Sub-basin in Randolph	Nutrient loading, land erosion, encroachment	Agricultural runoff, loss of riparian vegetation	Agriculture	Conduct outreach to farmers and agricultural assessments; implement RAPs and BMPs; riparian and aquatic area habitat restoration and protection; monitor for aquatic biota; monitor temperature

*Project leaders and partners are identified in Chapter 5.

B. Impaired and Priority Surface Waters

The Vermont Department of Environmental Conservation (VDEC) uses monitoring and assessment data to assess individual surface waters in relation to Vermont Water Quality Standards as outlined in the 2016 VDEC Assessment and Listing Methodology (Vermont Department of

Environmental Conservation, 2016). The four categories used in Vermont's surface water assessment are **full support, stressed, altered** and **impaired**. Under Section 303(d) of the Federal Clean Water Act, all states are required to develop lists of impaired waters. The list includes impaired lakes, ponds, rivers and streams that do not meet Water Quality Standards. For Vermont, impairment is substantiated by chemical, physical or biological data collected through monitoring and these waters are noted on the state's 303(d) list of Impaired Waters.

Aside from the 303(d) List, the State also produces the Priority Waters List which identifies other waters that do not meet standards but do not require a TMDL. Sections of that list include: Part B- impaired waters that have other required remediation measures in place; Part D-impaired waters with TMDLs in place; Part E-waters altered by aquatic invasive species; and Part F-waters altered by flow modifications.

Waters that support designated and existing uses and meet water quality standards are placed into the full support or stressed categories. The stressed category refers to those waters where stressors are present that prohibit the waters from attaining higher water quality, but still meet water quality standards. Waters that do not support uses and do not meet standards are placed into the altered or impaired category.

These priority waters comprise the 303(d) and the state priority surface waters lists and can be viewed on the Vermont Environmental Atlas. For a more detailed description of monitoring results use the Vermont Integrated Watershed Information System online data portal. Figure 7 and Table 2 show and list the known stressed, impaired or altered waterbodies in Basin 9.

Two waters were removed from the stressed waters list (highlighted in red in Table 2) in 2018. The waters removed were a 0.2-mile section of Ayers Brook in Randolph and a 0.2-mile section of the White River in West Hartford. Both sites were identified as stressed for elevated levels of chromium and nickel after sampling conducted by the United States Geological Survey in 1992-94. The data were re-assessed in 2018 by VDEC MAPP and compared to the VDEC Sediment Quality Guidelines (SQGs).

Copper, lead, chromium, and nickel in Ayers Brook and copper, chromium and nickel in the White River did not exceed the probable effect concentration (PEC) above which adverse effects are likely to be observed. The sediment concentrations are not considered to be unusually high given the sampling locations - at the mouth of both rivers - and activities within the watershed. There are background levels of these metals found within sediment, and particle size as well as total organic carbon (TOC) can influence how well the contaminants sorb to sediment, although definitive numbers of background levels are unknown.

No biological or chemical monitoring conducted at either site currently supports the previous stressed designation for aquatic life support or exhibits violations of water quality related to metals. The most recent sampling closest to the USGS sample site in Ayers Brook (2006) scored very good for the macroinvertebrate assessment and the dissolved metals levels for chromium, copper, nickel and lead were below detection limits. The sediment composition has likely changed over time due to sediment transport and flood events over the past 23 years since the original sampling event.

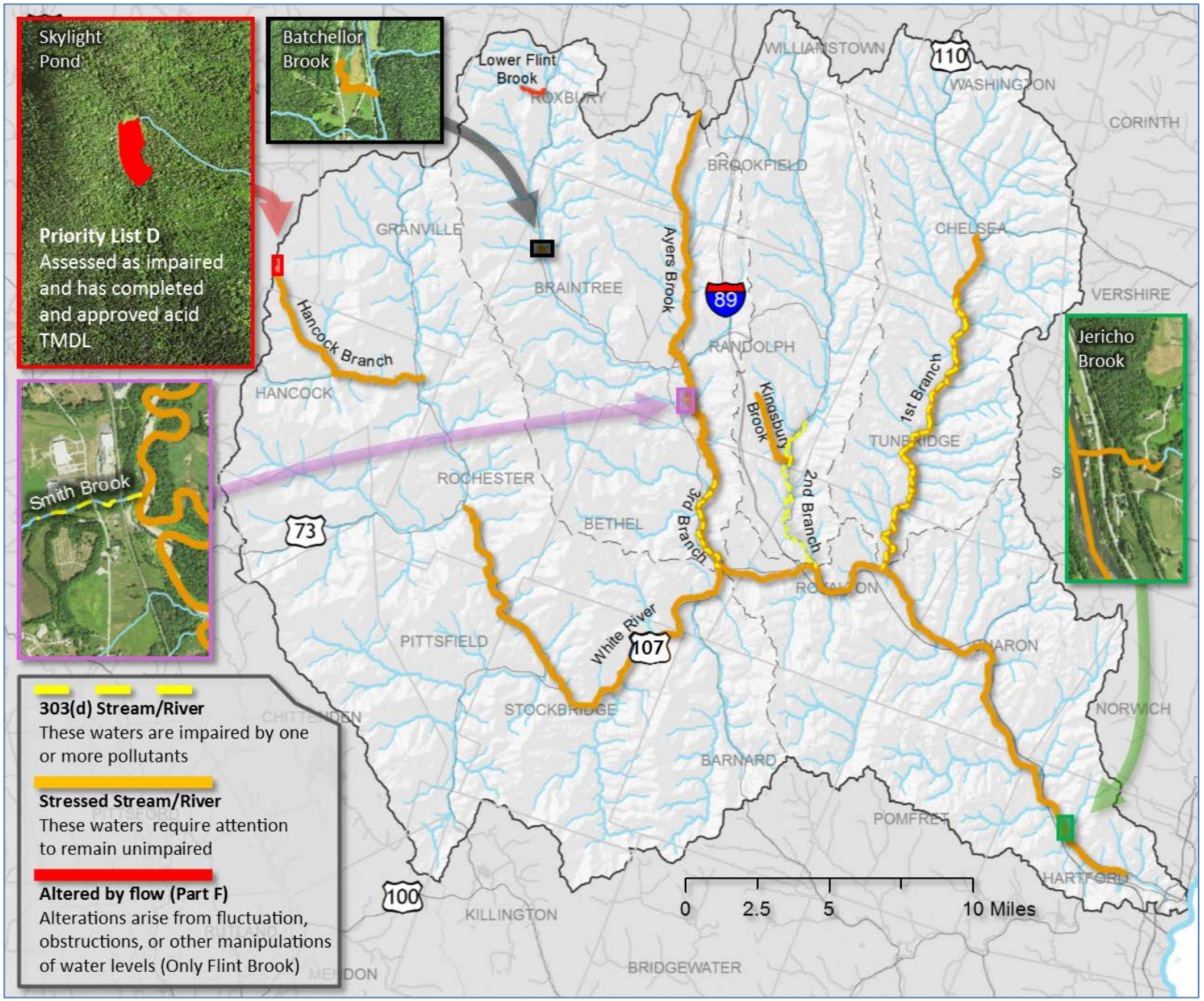


Figure 7. Impaired, stressed and altered priority surface waters in the White River Basin. This map corresponds with Table 2.

Table 2. Basin 9 priority waters and pollutants, stressors, sources, and proposed actions or removal information. This table corresponds with Figure 7.

Waterbody, Town	Pollutant	Stressor	Source	Proposed Action/Removal Information
Part A. 303(d) List of Impaired Waters (VDEC, 2016b) or Part D. with completed TMDL (VDEC, 2016c)				
First Branch White River - 15.2 miles Royalton, Tunbridge, Chelsea	*E. coli*	Pathogens	Not yet known	See Table 1
Second Branch of White River – 9.8 miles Bethel, Randolph, Royalton	*E. coli*	Pathogens	Not yet known	See Table 1
Third Branch White River – 4.3 miles Bethel	*E. coli*	Pathogens	Not yet known	See Table 1
Smith Brook – 0.3 miles Randolph	Iron	Toxics	Old landfill leachate	See Table 1
Skylight Pond – 2 acres Ripton	Acid	Acidity	Atmospheric deposition	Follow EPA approved TMDL, dated September 20, 2004; continue VDEC monitoring efforts
Part F. WATERS ALTERED BY FLOW REGULATION (DEC, 2016f)				
Lower Flint Brook – 0.2 miles	Low and fluctuating flows	Flow Alteration	Artificial flow regulation and lack of established conservation flow below fish hatchery withdrawal	VDFW needs to obtain a Section 401 Water Quality Certification for operations of the intake on Flint Brook because of modification needed related to rebuilding the hatchery; VDFW is conducting flow monitoring to determine the seasonal conservation flows below the intake; VDEC will conduct biological monitoring below fish hatchery
STRESSED SURFACE WATERS (DEC, 2016c)				
White River – mouth to Bethel – 26 miles Hartford, Pomfret, Sharon, Royalton, Bethel	*E. coli*	Pathogens	Not yet known	Continue monitoring swimming areas to protect public health
White River – 0.2 miles West Hartford	Metals	Toxics	Unknown source, elevated levels of Cr and Ni in sediment from early 1990's USGS study	REMOVED from list in 2018. *See explanation in text above.*

Waterbody, Town	Pollutant	Stressor	Source	Proposed Action/Removal Information
White River – from West Branch to the mouth of the Third Branch – 24 miles Bethel, Pittsfield, Rochester, Stockbridge, Hartford	Sediment, physical alterations, thermal modification, knotweed	Encroachment	Erosion and landslides caused by loss of riparian vegetation, road runoff, floodplain encroachments, post-Irene dredging and windrowing	See Table 1
Jericho Brook – upstream 0.2 miles to mouth Hartford	Siltation, turbidity	Channel erosion, land erosion, encroachment	Eroding streambanks, road close to brook	See Table 1
First Branch – from mouth to Chelsea – 15.5 miles Chelsea, Royalton, Tunbridge	Sediment, temperature	Encroachment, land erosion, channel erosion	Soil and streambank erosion, loss of riparian vegetation	See Table 1
Kingsbury Brook – 0.5 miles Randolph	Nutrients, temperature	Nutrient loading, land erosion, encroachment	Agricultural runoff, loss of riparian vegetation	See Table 1
Third Branch – from Bethel to the confluence with Ayers Brook – 11 miles Bethel, Randolph	Sediment, Nutrients	Land erosion, nutrient loading, encroachment, channel erosion	Stormwater and agricultural runoff, livestock access, loss of riparian vegetation, bank erosion	See Table 1
Ayers Brook – 0.2 miles Randolph	Metals	Toxics	Unknown source elevated levels of Cr and Ni in sediment from early 1990's USGS study	REMOVED from list in 2018. *See explanation in text above.*
Ayers Brook – from mouth to Brookfield Gulf – 5.5 miles Randolph, Braintree, Brookfield	Sediment	Encroachment, channel erosion, land erosion	Morphological instability	See Table 1
Batcheldor Brook – from mouth upstream 0.2 miles Braintree	Sediment, physical alterations	Encroachment	Beaver dam removal, dredging, channelization	Assessment site for wetland condition and restore if practicable; monitor for water chemistry and aquatic biota
Hancock Branch – 4.3 miles Hancock, Ripton	Acid, sediment	Acidity, land erosion, channel erosion, encroachment	Acid precipitation, streambank erosion and scouring	See Table 1

Basin Specific Total Maximum Daily Loads (TMDLs)

A Total Maximum Daily Load or TMDL is the calculated maximum amount of a pollutant that a waterbody can receive and still meet Vermont Water Quality Standards. In a broader sense, a TMDL

is a plan that identifies the pollutant reductions a waterbody needs to meet Vermont's Water Quality Standards and develops a means to implement those reductions. TMDLs can be calculated for reducing water pollution from specific point source discharges or for an entire watershed to determine the location and amount of needed pollution reductions.

TMDLs for Basin 9 include:

- 2004 TMDL for 7 Acid Impaired Lakes in Vermont
- Vermont Statewide Total Maximum Daily Load (TMDL) for Bacteria-Impaired Waters
- Long Island Sound (LIS) Dissolved Oxygen TMDL
- Northeast Regional Mercury Total Maximum Daily Load

Long Island Sound Total Maximum Daily Load

The Long Island Sound Dissolved Oxygen TMDL released in 2000 is designed to address low dissolved oxygen or hypoxia in Long Island Sound bottom waters. It is often referred to as the Connecticut River Nitrogen TMDL because it is linked to an overabundance of nitrogen discharging into the Sound from the Connecticut River and other tributaries. While nitrogen is essential to a productive ecosystem, too much nitrogen fuels the excessive growth of algae. When the algae die, they sink to the bottom, where they are consumed by bacteria. The microbial decay of algae and the respiration of these organisms use up the available oxygen in the lower water column and in the bottom sediments, gradually reducing the dissolved oxygen concentration to unhealthy levels (New York State Department of Environmental Conservation; Connecticut Department of Environmental Protection, 2000).

In 2013 a Vermont-specific section, the Vermont Enhanced Implementation Plan for the Long Island Sound TMDL, was added to the LIS-TMDL to address four goals:

1. To identify the Vermont sources of nitrogen as they are currently understood, across broad land use sectors, such as developed, agricultural and forested;
2. To identify the status and trends of important drivers of nitrogen export such as the intensity of agricultural and development activities and investigate how these might have changed since the TMDL baseline period of 1990;
3. To identify the management programs, operating at that time, that address these drivers of nitrogen loading that have a significant effect on reducing or preventing nitrogen export. A part of this is to identify a timeline as to when programs were initiated or enhanced; and
4. Using a weight-of-evidence approach, to assess the combined management programs/projects to develop a qualitative evaluation as to whether management efforts are sufficient to meet the original 2000 TMDL of a 10% non-point source nitrogen reduction and if these actions are sufficient to maintain that control into the future (Vermont Department of Environmental Conservation, 2013).

Vermont nitrogen export to LIS is estimated to be about 4% of the total load to the Sound. Modeling estimates the breakdown of nitrogen sources in Vermont. Approximately 21% of Vermont's nitrogen export originates from agricultural areas, 9% from point sources, and 4% from developed areas. Of note is that approximately 65% of the nitrogen exported from Vermont originates as atmospheric deposition (Vermont Department of Environmental Conservation, 2013). Efforts to reduce atmospheric deposition has been occurring at the national level through the Clean Air Act and its amendments. Total nitrogen deposition has declined since 1985 (NADP, 2018)

In 2017, EPA embarked on its Nitrogen Reduction Strategy to investigate and better define control actions to reduce nitrogen in the Long Island Sound. Information on the most current developments and strategies can be found in EPA's Long Island Sound Study.

The sources of nitrogen to be addressed in Vermont include wastewater discharges, agricultural lands, developed lands and forest practices. The adoption of Vermont's Act 64 helps implement overarching strategies and steps required to meet loading reductions for the Long Island Sound's TMDL (see The Vermont Clean Water Act in the previous section for details).

In addition, the Long Island Sound Watershed Regional Conservation Partnership Program (LISW-RCPP) was created in 2015 across six states to coordinate the development and implementation of a comprehensive working lands program with foci on: 1) nutrient management and soil health, 2) protection of non-industrial forest habitat, biodiversity, and drinking water sources, and 3) stream erosion and flood resiliency improvements on working lands through riparian restoration. In partnership with the Vermont Association of Conservation Districts (VACD), UVM Extension, the Connecticut River Conservancy, The Nature Conservancy and federal, state and local organizations in VT, NH, MA, CT, NY and RI, ten million dollars is being invested in the adoption of best management practices on private working lands, providing both technical and financial assistance (Connecticut Council on Soil and Water Conservation, 2015).

C. Priority Waters for Protective Action

All surface waters in Vermont are managed to support designated uses valued by the public at a level of Class B(2) or better. These uses include swimming, boating, fishing, aquatic biota, aquatic habitat, aesthetics, drinking water source and irrigation. In this section of the plan, several waters are identified as being high quality, and these, as well as other unique waterbodies, are candidates for establishing alternate management objectives or augmented protections through one of the processes that are further described below.

- Reclassification of surface waters
- Class I Wetland designation
- Outstanding Resource Waters designation
- Designation of waters as cold-water fisheries
- Identification of existing uses

Figure 8. Actions identified for water quality protection in the 2018 White River TBP. Numbers refer to the number of waterbodies recommended for increased protection.

Four waters in Basin 9 meet criteria for B(1) aquatic biota, 34 waters meet criteria for B(1) fishing, 1 water is recommended as an Outstanding Resource Water, one wetland is recommended as a Class I wetland and one wetland is recommended for further study as a Class I wetland, two abandoned A(2) public water sources are recommended for evaluation for reclassification, and five waters have been protected at a higher level since the 2013 White River Basin Plan (Figure 9).

The Vermont Water Quality Standards establish water quality classes and associated management objectives. The protection of water quality and water-related uses can be promoted by establishing specific management objectives for bodies and stretches of water. The management objectives describe the values and uses of the surface water that are to be protected or achieved.

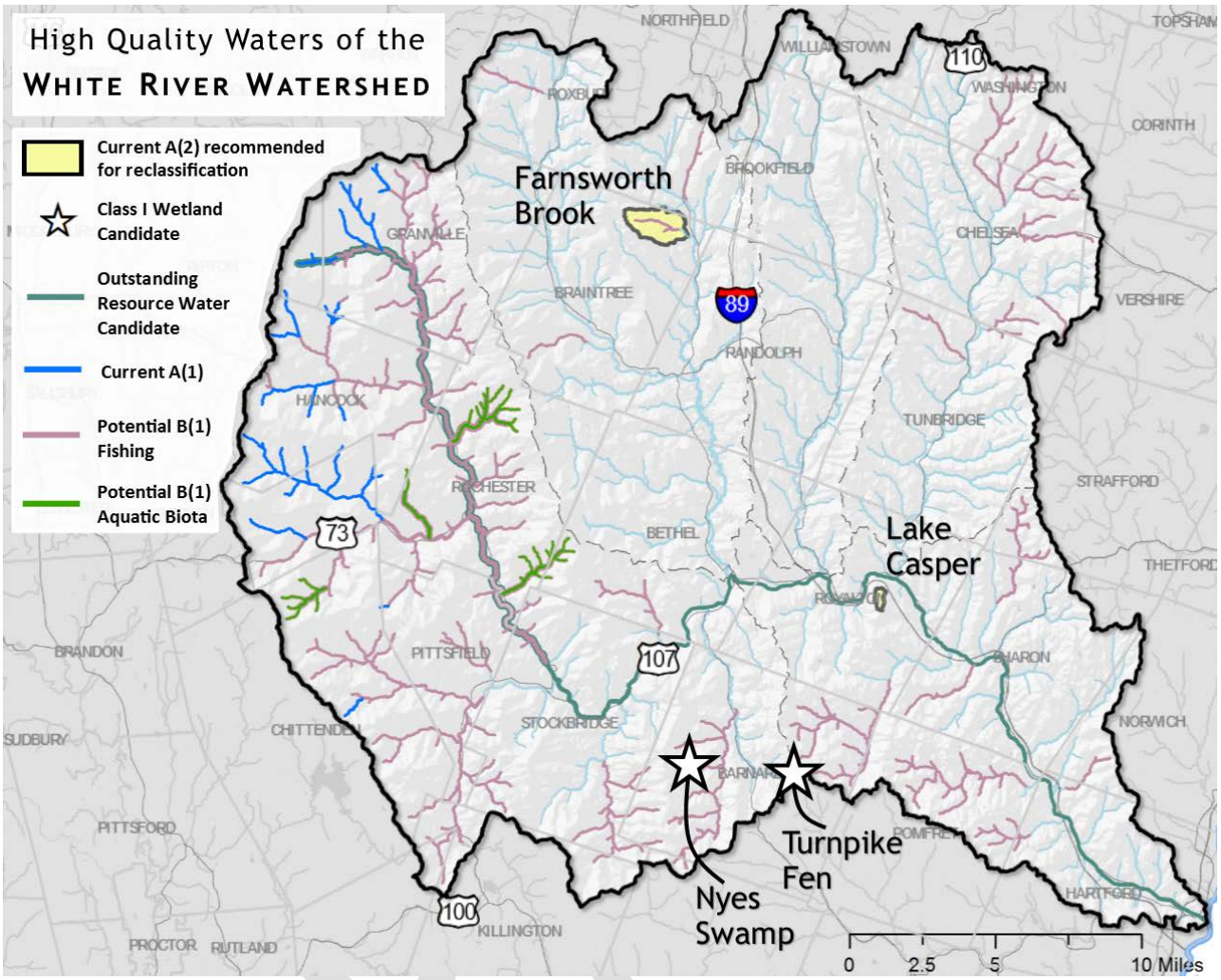


Figure 9. Recommended and existing high-quality waters of the White River basin.

The Agency of Natural Resources is responsible for determining the presence of existing uses on a case-by-case basis or through basin planning and is also responsible for classification or other designations. Once the Agency establishes a management goal, the Agency manages state lands and issues permits to achieve all management objectives established for the associated surface water.

Before the Agency recommends management objectives through a classification or designation action: input from the public on any proposal is required and considered. The public may present a proposal for establishing management objectives for Agency consideration at any time, while the Agency typically relies on the publication of basin plans to promote reclassification (10 V.S.A. § 1424a). When the public develops proposals regarding management objectives, the increased community awareness can lead to protection of uses and values by the community and individuals.

Public involvement is an essential component to restoring and protecting river and lake ecology. The Vermont Water Quality Standards indicate that in the basin planning process, "*Public participation shall be sought to identify and inventory problems, solutions, high quality waters, existing uses and significant resources of high public interest.*" Emphasis on the identification of values and expectations for future water quality

conditions can only be achieved through public contributions to the planning process. The public, watershed partners and stakeholders are encouraged to make recommendations for additional monitoring and research where very high-quality waters appear to exist.

Reclassification of Surface Waters

Since the 1960s, Vermont has had a classification system for surface waters that establishes management goal objectives and supporting criteria for each use in each class of water. Pursuant to Act 79 of 2016, the Vermont General Assembly, recognizing the wide range of quality for Class B waters, created a new intermediary water quality class between B(2) and A(1), now called Class B(1). Act 79 also sets forth the expectation that individual uses of waters (e.g., aquatic biota and wildlife, aquatic habitat, recreation, aesthetics, fishing, boating, or swimming) may be individually classified, so a specific lake or stream may have individual uses classified at different levels. Act 79 indicates that uses may be reclassified independently to Class B(1) for individual uses if the quality of those uses are demonstrably and consistently of higher quality than Class B(2). The extent of the water being reclassified is subject to review based on documented conditions.

These waters and their elevated uses are identified through the tactical planning process or on a case by case basis. The current classification of a water does not signify that B(1) criteria is not met. Additional waters suitable for reclassification may be identified in the future as some waters have not been previously monitored. Table 3 lists the possible classes into which each use may be placed.

Table 3. A list of uses that can be placed into each water class in the Vermont Water Quality Standards.

Classification (2016)	Applicable Uses
Class A(1)	One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, or swimming
Class A(2)	Public water source
Class B(1)	One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, or boating
Class B(2)	Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water source or irrigation

The VWQS begin classification with two broad groups based on elevation:

- All waters above 2,500 feet altitude, National Geodetic Vertical Datum, are designated Class A(1) for all uses, unless specifically designated Class A(2) for use as a public water source.
- All waters at or below 2,500 feet altitude, National Geodetic Vertical Datum, are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any use.

Tactical basin plans identify surface waters where monitoring data indicates conditions are significantly better than the water quality objectives and criteria of the VT Water Quality Standards. This high-level of quality may be protected by site-specific application of the anti-degradation policy of the Standards, or by reclassification to a higher-level designated use.

Three waters are designated as A(2) public water sources in the White River Basin. Two of the three waters have been abandoned as public water sources and are recommended to be reclassified to reflect their current condition for each designated use (Table 4).

Table 4. Class A(2) designated public water sources in the White River Basin.

Waters	Water Source	Description
Farnsworth Brook	Village of East Braintree	**Abandoned**. Farnsworth Brook and all waters within its watershed in the Town of Braintree upstream of the water intake.
Lake Casper	Village of South Royalton	**Abandoned**. Lake Casper and all waters within its watershed in the Town of Royalton.
Lake John	Village of South Royalton	**Permanent**. Lake John and all waters within its watershed in the Town of Royalton. Water is pumped from the Carpenter Field infiltration gallery in the White River up to Lake John.

In 2016, during the update to the water quality standards, five waterbodies were reclassified to A(1) for multiple uses through the rulemaking process (Table 5).

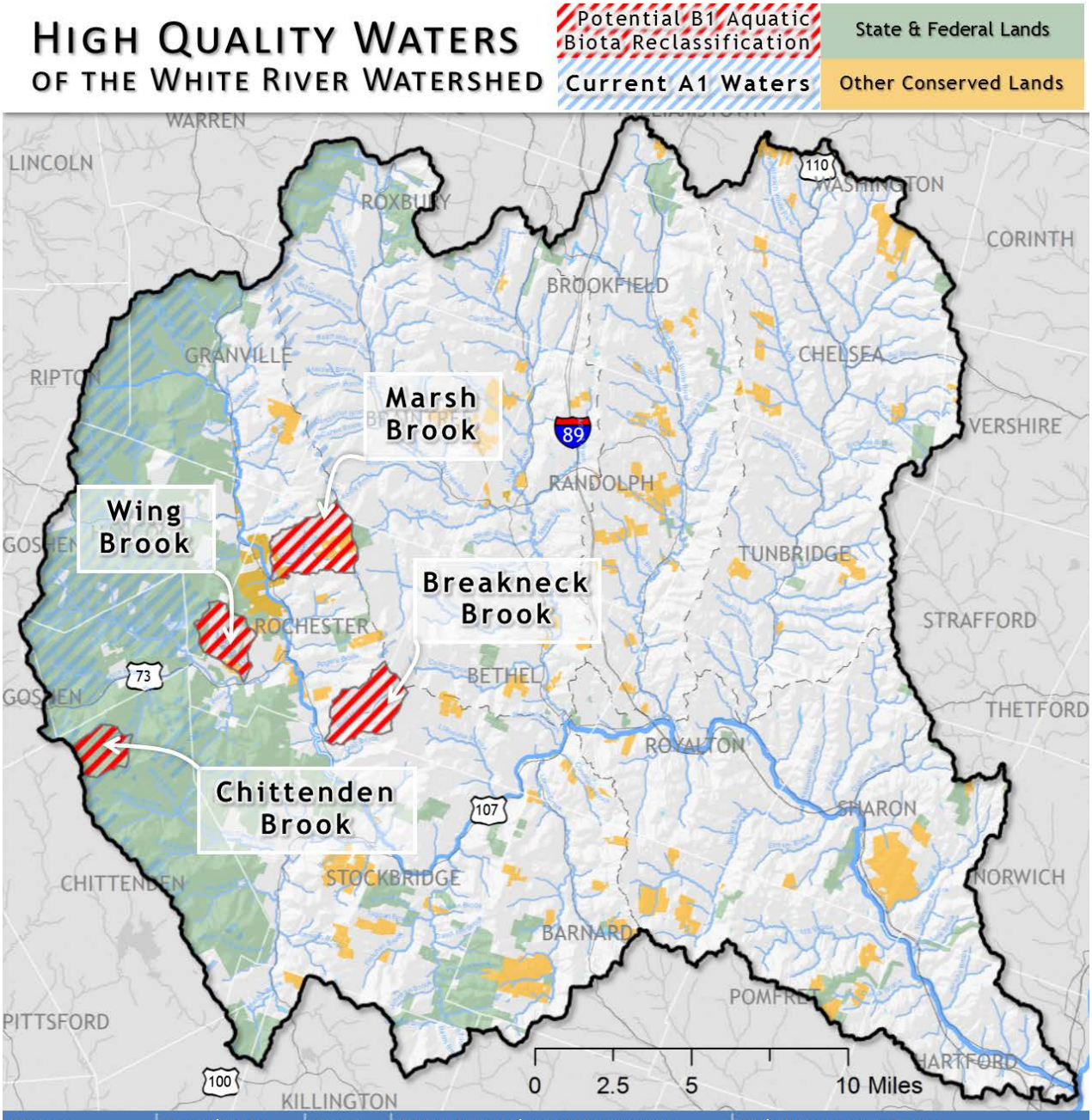
Table 5. Waters under 2500' in elevation in the White River watershed with A(1) status for at least one designated use.

Water Quality Classification of Waters in the White River (Basin 9)	Aq. Biota	Aq. Hab.	Aesthetics	Boating	Fishing	Swim	Pub. WS	Irrigate	Date effective
Surface waters of the Breadloaf Wilderness. All streams, lakes, and ponds located within the boundaries of the federally-designated Breadloaf Wilderness Area of the Green Mountain National Forest.	A1	A1	A1	A1	A1	A1	B2	B2	01/15/17
Surface waters of the Joseph Battell Wilderness. All streams, lakes, and ponds located within the boundaries of the federally-designated Joseph Battell Wilderness Area of the Green Mountain National Forest.	A1	A1	A1	A1	A1	A1	B2	B2	01/15/17
Bingo Brook. Bingo Brook and tributaries from headwaters downstream to the Green Mountain National Forest boundary above Kings Pond (Hancock/Rochester).	A1	A1	B2	A1	A1	B2	B2	B2	01/15/17
Smith Brook (Rochester). Smith Brook and tributaries from headwaters downstream to Rt. 73.	A1	A1	B2	B2	A1	B2	B2	B2	01/15/17
Beaver Meadows Ponds. All ponds and tributaries, beginning from headwaters, and ending at outlet of downstream most pond.	A1	A1	B2	B2	B2	B2	B2	B2	01/15/17

Very High-Quality Waters Supporting Aquatic Biota

Based upon biomonitoring assessments conducted by the VDEC WSMD, four surface waters in the Basin consistently and demonstrably attain a higher level of quality than Class B(2), meeting Class B(1) criteria for aquatic biota (Figure 9). These waters are Marsh Brook, Breakneck Brook, Wing Brook and Chittenden Brook. Through the rulemaking process which provides opportunities for public comment and input, these waters are recommended for reclassification to B(1).

Eight additional sites are recommended for additional sampling to determine eligibility for B(1) for aquatic biota: Deer Hollow Brook (0.9), Foundry Brook (0.8), George Brook (0.1), Stoddard Brook (0.5), Podunk Brook (0.9), First Branch (17.1), Locust Creek (4.7), Upper White Mainstem, Stoney Brook (1.9) and Second Branch (18.5).



Name	Sampling in Town of	River Mile	Macroinvertebrate Assessment Score	Fish Assessment Score
Marsh Brook	Rochester, Braintree	1.0	1 excellent (2014), 1 good (2015), 1 very good-excellent (2016)	2 very good (2014, 2016), 1 excellent (2015)
Breakneck Brook	Rochester	0.2	1 very good-excellent (2014), 1 very good (2015), 1 good (2016)	3 very good (2014, 2015, 2016)
Chittenden Brook	Rochester	2.4	1 very good-excellent (2014), 2 very good (2015, 2016)	Unable to assess
Wing Brook	Rochester	0.2	1 excellent (2014), 1 good (2015), 1 very good-excellent (2016)	1 very good (2014)

Figure 10. Basin 9 A(1) waters identified in the VT Water Quality Standards (blue hatch) and waters meeting B(1) criteria for Aquatic Biota (red hatch) for reclassification. River Mile = as measured from the mouth upstream to sampling point.

Very Good Waters for Recreational Fishing

Certain waters in Basin 9 support productive noteworthy populations of cold-water salmonids. Rivers and streams classified as B(1) recreational fishing waters, support wild, self-sustaining salmonid populations characterized by the presence of multiple age classes and a minimum abundance of 1000 individuals per mile (all species/ages/sizes); and/or 200 large (> 6 inches total length) individuals per mile; and/or 20 pounds/acre (all species/ages/sizes)[2]. Table 6 lists the names of streams that meet B(1) criteria for recreational fishing (§29A-306), and Figure 10 displays their watersheds.

These waters shall be managed to achieve and maintain very good quality fishing. The list in Table 6 may be adjusted in the future based on new and updated surveys and as protocols are refined. Waters that meet the revised criteria in the water quality standards for both B(1) and A(1) fishing use will be continually identified and updated. It is important to note that all waterbodies that would naturally support fish populations are protected and maintained in perpetuity.

Table 6. Waters meeting B(1) criteria for recreational fishing in the White River basin.

ID	Stream Name	Elevation (ft.)	Town	Trout Species Present		
				Brook	*Brown*	*Rainbow*
1	Locust Creek	900	Barnard	X	X	X
2	Lilliesville Brook	700	Bethel	X	X	X
3	Farnsworth Brook	1020	Braintree	X		
4	Riford Brook	960	Braintree	X		X
5	Jail Brook	1050	Chelsea	X		
6	Jenkins Brook	1200	Chelsea	X		
7	South Washington Creek	1137	Chelsea, Washington	X		
8	Unnamed Tributary to South Washington Creek	1140	Chelsea	X		
9	Hart Hollow Brook	1020	Chelsea, Washington	X		
10	Chittenden Brook	1940	Chittenden	X		
11	Joe Smith Brook	1490	Chittenden	X		X
12	Alder Meadow Brook	1030	Granville	X	X	X
13	Clark Brook	1360	Granville	X		
14	Deer Hollow Brook	1640	Granville	X		
15	Patterson Brook	1240	Granville	X		
16	Robbins Branch	1280	Hancock	X		X

[2] It should be recognized that wild trout populations vary widely from year to year and therefore an individual population may sometimes go below or greatly exceed these values in any given year. The upstream and downstream extent of the stream classification should be based upon consistent or improving water quality, physical habitat quality and land use conditions. The reach should include all upstream habitats which are deemed essential to sustain water quality and physical habitat requirements necessary to support wild salmonid populations at a very good level.

ID	Stream Name	Elevation (ft.)	Town	Trout Species Present		
				Brook	*Brown*	*Rainbow*
17	Michigan Branch Tweed River	1040	Pittsfield, Chittenden	X		X
18	Tweed River	800	Pittsfield	X	X	X
19	Ayers Brook	831	Randolph	X		X
20	Brandon Brook	1020	Rochester	X		X
21	Unnamed Tributary to the Mainstem	1450	Rochester	X		
22	West Branch White River	940	Rochester	X		X
23	Flint Brook	1300	Roxbury	X		
24	Guernsey Brook	940	Pittsfield	X		X
25	Broad Brook	820	S. Royalton	X	X	X
26	Elmers Brook	445	S. Royalton	X		
27	Fay Brook	830	Sharon	X		
28	Stony Brook	910	Stockbridge	X		X
29	White River	740	Stockbridge		X	X
30	Bicknell Brook	820	Tunbridge	X		
31	Dickerman Brook	880	Tunbridge	X		
32	Dimick Brook	710	W. Hartford	X		
33	Mill Brook	470	W. Hartford	X		X
34	Podunk Brook	680	W. Hartford	X		

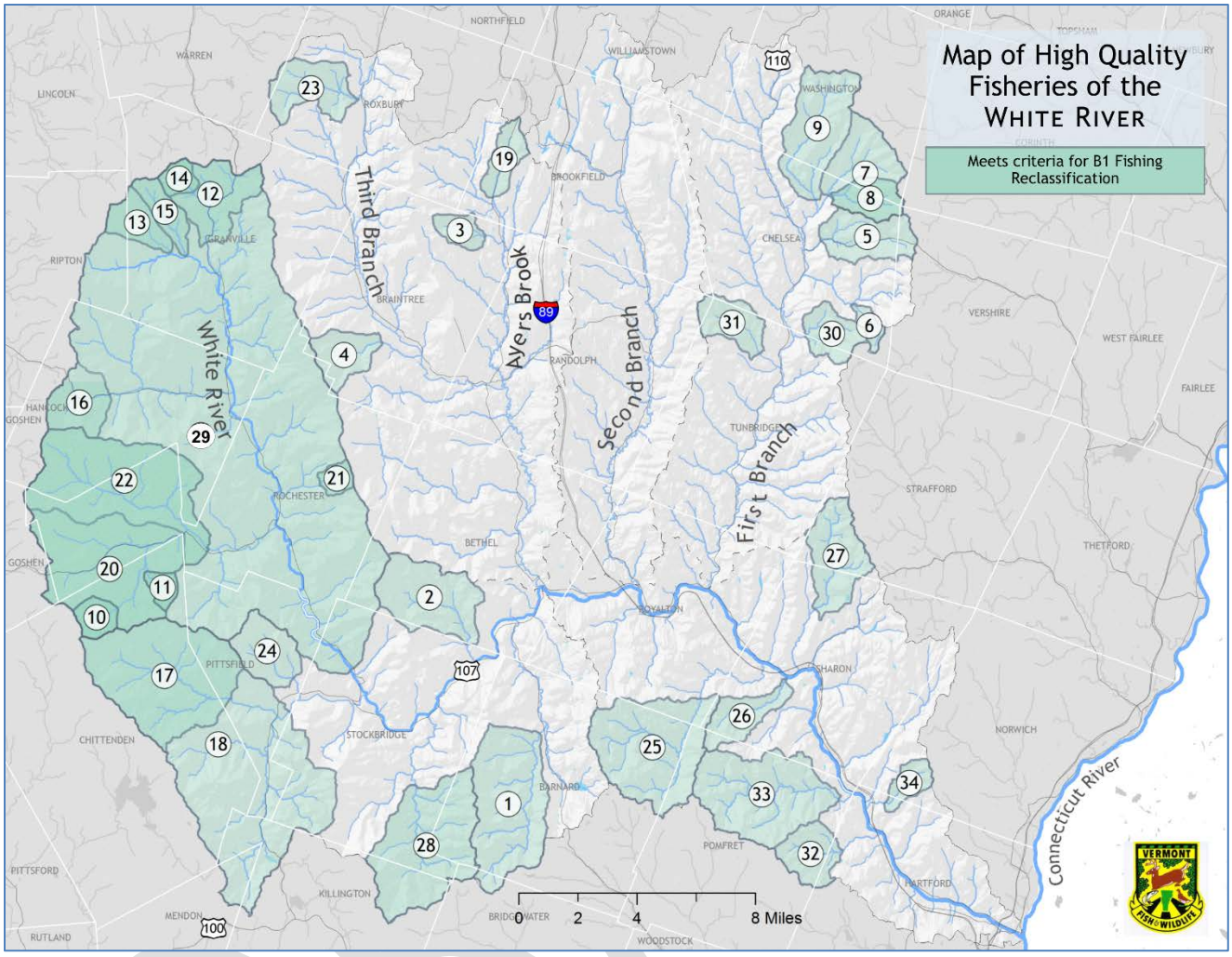


Figure 11. Very good waters for recreational fishing in the White River are shaded in light green. The numbers on the sub-watersheds correspond with the stream ID in Table 6 above.

Warm and Cold-Water Fish Habitat Designations

Warm Water Fish Habitat

All surface water wetlands and the following waters are designated as warm water fish habitat for purposes of the Vermont Water Quality Standards:

- Lamson Pond, Brookfield
- Silver Lake, Barnard

The WQS specify a lower minimum dissolved oxygen concentration than waters in the remainder of the basin, which are Cold-Water Habitat. There are no proposed changes to warm water fish habitat designations at this time.

Cold-Water Fish Habitat

All waters not designated as warm water fish habitat above are designated as cold-water fish habitat for Basin 9, as noted in the Vermont Water Quality Standards (Vermont Department of Environmental Conservation, 2017).

Outstanding Resource Waters Designation

In 1987, the Vermont Legislature passed Act 67, "An Act Relating to Establishing a Comprehensive State Rivers Policy." A part of Act 67 provides protection to rivers and streams that have "exceptional natural, cultural, recreational or scenic values" through the designation of Outstanding Resource Waters (ORW). Depending on the values for which designation is sought, ORW designation may protect exceptional waters through permit conditions in stream alteration, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects and other activities. ORWs are waters which can be designated by the Agency of Natural Resources through a petition process. ORWs display outstanding qualities that are determined to deserve a higher level of protection.

There are currently no ORW designations in Basin 9. The White River mainstem was recommended as an ORW in the 2013 White River Basin Plan for very good water quality and exceptional recreational and scenic values. This recommendation still stands. Although no other waters have been identified as ORW in this plan, there may be waters in the basin which merit this designation and for which ORW status should be pursued. The Agency will support collaborative efforts to develop the materials, and to conduct outreach necessary to support rulemaking for ORW designation of these waters, should there be public interest.

Class 1 Wetland Designation

It is policy of the State of Vermont to identify and protect significant wetlands and the values and functions they serve in such a manner that the goal of no net loss of such wetlands and their functions is achieved. Based on an evaluation of the extent to which a wetland provides functions and values, it is classified at one of three levels:

- **Class I**: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and therefore, merits the highest level of protection
- **Class II**: Merits protection, either taken alone or in conjunction with other wetlands
- **Class III**: Neither a Class II or Class I wetland

Impacts to Class I wetlands may only be permitted when the activity is necessary to meet a compelling public need for health or safety. The VT Wetlands Program has created a Class I website with an interactive map. This website includes the determinations for eight Class I wetlands: Dorset Marsh, Northshore Wetland, Tinmouth Channel, Chickering Fen, Dennis Pond Wetlands, Sandbar Wetlands, Peacham Bog and the LaPlatte River Wetlands. The last five wetlands were added in the

past three years. Over time new materials will be added, such as a Class I wetland petition form and a list of other wetlands which likely qualify.

The VT Wetlands Program welcomes recommendations for Class I candidates. There are currently no Class I wetlands in Basin 9, however there is one wetland recommended for Class I designation and one wetland that warrants further study as a Class I candidate. These wetlands are listed below:

Wetlands Recommended for Class I Designation

- Turnpike Fen - Barnard

Wetlands for Further Study for Class I Designation

- Nyes Swamp - Barnard

As part of the implementation of this tactical basin plan, the Department will develop and implement procedures and documents to enable submission, evaluation, and implementation of petitions to classify wetlands as Class I. Those wetlands that satisfy criteria for designation may be proposed for such designation through departmental rulemaking authority, and as consistent with the Vermont Wetland Rules.

Identification of Existing Uses

The Agency may identify existing conditions, known as existing uses, of waters during the tactical basin planning process or on a case-by-case basis during application reviews for State or federal permits. Consistent with the federal Clean Water Act, the Vermont Water Quality Standards have always stipulated that existing uses may be documented in any surface water location where that use has occurred since November 28, 1975. Pursuant to the definition of the new Class B(1) in Act 79, the Agency may identify an existing use at Class B(1) levels when that use is demonstrably and consistently attained. The public is encouraged to recommend waters for existing uses for swimming, boating, fishing, drinking water, and ecological significance given that they provide evidence of such use.

It is the Agency's long-standing stipulation that all lakes and ponds in the basin have existing uses of swimming, boating and fishing. Likewise, the Agency recognizes that fishing activities in streams and rivers are widespread throughout the state and are too numerous to thoroughly document for Basin 9. Also recognized is that streams too small to support significant angling activity provide spawning and nursery areas, which contribute to fish stocks downstream where larger streams and rivers support a higher level of fishing activity. As such, along with the larger streams and rivers that support a higher level of fishing activity, these small tributaries are considered supporting the use of fishing and are protected at a level commensurate with downstream areas.

Existing uses identified by VDEC for Basin 9 to date should be viewed as only a partial accounting of known existing uses based upon limited information. The list does not change protection under

the Clean Water Act or Vermont Water Quality Standards for waters not listed. The existing uses in the White River Basin for swimming, boating, fishing, and drinking water supply are found on the White River Basin Plan webpage at: http://dec.vermont.gov/watershed/map/basin-planning/basin9. New recommendations for existing uses should be sent to the White River Basin Watershed Coordinator for review.

For existing uses of waters, the level of water quality necessary to protect those existing uses shall be maintained and protected regardless of the water's classification (Vermont Department of Environmental Conservation, 2017).

Chapter 3 – Water Quality in the Basin

The Agency's Watershed Management Division (WSMD) in the Department of Environmental Conservation (VDEC) assesses the health of a waterbody using biological, chemical and physical criteria. The results of assessments are the basis for the biennial statewide 303(d) List of Impaired Waters and List of Priority Surface Waters Outside the Scope of 303(d). Table 2 in Chapter 2 describes these waters and actions for their remediation where applicable. The results of monitoring and assessment also feed the prioritization of surface waters where the waters are beginning to show signs of stress.

Sections of rivers, sub-basins and lakes are highlighted for specific intervention based on VDEC's evaluation of monitoring and assessment data from the last five years. Four detailed assessments of the White River Basin were completed in 1997, 2002, 2012 and 2016. The assessments can be viewed on the web at: http://dec.vermont.gov/watershed/map/assessment#Assessment. A summary of scientific assessments and data collected since the last basin plan are described in the following sections.

A. Climate Change and Localized Watershed Implications

Overview

A region's climate is defined by long term patterns of variation in weather. The phrase 'long term' is important in distinguishing climate from weather. Weather, which includes common measurements such as air temperature, precipitation, air pressure, and humidity, exhibits variability over relatively short time frames. Climate is 'average' weather – long term patterns that can be described in terms of typical values over a given period. Climate has tremendous influence over natural systems, including lakes, streams, wetlands, and the flora and fauna that depend on them for survival.

Nearly all climate scientists believe that human activity, notably fossil fuel consumption, is altering the relatively stable climate regime that has been in place for most of human history (Cook et al., 2013; Oreskes, 2004). This change is due to alterations in the greenhouse effect, the process by which carbon dioxide, methane, nitrous oxide and other heat trapping gasses in the atmosphere absorb and radiate thermal energy from the sun. The greenhouse effect was first described in the

19th century, a century which also saw the first quantitative prediction of anthropogenic warming due to increasing carbon dioxide concentrations and other greenhouse gases.

Predicted Impacts

Climate models developed by governmental and university researchers are used to predict how global and regional climate will respond to increasing concentrations of greenhouse gasses. In the Northeastern United States, climate models predict shifts in both temperature and precipitation (U.S. EPA, 2016; U.S. GCRP, 2014). These predicted changes, however, are no longer hypothetical. For instance, the average air temperature in the northeast increased almost 2^0 F between 1895 and 2010 (U.S. EPA, 2016); temperatures are expected to warm much faster in New England than most other regions of North America. Precipitation patterns are also changing, especially in terms of rainfall intensity and frequency; the amount of rainfall in heavy precipitation events increased as much as 70% from 1958 to 2012 (U.S. EPA, 2016). In general, numerous studies point to a warmer and wetter climate for New England, especially in the winter and spring seasons. The timing of precipitation and warmer temperatures, however, may lead to an increased risk of summer drought due to earlier rains, decreased snow pack, and higher rates of evapotranspiration (Galford, et al., 2014; U.S. EPA, 2016; U.S. GCRP, 2014).

The impact of climate change on Vermont's watersheds can be assessed by identifying climate signals – measurable, climate-driven outcomes expected to be impacted by changes in climate. Climate signals include direct climate variables such as the number of freeze days in a year or the annual number of extreme precipitation events, and indirect measures like stream and lake temperature, hydrologic flow metrics, and the composition of aquatic species communities in lakes and streams.

Because climate-driven systems typically exhibit high natural variability, long term data records are essential for identifying potential trends in climate signals over time. In addition, 'stationary' data sources – data records that describe the same variable or outcome measure over time, without major changes in instrumentation, methodology, or undue influence from localized human activity – are required to assess whether observed trends could be due to changes in the underlying climate state.

White River Basin

Vermont's rivers are expected to continue to be heavily impacted by changes in precipitation patterns. On average, stream flows are predicted to continue to increase as precipitation contributes more runoff to watersheds (Galford, et al., 2014). Potential climate-changed induced shifts in streamflow can be assessed by analyzing long term flow records at monitoring stations that are not influenced by hydrologic control structures such as dams or industrial intakes and discharges.

The White River Basin has two long term USGS stream gages in unregulated watersheds, USGS Station 01142500 at Ayers Brook in Randolph, VT, and USGS Station 01144000 at the White River

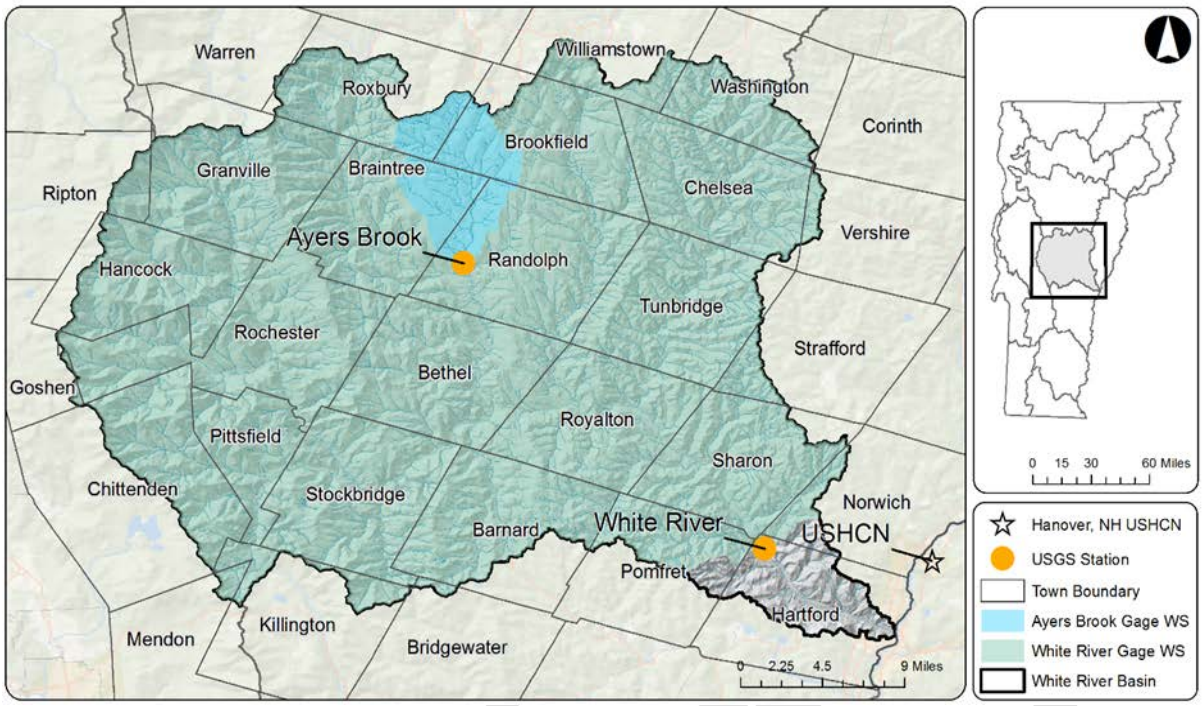


Figure 12. Location and watershed extent of unregulated USGS gages in Basin 9.

in West Hartford, VT (Figure 12). A long-term US Historic Climate Network (USHCN) station is also located in Hanover, NH (Figure 12).

In addition to the hydrology data covered in this section, VDEC has three long-term monitoring stations in White River Basin to look at climate change effects on biology, which includes temperature monitoring at three sites and hydrology monitoring at one site.

If precipitation-driven runoff is increasing over time, the amount of water moving through a stream system should also increase. A common metric describing the amount of water moving through a stream is the mean annual daily flow, or the average daily streamflow at a site over the course of a year. The median, or 50th percentile annual daily flow can also be calculated. Both metrics have increased at the two unregulated gages in the White River basin between 1940 and 2016 (Figures 13 and 14). The mean and median flow increased at Ayers Brook from 39 to 57 cubic feet per second (cfs) and 20 to 37.5 cfs, and at the White River from 1075 to 1346 cfs and 500 to 875 cfs, respectively (Table 7). Despite the year-to-year variability expected from climate-driven phenomena, a clear increasing trend signal is apparent as seen in Figures 13 and 14.

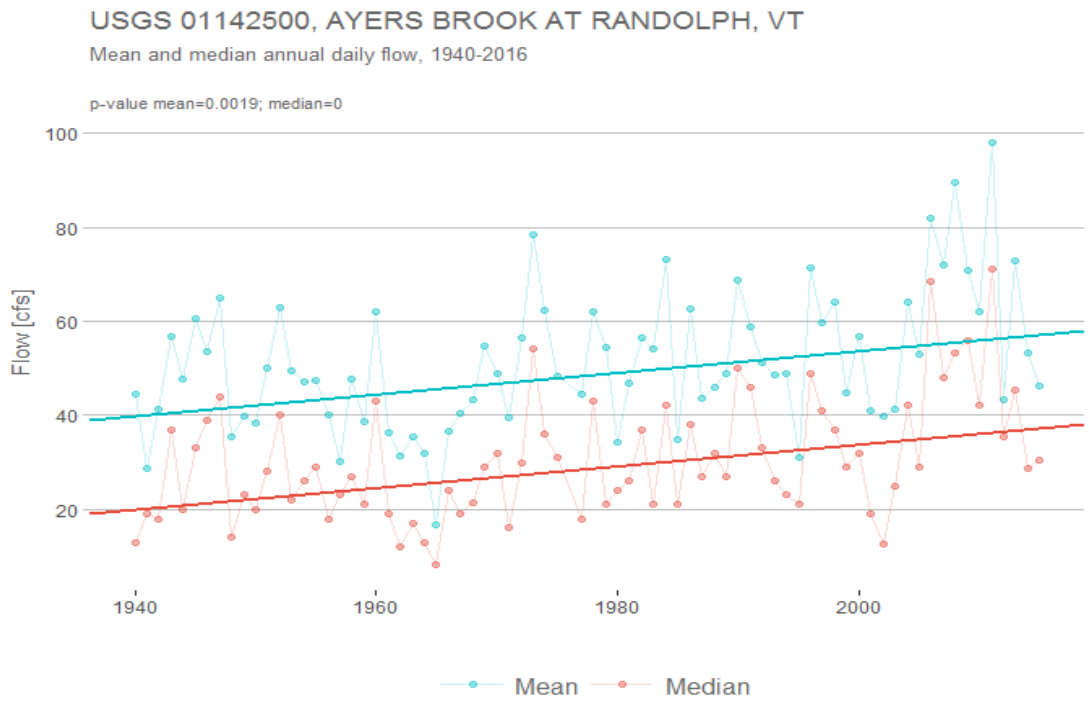


Figure 13. Mean and median annual daily flow at the Ayers Brook USGS gage. The period of record is 1940-2016. Both increasing trends are statistically significant.

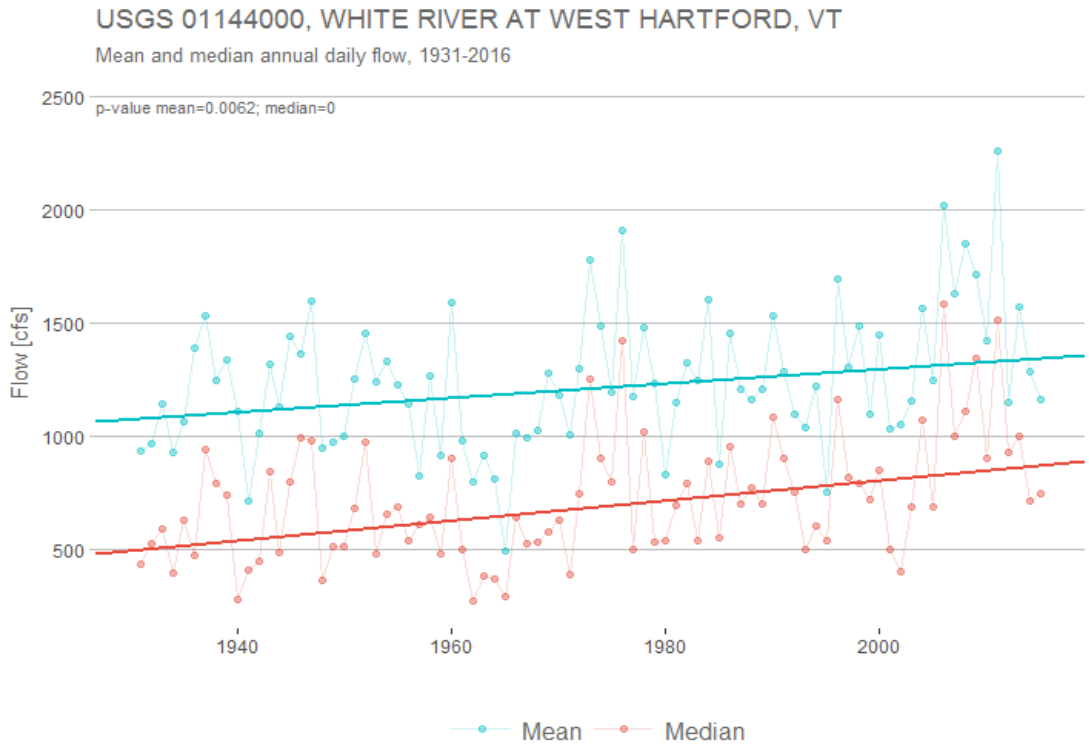


Figure 14. Mean and median annual daily flow at the White River USGS gage. The period of record is 1931-2016. Both increasing trends are statistically significant.

Table 7. Linear trend estimates of mean and median annual daily flow increases over the station period of record.

	USGS Station					
	White River			Ayers Brook		
Metric	Start	End	Difference	Start	End	Difference
Mean annual daily flow (cfs)	1075	1346	+271	39	57	+18
Median annual daily flow (cfs)	500	875	+375	20	37.5	+17.5
7-day minimum annual flow (cfs)	104	180	+76	2.15	7.35	+5.2
75th percentile annual flow (cfs)	1053	1606	+553	40.9	66	+25.1

The degree of change in the annual daily flow statistics can be contextualized by comparing the linear trend estimate to the overall mean and median annual daily flows at each station over the entire period of record (Figure 15). Looked at in this way, the data indicate that median annual daily flows at the White River and Ayers Brook stations have increased by 52% and 58%, respectively, while mean annual daily flows have increased by 35% and 22%.

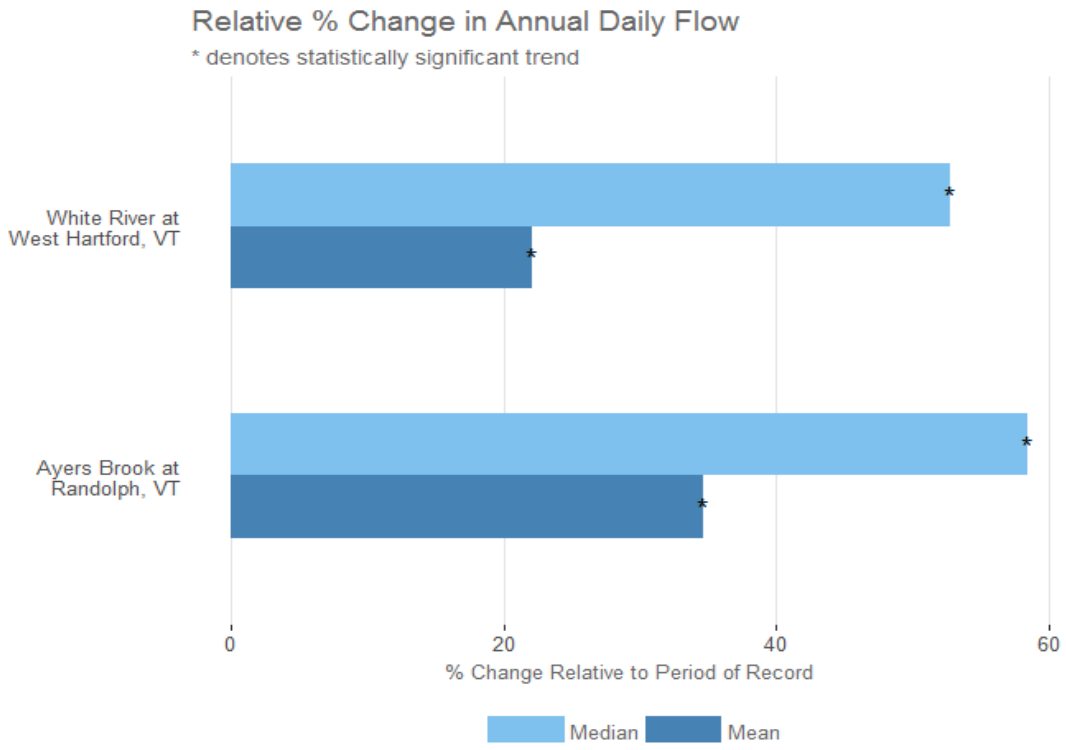


Figure 15. Relative % change in mean and median annual daily flow. Percent change is based on trend increase relative to flow value over entire period of record. All trends are statistically significant.

The increasing trend in annual daily flow is also apparent in other streamflow metrics, from low flows to mid high-level flows. For example, the annual minimum seven-day flow, or the seven-day period in a year with the lowest total cumulative flow, has steadily increased at both Ayers Brook and the White River (Figures B1-B2, Appendix B). This flow statistic has increased by 73% at the White River gage, and more than doubled at Ayers Brook (a 242% increase) based on a statistically

significant linear trend test. At the other end of the spectrum, moderate high flows, denoted by the annual 75th percentile flow, have also significantly increased (Figures B3-B4, Appendix B).

Climate Change Signal

While the results presented above are consistent with what scientists expect from climate change, the observed increases in flow cannot be tied directly to changes in climate based solely on this analysis. What we can say at this point is that there is very strong evidence that more water is moving through these systems.

In general, changes in streamflow, especially increases in streamflow, can be attributed to one or more causes, including:

1. changes in precipitation that impact watershed runoff;
2. changes in land use that increase or decrease stormwater runoff and storage;
3. changes in anthropogenic discharges and or withdrawals from streams; and
4. implementation of control structures (i.e., dams) that alter the natural hydrologic regime.

Which of these factors might explain the observed changes in the White River Basin? Items 3 and 4 are unlikely to explain streamflow trends since only unregulated USGS stations were examined and no new dams were constructed in the area. Large-scale changes in watershed land use and cover (Item 2) can drive shifts in hydrologic regimes but identifying these trends can be difficult due to the lack of consistent long-term data; currently, the only national, consistent land use dataset – the National Land Cover Dataset – provides three data years over a 10-year period from 2001 to 2011. During this period, neither USGS station watershed experienced substantial changes in estimated land cover percentages (Table 8).

Table 8. Percent area summary of National Landcover Dataset (NLCD) data years 2001 and 2011 for USGS station watersheds. Estimated land cover has not changed appreciably over a 10-year period.

	Ayers Brook			White River		
NLCD	2001	2011	% Difference	2001	2011	% Difference
Cultivated Crops	6.28	6.29	0.01	2.44	2.43	-0.01
Deciduous Forest	35.91	35.76	-0.15	45.27	45.12	-0.15
Developed, High Intensity	0.02	0.04	0.02	0.03	0.03	0
Developed, Low Intensity	1.9	1.92	0.02	1.04	1.06	0.02
Developed, Medium Intensity	0.27	0.29	0.02	0.29	0.34	0.05
Developed, Open Space	4.43	4.46	0.03	2.91	2.89	-0.02
Evergreen Forest	14.86	14.4	-0.46	15.68	15.34	-0.34
Grassland/Herbaceous	0.39	0.45	0.06	0.4	0.43	0.03
Mixed Forest	21.14	20.88	-0.26	22.8	22.65	-0.15
Pasture/Hay	11.41	11.12	-0.29	5.94	5.89	-0.05

A major driver of streamflow that could influence both USGS station records is precipitation. As previously mentioned, long term climate data is available at a USHCN station located at Hanover, NH (Figure 12). Precipitation records at this station go back to the mid-1880s. If precipitation totals have increased over time, additional runoff could explain the observed changes in streamflow.

To assess precipitation trends, the Hanover USHCN station data were analyzed over two-time steps: monthly and annual. First, total precipitation was calculated for each month and analyzed for trends. The results of this analysis indicate that precipitation totals have increased in 10 out of 12 months over the station's period of record (B6, Appendix B); this result is statistically significant. Next, annual total precipitation was calculated. A trend test on this data series indicates that annual precipitation totals have increased by an additional 4.5 inches over the historical record using a linear trend line, and 6.7 inches using a polynomial line (B7, Appendix B). These results are in line with what climate models predict for New England, namely, a wetter climate. This increase in precipitation – and hence runoff – is likely to be a substantial contributing factor to observed streamflow trends in the White River Basin, regardless of any other changes in the watershed.

Potential Impacts

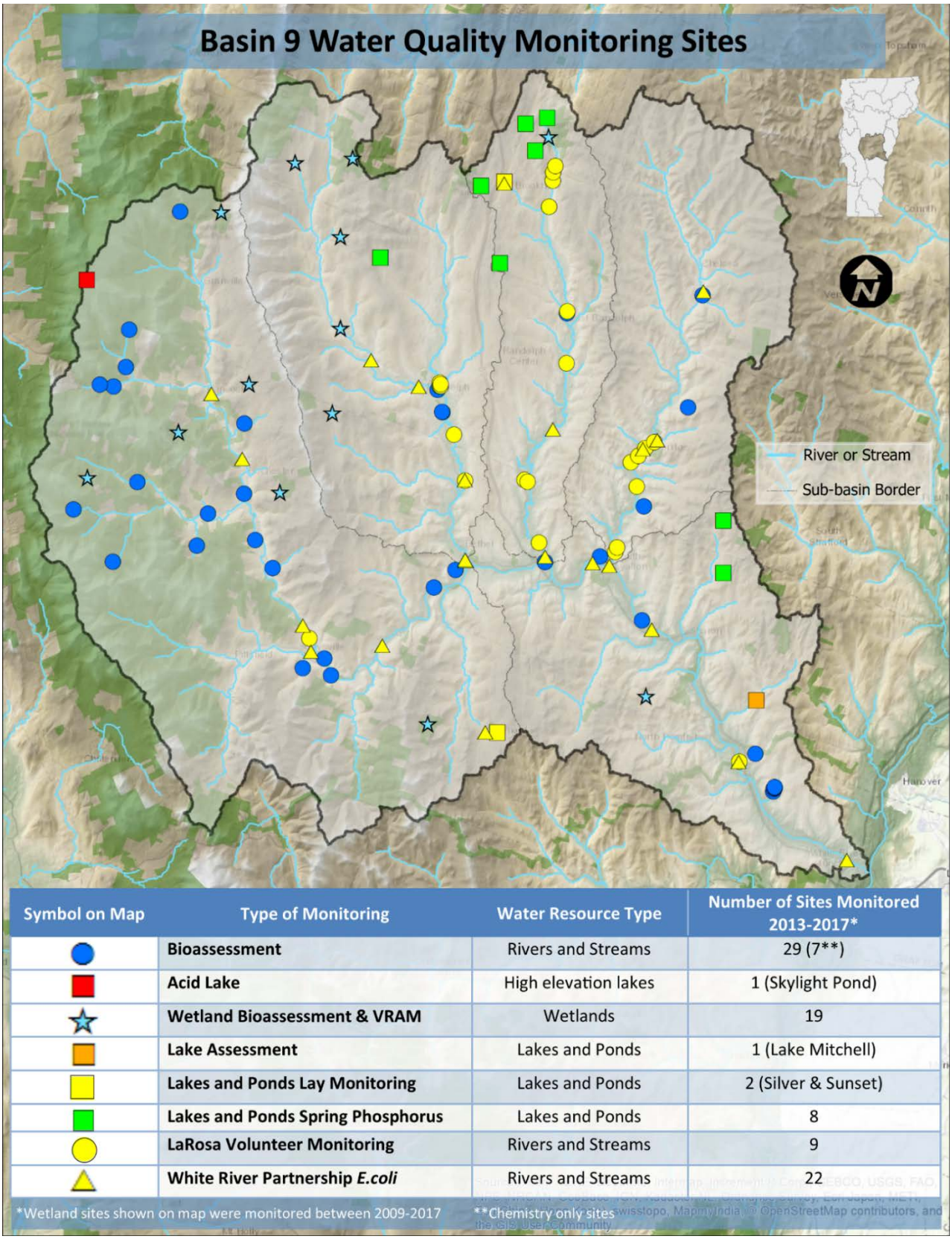
The impact of increased runoff and streamflow in a watershed depends heavily on local land use. In developed areas, more precipitation can lead to increased stormwater volume and velocity; these changes will mobilize larger pollutant loads on developed land surface (Galford, et al., 2014). In addition, increased runoff velocities in streams will increase bed and bank erosion and deliver higher sediment loads downstream. In areas where diffuse pollution sources are a concern – hay, pasture, row crops, lawns, etc. – more runoff can likewise increase sediment, nutrient, and pathogen loading to surface waters (Galford, et al., 2014). Increased stormwater and non-point surface runoff controls will be crucial to help counteract these pollutant transport mechanisms.

Increasing runoff and streamflow will also alter aquatic habitats in the watershed via sedimentation, nutrient loading (and associated biological response), scouring, and changes in water temperature. These changes may alter the distribution of certain aquatic species, although impacts are likely to be highly localized. In addition, taking this analysis a step further by evaluating a trend in variability of flow volume will help towns and villages to further understand their increased risk of flooding and drought over time, which will encourage them to develop in a more resilient manner.

B. Monitoring and Assessment Data Summary 2013-2017

Eight different types of monitoring and assessment were conducted on 98 sites in the White River Watershed from 2013-20173 (Figure 16). A total of 12 lakes and ponds were monitored by Lay Monitor volunteers for water quality parameters such as Secchi clarity, spring and summer total phosphorus, chlorophyll-a, habitat condition, and littoral habitat health. A total of 29 river and

[3] The 19 monitoring occurrences in wetlands took place between 2009-2017. Because this data was not included in previous basin plans, it is included here.



Symbol on Map	Type of Monitoring	Water Resource Type	Number of Sites Monitored 2013-2017*
	Bioassessment	Rivers and Streams	29 (7**)
	Acid Lake	High elevation lakes	1 (Skylight Pond)
	Wetland Bioassessment & VRAM	Wetlands	19
	Lake Assessment	Lakes and Ponds	1 (Lake Mitchell)
	Lakes and Ponds Lay Monitoring	Lakes and Ponds	2 (Silver & Sunset)
	Lakes and Ponds Spring Phosphorus	Lakes and Ponds	8
	LaRosa Volunteer Monitoring	Rivers and Streams	9
	White River Partnership *E.coli*	Rivers and Streams	22

*Wetland sites shown on map were monitored between 2009-2017 **Chemistry only sites

Figure 16. White River Basin water quality monitoring and assessment sites from 2013-2017.

stream sites were assessed by VDEC for biological integrity evaluating macroinvertebrate and fish communities. And a total of 31 river and stream sites were monitored by the local watershed organization White River Partnership.

Twenty-two of those sites monitored by the White River Partnership are part of a long-term monitoring program for bacteria and nine of those sites were part of targeted sampling funded by the WSMD LaRosa Partnership Program (LPP). The LPP provides funding for processing samples at the State's Vermont Agricultural and Environmental Laboratory that may help to identify sources of nutrients and bacteria along the *E. coli* impaired reaches of the First, Second, and Third Branches.

Bioassessment on Streams

Macroinvertebrate Monitoring Results

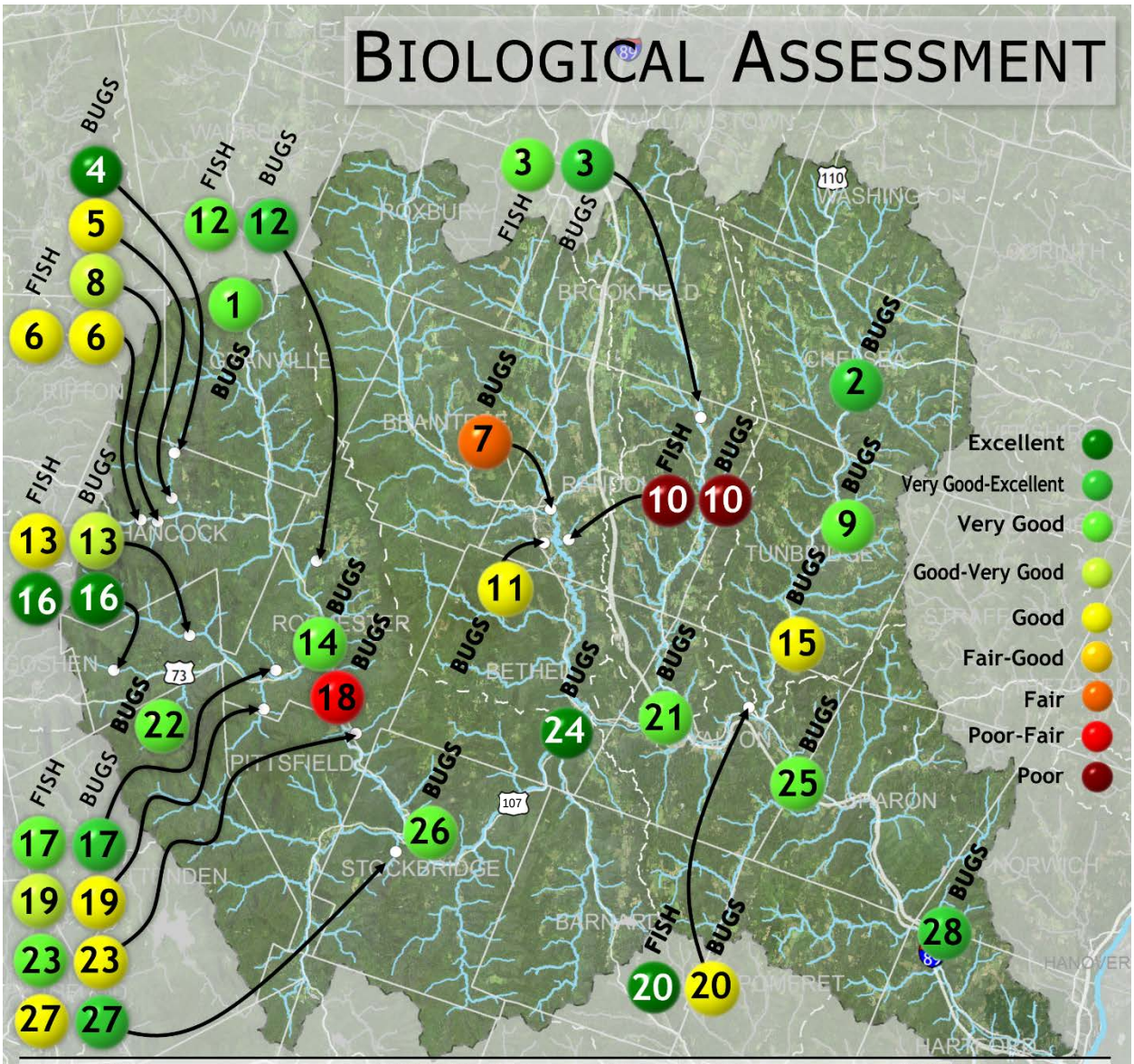
A total of 58 sampling events at 29 individual sites were sampled for macroinvertebrates in the White River basin (Figure 17 and Table C1 in Appendix C).

Thirty-three sampling events exhibited macroinvertebrate communities in *very good* or better condition. The following streams meet this condition: Bartlett Brook (1)[4], Bingo Brook (4), Breakneck Brook (2), Chittenden Brook (3), Deer Hollow Brook (1), river mile 17.1 of the First Branch (1), Foundry Brook (1), George Brook (1), Podunk Brook (1), Marsh Brook (2), river mile 18.5 of the Second Branch (1), river mile 1.3 of Smith Brook in Rochester (4), Stoddard Brook (1), Wing Brook (2), and the mainstem of the White River from river mile 15.4 through 43.7 (7). Two streams of note are Marsh Brook and Wing Brook. In 2014 the macroinvertebrate communities were in *excellent* condition. In 2015, both were rated as *good* and then in 2016 both were rated as *very good-excellent*. Changes in the condition of these communities are common when either experiencing impacts or recovering from them. Based on this information, both streams appear to be recovered. Streams in *very good* or better condition are considered to support aquatic biota at class B(1) or higher.

Sixteen sampling events exhibited macroinvertebrate communities in *good* to *good-very good* condition. The following streams meet this condition: Button Brook (1), Corporation Brook (2), Grindstone Brook (1), Hancock Branch (1), Happy Hollow Brook (1), Robbins Branch (1), and river miles 8.5 and 9.7 of the Third Branch (4). Sites in *good* to *good-very good* condition are considered to support aquatic biota.

Four sampling events exhibited macroinvertebrate communities in *poor* to *fair-good* condition. The streams sampled that meet this condition include: Liberty Hill Brook (2), river mile 0.1 of Smith Brook in Randolph (1), and river mile 9.5 of the Third Branch. Sites that are hovering at the *fair-good* level are indeterminate for fully supporting healthy aquatic biota and require further investigation for signs of impact from stressors. Sites in this condition are Liberty Hill Brook and the Third Branch

[4] Number of monitoring events from 2013 to 2017.



Map ID	Stream	River Mile	Date	Map ID	Stream	River Mile	Date
1	Deer Hollow Brook	0.9	9/2/2015	15	Button Brook	0.3	9/2/2014
2	First Branch White River	17.1	9/2/2014	16	Smith Brook (Rochester)	1.3	9/8/2016
3	Second Branch White River	18.5	9/2/2014	17	Wing Brook	0.2	9/8/2016
4	George Brook	0.1	9/8/2016	18	Liberty Hill Brook	0.1	10/7/2016
5	Hancock Branch	3.9	8/31/2017	19	Corporation Brook	1.1	9/8/2016
6	Robbins Branch	1.4	8/31/2017	20	Happy Hollow Brook	0.4	9/5/2014
7	Third Branch White River	9.5	8/31/2015	21	White River	21.8	9/2/2014
8	Grindstone Brook	0.1	9/7/2016	22	Chittenden Brook	2.4	9/8/2016
9	Foundry Brook	0.8	9/2/2014	23	Breakneck Brook	0.2	9/7/2016
10	Smith Brook (Randolph)	0.1	9/2/2014	24	Stoddard Brook	0.5	9/5/2014
11	Third Branch White River	8.5	9/2/2014	25	White River	15.4	9/2/2014
12	Marsh Brook	1	9/7/2016	26	White River	32.4	9/2/2016
13	Bingo Brook	1.8	8/31/2017	27	Bartlett Brook	0.5	9/7/2016
14	White River	43.7	9/4/2014	28	Podunk Brook	0.9	9/8/2014

Figure 17. White River basin biomonitoring results for the most recent sampling events for all streams assessed for fish and macroinvertebrates (bugs) from 2013-2017. Some sites were sampled more than once in that period. All results can be found in Table C1 in Appendix C.

of the White River.

Sites that are in *poor* condition do not meet water quality standards and require steps for mitigation. Only one stream sampled from 2013-2017 was rated *poor*, Smith Brook in Randolph.

Fish Monitoring Results

A total of 24 sampling events at 17 individual sites were sampled for fish in the White River Basin (Figure 17 and Table C1 in Appendix C). Nine of the 24 sampling events sampled for fish were unable to be assessed. Of the nine fish sampling events that were unable to be assessed, six were unable to be assessed because there was only one species of fish (Brook Trout in Button Brook, Chittenden Brook, Deer Hollow Brook, Foundry Brook, Podunk Brook and Stoddard Brook), one was unable to be assessed because the stream reach was too short (Corporation Brook sampled by USFS and would likely have scored a very good if reach was long enough), and two were unable to be assessed because the samples were collected by United State Forest Service (USFS) outside of the VDEC sampling window (Liberty Hill Brook and Chittenden Brook).

Three sampling events exhibited fish communities in *excellent* condition. The following streams meet this condition: Happy Hollow Brook, Marsh Brook, and river mile 1.3 of Smith Brook in Rochester.

Eight sampling events exhibited fish communities in *very good* condition. The following streams meet this condition: Bingo Brook (1), Breakneck Brook (3), Corporation Brook (1), Marsh Brook (2), river mile 18.5 of the Second Branch (1), and Wing Brook (1). Streams in *very good* or better condition are considered to support aquatic biota at class B(1) or higher.

Two sampling events exhibited fish communities in *good* condition and one sampling event exhibited a fish community in *poor* condition. The following streams meet this condition: Bartlett Brook (1) and Bingo Brook (1) showing *good* fish communities and river mile 0.1 on Smith Brook in Randolph showing a *poor* fish community. These communities often have a mix of tolerant and intolerant species, with higher densities of tolerant and non-native species. Those exhibiting *poor* condition do not meet water quality standards.

More information about the results of these sampling sites can be found in the VDEC 2016 Basin 9 Water Quality Assessment Report and the Vermont Integrated Watershed Information System (IWIS).

Long-Term Monitoring of Acid Sensitive Lakes

Sulfur and nitrogen oxides are largely transported to Vermont from out of state air emissions and are beyond this plan to address. The TMDL addressing the acid impaired lake in the White River basin has been approved by EPA. The TMDL can be found at: http://dec.vermont.gov/sites/dec/files/documents/WSMD_mapp_TMDL_2004_Acid.pdf

Two small ponds in Basin 9 are regularly sampled to ascertain impacts of acid precipitation. Skylight Pond in Ripton, sampled in 2014, is considered impaired for acidity and is on Part D of the priority

list of waters. Additionally, Colton Pond in Killington, last sampled in 2011, is considered acid stressed by the VT Lakes and Ponds Program. Both waterbodies will be sampled and assessed before the next iteration of the Basin 9 plan.

Volunteer Monitoring on Streams

White River Partnership Long-term Bacteria Monitoring

For the last 17 years, the White River Partnership (WRP) has monitored water quality and bacteria in Basin 9. In 2017, trained volunteers working with WRP monitored 23 swimming holes every other week from May to September (Table 9 and Figure 18). WRP collects bacteria (*Escherichia coli*), conductivity and turbidity data. The White River Partnership 2017 Water Quality Report is found here: http://whiteriverpartnership.org/wp-content/uploads/2013/10/2017-White-River-Water-Quality-Report.pdf. The report summary stated:

- Bacteria levels are usually highest immediately after rain and generally low during dry weather.
- Exceedances of the daily bacteria standard were the lowest in five years (Table 10, row 2).
- The number of sites exceeding the seasonal standard increased from 2016 (Table 10, row 3).
- The 2017 bacteria results continued a trend of lower levels since post-Irene 2012 results, but the Branches still had high readings (Table 10).

Table 9. Twenty-three long-term E. coli monitoring sites in the White River watershed (source: WRP 2017 Water Quality Report).

Lower White River	First Branch
1. Old River Rd Ledges–Hartford	12. Mouth of 1st Branch–Royalton
2. West Hartford Bridge–Hartford	13. Tunbridge Fairgrounds
3. The Sharon Academy–Sharon	14. Tunbridge Town Pool Tributary
4. Pinch Rock–Royalton	15. Chelsea Recreation Park
	Second Branch
Upper White River	16. Mouth of 2nd Branch–Royalton
5. Peavine Park–Bethel	17. Dugout Road–Randolph
6. Silver Lake–Barnard	18. Sunset Lake–Brookfield
7. Gaysville Bridge–Stockbridge	**Third Branch**
8. Mouth of Tweed–Stockbridge	19. Mouth of 3rd Branch–Bethel
9. Peavine Park–Stockbridge	20. Stock Farm Road–Bethel
10. Lion's Club Park–Rochester	21. Randolph Recreation Park
11. Taylor Meadow Road–Hancock	22. Riford Brook Road–Braintree
23. Bingo Brook—Rochester	

Table 10. Summary of long-term E. coli monitoring data from 2013 to 2017 (source: WRP 2017 Water Quality Report).

	2013	2014	2015	2016	2017
# of samples exceeding the daily standard	44 of 191 = 23%	45 of 195 = 23%	51 of 197 = 26%	41 of 195 = 21%	34 of 203 = 17%
# of samples exceeding the chart maximum: >2419 colonies *E. coli*/100mL sample	4	2	8	5	5
# of sites exceeding the seasonal standard	9 of 22	7 of 22	10 of 22	6 of 22	8 of 23

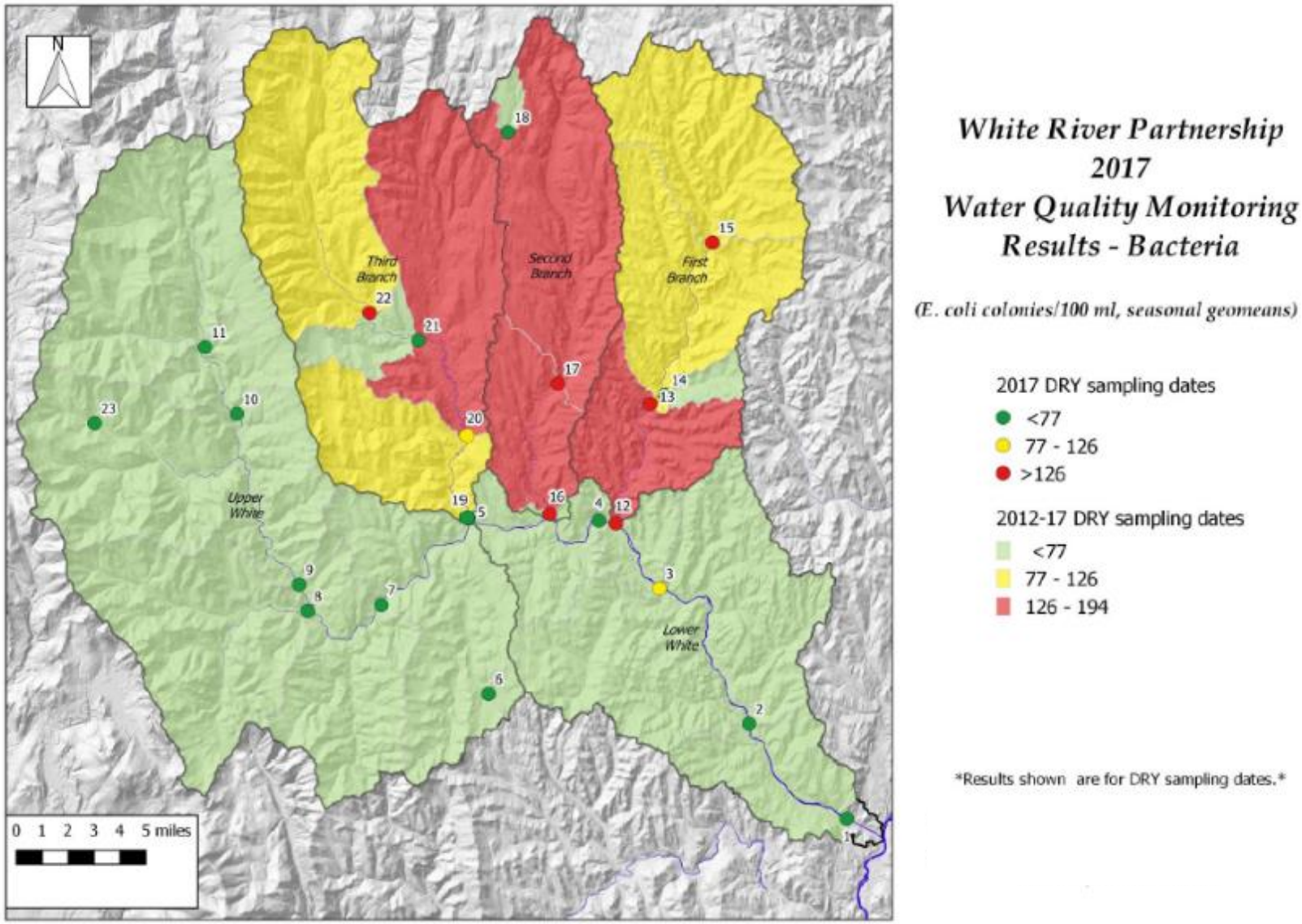


Figure 18. Twenty-three Basin 9 *E. coli* monitoring sites and geometric mean results from the 2017 sampling season. See Table 9 for site names. (source: WRP 2017 Water Quality Report)

Further analysis of the monitoring results from 2012 to 2017 was conducted by VDEC to look at patterns in the data that may help to determine sources or trends. There was difficulty determining trends from a five-year dataset, but some patterns were evident to help target potential sources. Figure 19 shows that the highest *E. coli* levels are correlated with areas of cultivated cropland use over 7 percent while moderate *E. coli* levels are more closely correlated with cultivated cropland use less than 7 percent and developed land use greater than 0.012 percent. Focusing water quality best management practices in these areas may provide the most benefit.

Figure 20 shows that many sites have significantly higher levels of *E. coli* during wet weather events. Of those sites sampled from 2012 to 2017 with *E. coli* levels higher than 126 colonies per 100 ml, site 17, on the Second Branch on Dugout Road in Randolph, and site 16, on the mouth of the Second Branch in Royalton, are the most significantly different during dry and wet weather events.

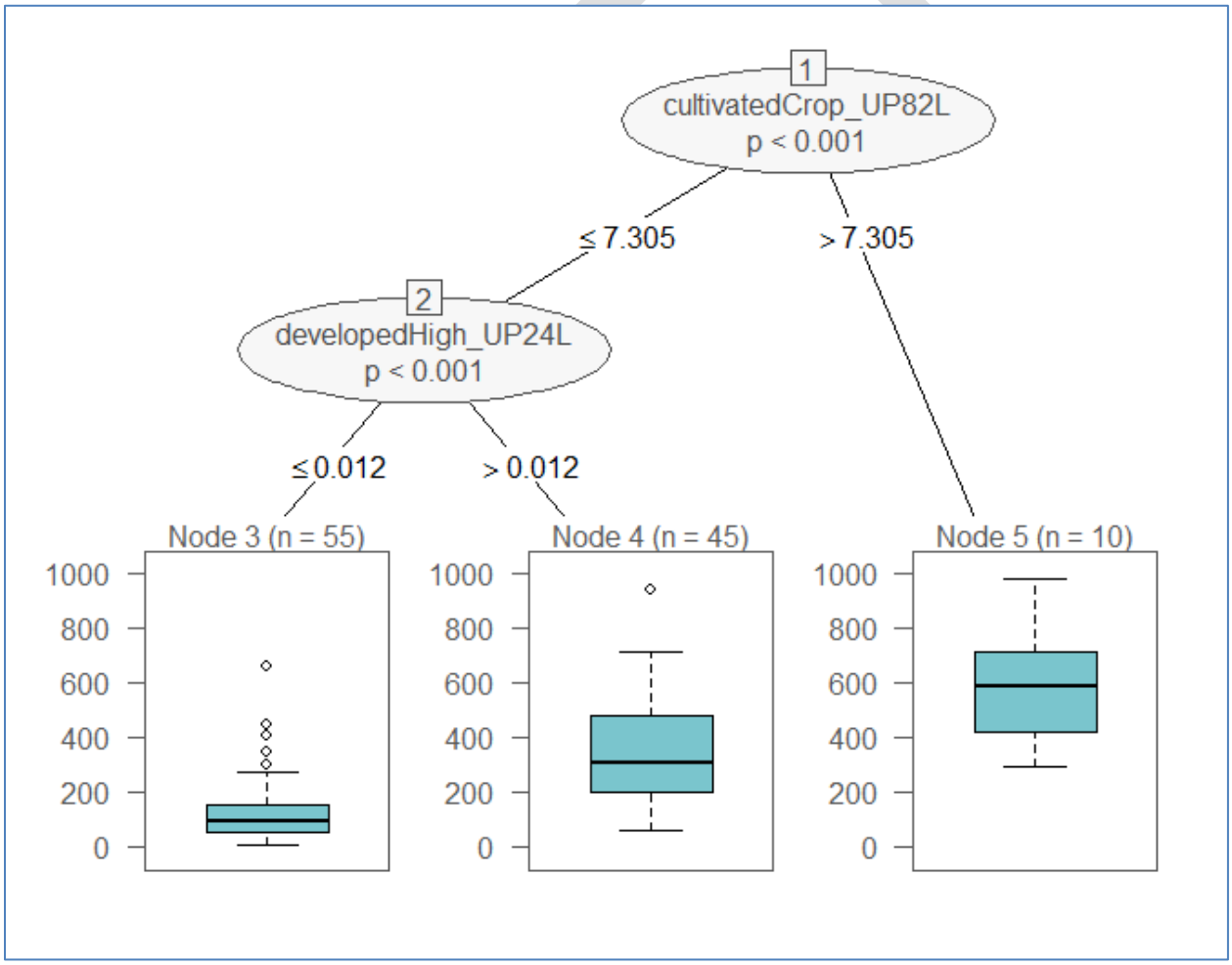


Figure 19. Graphical tree comparing mean *E. coli* colonies value to land-use. The highest mean *E. coli* levels are correlated with catchments with higher than 7.305% cultivated crop cover. Moderate mean *E. coli* levels are correlated with catchments with >0.012% cover of highly developed lands and ≤7.305% cultivated crop.

This pattern indicates that substantial amounts of *E. coli* in these areas come from external sources that are washed into the river during rain events. *E. coli* sourcing is particularly difficult and problematic, leading to false source identifications. Because *E. coli* can live in the soil and be re-suspended during rain events, legacy populations could be contributing in these areas during dry periods. The WRP has been monitoring dam sites to determine if re-suspended fine sediments play a part in continuing *E. coli* impairment. They are also pursuing dam removal projects where feasible. One site that might be seeing an improvement is site 21 in Randolph below a dam removal and an upgraded Wastewater System.

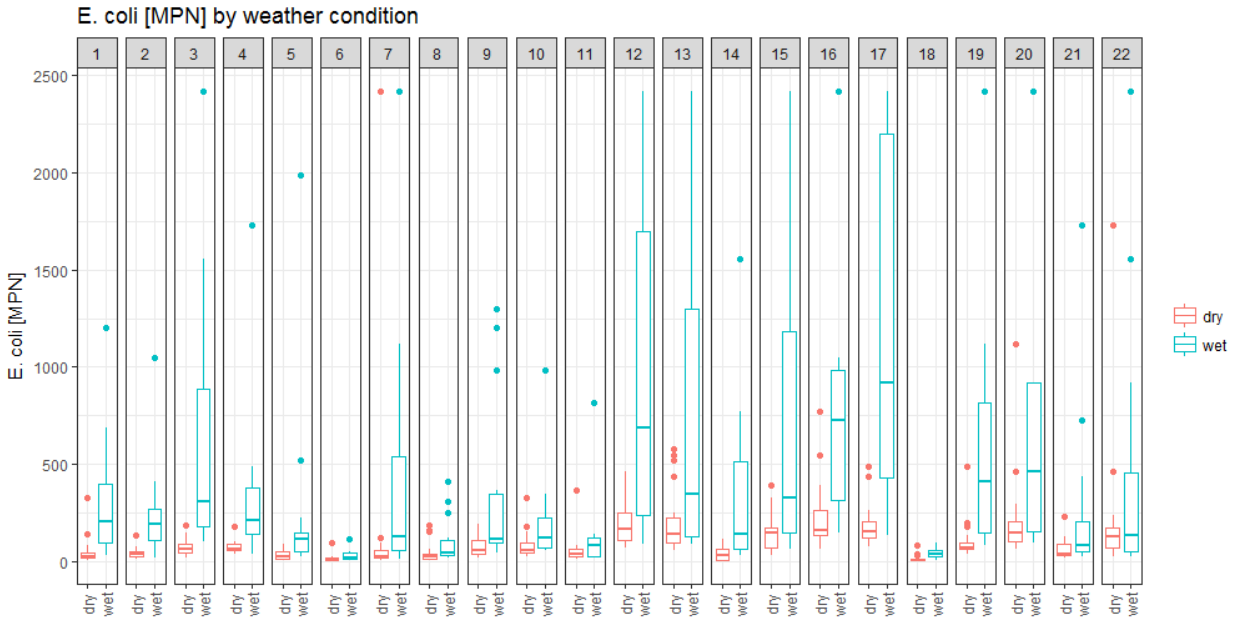


Figure 20. *E. coli* monitoring sites comparing mean MPN values collected during dry and wet weather[5]. Numbers at the top of each column represent the site number as shown in Table 9.

LaRosa Volunteer Partnership Program

In addition to the 23 swimming hole sites, WRP also participates in adaptive monitoring through the LaRosa Partnership Program (LPP). Since 2003 the LPP has helped watershed associations and monitoring groups across the state of Vermont implement new and ongoing surface water monitoring projects for waters in need of water quality assessment by helping to alleviate the financial burden of laboratory analysis costs. Additional details and reports on the LaRosa Monitoring for Basin 9 data can be found at: http://dec.vermont.gov/watershed/map/monitor/larosa.

[5] Wet weather is reported as more than 0.1 inches in the last 24 hours or more than 0.25 inches in the last 48 hours.

2013

In 2013, WRP bracketed three potential sources of bacteria on three tributaries to the Second Branch. No major sources were revealed, but undeveloped areas of the Second Branch exhibited high levels of bacteria as well as areas dominated by agricultural land cover.

2014

In 2014, efforts were focused on determining if the tributaries to the Second Branch were significant contributors of bacteria to the Second Branch. Twelve tributaries to the Second Branch were sampled in 2014. The data did not support that any of the tributaries are contributing significantly to the elevated bacteria levels observed at sites along the Second Branch, leading to the conclusion that the *E. coli* is probably coming from sources along the Second Branch itself.

The conclusions from the 2014 monitoring data lead WRP to sample for nutrients and turbidity in addition to bacteria to differentiate between natural and anthropogenic sources such as agricultural runoff and failed septic systems in 2015.

2015

In 2015, four sites in the upper reaches of the Second Branch were sampled for bacteria, total nitrogen, nitrate-nitrite, and total phosphorus. Turbidity measurements were also taken. For these four sites, *E. coli* levels did not exceed the VT Water Quality Standards daily criteria, however the site furthest downstream had bacteria levels that exceeded the seasonal criteria.

Total phosphorus was the only other measured parameter that approached or exceeded criteria updated in the 2016 VT Water Quality Standards. Background levels of phosphorus appeared to be somewhat elevated in the upstream portion of the Second Branch. One site met or exceeded the medium, high-gradient criteria of 15 µg/L total phosphorus (TP) on each of the four sampling dates in 2015. The furthest site upstream, adjacent to a beaver meadow wetland and upstream of active land use, also exceeded the TP criteria on two sampling dates. The previously described site was likely historically farmed. Fine sediments were also dominant in this section of the Second Branch.

2016

In 2016, monitoring, in partnership with LaRosa, was conducted again on the four sites along the Second Branch with additional sites upstream and downstream of chronic high bacteria sites on the Third Branch to identify potential sources. For the Second Branch, the results for 2016 showed the most downstream site exceeding *E. coli* daily criteria on every sampling date. All other sites were under the criteria. All sites were above the TP criteria for all sampling dates except two sites, which only exceeded the TP criteria on one date in June.

For the Third Branch sites in Randolph Village and the Upper Stock Farm, daily standards for bacteria were exceeded in August, while the Ayers Brook and Lower Stock Farm sites were below

daily and seasonal criteria on the two testing dates. Total phosphorus was the only other measured parameter that exceeded criteria in the Third Branch. TP exceeded the 15 µg/L criteria for medium, high gradient streams at the Randolph village sites and Upper Stock Farm in August and there were no other exceedances of this criteria on either date.

Results for the First Branch collected in dry weather confirmed that it is highly unlikely there are any cross-ties between the stormwater drains that discharge in Tunbridge village and sanitary systems along this stretch. Somewhat surprisingly, however, *E. coli* readings were higher at the upstream Mill Dam than at the Fairgrounds on all sampling dates, and significantly decreased at the downstream farm site being used for swimming. This indicates that a problem exists in the upstream area.

Based on sampling results, extremely fine sediments along the Second Branch may be contributing to chronically high bacteria levels indicated by WRP's long-term monitoring, as well as interacting with transport and storage of phosphorus within the watershed. Dams may be playing into these dynamics as well. A set of four sites (upstream and downstream of two dams) on the Second Branch were included in the 2017 sampling plan, as well as focusing on two dam sites on the First Branch in Tunbridge.

2017

The 2017 monitoring effort refined the spatial resolution of water quality data in the First and Second Branch watersheds to include more information about bacteria levels and potential relationships to nutrients on segments recently listed for impairment due to chronic high levels of *E. coli*, as well as collecting baseline data for project monitoring near the top-ranked *E. coli* long-term sentinel site at Dugout Road on the Second Branch. Some weak relationships were identified between upstream and downstream sites, where *E. coli* levels were higher above the dam than below. WRP will continue to monitor at these sites to establish baseline data to look at changes in the watershed as dam removals and other watershed projects are implemented in the watersheds of Ayers Brook and the First, Second and Third branches.

Stream Geomorphic Assessments

Rivers are in a constant balancing act between the energy they produce and the work that must be done to carry the water, sediment and debris produced in their watersheds. A change in any one of these factors will cause adjustments of the other variables until the river system comes back into equilibrium (balance). These changes can be caused by natural events and by human activity. The impact of which may be seen immediately or for decades after the activity occurred.

The goal of managing toward, protecting, and restoring the equilibrium condition of Vermont rivers is to resolve or avoid conflicts between human investments and river dynamics in a manner that is technically sound, and both economically and ecologically sustainable.

While water quality in Basin 9 is some of the best in the state, the degraded geomorphic condition of the basin's streams implies impacts to wildlife and fish habitat (e.g. riparian buffer removal that

reduces shading and habitat for insects that feed fish, and channel alteration that destroys aquatic habitat), public safety (e.g. loss of floodplains that store floodwaters, accelerated streambank erosion which results in infrastructure damage, and channel straightening that increases flow velocity during rain events) and water quality (e.g. higher *E. coli* populations caused by increased fine sediment resuspension and bank soil erosion, and nutrient and chemical runoff from encroachment of impervious surfaces and agricultural land). Major stream alterations following flooding events like Tropical Storm Irene are a major driver of degraded geomorphic conditions in the White River basin. The legacy from Irene and other intense storms will be felt for years to come. Managing towards stream equilibrium is essential for good water quality, healthy aquatic habitat, and flood resilience in the basin and will help to mitigate impacts of increased runoff and streamflow described in the Climate Change Signal section.

Between 2013 and 2017 three Phase II Stream Geomorphic Assessments (SGAs) were completed in Basin 9 (see table in Figure 21). Figure 21 also shows the geomorphic condition for those streams with Phase II SGAs completed before 2013. Most of the White River Mainstem and its major tributaries have been assessed, excluding the entire Second Branch, the Upper Third Branch and sections of the middle and lower White River mainstem.

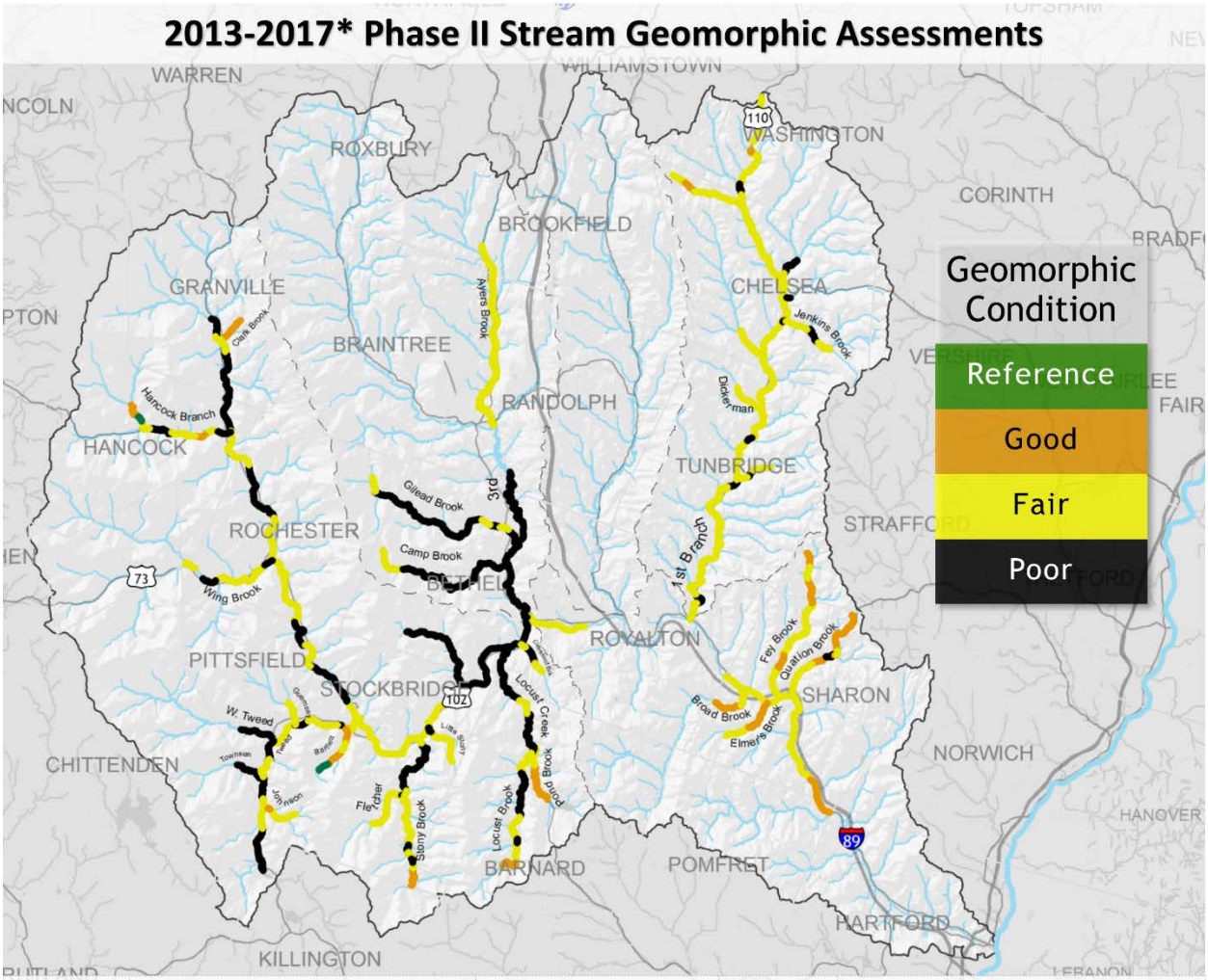
A River Corridor Plan (RCP) includes the work completed in the Phase I and II SGAs based on protocols and guidelines developed by the Vermont River Management Program (Redstart Consulting, 2014). All SGAs and RCPs can be found at: https://anrweb.vt.gov/DEC/SGA/finalReports.aspx.

Most streams with Phase II SGA data in Basin 9 are in fair geomorphic condition, with a significant number in poor condition as they have suffered a "stream type departure". Stream type departure occurs when the channel dimensions deviate so far from the reference condition that the existing stream type is no longer the reference stream type. These stream type departures represent a significant change in floodplain access and stability. Watersheds that have lost attenuation or sediment storage areas due to human related constraints are generally more sensitive to erosion hazards, transport greater quantities of sediment and nutrients to receiving waters and lack the sediment storage and distribution processes that create and maintain habitat (Bear Creek Environmental, LLC, 2015).

Geomorphic Condition Summaries

Middle White River and Third Branch Watersheds

The 2014 Middle White River and Third Branch Phase II SGA and RCP was conducted mostly in the town of Bethel on the White River and Third Branch, and their tributaries. Physical conditions in this part of the watershed indicate: deeply entrenched channels in the White and Third Branch that increase the force of water flow, which exacerbates flooding conditions; loss of access to floodplains, which store water and attenuate sediment during flooding events; and removal of natural materials from streams that provide habitat and channel roughness to slow down flood flows



Date Completed	Streams Assessed (miles)	Report	# of Segments Assessed	Summary of Geomorphic Condition
12/24/2014	Third Branch, Camp Bk, Gilead Bk, Middle White main stem, Cleveland Bk, Locust Creek, Lilliesville Bk	Middle White River and Third Branch Watersheds River Corridor Plan	36	72% poor 28% fair 0% good 0% reference
7/17/2014	First Branch mainstem, Dickerman Bk, Cram Bk, Jenkins Bk, Hart Hollow Bk, Jones Pond Bk, and one unnamed stream in Tunbridge	First Branch White River Corridor Plan	61	15% poor 82% fair 3% good 0% reference
7/15/2015	White River mainstem, Locust Creek, Pond Bk, Little Stony Bk, Stony Brook, Fletcher Bk, Bartlett Bk, Johnson Bk, Hancock Branch, West Branch	Upper & Middle White River Watershed Corridor Plan	60	28% poor 57% fair 15% good 0% reference

Figure 21. Mapped geomorphic condition of all streams with a Phase II SGA. *The table shows the results of the three Phase II geomorphic assessments completed from 2013 to 2017.

(Redstart Consulting, 2014).

Thirty-six miles of linear stream including 18 stream reaches making up and 38 segments, were assessed. Largely because of the impacts resulting from Tropical Storm Irene and human activity in response to the storm in August 2011, no reaches were rated in good geomorphic condition. Twenty-six segments were in poor geomorphic condition and ten of the segments were in fair geomorphic condition (Figure 21). Two segments were unable to be assessed due to beaver impoundments (Redstart Consulting, 2014).

Pages five through nine of the RCP provide a summary of priority strategies and initiatives to address degraded physical conditions. High priority projects listed in the 2014 plan should be considered for development and implementation where reach-scale projects are possible.

First Branch White River

Based on the 2014 First Branch White River Phase II SGA and RCP, current geomorphic conditions in the First Branch basin are largely related to two primary factors, both human caused: widespread restriction of access to historic floodplains and extensive and pervasive channel straightening (Redstart Consulting, 2014). These factors lead to prioritization for protection and restoration of existing floodplains that attenuate high flows and storage of sediment and nutrients, while also allowing streams to widen that are undergoing lateral migration to recreate floodplains. These objectives will improve water quality in the long-term and improve public safety by decreasing impacts of flash flooding (Redstart Consulting, 2014).

Sixty-one segments were assessed in the study. Two were in good condition, 50 segments were in fair condition and nine segments were in poor condition (Figure 21).

Priority reaches and segments for integrated reach-scale restoration strategies and stand-alone buffer establishment implementation priorities are found on pages five and six of the First Branch River Corridor Plan. High priority projects should be implemented and developed where there is landowner and municipal interest.

Upper and Middle White River

The 2015 Upper and Middle White River Watershed Corridor Plan identifies the major stressors to geomorphic stability and habitat conditions in the White River mainstem and tributaries in Granville, Hancock, Rochester, Stockbridge and Barnard, as stream channel straightening and corridor encroachment associated with the existence of roads. The stressors lead to limited floodplain access and have caused moderate to extreme channel degradation that results in sediment build up, channel widening and lateral movement of the stream channel to regain equilibrium. The transportation corridor conflicting with the river corridor has also led to landslides and mass failures along streams working to adjust by rebuilding their floodplains. The failures are a major source of fine sediment to streams that impacts the health of aquatic biota (Bear Creek Environmental, LLC, 2015).

Gravel mining, windrowing and channel straightening following Tropical Storm Irene left a large footprint on the aquatic habitat and functionality of river corridors and floodplains. To achieve equilibrium, watershed wide strategies are recommended in the RCP.

Twenty-three study reaches identified were broken down into 66 segments. Seventeen segments are in poor geomorphic condition, 34 are in fair condition and nine are in good condition. Six segments were not assessed (Figure 21).

Ninety-four projects were identified in the plan. Many of the projects are focused on floodplain improvement and conservation (44) and stream channel improvement and restoration (24). A summary of the priority projects is described on pages 93 through 94 of the RCP.

Wetland Monitoring

The Vermont Wetlands Program uses its Bioassessment project to gather data about the health of Vermont wetlands. Based on a 2017 analysis of bioassessment data, the principal factors that correlate with poor wetland condition are:

- presence of invasive species,
- disturbance to the wetland buffer or surrounding area,
- disturbance to wetland soils, and
- disturbance to wetland hydrology (how water moves through a wetland) through ditching (e.g. agricultural), filling (e.g. roads) and draining (e.g. culverts).

Wetlands in remote areas and at high elevations tend to be in good condition, with the most threatened wetlands occurring in areas of high development pressure and exhibiting habitat loss.

The Bioassessment Program has conducted 218 detailed vegetation plots in wetlands throughout the state. However, the White River watershed is under-sampled relative to the rest of the state, with only 13 vegetation plots, the most recent having been conducted in 2014 (most were conducted in 2009).

The lack of data is in part due to the lack of mapped wetlands in this watershed relative to other areas of Vermont, though improvements in mapping are allowing for more reliable detection of the small forested wetlands, which are common in the White River watershed. Surveys are primarily conducted on a rotating basis by watershed, and the White River basin will be surveyed in more detail with the next rotation in 2019.

In addition to detailed vegetation plots, the Wetlands program also conducts rapid assessments of wetlands using the Vermont Rapid Assessment Method (VRAM). Because these rapid assessments can be conducted quickly and can occur during most of the year, more of these surveys have been completed in the White River watershed.

A total of 18 VRAM assessments have been conducted in Basin 9 with the most recent in 2017. VRAM assesses both the condition and the function of wetlands with the best possible score at 100

and the worst at around 15. In this watershed, the lowest-scoring VRAM was a 37 in a disturbed roadside wetland and the highest was two scores of 86 at two beaver wetlands – one high in the headwaters of the Third Branch and another above Brandon Gap in the Green Mountains. This shows a clear pattern in this watershed (and in the rest of Vermont) where high-elevation, small wetlands are often in excellent condition, but floodplain wetland complexes low in the watershed are often in poor condition and heavily impacted by human use (but also offer a great deal of restoration potential).

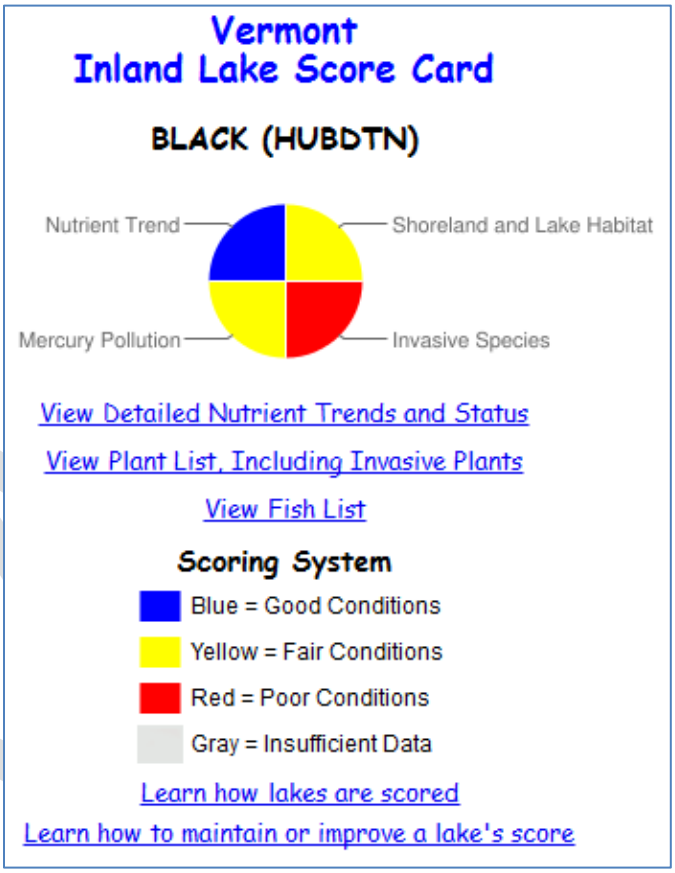
The Wetlands Program also maps natural communities in wetlands using Natural Heritage Inventory methodology. This mapping is opportunistic based on field visits and desktop review and is not intended to be a comprehensive map of the entire watershed. However, the mapping is extensive, with around 400 discrete natural communities mapped. The most commonly encountered natural community types in this dataset are Beaver Wetland, Hemlock-Balsam-Fir-Black Ash Seepage Swamp, Rich Fen, Seep, and Vernal Pool.

Many softwood swamps that could not be classified in further detail were also mapped for possible future field visits. There is also mapping for a significant number of disturbed wetlands that could not be assigned a natural community type based on the information available. Further field work and desktop review will result in additional natural community mapping.

Interested organizations and citizens can help build the dataset of wetlands in the White River Basin by conducting VRAM analysis. Individuals or groups interested in learning the VRAM protocol should contact Wetlands scientist Charlie Hohn at Charlie.Hohn@vermont.gov for further information.

Lakes and Ponds Monitoring and Assessment

There are 40 lakes in the Vermont Lakes Inventory in the White River Basin (see Appendix D). All 40 lakes are in accordance with the Vermont Hydrology Policy and meet the Hydrology Criteria (§29A-304) in the 2017 VT Water Quality Standards. Fourteen of the lakes are ten acres or greater and eight are 20 acres or greater. The remaining 25 lakes range from 1.3 to nine acres. The largest lake in the basin is Silver Lake at 81 acres. With a total of eight, Brookfield hosts more than a fifth of all the lakes and ponds and almost half of the waterbodies over ten acres. Sharon comes in a close second with six lakes and ponds, three of which are over ten acres.



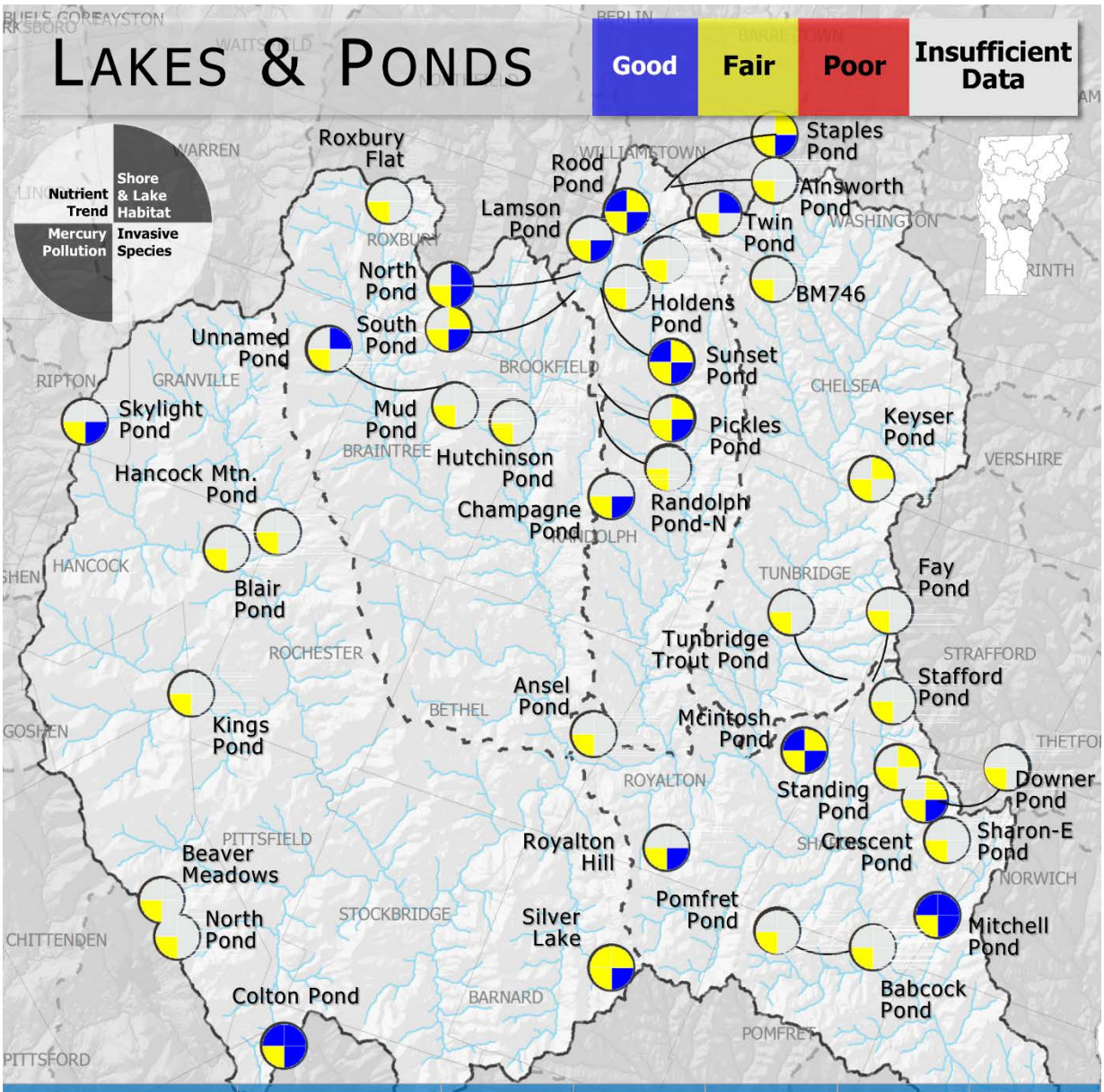
Thirty-three out of the 40 lakes in Basin 9 have at least one rating on the VT Inland Lakes Scorecard (Figure 22). The VT Inland Lake Score Card is a user-friendly interface developed by the Vermont Lakes and Ponds Management and Protection Program (VLPP) to share available data on overall lake health with lake users (see adjacent graphic). Lake-specific water quality and chemistry data can be accessed online through the Vermont Integrated Watershed Assessment Information System (IWIS).

Those wishing to better understand the scoring process are encouraged to read the 'How Lakes Are Scored' sections and watch the recorded webinar on the YouTube channel for the VDEC Watershed Management Division.

Lake users interested in becoming involved in the health of their favorite lake or pond should use the Lake Score Card Checklist of Lake Protection Actions as a first step to moving toward a healthier lake or pond.

Water Quality Status

Three lakes, Colton Pond in Killington, Sunset Lake in Brookfield and Lake Champagne in Randolph, have a fair condition for water quality status. Colton Pond is considered acid stressed by the VT Lakes and Ponds Program. The water quality sampling from 2000 in Sunset Lake showed extremely high conductivity for a lake environment and historical monitoring data showed high



Lake Name	Town	Water Quality Status	Nutrient Trend	Invasive Species	Mercury Pollution	Shore & Lake Habitat
Crescent Lake	Sharon	Blue	NA	Blue	Yellow	Yellow
Lamson Pond	Brookfield	Blue	NA	Blue	Yellow	NA
McIntosh Pond	Royalton	Blue	Blue	Blue	Yellow	Yellow
Mitchell Pond	Sharon	Blue	Blue	Blue	Yellow	Blue
North Pond	Brookfield	Blue	NA	Blue	Yellow	Blue
Pickles Pond	Brookfield	Blue	NA	Blue	Yellow	Yellow
Rood Pond	Williamstown	Blue	Blue	Blue	Yellow	Yellow
Royalton Hill	Royalton	Blue	NA	Blue	Yellow	NA
Silver Lake	Barnard	Blue	Yellow	Blue	Yellow	Yellow
South Pond	Brookfield	Blue	NA	Blue	Yellow	Yellow
Staples Pond	Williamstown	Blue	NA	Blue	Yellow	Yellow
Colton Pond	Killington	Yellow	Blue	Blue	Yellow	Blue
Lake Champagne	Randolph	Yellow	NA	Blue	Yellow	NA
Sunset Lake	Brookfield	Yellow	Blue	Blue	Yellow	Yellow
Skylight Pond	Ripton	Red	NA	Blue	Yellow	NA

Figure 22. Scorecard information for lakes and ponds in Basin 9. Table shows lakes or ponds with three or more documented scores. Skylight Pond, with a red water quality status, is a high-elevation lake that is acid impaired.

phosphorus levels. For Sunset Lake, summer Secchi data are collected by a Lay Monitor Volunteer during the summer months and total phosphorus is collected during spring runoff. Additional sampling for chloride and total phosphorus during the summer is required to determine if the high conductivity is indicative of a chronic problem and if there is a significant summer nutrient trend or elevated phosphorus levels in the lake. Lake Champagne is in fair condition for flow alterations that may have been discontinued.

One lake in Basin 9, Skylight Pond in Ripton, has a poor water quality status due to high elevation acid precipitation and a low acid buffering capacity in the spine of the central Green Mountains.

Nutrient Trend

Only one lake in Basin 9, Silver Lake in Barnard, has data with a negative trend. Based on Lay Monitoring data, collected by Silver Lake State Park, summer Secchi depths are highly significantly decreasing. This indicates a decrease in water clarity. Water clarity can be affected by several stressors including runoff from roads and developed lands around the lake. Chlorophyll-a and summer total phosphorus samples have not been collected since the early 1990s. The VT Lakes and Ponds Program will be collecting water quality data on Silver Lake in summer 2018. Additional water quality information on Silver Lake in Barnard can be found on the VT Lay Monitoring Website.

Invasive Species

No aquatic invasive species have been confirmed in lakes in Basin 9. Lakes with the highest risk potential for invasive species introduction should take preemptive measures to prevent spread. Those lakes and ponds with public access areas (Fish and Wildlife Accesses) are good sites to host spread prevention signage and materials, public greeters, and Vermont Invasive Patrollers (VIP). The priority lakes and ponds for AIS outreach are Silver Lake (which has Silver Lake State Park), Colton Pond in Killington (VFWD Access Area), Rood Pond in Williamstown (VFWD Access Area), McIntosh Pond in Royalton (VFWD Access Area), Sunset Lake in Brookfield and Mitchell Pond in Sharon (privately owned and managed).

The 2013 Basin 9 plan highlights didymo (*Didymosphenia geminata*) as a nuisance organism (Figure 23). Initially thought to be an introduced non-native, the state announced a felt-soled wader ban in 2011. In 2016, the ban was repealed because the algae were found to be native and widespread in VT waters. Although native, Didymo blooms can still impact aquatic habitat quality. In 2017, Gilead

Figure 23. Didymo, no longer considered a non-native invasive, blooms on the stream bottom substrate.

Brook in Bethel (tributary to the Third Branch) experienced a substantial didymo bloom observed by VFWD staff.

Mercury Pollution

There are two main airborne pollution types that affect lakes and ponds in Vermont: sulfur or nitrogen oxides and mercury. The latter is discussed here. Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont and those of nearby states as well – so all lakes in Basin 9 get a fair condition score.

Shoreland Condition

No lakes in the White River Basin have a poor shoreland score. However, ten lakes have a fair shoreland score. The largest of these lakes are Silver Lake in Barnard, Sunset Lake in Brookfield, Rood Pond in Williamstown, McIntosh Pond in Royalton and Crescent Pond in Sharon. Three ponds have shorelands in good condition including Mitchell Pond in Sharon, Colton Pond in Killington and North Pond in Brookfield (Table 11).

Table 11. Shoreland condition scores for large lakes in Basin

Lake Name	Town	Shore & Lake Habitat Score
Mitchell Pond	Sharon	Blue
Colton Pond	Killington	Blue
North Pond	Brookfield	Blue
Twin Pond	Brookfield	Blue
McIntosh Pond	Royalton	Yellow
Rood Pond	Williamstown	Yellow
Sunset Lake	Brookfield	Yellow
Silver Lake	Barnard	Yellow
Crescent Lake	Sharon	Yellow
Pickles Pond	Brookfield	Yellow
South Pond	Brookfield	Yellow
Staples Pond	Williamstown	Yellow
Keyser Pond	Chelsea	Yellow
Standing Pond	Sharon	Yellow

Effective July 1, 2014, the Vermont Legislature passed the Shoreland Protection Act (Chapter 49A of Title 10, §1441 et seq.), which regulates shoreland development within 250 feet of a lake's mean water level for all lakes greater than 10 acres in size. The intent of the Act is to prevent degradation of water quality in lakes, preserve habitat and natural stability of shorelines, and maintain the economic benefits of lakes and their shorelands. The Act seeks to balance good shoreland management and shoreland development.

Shoreland developed prior to July 1, 2014 is not required to retroactively meet standards. The Lake Wise Program, an Agency of Natural Resources initiative that awards lake-friendly shoreland property, including that of state parks, town beaches, private homes and businesses, is available to lakeshore owners and Lake Associations to assess shoreland property for improvements that benefit water quality and wildlife habitat. Lakes with a fair shoreland score will benefit from implementing Lake Wise Program best management practices. More information on the program can be found at: http://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/what.

Silver Lake State Park on Silver Lake participated in a Lake Wise Evaluation in 2015. Ten recommendations were made to address runoff from driveway and parking areas, shoreland, and recreational areas.

Road Erosion Inventories

Road Erosion Inventories (REI) are used by Vermont municipalities to:

- identify sections of local roads in need of sediment and erosion control,
- rank road segments that pose the highest risks to surface waters, and
- estimate costs to remediate those sites using Best Management Practices.

REI's are required by the Municipal Roads General Permit (MRGP) as part of the Road Stormwater Management Plan. The MRGP is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. Municipalities will implement a customized, multi-year plan to stabilize their road drainage system. The plan will include bringing road drainage systems up to basic maintenance standards, and additional corrective measure to reduce erosion as necessary to meet a TMDL or other water quality restoration effort. The permit is required by the Vermont Clean Water Act (Act 64) and the Lake Champlain Phase I TMDL.

The implementation of the priorities identified in REI's will reduce sediment, phosphorus and other pollutants associated with stormwater-related erosion generated from unpaved municipal roads that contribute to water quality degradation. The inventories are conducted for "hydrologically-connected roads". Hydrologically-connected roads are those municipal roads within 100' of or that bisect a wetland, lake, pond, perennial or intermittent stream or a municipal road that drains to one of these water resources. These road segments can be viewed using the "Municipal Road Theme" on the ANR Natural Resource Atlas.

Based on the protocols developed by VDEC, and with the assistance of the regional planning commissions, many of the towns in the basin will have developed inventories by the end of 2018 (Table 12).

Table 12. Status of towns with Road Erosion Inventories, now required by the Municipal Road General Permit.

REI Status	Complete	Funded (2018)	Applied for funding (2019-20)	On the radar
Towns	Pittsfield, Granville, Hancock, Stockbridge, Roxbury,	Braintree, Randolph, Sharon, Chelsea, Williamstown	Royalton, Tunbridge, Hartford, Barnard, Pomfret, Rochester	Brookfield, Bethel, Washington

This plan recommends that technical and financial assistance be prioritized for interested towns based on the water quality benefit of a project. Projects that "do not meet standards" and are in sub-basins with sediment impairments related to road runoff are water quality priorities (Tables 1 and 13). More information on priority areas can be found in Chapter 2. Resources available from the Clean Water Fund (e.g. VDEC Grant-in-Aid and VTrans Better Roads grants) assist with development of designs, capital budgets, cost estimates and implementation of road projects. Completion of these projects may be counted towards meeting the requirements of the MRGP. For additional information see the VDEC Municipal Roads Program.

Table 13. Coarse or default prioritization of municipal road segments based on MRGP road erosion inventory and slope. Road segments that do not meet standards and are on a steep slope are priorities for water quality protection.

MRGP Status	0-4% slope	5-9% slope	10%+ slope
Fully Meets	-	-	-
Partially Meets	Low priority	Moderate priority	Moderate priority
Does Not Meet	Moderate priority	High priority	Very High priority*

*Very high priority sites that are not Class 4 require remediation by 2025; Class 4 roads by 2028

Implementation of Best Management Practices (BMPs) for hydrologically connected road segments higher up in the watershed has a cumulative benefit lower down in the watershed. The yellow, orange and red shaded regions on the map in Figure 24 show areas that are estimated to receive the largest amount of cumulative runoff. These areas occur mostly along the mainstem of the White and the First and Third Branches. These areas are likely to yield the highest levels of sediment loading if BMPs for water quality are not followed and MRGP standards are not met higher up in the watershed.

Managing for road runoff in the upper catchments will lessen the pressure on the areas receiving larger contributions of runoff. Waters being stressed or impaired lower in the watershed does not negate the need for action high up in the watershed. Lack of good management in the upper parts of the sub-basins can often be the cause of water quality issues further downstream because of cumulative impacts. For this reason, target road BMPs for water quality are recommended basin-wide.

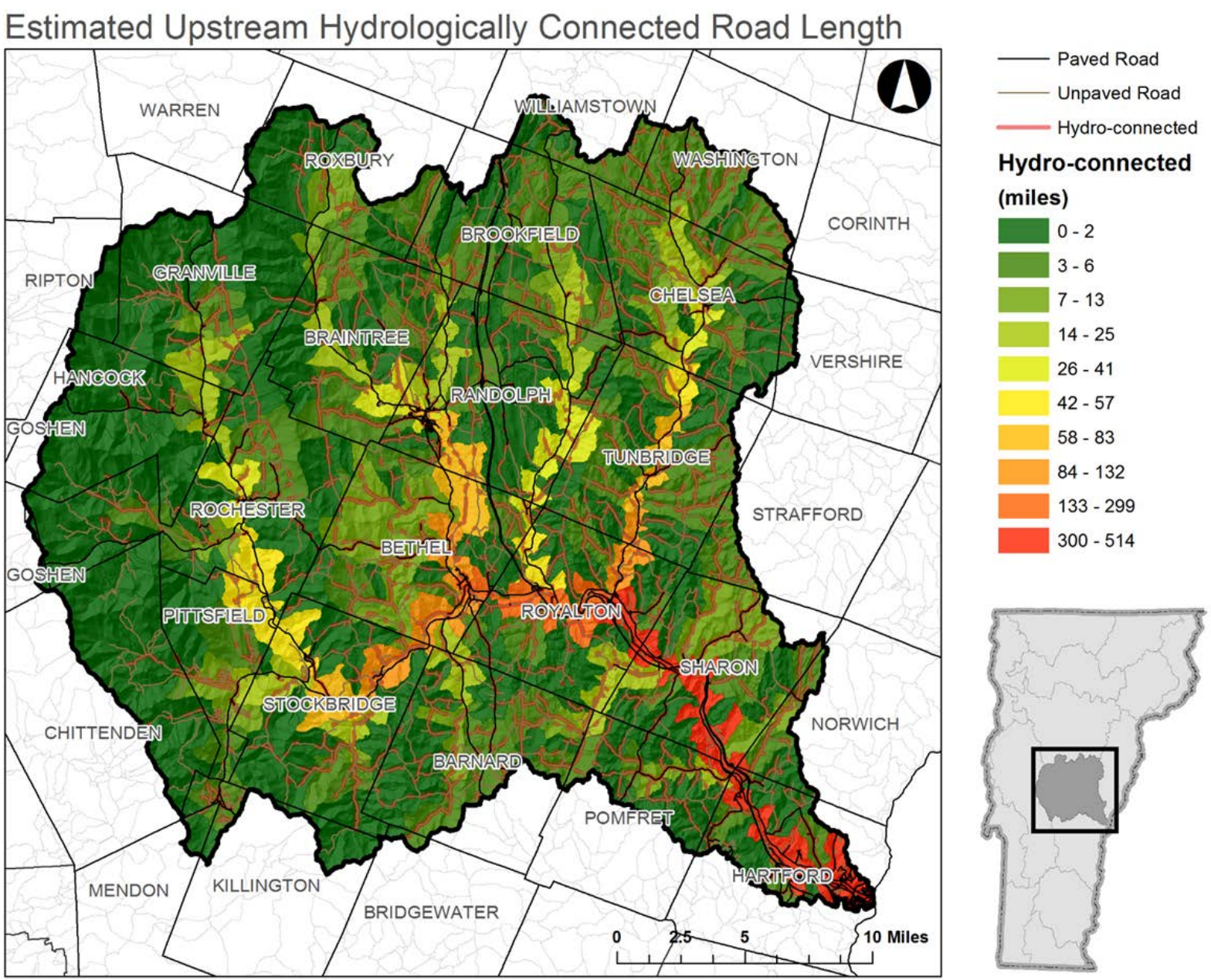


Figure 24. Hydrologically connected road segments and estimated upstream mileage. The hydro-connected road miles refer to cumulative miles contributing to the highlighted catchment

Stormwater Mapping and Master Planning

Stormwater infrastructure mapping projects are completed for municipalities by the Vermont Clean Water Initiative Program to supplement the existing drainage data collected by towns and with the intention of providing a tool for planning, maintenance, and inspection of the stormwater infrastructure. Stormwater mapping reports were completed for 15 towns in the White River basin (Figure 25). The reports can be found at: **http://dec.vermont.gov/watershed/cwi/manage/idde**.

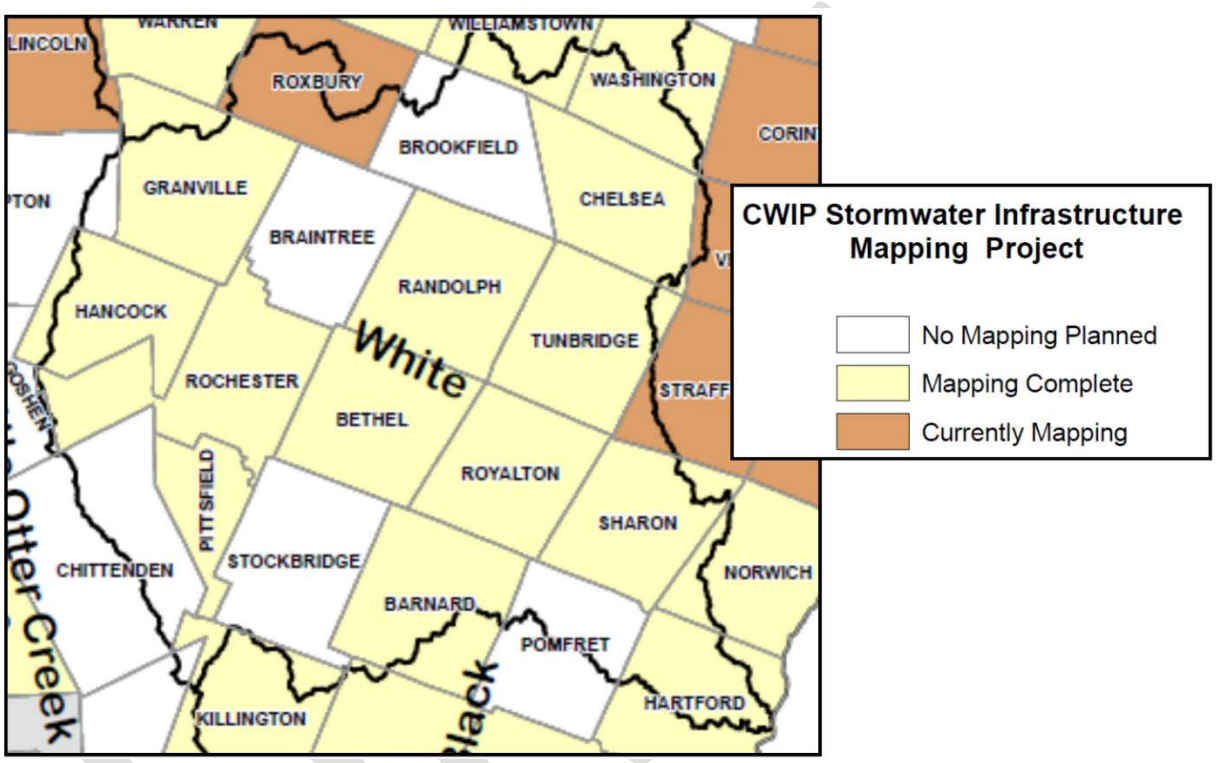


Figure 25. Status of stormwater mapping activity in the White River basin.

The reports and maps from each project are meant to provide an overall picture and understanding of the connectivity of the storm system on both public and private properties to raise the awareness of the need for regular maintenance. These reports identify potential priority projects in the study areas and provide information necessary to develop a stormwater master plan. The highlighted projects can be completed separately or in conjunction with the development of a stormwater master plan.

Projects identified as high priority in the stormwater mapping reports may be implemented by towns with the aid of Regional Planning Commissions or other partners where necessary. Those towns with significant development should consider developing a stormwater master plan, while a multi-town stormwater masterplan can be developed for smaller towns. Rochester and Randolph have SWMPs in development (Table 14). The Ayers Brook Stormwater Management Plan was completed in 2016 in the towns of Randolph, Braintree and Brookfield. Projects from this report are being

implemented with a 2017 grant from the VT Clean Water Fund. The reports for Granville and Hancock did not identify any high priority projects, however, if a stormwater issue is identified in either of these towns, they can work with partners to identify solutions.

Table 14. Towns with completed stormwater mapping reports ranked by number of high priority projects identified at the highest level. Towns in italics are recommended for stormwater mastering planning. Click on the town to link to report.

Town Name	Year Completed	Stormwater Master Plan Status	Number of High Priority Projects Identified	
			Highest	High
Hartford	*2015*	*Recommended*	*9*	*5*
Randolph	*2015*	*In progress*	*6*	*9*
Bethel	*2015*	*Recommended*	*4*	*2*
Chelsea	*2015*	*Recommended*	*3*	*0*
Rochester	*2015*	*In progress*	*3*	*1*
Royalton	*2015*	*Recommended*	*3*	*2*
Norwich	2014	Multi-town or single projects	2	1
Sharon	2015	Multi-town or single projects	2	0
Washington	2016	Multi-town or single projects	2	0
Williamstown	2013	*Recommended*	2	2
Barnard	2016	Single projects	1	2
Pittsfield	2015	Single projects	1	0
Tunbridge	2015	Single projects	1	0
Granville	2015	Not recommended	0	0
Hancock	2015	Not recommended	0	0

Agriculture

Agricultural land use makes up approximately eight percent of the land cover in the White River basin. Around two percent is mapped as cultivated crops and six percent as hay or pasture. The two sub-basins with the highest concentration of agricultural activity are the First and Second Branches (Table 15). For a visual estimate of agricultural land cover, follow this link to the landcover map in Chapter 1.

Table 15. Agricultural land use totals for the White River basin.

Watershed	White River Basin	Headwaters White River	Third Branch White River	Second Branch White River	First Branch White River
Cultivated Crops	**2.35%**	0.40%	2.25%	7.63%	5.67%
Hay/Pasture	**6.03%**	3.05%	6.77%	11.15%	6.32%
Total	**8.38%**	**3.46%**	**9.02%**	**18.78%**	**11.99%**

The high level of cumulative agricultural intensity and bacteria impairment in these sub-basins make them a priority for outreach and implementation of agricultural best management practices for water quality (Figure 26). Additional on the ground assessment will help to locate areas for targeted action.

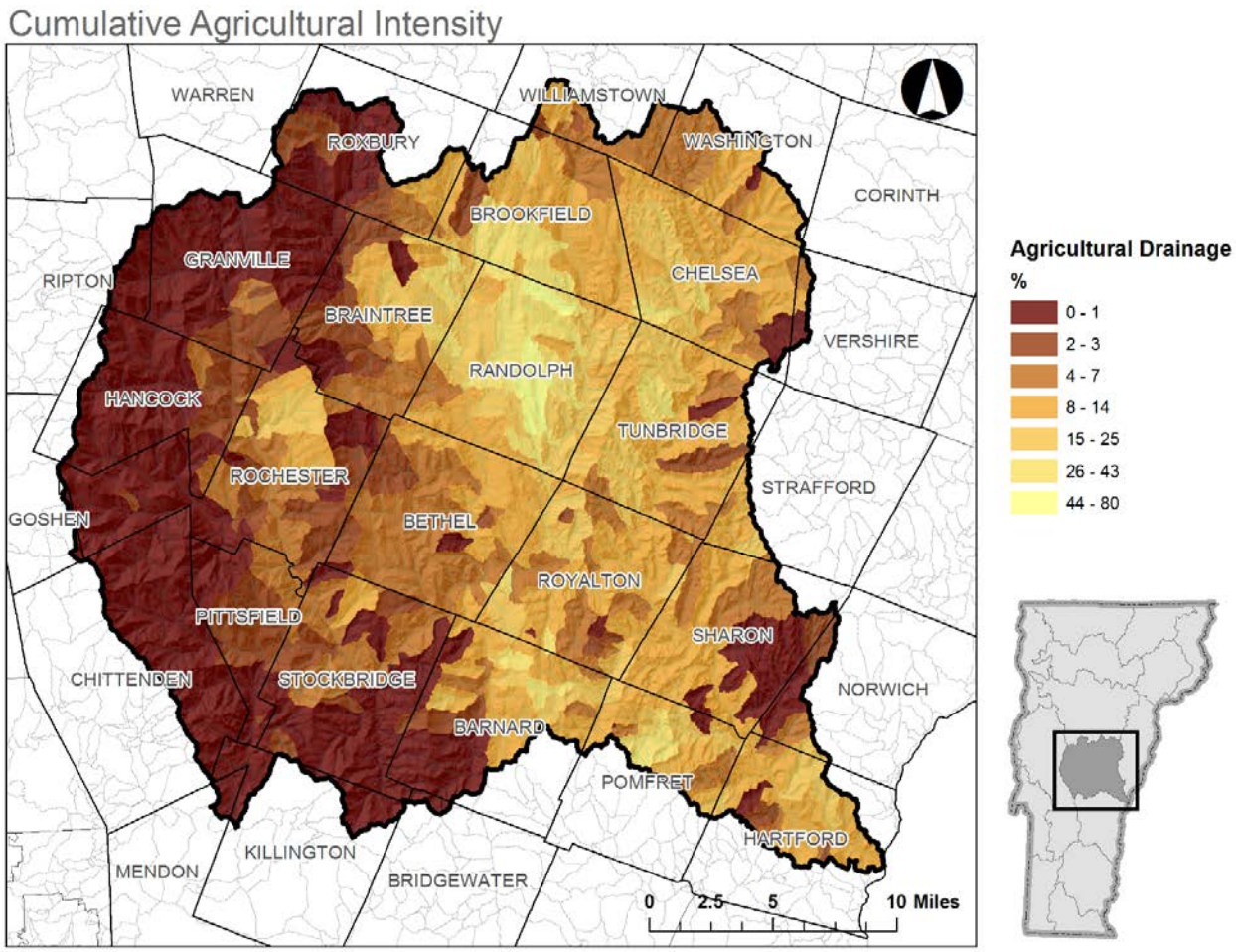


Figure 26. Cumulative agricultural intensity in the White River basin.

There are no large farm operations and five permitted medium farm operations in Basin 9. These farms are inspected once every three years by the Agency of Agriculture Food and Markets (AAFM). These farms must comply with Vermont's water quality standards.

There are an estimated 57 small farms that qualify as certified small farm operations (CSFO) that must comply with the Required Agricultural Practices (RAPs). CSFOs required to certify annually with the Agency, will be inspected at least once every 7 years, and need to comply with the RAPs. By the writing of this plan, 20 CSFOs have submitted certifications.

RAP small farms do not receive a routine inspection by the Agency, but still need to comply with the RAPs. There are an estimated 168 locations where livestock may be housed in the White River Basin; some of these locations may have livestock numbers below the requirement to follow the RAPs.

Since 2013, AAFM has dedicated over $205,000 in Basin 9 to best management practices through their cost-share program. Another $155,155 is estimated to be spent on practices in-progress or

slated to be implemented (Table 16) soon. Small farm inspections (once every 7 years) that verify compliance with the RAPs started in Basin 9 in the spring of 2018. The goal for each inspector is to inspect at least 25 certified small farms per field season. Meet and greets with farmers will occur on an on-going basis throughout the year. Outreach will need to continue throughout the watershed to the remaining farms or locations to help landowners understand where they fall within the RAP farm categories and to help them understand the requirements under the RAPs.

AAFM is also coordinating with agricultural partners throughout the watershed to streamline outreach to farmers where multiple resources may be available. This coordination ensures no duplicative actions and reduces confusion for farmers when dealing with multiple organization. AAFM provides a spectrum of assistance programs and resources (both technical and financial) that are available to farmers to improve agricultural practices that increase farm viability and protect water quality. These resources can be found at: http://agriculture.vermont.gov/water-quality/farmer-assistance.

The White River Conservation District (WRNRCD) is a strong non-regulatory agricultural partner in Basin 9. Since the last plan was published in 2013 WRNRCD has been actively pursuing actions to improve water quality in the basin in relation to agricultural activities. Several projects have been completed by the District and are listed in Figure 27. Some of these practices were funded in part by the USDA and AAFM and may include the practices listed in Table 16.

Table 16. Completed agricultural practices in Basin 9 funded by AAFM since 2013.

	Completed Practices				
Technical Practice Code Name	**Num**	**Actual Total Cost**	**Actual USDA Cost**	**Actual Landowner Cost**	**Actual State Cost**
Access Road	1	$329	$917	-$588	$0
Animal Trails and Walkways	1	$15,014	$0	$3,003	$12,011
Diversion	1	$24,312	$0	$6,938	$17,374
Heavy Use Area Protection	1	$6,271	$5,568	$704	$0
Pond Sealing or Lining - Flexible Membrane	1	$133,485	$0	$72,992	$60,493
Pumping Plant	2	$49,249	$35,562	$7,387	$6,299
Waste Facility Cover	1	$1,416	$2,134	-$718	$0
Waste Storage Structure	3	$297,020	$161,186	$41,907	$93,927
Waste Transfer	4	$33,275	$12,767	$5,566	$14,943
Total	**15**	**$560,371**	**$218,134**	**$137,190**	**$205,047**

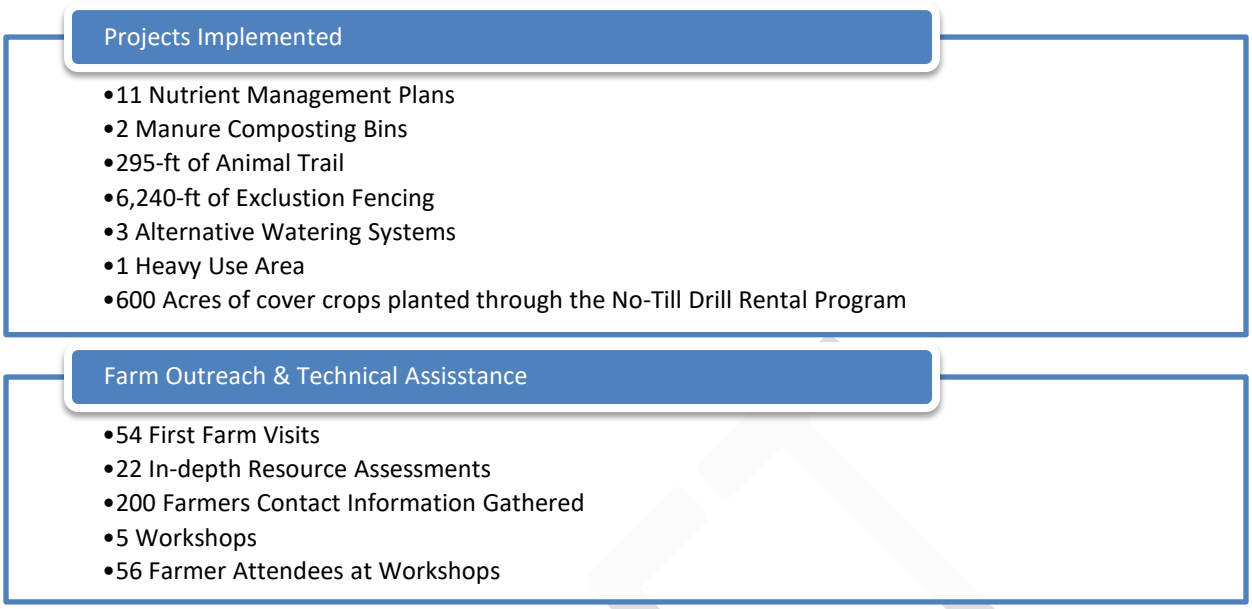


Figure 27. WRNRCD Agricultural work in Basin 9 from 2013-2017.

WRNRCD also offers assistance programs to farmers. These programs include:

- Regional Conservation Partnership Program (RCPP)
  - Provides funding for small farms to take the UVM Extension Nutrient Management Class
  - WRNRCD assists farms in taking soil samples and guiding them through the class
- Best Management Practice Planning and Design
  - WRNRCD helps farms address resource concerns and connect them to funding sources
- Required Agricultural Practices (RAPs) Education & Outreach
  - WRNRCD helps farmers navigate the RAPs, including paperwork, certification, and addressing resource concerns
- No-Till Drill Rental Program
  - WRNRCD has a No-Till Drill available for farmers to rent to do cover cropping, improve pasture forage, and reseed hay fields

In addition to RAP outreach, the plan recommends educational workshops for farmers, based on feedback from members of the farming community in Basin 9, on tile drain systems, river management and stream geomorphology, agriculture funding and grant opportunities, and nutrients (e.g. nitrogen) and water quality.

Dams of the White River Basin

The White River mainstem is the longest undammed tributary to the Connecticut River. There are approximately 87 dams of different types, sizes, and condition in the White River Basin. While dams provide renewable energy and recreational opportunities such as boating, fishing, and swimming, they can also:

- impede a stream's ability to transport flow and sediment;
- cause streambank erosion and flooding problems;
- degrade and alter fisheries habitat;
- create barriers to fish movement and migration;
- alter downstream temperature
- degrade water quality; and
- impede river-based recreational activity.

Of the 87 inventoried dams, 49 are in-service, 22 are fully breached, 6 have been removed, 5 are partially breached, 2 are drained and 3 were not able to be located during field surveys. Fifty-six (64%) of the dams in the White River Basin are active (Figure 28). Active dams constrict the stream channel enough to reduce sediment transport, prevent lateral movement, and inhibit aquatic organism passage (AOP). The remaining 31 (36%) dams are historical (Figure 29) and have been removed or breached to a point that they are not causing considerable constriction of the stream channel or impediments to AOP. A detailed list of known active and historic dams in the watershed can be found in Appendix E in Tables E1 and E2.

Table 17 provides a summary of information on the active dams in Basin 9. Most of the dams in Basin 9 are privately owned. Only one dam is regulated by the federal government, Bethel Mills in Bethel on the Third Branch, and 27 are regulated by VDEC. Two dams, Silver Lake Dam on Pond Brook in Barnard and Keyser Dam on Bicknell Brook in Chelsea, are considered high hazard dams[6]. High hazard dam failures can result in "more than a few" lives lost and excessive potential economic loss. Unplanned dam breaches can also result in water quality impacts. Most active dams with a known purpose were built for recreation or are now used for recreation. Only one dam is used for hydroelectric, Bethel Mills, and two are used for water supply, Lake Casper and Lake John in Royalton, one of which has been abandoned for this use.

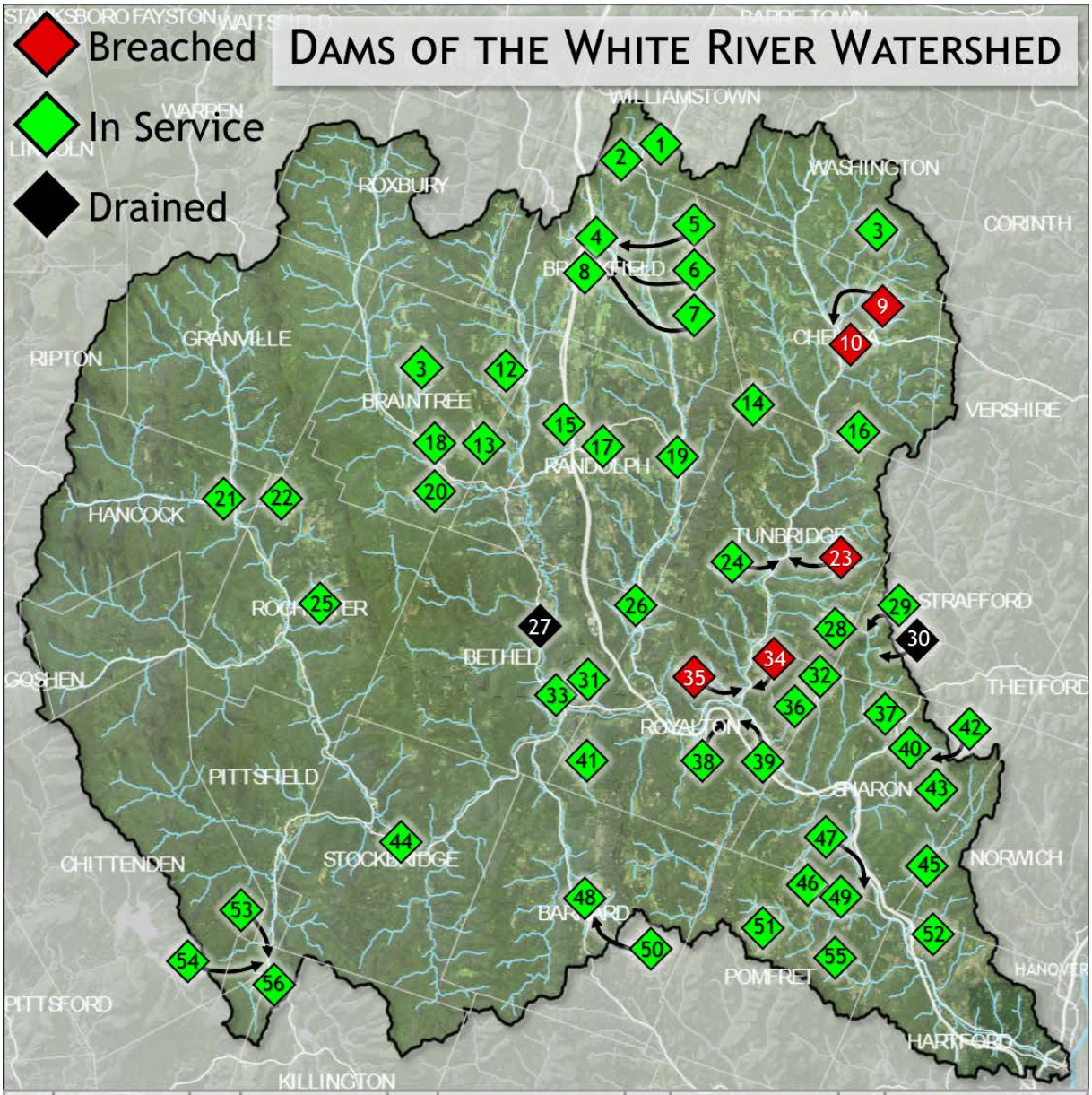
[6] The Downstream Hazard Classification system used by the VDEC is same as the U.S. Army Corps of Engineers system given in Recommended Guidelines for Safety Inspection of Dams (ER 1110-2-106, 25 Sept. 79, 24 Mar 80 Chg 1)

Table 17. Number of active dams in the White River basin by purpose, regulatory control, hazard status, and ownership where information is available.

Ownership	# of dams	Regulated by	# of dams	Hazard Status	# of dams	Current Purpose	# of dams	Original Purpose	# of dams
State	2	Federal (PSB)	1	**High**	2	**Recreation**	25	**Recreation**	11
Private	15	VDEC	27	**Significant**	11	**Hydro Power**	1	**Hydro Power**	2
Local Government	2	None	28	**Low**	42	**Water Supply**	2	**Water Supply**	2
								Mill Power	5
								Wildlife/ Recreation	1

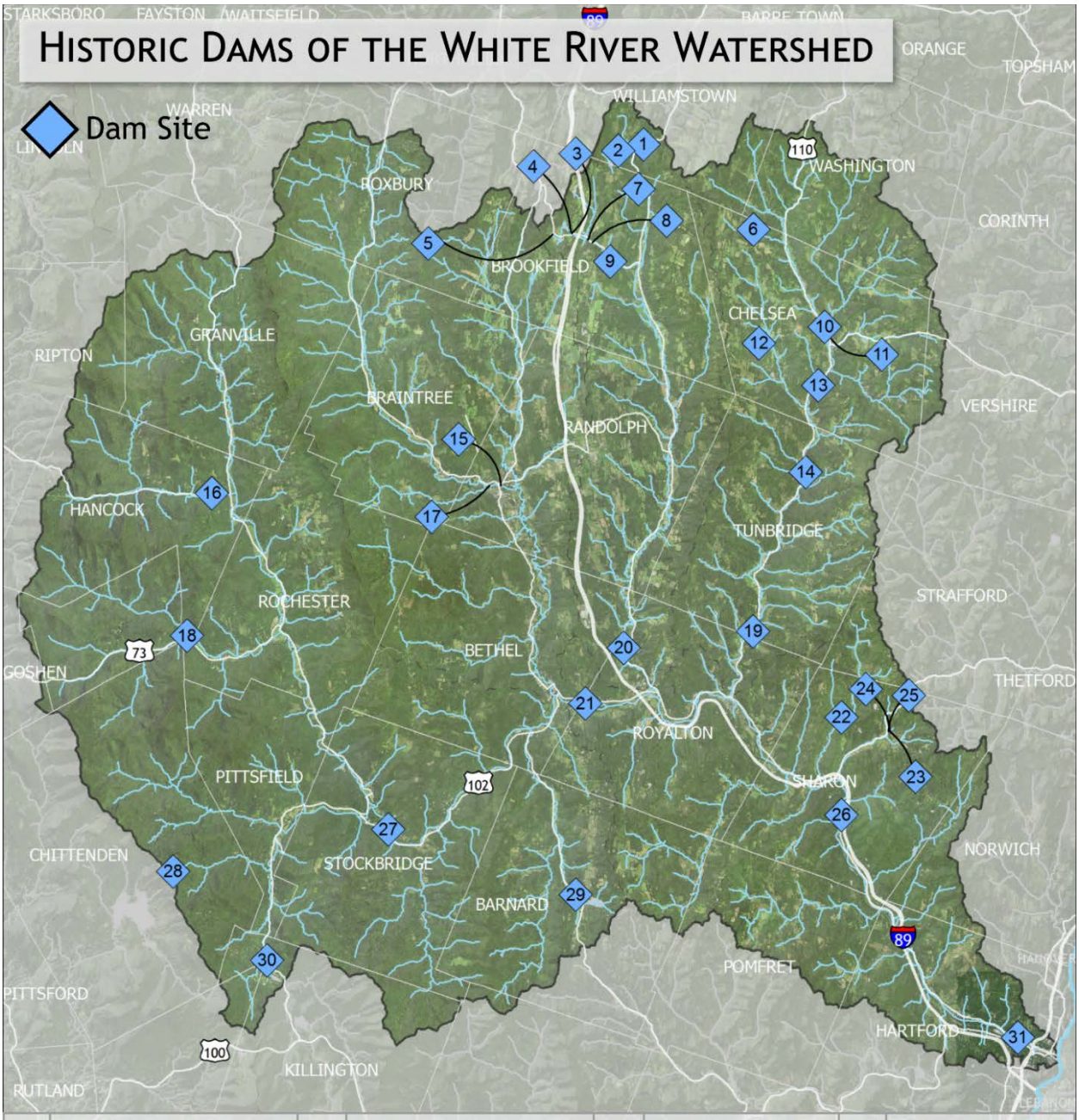
Dam removal activity in the White River basin has increased since 2013. One dam, Sargent, Osgood and Roundy dam, was removed in 2016 on the Third Branch of the White River in Randolph opening 98 miles of trout fishery. Four dams, Upper and Lower Eaton Dams on the First Branch, Camp Killooleet Dam on the Hancock Branch, and Hyde Mill Dam on the Second Branch, are currently being scoped for removal.

On January 18, 2018, H.554 or Act 161, the Dam Safety bill, passed the Vermont House of Representatives and received final approve on May 10th of the same year. The bill was developed collaboratively with the VDEC, Vermont Natural Resources Council, Vermont Trout Unlimited, the Vermont Section of the American Society of Civil Engineers, and other partners. The bill addresses gaps in inspection requirements for hundreds of small dams. Under the bill, VDEC will be required to maintain an inventory of all dams in the state and develop rules that will require all dams to be regularly inspected.



# on Map	Dam Name	# on Map	Dam Name	# on Map	Dam Name	# on Map	Dam Name	# on Map	Dam Name
1	Goyette	12	Braintree-5	23	Farnham Bros.	34	Eaton (Upper)	45	Lake Mitchell
2	Rood Pond	13	Bass	24	Haywood and Noble	35	Eaton (Lower)	46	McCord
3	Washington-5	14	Lafogg	25	McIntyre	36	McIntosh Pond	47	Sharon-12
4	Sunset Lake	15	Harvey	26	Hyde Mill	37	Standing Pond	48	Barnard-2
5	Holdens Pond	16	Keyser	27	Kellog	38	Lake John	49	Freeman
6	Brookfield-12	17	Lake Champagne	28	Tunbridge Trout Pond	39	Lake Casper	50	Silver Lake
7	Brookfield-10	18	Wain	29	Kratky	40	Crescent Lake	51	Johnson
8	Brookfield-7	19	Gulf Road	30	Day-Bruorton	41	Clark	52	Podunk Brook
9	Reed Mill	20	Delaney	31	Ansel Pond	42	Baribeau	53	Sherburne-2
10	Lyons Mill	21	Camp Killooleet	32	Walsh	43	Johnson Real Estate	54	Sherburne-1
11	Rose	22	Eller	33	Bethel Mills	44	Stockbridge - 1	55	Bunker HIll
								56	Colton Pond

Figure 28. Active dams in the White River basin.



Map #	Dam Name	Map #	Dam Name	Map #	Dam Name	Map #	Dam Name
1	Staples Pond	9	Sunset Brook	17	Playground	25	Day Farm Pond Upper
2	Matson	10	Bobbin Mill	18	Kings Pond	26	Sharon Power Co.
3	North Pond (Upper)	11	Chelsea Mill	19	South Tunbridge	27	Stockbridge - 2
4	North Pond (Lower)	12	Chelsea-8	20	Royalton-5	28	North Pond
5	Chase	13	Whitney	21	Bethel	29	Barnard-1
6	Jones Pond	14	Grants Mill	22	Wright	30	Sherburne-12
7	Tannery Dam	15	Sargent, Osgood and Roundy	23	Day Farm Pond Lower	31	Hartford Woolen Co.
8	Buxtonssaes Mill	16	Camp Killooleet Diversion	24	Day Farm Pond Middle		

Figure 29. Historic dams in Basin 9 that have been removed, fully breached or were unable to be located during a field survey.

Chapter 4 – Regulations and Initiatives for Protecting and Maintaining Water Quality

State and local water quality related regulatory programs and initiatives play a significant role in ensuring that pollutants and stressors responsible for degraded water quality are addressed and that high quality waters are protected.

Water quality is regulated both directly and indirectly through federal, state and local regulations and permits. In additions to pre-2015 regulatory programs, the 2015 Vermont Clean Water Act (VCWA) provides additional water quality protection through regulatory programs such as the Municipal Roads General Permit (MRGP) and the Required Agricultural Practices (RAPs) (Table 18). Local, statewide, and watershed-wide TMDL Plans identify pollutant reductions to meet state water quality standards and develop a means to implement the reductions. Programs within VDEC administer permits and aid the public in meeting water quality goals. Town regulations provide protections at a local level to ensure flood resilient communities and healthy lakes and rivers.

A. Regulations to Protect and Maintain Water Quality

The Vermont Clean Water Act

The passing of Act 64 in 2015, resulted in the creation of the State's Clean Water Initiative Program (CWIP). The goal of this Initiative is to satisfy the State's legal obligations under both the VCWA and the federal Clean Water Act so that all waters of the state are clean, fishable, swimmable, and of benefit to Vermonters. The priorities to achieve the objectives set out in Act 64 are to:

1. Implement required agricultural practices (RAPs) and best management practices (BMPs) on agricultural land.
2. Install pollution controls on state and municipal roads.
3. Restore and protect natural channel form for flood resiliency and water quality improvements.
4. Reduce and treat stormwater runoff and erosion from developed lands.
5. Increase investments in municipal wastewater treatment infrastructure.

The new and updated regulatory processes that will support the priorities include the development of the following permits or regulations:

Table 18. Timeline of new and updated regulatory programs required by the Vermont Clean Water Act (Act 64).

Regulatory Program or Permit	Application	Issuance Date	Regulated Community
Required Agricultural Practices (RAPs)	Adopt and implement a set of minimum conservation practices to protect water quality	December 5, 2016	Agricultural operations

Regulatory Program or Permit	Application	Issuance Date	Regulated Community
Transportation Separate Storm Sewer System (TS4) Permit	Inventory and control stormwater discharges from the transportation network and associated transportation facilities	November 29, 2017	State transportation
Municipal Roads General Permit (MRGP)	Inventory and control stormwater discharges from municipal roads	January 26, 2018	Municipalities
Acceptable Management Practices (AMP) for forestry operations - Updates	Minimize erosion from forestry operations	October 22, 2016 & new revisions for 2018	Forestry operations
Operational Three-Acre Permit	Inventory and control stormwater discharges on sites where impervious surfaces exceed 3 acres	On or before April 1, 2019	Municipalities and Private Land Owners

Wastewater Treatment Facilities (WWTF)

An overarching consideration for the issuance of permits in White River planning basin is the Long Island Sound TMDL for nitrogen. This multi-state TMDL has been promulgated with interim waste load and nonpoint source nitrogen load allocations. As of the issuance of this Plan, all facilities are operating under permits developed under a nitrogen permitting strategy whereby all Vermont WWTFs ultimately discharging to the Connecticut River must, collectively, discharge no more than 1,727 lbs. TN/day. Each individual facility has a unique TN loading limit. In addition to the nitrogen loading limit, WWTFs are required to develop optimization plans for maximizing nitrogen removal and regularly monitor for nitrogen compounds.

As part of an effort to be better informed about potential nutrient impacts, the WSMD, with assistance from certain municipalities, is conducting an extensive sampling effort to document the current loading conditions to determine the "reasonable potential" that WWTFs have, to cause or contribute to downstream water quality impairment. Results of these investigations are recorded as part of permit issuance documentation. The municipal wastewater discharge permits in the Basin are shown in Table 19.

Table 19. Summary of permit requirements for the wastewater treatment facilities in the White River watershed.

Facility (permit ID)	Permit expiration date	Design flow MGD	IWC* 7Q10 /LMM	Current Percent of Design Flow (YEAR)	Treatment type	Number of non-compliant CSOs	Receiving water
Bethel (3-1280)	9-30-2019	0.115	1.000/0.001	56.9%	Oxidation ditch	0	White River
Chelsea (3-1197)	6-30-2021	0.055	1.000/0.013	44.2%	Oxidation ditch	0	White River
Randolph (3-1198)	9-30-2020	0.400	1.000/0.017	39.3%	Sequencing batch reactor	0	Third Branch of The White River

Royalton (3-1165)	12-31-2018	0.070	1.000/0.001	33.3%	Aerated lagoon	0	White River

** Instream Waste Concentration – or the proportion of river flow at lowest base (7Q10) and low median monthly (LMM) flow attributable to discharge, for the facility design flow. Note that the IWC is specific to the flow of receiving water.*

Facility Specific Information

Bethel

The Town of Bethel WWTF is an oxidation ditch plant with secondary treatment followed by disinfection by ultraviolet light units. Sludge from the secondary clarifiers is wasted to sludge holding tanks where it is stored until application on agricultural fields in the spring and fall. The collection system consists of approximately 4.2 miles of pipe and four pump stations.

Chelsea

The Town of Chelsea WWTF consists of an in-plant pump station, an oxidation ditch, two clarifiers and chlorination/dichlorination for disinfection. Biosolids generated at the facility are temporarily stored in the aerated storage tanks and dewatered as needed. Biosolids are removed from the site by an independent contractor.

Randolph

The Town of Randolph WWTF was recently upgraded from an activated sludge process to a sequencing batch reactor with chlorine disinfection. Recently the Town eliminated the two remaining combined sewer overflows; the Central Street (Route 66) Pump Station and the Prince Street (manhole C-3).

Royalton

The Royalton WWTF is an aerated lagoon facility utilizing chlorine disinfection. The collection system conveys all wastewater through one pump station located off South Windsor Street. The aeration system and chlorine contact chamber were replaced in 2017.

VDEC Hazard Area Bylaws and ERAF

VDEC River Corridor and Floodplain Protection Program has prepared model flood hazard bylaws to assist municipalities in the development of their flood hazard regulations. These bylaws have been pre-reviewed by the Federal Emergency Management Agency (FEMA) and meet or exceed the requirements of the National Flood Insurance Program (NFIP). In addition, adoption and enforcement of Section D, River Corridors, qualifies communities for enhanced cost share under the Emergency Relief and Assistance Fund (ERAF).

ERAF provides State funding to match Federal Public Assistance after federally-declared disasters. Eligible public costs are reimbursed by federal taxpayers at 75%. As of October 23, 2014, the State

of Vermont contributes an additional 7.5% toward the costs. For communities that take specific steps to reduce flood damage the State will contribute 12.5% or 17.5% of the total cost. Only five towns in the White River Basin qualify for the 17.5% contribution. However, all towns are participating in the National Flood Insurance Program, have adopted the Town Road and Bridge Standards, and have adopted a Local Hazard Mitigation Plan.

Towns that meet ERAF criteria not only protect water quality but protect themselves financially, as well.

Local Zoning and Bylaws

Local zoning, bylaws, and town plan policies can provide community specific protections and guidance to maintain and enhance local water resources. Local protections also afford benefits to downstream communities and water resource users. Although a town may have bylaws or town plan policies it does not mean their resources are afforded the strongest protection. Communities should work with their regional planning commissions to identify opportunities that provide their constituents with the highest level of natural resource protection within their means. Towns with high development pressure, significant impervious surface cover including roads, and significant development within proximity to water resources are a high priority for protection, as well as those areas with deficiencies related to their protective policies, zoning or bylaws.

- Protecting river corridors helps protect roads and structures from erosive damage, improves water quality, moderates flooding, and enhances wildlife habitat. River corridor protection, limits development close to stream and river channels to allow the channel to establish and maintain a least-erosive path through the valley lessening the need to armor channel edges.
- Local stormwater regulations prevent runoff of pollutants from hard surfaces into wetlands, rivers and lakes. Stormwater management also slows flow into waterbodies during some flood events.
- Smart planning and design for development through Local Hazard Mitigation Plans (LHMP), floodplain bylaws, and ERAF attainment in towns and villages saves money and lowers the risk of significant loss during flood events, while protecting water quality as an added benefit.
- Limiting development on steep slopes and ridgelines can protect high quality water resources and prevent excessive erosion and sedimentation to streams and lakes that impacts water quality and aquatic habitat.

Recommendations for local water resource protection goals are illustrated in Figure 30. For detailed information on municipal protectiveness for towns in the White River Basin, please see Appendix F, Table F1.

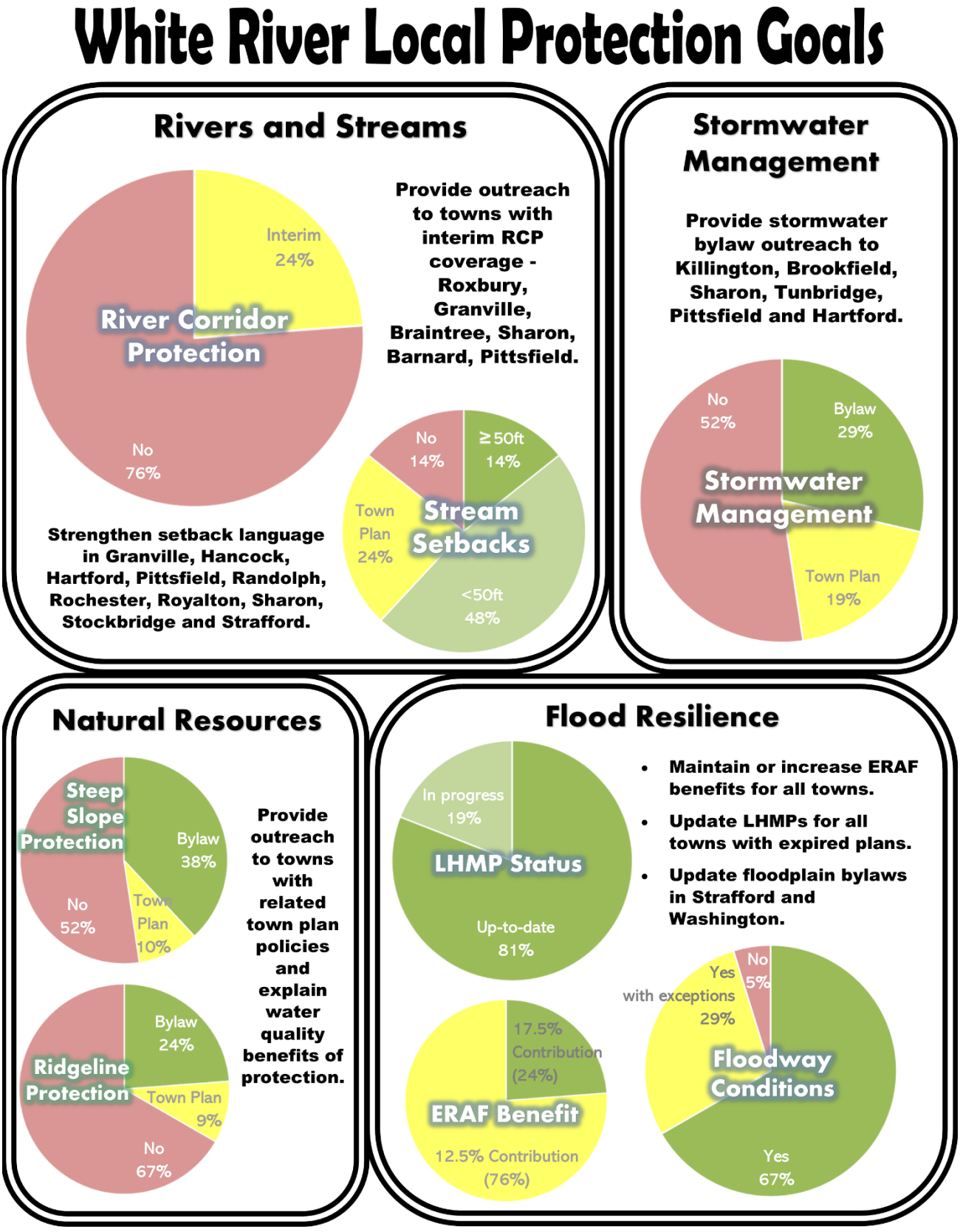


Figure 30. Municipal protection goals for towns and status of local protections in the White River basin.

B. Initiatives for Protecting and Maintaining Water Quality

DEC Environmental Assistance Office

Oftentimes, people are unfamiliar with all the regulatory and non-regulatory programs connected to water quality protection. The Environmental Assistance Office is a partnership of VDEC staff focused primarily providing information to the public, including municipalities and businesses on safe environmental practices. The Office provides guidance to anyone who has questions about state permits related to water quality protection and the disposal of hazardous wastes that can sometimes end up in our surface and ground waters due to harmful practices.

The EAO runs a hotline (800-974-9559) for Vermonters (also used by out-of-state folks) to respond to a wide range of questions including those related to water quality. If you or someone you know has concerns or questions related to water quality pollution prevention, contacting the EAO is a good first step to protect against pollution.

Forestry AMPs and Skidder Bridge Programs

The Vermont Department of Forest Parks and Recreation (VDFPR) provides temporary steel truck bridge rental opportunities for loggers during timber harvests. When properly installed, used, and removed, portable temporary bridges minimize stream bank and stream bed disturbance as compared with alternative devices, such as culverts or poled fords. Portable skidder bridges are also economical because they are reusable, easy to install, and can be transported from job to job. In addition, these bridges reduce the occurrence of sedimentation, channeling, and any degradation of aquatic habitat, while allowing loggers to harvest timber in compliance with The Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont. For more information on the truck bridge rental program visit: http://fpr.vermont.gov/forest/vermonts_forests/truckbridge.

In March, the VDFPR held a temporary skidder bridge lottery and twelve loggers and logging companies were chosen to receive bridges that were constructed by Fontaine Millworks in East Montpelier. VDFPR hopes to offer a cost-share for bridges in 2019 if funding can be secured. The VDFPR will also be offering workshops for building bridges throughout the state. In 2018 three workshops will be hosted by Tech Centers in Hardwick, Newport and Rutland where leaders and participants will build a bridge and participants will be trained on the installation and use of the bridge. The remainder of the workshop will be training on the AMPs. After the workshops, the bridges will be raffled off to a logger/forester that attended the workshops (one from each site). The material for one bridge is about $2,700. Randolph Technical Career Center would be a great a location for a future event. Specifications for building your own skidder bridge can be found here: http://fpr.vermont.gov/forest/your_woods/harvesting_your_woodlots/skidder_bridge

The VDFPR updated the AMPs for Maintaining Water Quality on Logging Jobs in Vermont effective as of October 22, 2016. Vermont first adopted these rules 1987. The AMPs are intended

and designed to prevent any mud, petroleum products and woody debris (logging slash) from entering the waters of the State and to otherwise minimize the risks to water quality. The AMPs are scientifically proven methods for loggers and landowners to follow for maintaining water quality and minimizing erosion.

Subsequent updates have occurred spring of 2018 (expected approval in May or June 2018) to include standards for permanent crossing on intermittent streams. Key modifications are found in Appendix G.

Septic Socials

Septic socials are neighborhood gatherings where homeowners learn about the options for a well-functioning septic system and good maintenance practices, including household products that are kind to septic systems. The event provides an informal opportunity for people who may never have seen a septic system to learn about them. The host opens the gathering by talking about the importance of water quality protection. A septic system specialist discusses operation and maintenance of septic systems using the host homeowner's system as the demonstration model. Attendees are provided with brochures and other resource materials to take home. Septic socials are best for areas with old septic systems that may be having an impact on water quality. These places are often around lakes with old camps or buildings built for seasonal use that are now seeing more activity year-round. Septic socials can also be held in riverbank communities. More information about septic socials can be found at: http://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/lake-wise-septic-system-socials.

Vermont Green Infrastructure Toolkit

Stormwater runoff from developed lands, including the road network, is one of the greatest threats to water quality in Vermont. Stormwater runoff is any form of precipitation that flows over the land during or after a storm event or because of snowmelt. On undeveloped lands, a portion of this runoff is absorbed into the ground through infiltration and the rest takes a slow path to nearby rivers, lakes and ponds. On developed lands, however, infiltration is reduced by impervious surfaces such as roads, rooftops, and driveways. This leads to an increased frequency and intensity of flooding as well as a greater likelihood that runoff will become contaminated with pollutants. The result is increased erosion and property damage, degraded aquatic and terrestrial habitats, and threats to public health via recreation sports and contaminated drinking water.

Many of the stormwater issues associated with developed lands can be mitigated and prevented using Low Impact Development (LID) and Green Stormwater Infrastructure (GSI) systems and practices. These emerging concepts strive to manage stormwater and pollutants by restoring and maintaining the natural hydrology of a watershed. Rather than funneling stormwater off site through pipes and infrastructure, these systems (gardens or permeable materials) focus on infiltration, evapotranspiration, and storage as close to the source as possible to capture runoff before it gets to surface waters.

The Vermont Green Infrastructure Toolkit is a project of the ten Regional Planning Commissions of the Vermont Association for Planning and Development Agencies (VAPDA) and the Vermont Agency of Natural Resources' Watershed Management Division. The toolkit is a clearinghouse of information useful to Vermont municipalities to explore how to promote the adoption of Green Infrastructure policies and practices to combat the problems caused by urban, suburban and rural stormwater runoff.

Wetland Conservation and Mapping

A new initiative is in progress for the protection of wetlands in Vermont. The state is currently working on a Wetlands Easement calculator to evaluate the value of wetlands for protection through the easement process. River Corridor Easements are used by the state and partner organizations to purchase channel management and development rights in the most sensitive and important areas along stream channels to encourage stream equilibrium, sediment and nutrient attenuation, and flood protection. The wetland conservation easements will be used in a similar way to protect and restore wetlands with significant function and values related to water quality, flood protection, climate change mitigation and wildlife habitat.

Landslide, Rockfall and Erosion Mapping

The Vermont Geological Survey responds to and monitors landslide and rockfall events, maps areas prone to erosion and landslides, and is working with our partners to implement landslide hazard mapping protocols (Clift & Springston, 2012) from the State Hazard Mitigation Plan. In 2015 the Division began a program to provide planning-level landslide hazard maps for all Vermont counties, contingent upon funding and availability of Lidar. Landslide hazard susceptibility maps were prepared for Addison County, the Town of Highgate, and Washington County in 2016 - 2017; Chittenden County is in progress in 2018. The maps help Vermont prepare for safer growth and development, develop mitigation and hazard avoidance strategies (FEMA), avoid economic loss, and be prepared (USGS preparedness list) to respond to events.

Anyone can report a landslide to the Vermont Geological by visiting: https://vtanr.maps.arcgis.com/apps/GeoForm/index.html?appid=505af0d19dd44faaa912ef3d5c80a3b6.

Chapter 5 – Summary Implementation Table: Protection and Restoration Actions

The Tactical Basin Plan addresses all impaired, stressed and altered waters (Tables 1 & 2) in the basin as well as protection needs for high quality waters. The list of actions in the Summary Implementation Table (Table 20) and the Monitoring and Assessment Table (Table 21) cover future assessment and monitoring needs, as well as projects that protect or remediate waters and related education and outreach.

The Implementation Table Summary is a summary of 60 priority actions created with the intention to be used as the guiding list to go to as a first step toward watershed action. A list of over 400 related individual project entries is found in the online Watershed Projects Database (WPD). The projects vary in level of priority based on the actions outlined in the summary. All 400 projects are not expected to be completed over the next five years, but each action in the summary is expected to be pursued and reported upon in the following plan and updated in the WPD.

As projects are developed, priority for Clean Water Initiative Program funding will be given to those projects that achieve the highest water quality benefits. Additionally, projects that provide cumulative benefits (i.e. flood resiliency, water quality improvement, water resource protection, aquatic organism passage) will receive additional consideration for prioritization.

The previous White River Tactical Basin Plan was completed in July of 2013. A total of 68 action items were identified in the 2013 plan. Fifty-four (80%) have been implemented or are in progress by VANR and its watershed partners, ten have been carried over to this plan, and four have been discontinued (Figure 31). A report card can be viewed in Appendix A.

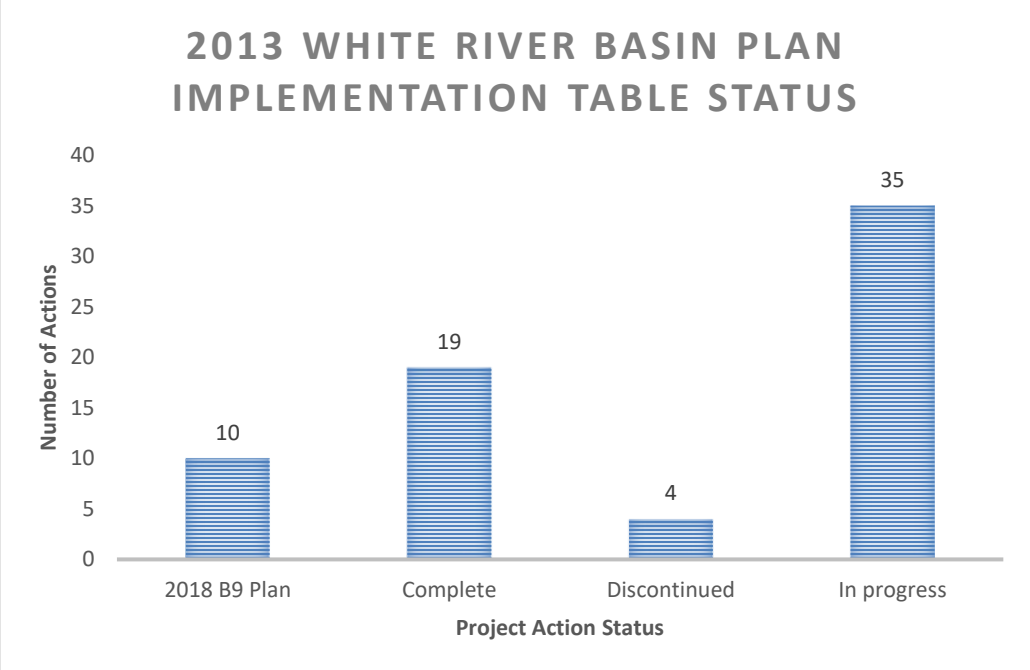


Figure 31. Status of the 68 priority actions identified in the 2013 White River Basin Plan.

The 2018 White River Tactical Basin Plan builds upon those original plan recommendations by promoting specific, geographically explicit actions in areas of the basin that have been identified for intervention, using environmental modeling and on-the-ground monitoring and assessment data where available.

A. Coordination of Watershed Partners

There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in Basin 9. These partners are non-profit, private, state, and federal organizations working on both private and public lands. Partnerships are crucial in carrying out non-regulatory actions to improve water quality. Central Vermont Regional Planning Commission, Connecticut River Conservancy, Rutland Regional Planning Commission, The Nature Conservancy, Two Rivers Ottauquechee Regional Commission, United States Forest Service, Vermont River Conservancy, Vermont Fish and Wildlife, White River Natural Resource Conservation District (WRNRCD), the White River Partnership and municipalities are active in:

- providing outreach and education to local stakeholders, private landowners, and municipalities;
- developing stream and floodplain protection and restoration projects (e.g. river corridor easements, tree plantings, culvert and bridge upgrades, dam removals, stream channel habitat restoration);
- developing stormwater projects (e.g. stormwater master plans, road erosion inventories, implementation of town road BMPs);
- and monitoring water quality (e.g. lay monitoring program on lakes, *E. coli* and nutrient monitoring in rivers).

Partners active in working with farms in the basin developing and implementing BMPs for water quality include Natural Resource Conservation Service (NRCS), Agency Agriculture Food and Markets (AAFM), WRNRCD, VDEC, Connecticut River Farmers Watershed Alliance (CRFWA), and University of Vermont Extension Service.

The large amount of work that is necessary to meet water quality targets in this basin require collaborations among all these groups to maximize the effectiveness of watershed partners. **Without funding or partners, little of this work would be possible.**

B. List of Funding Opportunities

The table below provides a list of funding opportunities with website links that can be used to carry out the priorities listed in the "Funding Opportunities" column of the Summary Implementation Table (Table 20). The list is not comprehensive, and partners are encouraged to look wherever funding may be available. Funding opportunities also change over time, so partners will want to be up-to-date on funding as they identify actions to complete.

Funding Opportunities	Basic Description	Web Link
VDEC CWF Grant	All Clean Water Fund grants out of VDEC including ERP grants, Clean Water Block Grants and others.	http://dec.vermont.gov/watershed/cwi/grants
AAFM Water Quality Grants	Vermont Agency of Agriculture, Farm and Markets (VAAFM) offers a spectrum of assistance programs and resources (both technical and financial) available to farmers in order to improve agricultural practices that increase farm and viability and protect water quality.	http://agriculture.vermont.gov/water-quality/farmer-assistance
LISW-RCPP	The Long Island Sound Watershed Regional Conservation Partnership Program (LISW-RCPP) focuses on private working lands to manage soil nutrient loss, protect non-industrial forest habitat, biodiversity, and drinking water sources, and stem erosion and thus improve resiliency on working lands through riparian restoration.	http://www.lisw-rcpp.com/about.html
LPP Monitoring Grant	The LaRosa Partnership Program (LPP) was developed in 2003 with the purpose of helping lake and watershed associations and other monitoring groups across the State of Vermont implement new and/or ongoing surface water monitoring projects for waters in need of water quality assessment, by helping alleviate the financial burden of laboratory analysis costs.	http://dec.vermont.gov/watershed/map/monitor/larosa
Watershed Grant	Vermonters have an opportunity to protect and restore watersheds through the Vermont Watershed Grants Program. The Program, co-administered by DEC and the Department of Fish and Wildlife, distributes grant dollars for noteworthy local and regional water-related projects within Vermont.	http://dec.vermont.gov/watershed/cwi/grants/watershed-grants
VTrans Better Roads Grant	The Vermont Better Roads Program provides technical support and grant funding to municipalities to promote the use of erosion control and maintenance techniques that save money while protecting and enhancing water quality around the State.	http://vtrans.vermont.gov/highway/better-roads
Municipal Planning Grant	The Municipal Planning Grant (MPG) program encourages and supports planning and revitalization for local municipalities in Vermont.	http://accd.vermont.gov/community-development/funding-incentives/municipal-planning-grant
604b Funding	Funding from the 604b US Clean Water Act program passed to VDEC and granted to Regional Planning Commissions to work on water quality focused work	
VT Clean Water State Revolving Fund (CWSRF)	Vermont's CWSRF Program provides funding for Vermont's Clean Water Projects in the form of low interest loans to municipalities. Several types of loans are available.	http://dec.vermont.gov/facilities-engineering/water-financing/cwsrf

Funding Opportunities	Basic Description	Web Link
Hazard Mitigation Grant Program (HMGP)	The HMGP program is funded through the Federal Emergency Management Agency (FEMA) and is administered by Vermont Emergency Management on behalf of the state. Typical hazard mitigation projects include: mitigation of local roads and bridges, home acquisition (buyout), structural elevations or relocations, replacement of undersized culverts, mitigation outreach and education, etc.	http://vem.vermont.gov/funding/mitigation
SWG Program	The State Wildlife Grant (SWG) Program provides Federal grant funds to State fish and wildlife agencies for developing and implementing programs that benefit wildlife and their habitats, including species that are not hunted or fished.	https://wsfrprograms.fws.gov/subpages/grantprograms/swg/swg.htm
USFWS Grants	The United States Fish and Wildlife Service offers grant programs which are a significant part of national efforts to strengthen partnerships between the federal government and the states in enhancing and protecting their fish and wildlife resources, and in making utilization of these resources possible for the public.	https://www.fws.gov/r5fedaid/grants.html
MEF Grants	The Upper Connecticut River Mitigation and Enhancement Fund supports restoration, protection, and enhancement of the river, wetlands, and shore lands within the Connecticut River watershed upstream of the confluence of the White River and the Connecticut River at White River Junction, VT and West Lebanon, NH.	https://www.nhcf.org/how-can-we-help-you/apply-for-a-grant/upper-connecticut-river-mitigation-and-enhancement-fund/
Aquatic Invasive Species Grant-In-Aid	The AIS Grant-in-Aid Program provides financial assistance to municipalities and agencies of the state for aquatic invasive and nuisance species management programs.	http://dec.vermont.gov/watershed/lakes-ponds/aquatic-invasives/funding
Roads Grant-In-Aid	The VT Clean Water Initiative Program offered a set amount of funding the last two years to aid municipalities in implementing best management practices on municipal roads to improve water quality.	http://dec.vermont.gov/watershed/cwi/grants
VDEC Contracts	Contracts between Regional Planning Commissions and Natural Resource Conservation Districts that serve to help with Tactical Basin Planning	NA
VDEC, VFWD, or AAFM Staff Time	Actions to be carried out by State staff	NA

C. White River Basin Implementation Priorities

The process for identifying priority actions is the result of a comprehensive compilation and review of both internal ANR monitoring and assessment data and reports, and those of our watershed partner organizations described in Chapters 2 and 3. The monitoring and assessment reports include, but are not limited to, stormwater mapping reports, geomorphic assessments, river corridor plans, bridge and culvert assessments, Hazard Mitigation Plans, agricultural modeling and assessments, road erosion inventories,

biological and chemical monitoring, lake assessments, fisheries assessments, and natural communities and biological diversity mapping.

As stated previously, a summary of priority actions to address water quality in Basin 9 are identified in Table 20. The summary is the guiding list to go to as a first step for watershed action. The actions can be linked to the on-going detailed list of actions in the online Watershed Projects Database.

The following tables serve to identify high priority implementation actions and tasks that provide opportunities for all stakeholders in surface water management across each major river basin to pursue and secure technical and financial support for implementation. For these priorities to be achieved, partners and stakeholders must help to carry out the actions identified in the basin plan.

Table 20, the Implementation Table Summary, provides a summary of strategies and actions to address water quality priorities and can be accessed directly by clicking on the bookmarks below:

A) Impaired waters
B) Flow-altered waters
C) Stressed waters
D) High-quality waters
E) Stormwater runoff
F) Stream equilibrium and wetland, floodplain and river corridor protection
G) Lake shoreland protection and remediation
H) Forests and water quality
I) Recreational uses
J) Aquatic and riparian invasive species

Discrete projects associated with more general actions in the plan can be found in the Watershed Projects Database.

Table 21 provides a list of monitoring and assessment recommendations for the White River Basin in the next 5 years.

White River Basin Implementation Table Summary

Table 20. Summary implementation actions for the Basin 9 tactical basin plan.

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
Strategies to address impaired waters - RESTORE					
1. Develop a Phase II SGA and River Corridor Plan for the Second Branch of the White River	Second Branch of White River	To identify projects that will address nutrient and sediment inputs; implement bacterial TMDL	Royalton, Randolph, Bethel, Brookfield, Williamstown	VDEC Rivers Program, WRP	VDEC CWF Grant
2. Rank, develop and implement projects in the First Branch River Corridor Plan that will reduce bacteria, sediment and nutrient input to the river	First Branch of White River	To address bacterial inputs and encourage stream equilibrium; implement bacterial TMDL	Royalton, Tunbridge, Chelsea	VDEC Rivers, WRP, WRNRCD	VDEC CWF Grant
3. Rank, develop and implement projects in the Third Branch River Corridor Plan that will reduce bacteria, sediment and nutrient input to the river	Third Branch of White River	To identify projects that will identify and address nutrient and sediment inputs; implement bacterial TMDL	Bethel, Randolph	VDEC Rivers, WRP, WRNRCD	VDEC CWF Grant
4. Rank, develop and implement projects on agricultural lands that will reduce agricultural runoff in areas where bacteria and nutrient levels are above the VT Water Quality Standards	First, Second and Third Branches	Identify and address sources of bacterial inputs; implement bacterial TMDL	Royalton, Tunbridge, Chelsea, Bethel, Randolph, Brookfield	AAFM, WRNRCD	AAFM Water Quality Grants, LISW-RCPP
5. Continue WRP water quality study to analyze *E.coli* and nutrient levels above and below dams	First Branch, Second Branch	To identify potential bacterial sources; implement bacterial TMDL	Tunbridge, Royalton, Bethel	WRP, VDEC MAPP	LPP Monitoring Grant
6. Continue monitoring popular swimming areas for the protection of public health	First Branch, Second Branch, Third Branch	To protect water quality for public health; continue long-term monitoring to identify trends and sources	Royalton, Tunbridge, Chelsea, Bethel, Randolph	WRP	WRP Funding
7. Identify target communities for septic social events for the impaired reaches of the First, Second and Third Branches of the White River	First Branch, Second Branch, Third Branch	Educate the public about septic systems for cleaner water; implement bacterial TMDL	Royalton, Tunbridge, Chelsea, Bethel, Randolph, Brookfield	WRNRCD, TROPC, WRP, VDEC DWGP	VDEC Contracts, Watershed Grant

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
8. Employ outreach by the VT Waste Management and Prevention Division to landowners and direct sampling and remediation efforts to Smith Brook	Smith Brook	Address old landfill leachate impairing water quality	Randolph	VDEC HWMP	VDEC Staff Time
Strategies to address flow-altered waters - RESTORE					
9. Proceed with flow study to determine water quality status and recommendations for flow regulation on Flint Brook	Lower Flint Brook	Determine if artificial flow regulation is having a negative impact on water quality	Roxbury	VDEC Rivers, VFWD	VFWD and Federal Grant (currently funded)
Strategies to address stressed waters, waters with a declining water quality trend, and waters with fair to poor geomorphic condition - RESTORE					
10. Develop and present general education and outreach on healthy lake practices and current water quality status of Sunset Lake and Silver Lake	Sunset Lake Silver Lake	Educate lakeshore community about BMPs for water quality; improve water quality and habitat on lakeshores	Brookfield, Barnard	VFPR, Lakeshore community, CC, VDEC Lakes & Ponds, WRNRCD	Watershed Grant, VDEC Contracts
11. Implement high priority recommendations in the 2015 Silver Lake State Park Lake Wise Evaluation report and VDEC Barnard Stormwater Infrastructure Report	Silver Lake State Park, Silver Lake	Improve water quality and reduce stormwater runoff from lakeshore	Barnard	VFPR	Watershed Grant, DEC CWF Grant
12. Develop and initiate “River Wise” outreach and assessment on Stony Brook	Stony Brook	Educate riverbank communities about practices that will improve water quality and fisheries habitat and encourage stream equilibrium	Stockbridge	VFWD, WRP	Watershed Grant
13. Continue to monitor swimming areas along the mainstem of the White River to protect public health	White River mainstem mouth to Third Branch	Protect public health at swimming holes; continue long-term monitoring to identify trends and sources	Hartford, Pomfret, Sharon, Royalton, Bethel	WRP	WRP Funding
14. Complete windshield survey of Breakneck Brook to identify stressors in watershed leading to decline in macroinvertebrate communities	Breakneck Brook	Determine if land uses are contributing to a negative trend in macroinvertebrate communities	Rochester	VDEC, WRP	VDEC Staff Time

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
15. Review aquatic biota, chemistry, temperature and creel survey data to determine if there is improvement on the White River mainstem from the West Branch to the mouth of the Third Branch	White River mainstem (stressed section)	Determine if Aquatic Life Use is stressed	Multiple towns	VFWD, VDEC MAPP	VDEC and VFWD Staff Time
16. Conduct road erosion inventory on roads hydrologically connected to Jericho Brook and implement BMPs. Follow up with monitoring and assessment once BMPs are implemented	Jericho Brook from mouth to 0.2 miles upstream	Improve water quality and habitat for aquatic biota	Hartford	TRORC, Municipality, VDEC MAPP, VFWD	VTrans Better Roads Grant
17. Implement high priority projects recommended in the First Branch River Corridor Plan (see Action 2)	First Branch from mouth to Chelsea	Assess past actions; address stressors indicated to be causing water quality issues	Chelsea, Royalton, Tunbridge	VDEC Rivers, WRP, VDEC Basin Planner, TRORC	DEC CWF Grants, AAFM Water Quality Grants
18. Target RAP outreach and implementation and riparian and aquatic area habitat restoration and protection on Kingsbury Brook	Kingsbury Brook (0.5-mile stressed segment)	Assess past actions; address stressors indicated to be causing water quality issues	Randolph	VDEC Rivers, WRP, WRNRCD, VDEC Basin Planner	DEC CWF Grants, AAFM Water Quality Grants, VDEC Contracts, LISW-RCPP
19. Target RAP outreach and implementation on the Third Branch (see Action 4)	Third Branch (11-mile stressed segment)	Address stressors indicated to be causing water quality issues	Bethel, Randolph	WRNRCD, VDEC Basin Planner	AAFM Water Quality Grants, VDEC Contracts, LISW-RCPP
20. Implement high priority projects recommended in the Third Branch River Corridor Plan (see Action 3)	Third Branch (11-mile stressed segment)	Assess past actions; address stressors indicated to be causing water quality issues	Bethel, Randolph	VDEC Rivers, WRP, VDEC Basin Planner, TRORC	DEC CWF Grants
21. Implement high priority projects recommended in the Stream Geomorphic Assessment identified in the Ayers Brook watershed	Ayers Brook (5.5 miles stressed segment)	Assess past actions; address stressors indicated to be causing water quality issues	Randolph, Braintree, Brookfield	VDEC Rivers, WRP, VDEC Basin Planner, VFWD, TRORC	DEC CWF Grants, Watershed Grants

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
22. Conduct road erosion inventory on hydrologically connected road segments for Ayers Brook and implement projects to meet standards (see Actions 30, 31)	Ayers Brook (5.5-mile stressed segment)	Address stressors indicated to be causing water quality issues	Randolph, Braintree, Brookfield	TRORC, VDEC Stormwater	Vtrans Better Roads Grants
23. Implement high priority projects recommended in the Stream Geomorphic Assessment for Hancock Branch	Hancock Branch (4.3-mile stressed segment)	Address stressors indicated to be causing water quality issues	Hancock, Ripton	VDEC Rivers, WRP, VDEC Basin Planner, TRORC	DEC CWF Grants, Watershed Grants
Strategies to address high-quality waters - PROTECT					
24. Investigate protection and restoration opportunities for oligotrophic waterbody, McIntosh Pond	McIntosh Pond	Determine if additional protections should be implemented to maintain high quality water condition	Royalton	WRNRCD, WRP, Town of Royalton, Lakeshore community	Watershed Grant, VDEC Contracts
25. Evaluate A(2) classification for Lake Casper and reclassify to appropriate water quality classification for designated uses and explore potential for removal and restoration of dammed tributary	Lake Casper	Determine if water source meets A(2) classification and if not, determine what the classification should be; restore natural flow regime of the tributary	Royalton	TRORC, Town of Royalton	Municipal Planning Grant, 604(b) Funding
26. Evaluate A(2) classification for Farnsworth Brook and reclassify to appropriate water quality classification for designated uses	Farnsworth Brook	Determine if water source meets A(2) classification and if not, determine what the classification should be	Braintree	TROPC, Town of Braintree	Municipal Planning Grant, 604(b) Funding
27. Reclassify waters recommended for A(1) and B(1) status to protect high quality fisheries and aquatic biota	Waters identified in Figures 10 and 11 and Table 6	Determine if additional protections should be implemented to maintain high quality water condition	Multiple towns	TRORC, WRP, VFWD, VDEC	Municipal Planning Grant, 604(b) Funding
28. Provide outreach to towns on B(1) candidate waters	Waters identified in Figures 10 and 11 and Table 6	Ensure towns and community members understand reclassification for protection	Multiple towns	TRORC, FWD, VDEC	Municipal Planning Grant, 604(b) Funding

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
Strategies to address stormwater runoff from developed lands and state and local roads – MAINTAIN, ENHANCE & PROTECT					
29. Complete road erosion inventories	Basin-wide	Identify water quality improvements on hydrologically connected road segments	Bethel, Brookfield, Royalton, Tunbridge, Hartford, Barnard, Pomfret, Rochester, Washington	TRORC, CVRPC Municipalities	VTrans Better Roads Grant
30. Implement high priority projects identified in road erosion inventories	Ayers Brook, Gilead Brook, Camp Brook, Jericho Brook	Improve water quality to waterbodies hydrologically connected to roads on stressed streams	Randolph, Bethel, Hartford	TRORC, Municipalities	VTrans Better Roads Grant, Grant-In-Aid
31. Develop stormwater master plans for Randolph, Hartford, Bethel, Royalton Williamstown and Rochester	Third Branch, Ayers Brook, Lower White, Upper White	Identify priorities for nutrient and sediment removal from stormwater runoff	Randolph, Hartford, Bethel, Royalton, Rochester	TRORC, CVRPC, WRP, Municipalities	DEC CWF Grant
32. Implement high priority projects identified in stormwater master plans for Randolph and Rochester	Ayers Brook, Upper White	Address stormwater runoff from impervious surfaces to improve water quality utilizing GSI	Randolph, Rochester	TRORC, WRP, Municipalities	DEC CWF Grant
33. Determine if high priority projects identified in Stormwater Mapping Report should be carried out singularly or through multi-town Stormwater Master Planning	Basin-wide	Identify next steps for small towns with stormwater runoff projects to improve water quality	Norwich, Sharon, Washington,Barnard, Pittsfield, Tunbridge, Roxbury	TROPC, CVRPC, Municipalities	VDEC Contract
34. Provide outreach and education for development of stormwater bylaws	Basin-wide	Mitigate new stormwater discharges in growing communities where state stormwater regulations do not apply	Killington, Brookfield, Sharon, Tunbridge, Pittsfield, Hartford	TROPC, RRPC, Municipalities	Municipal Planning Grant
35. Install signage at Bridge Street bridge informing users on “Risk of Creosote Exposure”. Develop corrective action plan to prevent “creosote weeping” from entering river corridor and public use area.	White River mainstem	Prevent further pollution and impacts to water quality and water-based recreation.	Bridge Street Bridge in Royalton	VDEC, VDOH, Town of Royalton, WRP	DEC CWF Grant, VT Clean Water State Revolving Loan Fund

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
Strategies to address bacteria and nutrient runoff from agricultural lands - RESTORE					
36. Provide outreach on cover cropping and other agricultural BMPs to farms in sub-basins where agricultural cropland is higher than seven percent land use.	First Branch, Second Branch, Third Branch	To reduce nutrient and bacteria run-off into the branches.	Randolph, Brookfield, Chelsea, Tunbridge, Royalton, Bethel	AAFM, WRNRCD, CRWFA	LISW-RCPP, AAFM Water Quality Grants
37. Target farm inspections on areas with data that suggests elevated nutrient loading and *E. coli* communities.	Basin-wide	To reduce nutrient and bacteria run-off in target areas to improve water quality	Basin-wide	AAFM	AAFM Staff Time
38. Provide educational workshops for farmers on tile drain systems, river management and stream geomorphology, agriculture funding and grant opportunities, and nutrients (e.g. nitrogen) and water quality.	Basin-wide with focus on First and Second Branch	To provide for education needs in the agricultural community that lead to better understanding of water quality	Basin-wide	AAFM, WRNRCD, VDEC, CRWFA	AAFM, Watershed Grant
See Actions 4, 18 and 19					
Strategies to encourage stream equilibrium and wetland, floodplain and river corridor protection - PROTECT					
39. Incorporate high priority floodplain encroachments for removal and other floodplain protection and restoration measures into Long-term Hazard Mitigation Plans and Stormwater Master Plans – towns are prioritized by number of structures and percent of all structures in the special flood hazard area.	First Branch, Upper White, Hancock Branch, Stony Brook, Tweed River, Mill Brook, Third Branch, Second Branch, Lower Mainstem	Identify high risk areas for flooding; encourage flood resilience; decrease water quality impacts from flooding events, encourage riparian buffer projects	Chelsea, Granville, Hancock, Stockbridge, Pomfret, Randolph, Hartford	TRORC, VDEC Rivers, Municipalities	Hazard Mitigation Grants

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
40. Municipal outreach for adoption of river corridor protection – towns are prioritized based on the value of protection by stream density and upstream protection value	Gilead Brook, Camp Brook, Third Branch, First Branch, White River Mainstem, Tweed River, Stony Brook, West Branch, Fay Brook	Establish protections for towns that will reduce water quality impacts of encroachment	Bethel, Stockbridge, Chelsea, Braintree, Rochester, Sharon, Royalton, Tunbridge, Roxbury	CVRPC, TRORC, VDEC Rivers	Municipal planning grant
41. Identify and field verify high priority post-Irene stream alterations for remediation from the *Irene Recovery Report* developed by VFWD	White River mainstem, Alder Meadow Bk, Broad Bk, First Branch, Hancock Branch, Lilliesville Bk, Locust Ck, Stony Bk, Third Branch, Tweed River, West Branch, Marshes Bk, Nason Bk, Clark Bk	Identify and address stream sites significantly altered during and after Tropical Storm Irene; encourage steam equilibrium; restore habitat for aquatic biota	Multiple towns	VFWD, VDEC Rivers, WRP, TRORC, Trout Unlimited, USFS	DEC CWF Grant, Watershed Grant, SWG
42. Review and evaluate pre-2013 river corridor plan priorities for project development.	Ayers Brook, Tweed River, Upper White, Streams in town of Sharon	Identify high priority water quality projects that have not been completed	Multiple towns	VDEC Rivers, WRP	DEC CWF Grant, VDEC Contract

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
43. Continue work to prioritize, design, and implement high-priority culvert replacement projects	Upper White, Tweed River	Encourage stream equilibrium, increase aquatic organism passage, and reduce channel erosion.	Granville, Hancock, Rochester, Pittsfield, Stockbridge	WRP, USFS, USFWS, VFWD, TRORC	USFS grants, USFWS Cooperative Agreement, Vtrans grants, VDEC CWF Grants
44. Continue work on dam removal prioritization, design and implementation on high priority sites	Basin-wide	Encourage stream equilibrium; increase aquatic organism passage; reduce channel erosion	Multiple towns	VDEC Rivers, WRP, USFWS, VFWD	DEC CWF Grants, MEF Grants, USFWS Funding, LISW-RCPP Funding
45. Continue work to assess, prioritize, design, and implement high-priority culvert replacement projects	Third Branch, Lower White, First Branch, Second Branch	Encourage stream equilibrium, increase aquatic organism passage, and reduce channel erosion	Multiple Towns	WRP, USFS, USFWS, VFWD	USFWS Cooperative Agreement, Vtrans grants, VDEC CWF Grants, SWG Grants
46. Implement high-priority culvert retrofit projects identified by VFWD	Mill Brook, Broad Brook	Increase aquatic organism passage	Pomfret, Sharon	WRP, USFWS, VFWD, TU	SWG Grants, USFWS Cooperative Agreement, VDEC CWF Grants
47. Identify wetlands impacted during and after flooding events	Stream and lake-associated wetlands throughout the basin	Learn about impacts of flooding on wetland functions	Sharon, Hartford, Bethel, Rochester, Stockbridge	VDEC Wetlands, VDEC MAPP, WRP, WRNRCD	VDEC Contract, VDEC Staff Time

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
48. Review new natural resource mapping and make recommendations for improving wetland mapping in target towns	All wetlands	Protect wetlands functions and values of significant wetlands that are not mapped	All towns	VDEC Wetlands, UVM	VDEC Contract
49. Continue and expand riparian buffer programs. Prioritize buffer plantings based upon recommendations in completed River Corridor Plans and target where previous studies have documented water quality issues.	Basin-wide	Improve geomorphic compatibility, habitat, water quality, and flood resilience	Multiple towns	WRP, USFS, USFWS, VDEC	USFS Grants, USFWS Cost-Share, VDEC CWF Grants, Private Foundation Grants
Strategies to address water quality on lakes and ponds					
50. Using Lake Wise assessment model, assess the public Fish & Wildlife access on Rood Pond and upgrade if recommended	Rood Pond	Assess and improve water quality where BMPs are recommended on a high-quality water	Williamstown	VDEC Lakes & Ponds, VFWD	Watershed Grant
51. Establish Lay Monitor on lakes recommended by the Lakes and Ponds Program	Sunset Lake, Rood Pond, Crescent Pond	Establish long-term trend data on lakes with significant shoreline development and potential water quality issues	Brookfield, Williamstown, Sharon	VDEC Lakes & Ponds, VDEC Basin Planner, WRNRCD	VDEC Staff Time, VDEC Contract
Strategies to address forests and water quality – MAINTAIN and PROTECT					
52. Continue funding and implementation for portable skidder bridges for logging	Basin-wide	Maintain and protect water quality on logging jobs; provide incentive for loggers to maintain water quality in forests	NA	VDFPR	FPR Clean Water Funding
53. Host portable skidder bridge building workshop at Randolph Technical Career Center	Basin-wide	Educate loggers on AMPs for logging and water quality; provide incentive for loggers to maintain water quality in forests	Randolph	VDFPR, WRP, WRNRCD	VDFPR funding, VDEC Contract
54. Support restoration actions identified in the Robinson Integrated Natural Resource Assessment on USFS land in the White River Basin	USFS Land in the Upper White	Restore waters impacted during Tropical Storm Irene; restore stream equilibrium and habitat for aquatic biota	Rochester, Pittsfield, Stockbridge, Hancock, Chittenden	USFS, VDEC Watershed Planner; VDEC Rivers	Federal Funding, VDEC CWF Grants

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
Strategies to support recreational uses					
55. Continue support for White River Water Trail for public access sites, river corridor protection, and outreach materials and events	White River Mainstem	Encourage recreational connection of water resources and the public	Granville, Hancock, Rochester, Pittsfield, Stockbridge, Bethel, Royalton, Sharon, Hartford	WRP, TRORC	MEF Grant, VDEC CWF Grant, Watershed Grant
56. Designate the White River mainstem as an ORW	White River Mainstem	Protect recreational uses of exceptional water resources	Granville, Hancock, Rochester, Pittsfield, Stockbridge, Bethel, Royalton, Sharon, Hartford	CRC, WRP, VRC, TRORC	604(b) funding
Strategies for prevention and protection from invasive species					
57. Continue outreach and education to prevent new introductions of invasive species introduction (including the rusty crayfish) in to the White River mainstem	White River Mainstem	Prevent spread of invasive species harmful to water resources	Bethel, Sharon, Hartford, Royalton, Randolph, Pomfret	WRNRCD, CC, municipalities, VDEC Lakes & Ponds	Grant-in-aid Program, Watershed Grant
58. Initiate regular monitoring and AIS spread prevention through signage or VIP program at Colton Pond, Rood Pond, McIntosh Pond, Sunset Lake and Lake Mitchell.	Colton Pond, Rood Pond, McIntosh Pond, Sunset Lake, Lake Mitchell	Prevent spread of invasive species harmful to water resources	Killington, Williamstown, Royalton, Brookfield, Sharon	WRNRCD, Municipalities, Lake and Pond Communities	Grant-in-aid Program, Watershed Grant
59. Recruit greeter and initiate AIS Greeter Program at Silver Lake or Silver Lake State Park	Silver Lake	Prevent spread of invasive species harmful to water resources	Barnard	VFPR, Lake Community, municipality, WRNRCD	Grant-in-aid Program, Watershed Grant

Strategies	Waterbody	Purpose	Town(s)	Partners*	Funding Opportunities
60. Initiate VIP where there is interest in small ponds in priority towns.	Lake Champagne, Randolph Pond, Ansel Pond, Mud Pond, No Name Pond, Hutchinson Pond	Prevent spread of invasive species harmful to water resources	Randolph, Bethel, Braintree	WRNRCD, Municipalities, Lake and Pond Communities	Grant-in-aid Program, Watershed Grant

*List of partner acronyms below.

AAFM Agency of Agriculture Food & Markets
CC Conservation Commission
CRC Connecticut River Conservancy
CRWFA Connecticut River Watershed Farmers Alliance
CVRPC Central Vermont Regional Planning Commission
VDOH Vermont Department of Health
HWMP Hazardous Waste Management Program
MAPP Monitoring Assessment and Planning Program
RRPC Rutland Regional Planning Commission
TNC The Nature Conservancy
TRORC Two Rivers-Ottauquechee Regional Commission
USFS United States Forest Service
USFWS United States Fish & Wildlife Service
VDEC Vermont Department Environmental Conservation
VDFW Vermont Department Fish and Wildlife
VDFPR Vermont Department of Forests Parks and Recreation
VRC Vermont River Conservancy
WRNRCD White River Natural Resource Conservation District
WRP White River Partnership

White River Basin Monitoring and Assessment Table

Table 21. White River Basin priorities for monitoring and assessment

Waterbody	Project Description	Location	Partner(s)	Purpose
Lakes and Ponds				
1. Sunset Lake	Lay monitor needed to collect Summer TP and chlorophyll-a. VDEC to collect chloride and conductivity data and spring P.	Brookfield	DEC Lakes & Ponds, Lay Monitoring Volunteer	To determine long-term nutrient trends and if chloride is impacting water quality
2. Colton Pond	Resample for acidity and consider listing as stressed based on results.	Killington	DEC Acid Lakes Program	To determine water quality condition for listing
3. Skylight Pond	Resample to monitor acid impaired status	Ripton	DEC Acid Lakes Program	Determine acid status and trend
4. Silver Lake	Lay monitor needed to collect summer phosphorus and chlorophyll-a samples.	Barnard	DEC Lakes & Ponds, Silver Lake State Park	To assess long-term trends for nutrients
5. Lake Mitchell	Coordinated outreach on A1 potential and results of full lake assessment. Investigation of levels of high TP on one tributary. Collect spring P.	Sharon	DEC Lakes & Ponds, Watershed Planner, Lake Mitchell Trout Club	To protect high quality water and determine source of high TP in tributary and if high TP values are impacting oligotrophic rating
6. Rood Pond	Recruit Lay Monitor Volunteer to collect water quality. VDEC to monitor high TN values and identify potential sources	Williamstown	Lay Monitoring Volunteer, VDEC staff	To establish long-term data trends on a larger lake with historically good in-lake water quality and high biodiversity. To determine if TN values are still high and if they are to determine the source(s)
7. Lamson Pond	Coordinate sampling with Wetlands and Lakes on Lamson Pond. Collect spring P and chloride. Determine new access for spring P sampling.	Brookfield	DEC Wetlands, VDEC Lakes & Ponds	To determine if pond functions primarily as a wetland. To determine if the water quality is impacted by activities from Route 89 (road salt application)
8. Crescent Pond	Recruit Lay Monitor Volunteer to	Sharon	DEC Lakes	To establish long-term monitoring data trends on a

Waterbody	Project Description	Location	Partner(s)	Purpose
	collect water quality. Collect spring P.		& Ponds, Lay Monitoring Volunteer	lake with historically good water quality but has a fair shoreline rating and moderately disturbed watershed.
9. North Pond	Evaluate for A1 potential	Brookfield	DEC Lakes & Ponds	To determine if lake should be reclassified as an A1 waterbody. Lake is in top 25% of best biodiversity lakes in the state and has four blue scorecard scores.
10. Pickles Pond, South Pond, Standing Pond, Twin Pond	Collect spring P	Multiple towns	DEC Lakes & Ponds	To determine spring P nutrient trend
11. Twin Pond, Sunset Lake, Standing Pond, Keyser Pond, Roxbury Flat	Check for AIS	Multiple towns	DEC Lakes & Ponds	To determine presence of AIS
12. Mud Pond, Pickles Pond	Calculate shoreland score	Braintree, Brookfield	DEC Lakes & Ponds	To determine shoreland score of undeveloped lakeshores
Rivers and Streams				
13. Hancock Branch	Bioassessment and water chemistry	Hancock	DEC MAPP	This site is stressed for acid and sediment. The site should be sampled to get one more datum point to determine if this site is no longer stressed for acid and sediment.
14. Flint Brook	Bioassessment and water chemistry	Roxbury	DEC MAPP	Determine if there are existing impacts to aquatic life support
15. Third Branch (above and below Flint Brook)	Bioassessment and water chemistry	Roxbury	DEC MAPP	Determine if there are existing impacts to aquatic life support
16. Jericho Brook	Bioassessment and water chemistry	RM 0.1, Hartford	DEC MAPP	Determine if there are impacts to aquatic life support further upstream from existing sampling site
17. Kingsbury Brook	Bioassessment and water chemistry	Randolph	DEC MAPP	Determine if there are impacts to aquatic life support further upstream from existing sampling site

Waterbody	Project Description	Location	Partner(s)	Purpose
18. Tributary 3 to Lower White River	Bioassessment and water chemistry	East of Christian Street in Hartford	DEC MAPP	Assess impacts from residential development
19. Podunk Brook	Bioassessment and water chemistry	RM 0.9, Hartford	DEC MAPP	Determine aquatic biota classification
20. Mill Brook	Bioassessment and water chemistry	Pomfret	DEC MAPP	Data gap - collect new data to determine condition
21. Mitchell Brook	Bioassessment and water chemistry	Sharon	DEC MAPP	Data gap - collect new data to determine condition above and below Lake Mitchell
22. Fay Brook	Bioassessment and water chemistry	Sharon	DEC MAPP	Data gap - collect new data to determine condition
23. Broad Brook	Bioassessment and water chemistry	Royalton, Sharon	DEC MAPP	Data gap - collect new data to determine condition
24. Sewall Brook	Bioassessment and water chemistry	Royalton	DEC MAPP	Data gap - collect new data to determine condition
25. Deer Hollow Brook	Bioassessment and water chemistry	RM 0.9, Granville	DEC MAPP	Determine aquatic biota classification
26. Lilliesville Brook	Bioassessment and water chemistry	Stockbridge, Bethel	DEC MAPP	Data gap - collect new data to determine condition
27. Locust Creek	Bioassessment and water chemistry	RM 4.7, Barnard	DEC MAPP	Determine aquatic biota classification
28. Robbins Branch	Bioassessment and water chemistry	RM 1.4, Hancock	DEC MAPP	Determine if there are still impacts to aquatic life support - 2011 macroinvertebrate communities were poor after Tropical Storm Irene
29. George Brook	Bioassessment and water chemistry	RM 0.1, Hancock	DEC MAPP	Determine aquatic biota classification
30. Stoddard Brook	Bioassessment and water chemistry	RM 0.5, Bethel	DEC MAPP	Determine aquatic biota classification
31. Stoney Brook	Bioassessment and water chemistry	RM 1.9, Stockbridge	DEC MAPP	Determine aquatic biota classification
32. Thatcher Brook	Bioassessment and water chemistry	Granville	DEC MAPP	Data gap - collect new data to determine condition
33. Upper White River mainstem	Bioassessment and water chemistry	Between RM 21.8 & 49.9, Rochester, Hancock	DEC MAPP	Old sampling data should be updated for fair and good-fair sites Determine aquatic biota classification – need fish data
34. First Branch	Bioassessment and water chemistry	RM 6.6, Tunbridge	DEC MAPP	Old sampling data should be updated
35. First Branch	Bioassessment and water chemistry	RM 19.3 or 23, Chelsea	DEC MAPP	Determine aquatic biota classification
36. Unnamed tributary	Bioassessment and water chemistry	Along Clarksville Road	DEC MAPP	Data gap - collect new data to determine condition
37. Farnham Branch	Bioassessment and water chemistry	Tunbridge	DEC MAPP	Data gap - collect new data to determine condition
38. Dickerman Brook	Bioassessment and water chemistry	Tunbridge	DEC MAPP	Data gap - collect new data to determine condition
39. Foundry Brook	Bioassessment and water chemistry	RM 0.8, Tunbridge	DEC MAPP	Determine aquatic biota classification
40. Cram Brook	Bioassessment and water chemistry	RM 0.7, Chelsea	DEC MAPP	Determine if there are existing impacts to aquatic life support – 2006 macroinvertebrate community was good-fair

Waterbody	Project Description	Location	Partner(s)	Purpose
41. Second Branch	Bioassessment and water chemistry	Randolph, Royalton, Bethel	DEC MAPP	Data gap - collect new data to determine condition – coordinate with *E. coli* sampling sites, determine aquatic biota classification for RM 18.0 and upstream
42. Penny Brook	Bioassessment and water chemistry	Randolph	DEC MAPP	Data gap - collect new data to determine condition
43. Halfway Brook	Bioassessment and water chemistry	Randolph	DEC MAPP	Data gap - collect new data to determine condition
44. Third Branch	Bioassessment and water chemistry	TBD	DEC MAPP	Data gap - collect new data to determine condition
45. Third Branch	Bioassessment and water chemistry	RM 18.1	DEC MAPP	Determine aquatic biota classification
46. Camp Brook	Bioassessment and water chemistry	Bethel	DEC MAPP	Data gap - collect new data to determine condition
47. Gilead Brook	Bioassessment and water chemistry	RM 2.0, Bethel	DEC MAPP	Old sampling data should be updated – significant changes since 2001
48. Thayer Brook	Bioassessment and water chemistry	Randolph, Braintree	DEC MAPP	Data gap - collect new data to determine condition
49. Adams Brook	Bioassessment and water chemistry	RM 1.5 & 2.8, Randolph	DEC MAPP	Old sampling data should be updated – site ranged from fair to excellent since 1997
50. Dunham Brook or Brackett Brook	Bioassessment and water chemistry		DEC MAPP	Data gap - collect new data to determine condition
51. Sandusky Brook	Bioassessment and water chemistry	Granville, Roxbury	DEC MAPP	Data gap - collect new data to determine condition
52. Riford Brook	Bioassessment and water chemistry	RM 0.9, Braintree	DEC MAPP	Questions on water quality issues downstream from agriculture
Wetlands				
53. Hancock Mountain, Holdens Pond, Lamson Pond, Mud Pond (Braintree), Pickles Pond, Randolph North, Roxbury Flat, Royalton Hill, Strafford Pond, Beaver Meadows	Lake-wetland complex analysis	Multiple towns	DEC Lakes & Ponds, VDEC Wetlands	Based on aerial imagery and recharge rates some lakes and ponds may function more as wetlands. Understanding which of these waterbodies are more wetlands will streamline monitoring and assessment
54. Kingsbury Brook wetland	Wetland assessment and VRAM	Randolph	DEC Wetlands	Water quality data on Kingsbury Brook suggests impacts from ag runoff and loss of riparian vegetation. Identify wetlands close to the sampling

Waterbody	Project Description	Location	Partner(s)	Purpose
				site and assess chemical and biological condition.
55. White River oxbow wetland	Wetland assessment and VRAM	Randolph	DEC Wetlands	The oxbow was removed after Tropical Storm Irene and the area may no longer be a wetland and should be evaluated.
56. Batcheldor Brook wetland	Wetland assessment and VRAM	Braintree	DEC Wetlands	The brook is listed as stressed for wetland impacts. The wetland should be assessed to determine the chemical and biological condition.
57. Nyes Swamp	Evaluate for Class I wetland potential	Barnard	DEC Wetlands, FPR	The wetland may meet Class I criteria but requires further assessment.
58. Wetlands impacted by flooding and alteration	Wetland assessment and VRAM	Sharon, Hartford, Bethel, Rochester, Stockbridge	DEC Wetlands	Identify wetlands that appear to have been altered after flooding events and develop a short list of wetlands for assessment

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Appendix A. 2013 Basin 9 Report Card

Overall, work completed in the watershed since the publication of the previous Tactical Basin Plan has allowed several assessments and efforts to support the implementation of specific actions. This includes mapping and assessing road and stormwater infrastructure, rivers and streams, agricultural land and wetlands. Extensive work has been done in partnership with the White River Partnership, Two Rivers-Ottauquechee Regional Commission, the White River NRCD, non-profits, and other divisions of state and federal government as well as landowners to work towards restoring impaired waters and managing the watershed for healthier rivers, wetlands, and lakes. Conservation projects and especially buffer projects have increased the total land under conservation, and towns and villages throughout the watershed are working to increase flood preparedness, reduce erosion and green their infrastructure for better water quality.

Table A1. 2013 Basin 9 report card with 2018 updates from partners.

Project Description	Project Type	Partners	Stage	Update
Action 01 - VDEC recommends that the main stem of the White River be designated an Outstanding Resource Water (ORW) for recreation value for boating, tubing, swimming, and fishing. VDEC would support a locally led effort to do so.	Water Resource Protection	Vermont Department of Environmental Conservation, White River Partnership, Two Rivers-Ottauquechee Regional Commission, Trout Unlimited	In progress	Local partners are ready to engage the ORW effort and are waiting for guidance from VDEC on updated procedure.
Action 02 - VDEC recommends that all streams within USFS designated Wilderness Areas within the basin and not already classified as A1 be re-classified from B to A1. In addition, Bingo Brook (Rochester) and Smith Brook (Goshen) should be considered for reclassification	Water Resource Protection	Vermont Department of Environmental Conservation, White River Partnership, Two Rivers-Ottauquechee Regional Commission	Complete	Complete.
Action 03 - VDEC recommends that Farnsworth Brook be re-classified from A(2) to B since it is no longer used as public water source	Water Resource Protection	Vermont Department of Environmental Conservation	2018 B9 Plan	Need to follow-up with town of Braintree and VDEC monitoring staff to determine on A1 potential
Action 03 - VDEC recommends that Lake Casper be re-classified from A(2) to B since it is no longer used as public water source	Water Resource Protection	Vermont Department of Environmental Conservation	2018 B9 Plan	Need to follow-up with town of Royalton and VDEC monitoring staff to determine on A1 potential

Project Description	Project Type	Partners	Stage	Update
Action 04 - Prioritize stream crossings for upgrades for aquatic organism passage by sub-basin and town. Contact municipalities and/or private landowners, GMNFS, and VTrans to further develop priorities. Focus on replacing structures to accommodate both AOP and geomorphic equilibrium.	Dam/Structure Removal - Preliminary Design	Vermont Agency of Transportation, Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department, White River Partnership, Two Rivers-Ottauquechee Regional Commission, United States Fish and Wildlife Service, United States Forest Service, Municipalities	In progress	WRP: completed data analysis for upper White River culverts, provided reports to the 5 towns (Granville, Hancock, Rochester, Pittsfield, Stockbridge), and is in the process of conducting an analysis looking at flood resilience. TRORC: 2014/2015 culvert inventories of Rochester, Braintree, Barnard, Bethel, Stockbridge, Pittsfield, Sharon, Tunbridge, and Granville. Did not specifically target AOP but identified poor and critical culverts.
Action 05 - Complete stream crossing assessments and run through AOP and geomorphic compatibility screens. Include the assessment of privately-owned structures. focus on Routes 14, 132, 100, I-89, and VTrans rail line.	Dam/Structure Removal - Preliminary Design	Vermont Department of Environmental Conservation, White River Partnership, Vermont Fish and Wildlife Department, United States Fish and Wildlife Service, United States Forest Service	In progress	WRP: Completed assessments for the upper White River, in 2017 and will finish Middle White and starting Upper Third Branch.
Action 06 - Initiate a dialogue and work group regarding high priority VTrans-owned crossings to upgrade for fish passage on state highways, the interstate and rail corridors	Education & Outreach	Vermont Agency of Transportation, Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department, White River Partnership, Trout Unlimited, Two Rivers-Ottauquechee Regional Commission, United States Fish and Wildlife Service	In progress	WRP: Providing input on the Vtrans modeling project in the upper White and is engaging Vtrans specifically in flood resilience analysis on the Upper White.

Project Description	Project Type	Partners	Stage	Update
Action 07 - Develop a dam removal feasibility study and prioritization to remove impediments to AOP on four specific waters.	Dam/Structure Removal	Vermont Department of Environmental Conservation, United States Fish and Wildlife Service, Vermont Fish and Wildlife Department, Trout Unlimited	In progress	WRP: Visited potential dam projects with American Rivers, prioritized Randolph Dam for removal and removed in 2016. Received funding to design Hyde dam removal in East Bethel in 2017 from TU and private foundations.
Action 08 - Establish a portable skidder bridge rental program for timber harvests within the GMNFS.	Technical Assistance	Vermont Department of Environmental Conservation, Vermont Department of Forests Parks and Recreation, United States Forest Service, White River NRCD, Vermont Fish and Wildlife Department	Discontinued	Through discussions with other Districts, WRNRCD suggests ending the rental program. Instead, we should focus on finding a way to cost share with loggers in owning them, as they are essential to environmentally friendly practices. The Senate of Ag committee first brought up this idea and is discussing it with the Districts. Rentals are infrequent, and many loggers simply want to buy them.
Action 09 - Expand the existing portable skidder bridge rental program in the basin by constructing 2 additional bridges and making them available to loggers	Forestry - Equipment	Vermont Department of Environmental Conservation, Vermont Department of Forests Parks and Recreation, White River NRCD	Discontinued	Through discussions with other Districts, WRNRCD suggests ending the rental program. Instead, we should focus on finding a way to cost share with loggers in owning them, as they are essential to environmentally friendly practices. The Senate of Ag committee first brought up this idea and is discussing it with the Districts. Rentals are infrequent, and many loggers simply want to buy them.

Project Description	Project Type	Partners	Stage	Update
Action 10 - Continue and expand riparian buffer programs. Prioritize buffer plantings based upon recommendations in completed P2 and River Corridor Plans and target where previous studies have documented excessive water temperatures.	Floodplain/Stream Restoration - Preliminary Design	White River Partnership, Vermont Department of Environmental Conservation	In progress	WRP: WRP planting 4,000-5000 stems per year in high impacted areas, Irene impacted areas and river corridor priority areas. TRORC: Received ERP funding for Ayers Brook and will work with WRP to get confirmation from landowners for buffer plantings. WRNRCD: Has completed some planting projects through Trees for Streams and located possible future planting sites. TFS is ending in 2017. Identified planting locations could be completed through ERP.
Action 11 - Undertake in-stream aquatic habitat enhancement projects	Floodplain/Stream Restoration - Preliminary Design	United States Forest Service, United States Fish and Wildlife Service, Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department	In progress	WRP: Implemented West Branch Phase 1 and Phase 2 projects in 2015 and 2016, working with partners to prioritize next in-stream project.
Action 12 - Map and prioritize flood plain encroachment parcels for possible removal/restoration based upon geomorphic equilibrium, flood inundation, fluvial erosion hazards and past flood damage with a focus on developed flood plains within village centers.	Floodplain/Stream Restoration - Preliminary Design	White River Partnership, Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, Municipalities	In progress	WRP: Working with towns to identify high-priority floodplains. Quintown project focused on upper White River. TRORC: Buyout sites are TRORC's best efforts to eliminate floodplain encroachment structures. Hazard Mitigation Plans also include maps of properties located in Special Flood Hazard Areas and River Corridor areas.
Action 13 - Continue to promote better floodplain and corridor protection in the towns to address encroachment and minimize channel management. Focus on Bethel and Stockbridge.	Water Resource Protection	Two Rivers-Ottauquechee Regional Commission, White River Partnership, Vermont Department of Environmental Conservation, Municipalities	In progress	WRP: Actively developing river corridor protection projects along the mainstem and in Bethel. TRORC: Bethel recently upgraded flood hazard regulations.

Project Description	Project Type	Partners	Stage	Update
Action 14 - Undertake floodplain restoration and buffer planting projects for parcels approved for HMGP buyouts. Approximately 40 sites	Floodplain/Stream Restoration - Preliminary Design	Two Rivers-Ottauquechee Regional Commission	In progress	WRP: Worked with towns of Granville, Hancock, Rochester, Pittsfield, Bethel, Braintree, Stockbridge and Royalton to enhance riparian buffers and floodplain function and buyout sites. (16 buyouts are being converted to public parks) TRORC: Buyout Sites in Basin 9 - 5 Hartford, 1 pomfret, 4 Royalton, 4 bethel, 1 Braintree, 12 Stockbridge, 7 Pittsfield, 4 Rochester, and 3 Granville. Follow-up: Need to determine if more work needs to be done.
Action 15 - Secure permanent protection of river corridors through easements or buyouts and flood plain encroachment removals. Focus area: Tweed and Ayers Brook	River Corridor Easement - Scoping	Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation, Municipalities, Landowners	In progress	WRP: Working with VRC to implement river corridor easements on the main stem and in Bethel; completed 2 in Hancock, 2 in Stockbridge, developing 4 in Bethel. TROPC: Ayers Brook ERP project (2017) will target easements on RC areas. Multiple buyouts of Chalet Village on Schaff-Haus Drive on Tweed River in Stockbridge. Follow-up: Need to determine if more work needs to be done.
Action 16 - Secure permanent protection and restoration of the river corridor and floodplain within the Village of Hancock including the salvage yard	River Corridor Easement - Design	Two Rivers-Ottauquechee Regional Commission, White River Partnership, Vermont Department of Environmental Conservation, Landowners, Hancock, Municipalities	In progress	WRP: 2 River corridor easements completed in Hancock. VRC: Received funding for River Corridor Easement on Bettis parcel (Salvage yard in Hancock). Follow-up: Need to determine if more work needs to be done.

Project Description	Project Type	Partners	Stage	Update
Action 17 - Protect significant riparian natural communities from development and/or excessive logging by improving zoning bylaws and/or fee simple purchases or conservation of development rights. Focus Area: Lower White, middle White, First Branch (4 Rich Fens), Third Branch (Randolph to Gilead Brook)	Water Resource Protection	Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department, Vermont Department of Forests Parks and Recreation, Two Rivers-Ottauquechee Regional Commission, Vermont River Conservancy	In progress	TRORC: Zoning/Flood Regulation Bylaw updates since 2013 include: Pittsfield, Randolph, and Tunbridge. Bethel is currently in the process of adopting new flood regulations.
Action 18 - Collect additional data necessary to assess wetlands using new criteria for possible re - classification from Class 2 to Class 1.	Research	Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department, White River Partnership, Two Rivers-Ottauquechee Regional Commission	Complete	Wetlands Vermont Rapid Assessment Method (VRAM) and field plant inventory completed for fen.
Action 18 - Collect additional data necessary to assess wetlands using new criteria for possible re - classification from Class 2 to Class 1.	Research	Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department	In progress	Wetlands Vermont Rapid Assessment Method (VRAM) completed for Nyes Swamp.
Action 18 - Collect additional data necessary to assess wetlands using new criteria for possible re - classification from Class 2 to Class 1. Focus Sites: Barnard Fen	Research	Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department, White River Partnership, Two Rivers-Ottauquechee Regional Commission	Complete	Wetlands Vermont Rapid Assessment Method (VRAM) and field plant inventory completed for fen.

Project Description	Project Type	Partners	Stage	Update
Action 19 - Compile a list of high priority privately - owned sites to secure permanent public access to swimming holes and waterfalls through permanent easements.	Research	White River Partnership, Vermont River Conservancy, Vermont Department of Environmental Conservation, Municipalities	Complete	WRP: Conducted an inventory of formal and informal access sites watershed-wide and purchased the Rikert parcel in Sharon with Vermont River Conservancy. TRORC: Formal and informal access map on file, Update required to reflect current buyout status. Plan to update once buyouts are complete.
Action 20 - Inventory additional possible public access areas for swimming, boating, and fishing within the Second Branch watershed.	Research	Vermont Department of Environmental Conservation, Vermont Fish and Wildlife Department, White River Partnership	Complete	WRP: See update for Action 19.
Action 21 - Conduct BBR capital budget inventories for road -related erosion, AOP impediments, and river -road conflicts with an emphasis on flood resiliency parameters.	Road Erosion Control Inventory	Municipalities, Vermont Youth Conservation Corps, Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	Complete	TRORC: Stockbridge competed a culvert inventory in 2015. TRORC working on 2017 Road erosion inventory in Stockbridge. WRP: Incorporated capital budget inventories in analysis of culvert assessments in Stockbridge.
Action 21 - Conduct BBR capital budget inventories for road -related erosion, AOP impediments, and river -road conflicts with an emphasis on flood resiliency parameters.	Road Erosion Control Inventory	Municipalities, Vermont Youth Conservation Corps, Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	In progress	TRORC: Bethel completed a culvert inventory in 2015. Road Erosion inventory planned for 2020.
Action 21 - Conduct BBR capital budget inventories for road -related erosion, AOP impediments, and river -road conflicts with an emphasis on flood resiliency parameters.	Road Erosion Control Inventory	Municipalities, Vermont Youth Conservation Corps, Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	In progress	TRORC: Braintree completed a culvert inventory in 2015; Road Erosion Inventory to be completed in 2018.

Project Description	Project Type	Partners	Stage	Update
Action 21 - Conduct BBR capital budget inventories for road -related erosion, AOP impediments, and river -road conflicts with an emphasis on flood resiliency parameters.	Road Erosion Control Inventory	Municipalities, Vermont Youth Conservation Corps, Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	In progress	TRORC: Brookfield conducted a culvert inventory in 2014. VYCC: Taylor Hill Road BMP implementation in 2017. Road Erosion inventory planned for 2020.
Action 22 - Implement high priority road BMP and river -road conflict remediation as identified in Capital Budgets.	Road Project - Preliminary Design	Vermont Department of Environmental Conservation, Vermont Agency of Transportation, Municipalities	In progress	WRP: Following culvert prioritization process and may identify projects for future implementation in the Upper White and Tweed. TRORC: Quintown Project assisted in several major in-stream culvert upgrades.
Action 22 - Implement high priority road BMP and river -road conflict remediation as identified in Capital Budgets.	Road Project - Preliminary Design	Vermont Department of Environmental Conservation, Vermont Agency of Transportation, Municipalities	In progress	TRORC: Stockbridge Better Roads Projects - BR 17 (applied) Improve culverts and ditching on Lyon Hill Road and Stony Brook Road; BBR16: culvert improvements and stone-line ditching on Driscolls Rd and Stockle Dr; BR 15: River Rd culvert replacement
Action 22 - Implement high priority road BMP and river -road conflict remediation as identified in Capital Budgets.	Road Project - Preliminary Design	Vermont Department of Environmental Conservation, Vermont Agency of Transportation, Municipalities	In progress	TRORC: CDBG Project to realign and reconstruct Taggart Hill Road: Construction of 756-foot-long retaining wall; replacement of roadway culverts regrading and resurfacing; and installation of roadside drainage swale and erosion control. Widening of constricted stream channel through ledge removal on right streambank.

Project Description	Project Type	Partners	Stage	Update
Action 23 - Continue implementation of high and medium priority erosion remediation projects identified in the White River Class 4 Road Inventory and conduct outreach to Class 4 Road user groups to enhance stewardship of these resources	Road Project - Preliminary Design	White River Partnership, Vermont Youth Conservation Corps, Vermont Department of Forests Parks and Recreation, Vermont Department of Environmental Conservation, Vermont Agency of Transportation, Municipalities	Complete	Future road erosion inventories will be part of the required MRGP. WRP: Worked with VYCC to address priority Class 4 road projects, VYCC will continue to work with towns on municipal roads permit/issues on Class 4 roads.
Action 24 - Encourage towns to adopt locally appropriate Bridge and Road Standards meeting VTRANS minimum guidelines	Education & Outreach	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, Municipalities	Complete	All towns have adopted Bridge and Road Standards
Action 25 - Conduct road erosion BMP, river -road conflict remediation, and stream crossing workshops	Education & Outreach	Vermont Agency of Transportation, Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission	Complete	Training held in Berlin. VDEC is working with Rivers Program to schedule a training in the White River Basin. MRGP Trainings held during 2016 and 2017.
Action 26 -. Develop a sampling plan to determine what risk the dumpsite poses to the environment. Sample water and sediments in Smith Brook for the presence of volatile organic compounds, semi -volatile organic compounds, arsenic and heavy metals. Based on the results, the Waste Management Division will work with the Watershed Management Division and property owners to determine appropriate next steps for this site.	Research	Vermont Department of Environmental Conservation, Municipalities, White River Partnership	Complete	WRP: Collaborated with Stone Environmental to develop a site assessment plan for potential SEP funds, which were not received.

Project Description	Project Type	Partners	Stage	Update
Action 27 - Design and install practices that will address creosote discharges to the White River from the truss bridge decking in Royalton (Bridge Street bridge). Determine if other similar stream crossings are causing an impact.	Water Resource Protection	White River Partnership, Vermont Department of Environmental Conservation, Municipalities	2018 B9 Plan	WRP: Explored solutions to the discharge issue but couldn't identify funding for next steps. New discharges were reporting in July 2018.
Action 28 - Conduct a GIS level inventory of undeveloped lakeshores in the basin using VDEC's Lakes and Ponds' and other relevant **methodologies**	Research	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission	2018 B9 Plan	Funding for the mapping project was discontinued, however, if a shoreland score was calculated by the Vermont Lakes & Ponds Program no further action is needed.
Action 28 - Conduct a GIS level inventory of undeveloped lakeshores in the basin using VDEC's Lakes and Ponds' and other relevant **methodologies**	Research	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission	Discontinued	Funding for the mapping project was discontinued, however, if a shoreland score was calculated by the Vermont Lakes & Ponds Program no further action is needed.
Action 28 - Conduct a GIS level inventory of undeveloped lakeshores in the basin using VDEC's Lakes and Ponds' and other relevant **methodologies**	Research	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission	Discontinued	Funding for the mapping project was discontinued, however, if a shoreland score was calculated by the Vermont Lakes & Ponds Program no further action is needed.
Action 28 - Conduct a GIS level inventory of undeveloped lakeshores in the basin using VDEC's Lakes and Ponds' and other relevant methodologies	Research	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, United States Forest Service	2018 B9 Plan	Funding for the mapping project was discontinued, however, if a shoreland score was calculated by the Vermont Lakes & Ponds Program no further action is needed.
Action 29 - Prioritize lakeshore protection projects for the basin and begin securing permanent lakeshore protection easements.	Water Resource Protection	Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation, Vermont River Conservancy	In progress	The 2018 plan will identify highest quality lakes and ponds in the watershed and recommend protection where needed. No conservation efforts have been tracked since the 2013 plan.

Project Description	Project Type	Partners	Stage	Update
Action 30 - Promote and initiate the Lake Wise program	Lake Shoreland - Scoping	Vermont Department of Environmental Conservation, Landowners, Vermont Department of Forests Parks and Recreation	In progress	Grant received by Lakes and Ponds Program for Lake Wise project on Silver Lake in Barnard. WRNRCD willing to support additional efforts if necessary.
Action 31 - Bracket potential sources of bacteria through windshield surveys, additional monitoring sites, and possible sanitary surveys	Water Quality Sampling	White River Partnership, Vermont Department of Environmental Conservation	In progress	WRP: working with LaRosa lab to bracket potential bacteria sources on First, Second and Third Branches. Third Branch sources are likely stormwater inputs. LaRosa monitoring on First and Second Branch continued in 2017. TRORC: Developed a stormwater master plan for Ayers Brook Watershed.
Action 33 - Conduct AEM assessments in targeted sub -basins to better determine possible sources of sediment, channel erosion, encroachments, and nutrients	Agricultural Pollution Prevention - Scoping	Vermont Agency of Agriculture Food and Markets, Vermont Department of Environmental Conservation, White River NRCD	In progress	WRNRCD: Completed BMP outreach to 30 farms in the 1st and 3rd Branches. 7 BMP practices were installed on 5 farms. Through Agency of Ag funding, WRNRCD will continue BMP outreach and BMP design along the 2nd Branch and the main branch of the White River.
Action 35 - Inventory high priority agriculturally - impacted wetlands for restoration. High priority wetlands are those that are sediment and phosphorus attenuation areas.	Research	Vermont Department of Environmental Conservation, White River NRCD, Vermont Agency of Agriculture Food and Markets, Natural Resources Conservation Service, Ducks Unlimited	In progress	VDEC staff and WRNRCD completed windshield survey and site identification for the Second and Third Branch. WRNRCD and WRP have worked with Ducks Unlimited to identify sites, but they are looking for large areas and most wetlands in Basin 9 do not meet size criteria.

Project Description	Project Type	Partners	Stage	Update
Action 36 - Complete additional Phase 1 and 2 Geomorphic Assessments and River Corridor Management Plans for the basin.	River Corridor Planning	White River Partnership, Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation	Complete	WRP: Middle Mainstem and tributaries and remaining portions of Upper White are completed. TRORC: 2014 First Branch River Corridor Plan (Chelsea, Tunbridge, Washington, Royalton, Williamstown, Brookfield, Randolph, and Strafford); 2014 Middle White River and Third Branch Watersheds (Bethel); 2015 Upper and Middle White River Watershed Corridor Plan (Barnard, Hancock, Pittsfield, Rochester, & Stockbridge)
Action 36 - Complete additional Phase 1 and 2 Geomorphic Assessments and River Corridor Management Plans for the basin. Remaining sections of the Lower Mainstem.	River Corridor Planning	White River Partnership, Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation	In progress	The mainstem White and all major tributaries in Sharon have had a Phase 2 SGA. The rest of the lower mainstem is a lower priority for Phase 2 SGA due to the natural confinement and existing major encroachments. Tributaries in Pomfret and Hartford could be assessed if there is interest in the data from towns.
Action 36 - Complete additional Phase 1 and 2 Geomorphic Assessments and River Corridor Management Plans for the basin. Remaining sections of the Second Branch.	River Corridor Planning	White River Partnership, Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation	2018 B9 Plan	This is the largest SGA data gap in the White River watershed and is the highest priority for Phase 2 SGA in this basin. Partners are exploring capacity to work on this project in 2018-2019.
Action 36 - Complete additional Phase 1 and 2 Geomorphic Assessments and River Corridor Management Plans for the basin. Remaining sections of the Third Branch.	River Corridor Planning	White River Partnership, Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation	In progress	Phase 2 is complete on the Third Branch from the mouth through Bethel, and Ayers Brook watershed. The remaining mainstem and tributaries could be assessed, but are lower priority given small drainage area.

Project Description	Project Type	Partners	Stage	Update
Action 36 - Complete additional Phase 1 and 2 Geomorphic Assessments and River Corridor Management Plans for the basin. Remaining sections of the Upper White River.	River Corridor Planning	White River Partnership, Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation	Complete	SGA is complete in this part of the watershed.
Action 38 - Complete IDDE and stormwater mapping inventories and recommendation plans	Stormwater - IDDE	Vermont Department of Environmental Conservation	Complete	Stormwater mapping completed by VDEC.
Action 38 - Complete IDDE and stormwater mapping inventories and recommendation plans	Stormwater - IDDE	Vermont Department of Environmental Conservation	Complete	Stormwater mapping completed by VDEC.
Action 38 - Complete IDDE and stormwater mapping inventories and recommendation plans	Stormwater - IDDE	Vermont Department of Environmental Conservation	Complete	Stormwater mapping completed by VDEC.
Action 38 - Complete IDDE and stormwater mapping inventories and recommendation plans	Stormwater - IDDE	Vermont Department of Environmental Conservation	Complete	Stormwater mapping completed by VDEC.
Action 38 - Complete IDDE and stormwater mapping inventories and recommendation plans	Stormwater - IDDE	Vermont Department of Environmental Conservation	Complete	Stormwater mapping completed by VDEC.
Action 39 - Implement high priority recommendations from IDDE Stormwater Mapping Report (Action 38)	Stormwater - IDDE		In progress	WRP: Working with Rochester to explore high priority recommendations from mapping report. TRORC: Two IDDE projects in Randolph (Ayers Brook SWMP) - Ayers Brook ERP to develop scoping for owner commitment
Action 40 - Undertake Green Infrastructure demonstration projects throughout the watershed	Stormwater - Preliminary Design	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	In progress	Work will be continued via Stormwater Master Planning and Project Implementation. WRNRCD: Plans to complete one project from a stormwater master plan or mapping report - funding for project planning secured.

Project Description	Project Type	Partners	Stage	Update
Action 41 - Provide outreach to municipalities regarding stormwater zoning and bylaws	Education & Outreach	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	Complete	TRORC: Conducted municipal outreach regarding Hazard Mitigation Planning, Flood Hazard Bylaws, River Corridor Bylaws, Stormwater Manual, Municipal Roads General Permit, Required Agricultural Practices, and Tactical Basin Planning. Outreach will continue primarily through the Clean Water Action Committee.
Action 42 - Provide technical assistance to towns in implementing high priority stormwater best management practices (Action 38)	Technical Assistance	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, White River Partnership	In progress	WRP: Currently working with Randolph to implement two projects and will conduct a stormwater master plan for the Town. IDDE map outreach could be a future Clean Water Action Committee topic.
Action 43 - Raise awareness of aquatic invasive and nuisance plants, animals, and pathogens spread prevention based on recommendations from the Lakes and Ponds Program.	Education & Outreach	Vermont Department of Environmental Conservation, Trout Unlimited, White River Partnership	In progress	Specific waterbodies are identified in the 2018 White River TBP for maintenance and identification of priority sites for Aquatic Invasive Outreach.
Action 44 - Hold an annual Vermont Invasive Patrollers (VIP) training to support the establishment of VIP programs in the basin.	Technical Assistance	Vermont Department of Environmental Conservation, Watershed groups	2018 B9 Plan	Specific waterbodies are identified in the 2018 White River TBP for Vermont Invasive Patrollers training.
Action 45 - Support new and existing public access greeter programs. Encourage greeter programs on waters with invasives (e.g. Eurasian watermilfoil) to provide information to recreational users and to encourage actions to prevent water body to water body transport.	Education & Outreach	Vermont Department of Environmental Conservation, Watershed groups, Landowners, Municipalities	2018 B9 Plan	Specific waterbodies are identified in the 2018 White River TBP for the public access greeter programs.
Action 46 - Assess municipalities for resiliency against catastrophic loss from both fluvial erosion and flood inundation damages	Research	Vermont Department of Environmental Conservation, Two Rivers-Ottauquechee Regional Commission, Municipalities	Complete	WRP: Developed Quintown project and gathered Phase II data in First Branch, Bethel and Middle Upper White. TRORC: Flood Resilience Checklists and Municipal Protections for Towns in the White River Complete. TRORC supporting WRP efforts.

Project Description	Project Type	Partners	Stage	Update
Action 47 - Prepare plans for village centers located within delineated river corridors that identify high priority floodplain encroachments for removal and other floodplain protection and restoration measures	Technical Assistance	Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation, Municipalities	2018 B9 Plan	Specific areas are identified in the 2018 White River TBP for identification and mapping of high priority floodplain encroachments.
Action 48 - Inventory highly sensitive and vulnerable State highway transportation infrastructure and river -road conflicts. Develop a remediation and avoidance plan for these areas. Focus areas: Corridors along Routes 12, 12A, 73, 14, 107, 132, and 100	Road Project - Scoping	Vermont Department of Environmental Conservation, Vermont Agency of Transportation	In progress	TRPRC engaged with ongoing Vtrans Upper White River transportation resilience planning project. WRP provided input on Vtrans modeling project in the Upper White.
Action 49 - Identify and restore high priority post - Irene dredged areas for remediation needs. High priority sites are those where aquatic habitat resources were degraded and sites where dredging has left infrastructure vulnerable to future events.	Floodplain/Stream Restoration	Vermont Department of Environmental Conservation, United States Forest Service, United States Fish and Wildlife Service, White River Partnership, Trout Unlimited	2018 B9 Plan	Specific areas are identified in the 2018 White River TBP for follow-up to Post-Irene River Alteration Assessment.
Action 50 - Protect undeveloped headwater areas to promote flood resiliency and aquatic habitat protection through revisions to town plans and zoning bylaws	Water Resource Protection	Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation, Municipalities	In progress	Reclassification for areas that meet biological criteria is currently in progress and five surface waters were re-classified to A(1) in the 2016 Water Quality Standards. Additionally, all waters 2500ft and above are protected to the A(1) standard.
Action 51 - Delineate river corridors and develop river corridor build -out analysis for stream reaches significantly impacted by TS Irene and share information with planning commissions and select boards	Research	Two Rivers-Ottauquechee Regional Commission, Vermont Department of Environmental Conservation, Municipalities	In progress	TROPC: VDEC, with TRORC support, working on HMGP administrative river corridor modification procedure to Modify Village Areas in River Corridor areas.

Project Description	Project Type	Partners	Stage	Update
Actions 32 and 34 - Implement targeted (selective) agricultural BMPs that will address possible sources of E. , channel erosion, sediment, encroachments, and nutrients such as repairing malfunctioning manure pits and manure storage areas, livestock fencing, riparian buffers, barnyard manure management, and nutrient management	Agricultural Pollution Prevention - Design	Vermont Agency of Agriculture Food and Markets, Vermont Department of Environmental Conservation, White River NRCD	In progress	WRNRCD: Completed BMP outreach to 30 farms in the 1st and 3rd Branches. 7 BMP practices were installed on 5 farms. Through Agency of Ag funding, WRNRCD will continue BMP outreach and BMP design along the 2nd Branch and the main branch of the White River. WRP/TROPC/WNRDC: TRORC is partnering with WRNRCD to do BMP/RAP outreach that will lead to assessment of individual farms. Ayers Brook ERP will include partnership with WRNRCD to do : 4 tier 1 BMP visits, 2 tier 2 BMP remediation identification; and 1 Tier 3 BMP plan"

Appendix B. Climate Change Signal Figures

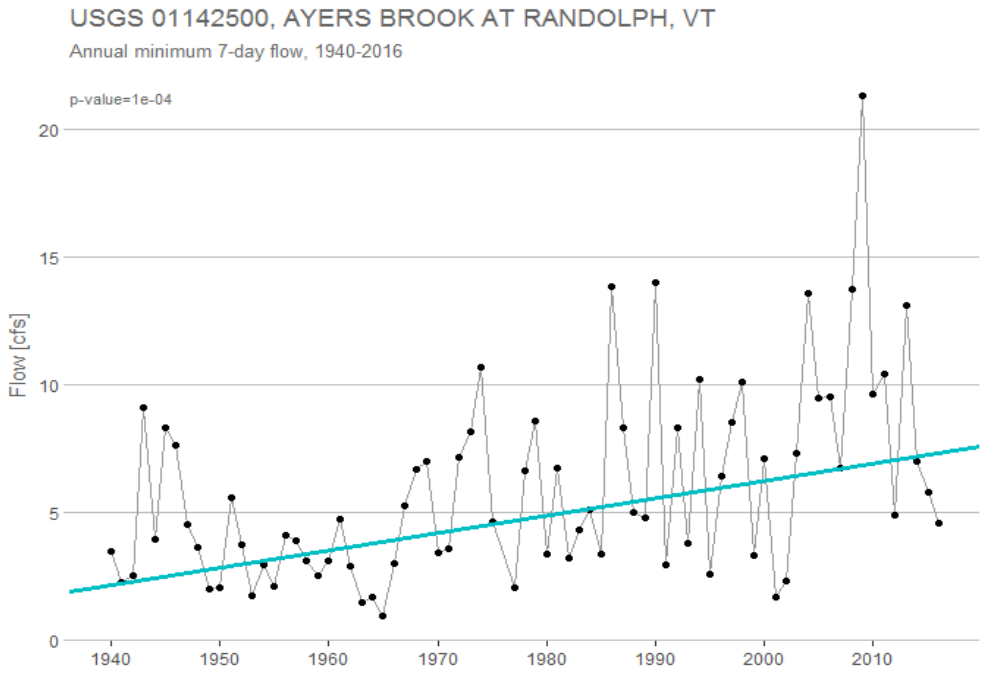


Figure B1. Annual minimum 7-day flow with trendline for the Ayers Brook USGS station. The annual 7-day minimum flow is the 7-day period in each year with the smallest cumulative flow total.

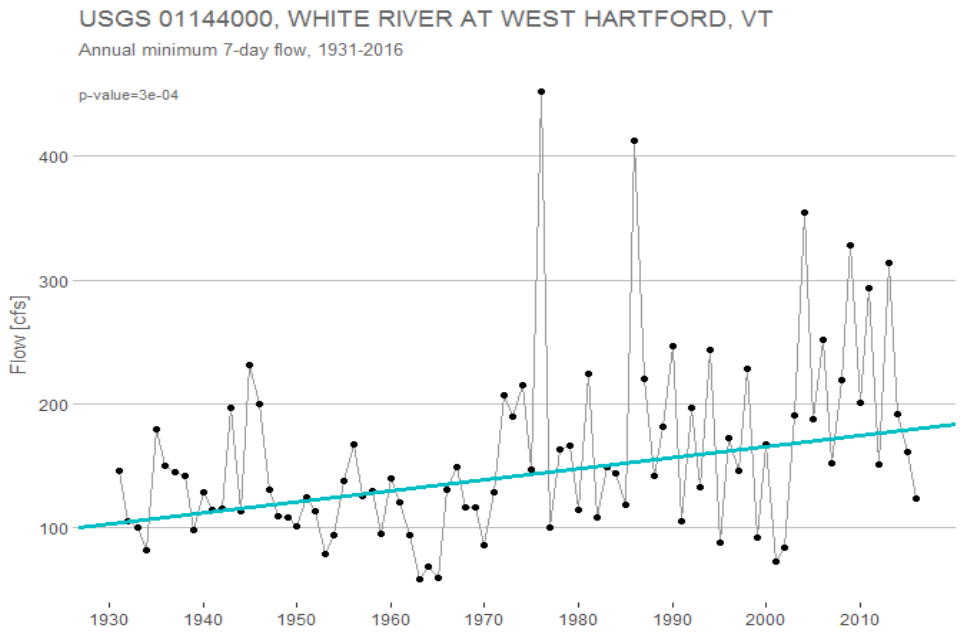


Figure B2. Annual minimum 7-day flow with trendline for the White River USGS station. The annual 7-day minimum flow is the 7-day period in each year with the smallest cumulative flow total.

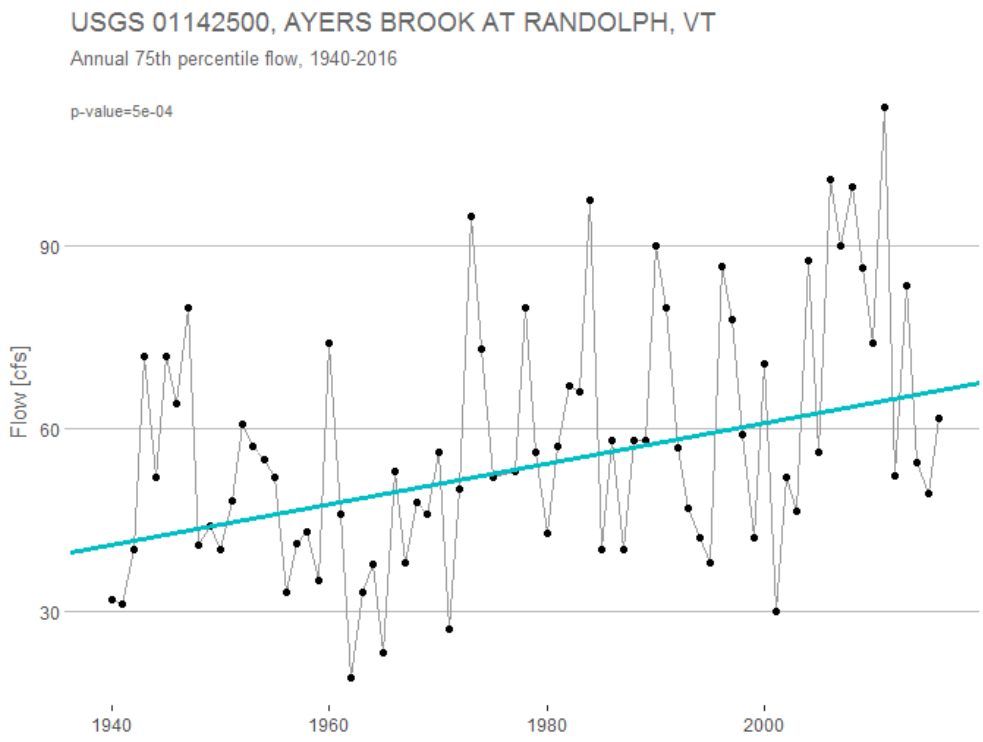


Figure B3. Annual 75th percentile streamflow at the Ayers Brook USGS station. The annual 75th percentile streamflow is the flow level that is only exceeded 25% of the time in a given year.

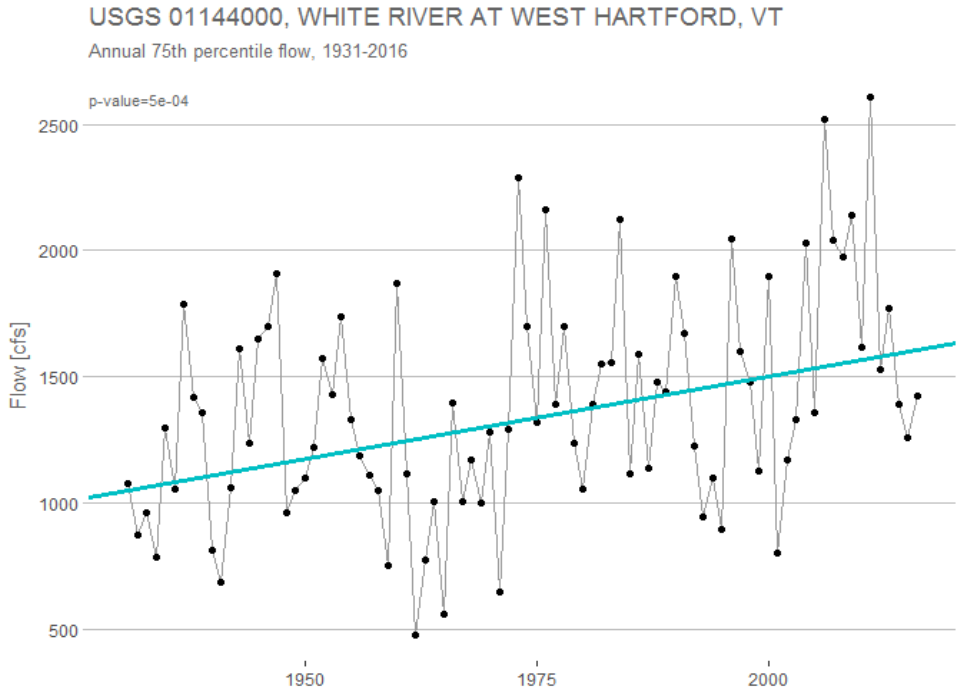


Figure B4. Annual 75th percentile streamflow at the White River USGS station. The annual 75th percentile streamflow is the flow level that is only exceeded 25% of the time in a given year.

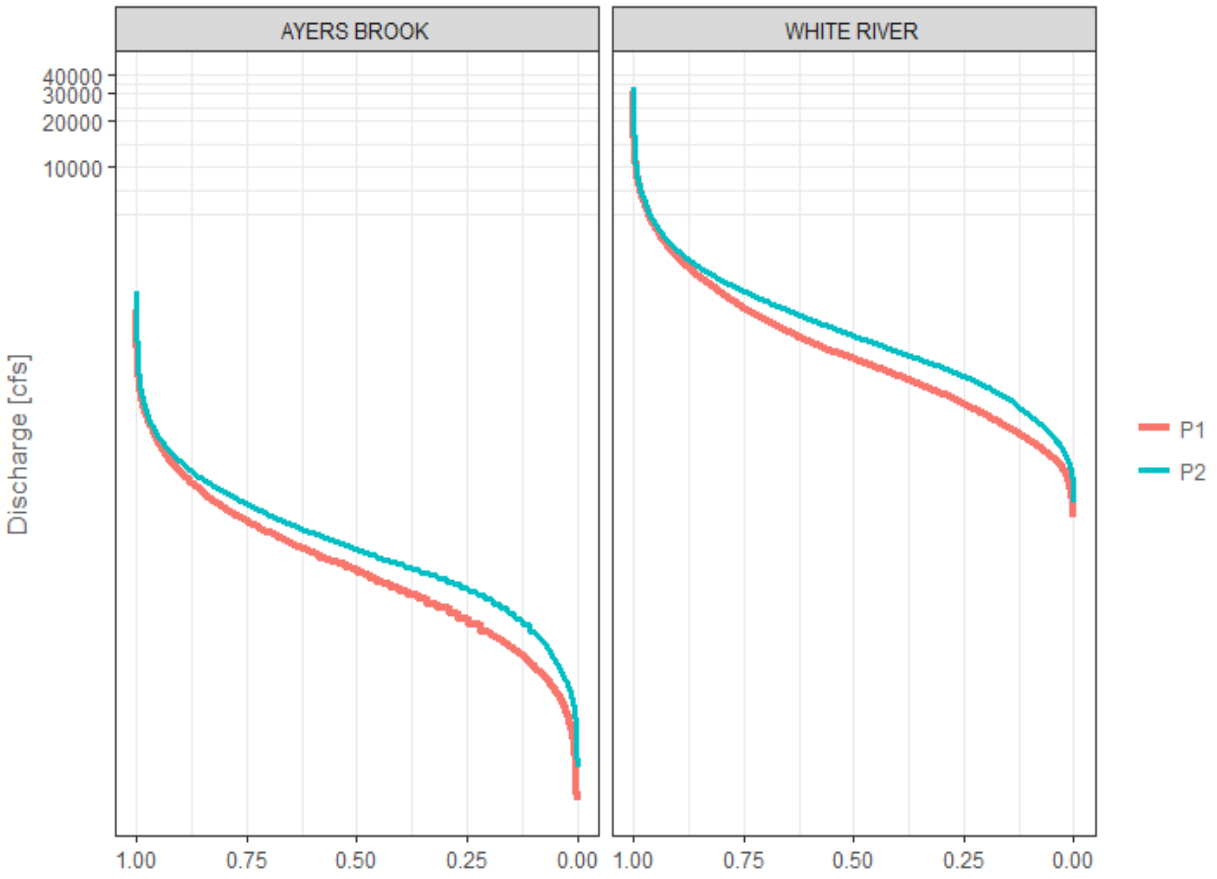


Figure B5. Flow duration curves based on daily mean flow. "P1" is the first half of each station's flow record; "P2" is the second half. A similar shift is apparent in both watersheds; low to moderate high flows have increased, while the highest flows have increased in Ayers Brook, but not the White River. The similarity across watersheds indicates that the same mechanism altering streamflow is present in both watersheds.

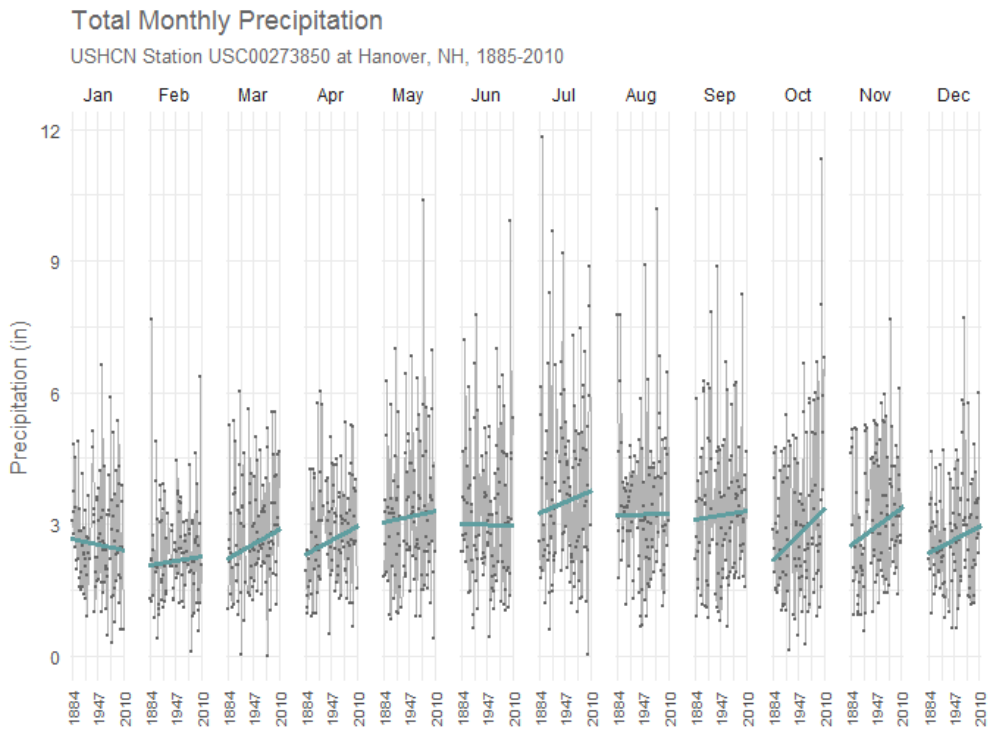


Figure B6. Trend lines for monthly precipitation totals from 1885-2010. Precipitation totals have increased in 10 of 12 months. Results are statistically significant.

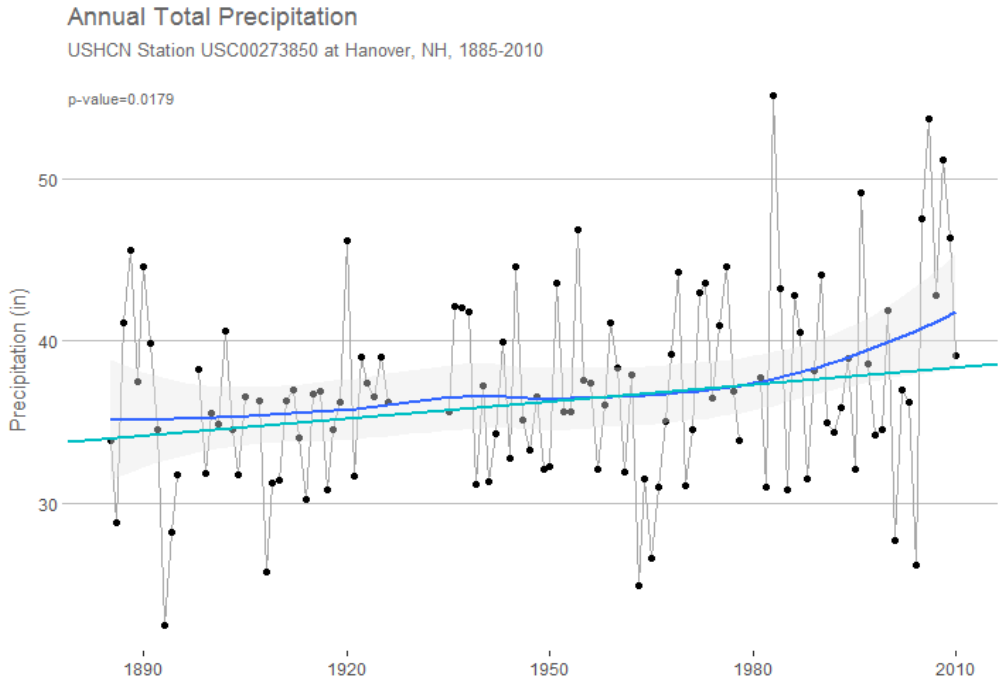


Figure B7. Annual total precipitation totals with linear and polynomial trend lines. Annual precipitation has increased by 4.5 inches using the linear trend, and 6.7 inches using the polynomial trend line. Results are statistically significant.

Appendix C. Monitoring and Assessment Data

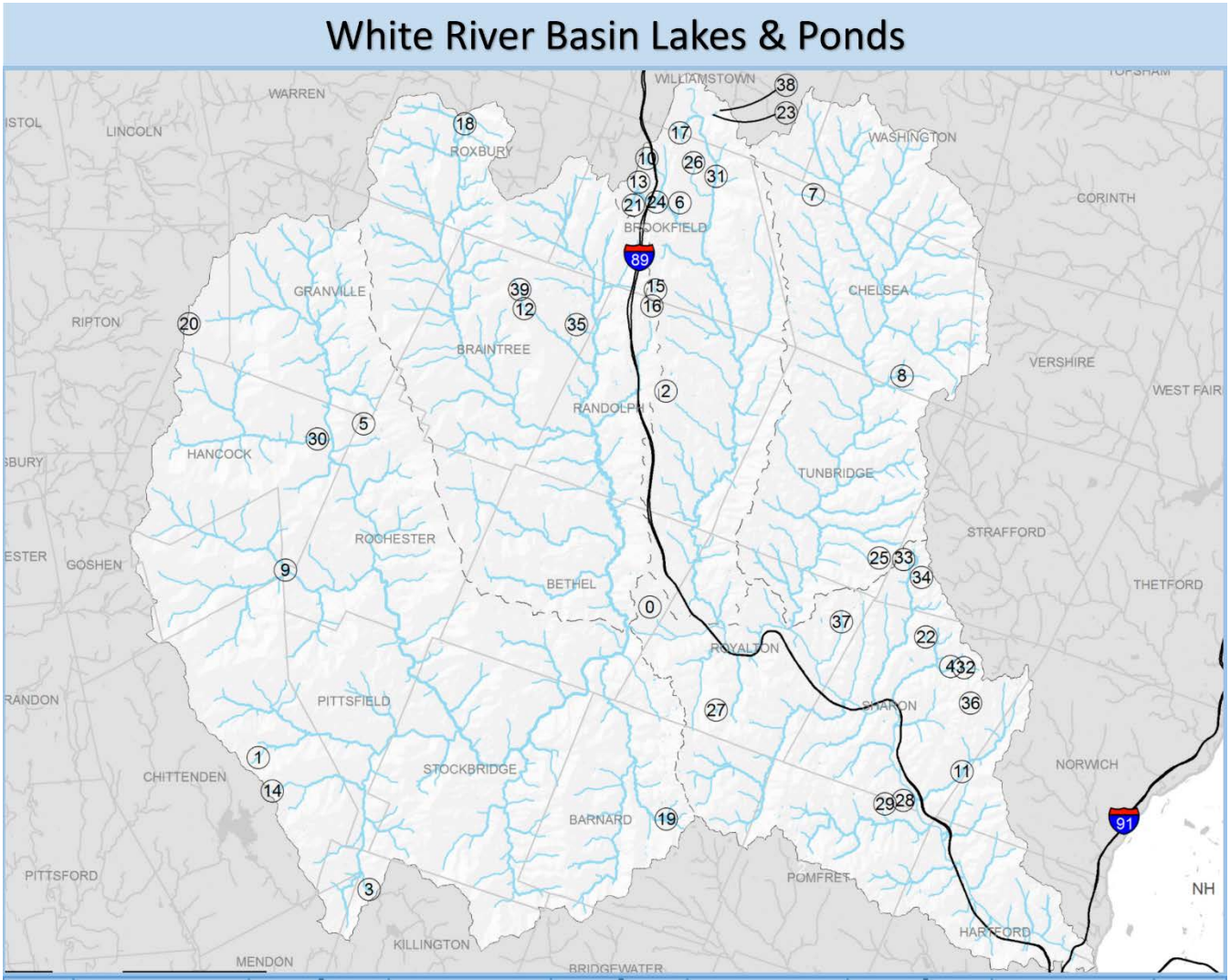
Table C1. Macroinvertebrate community assessment*

Location Name	River Mile	Stream Type	Date	Macroinvertebrate Community Assessment	Fish Community Assessment
Bartlett Brook	0.5	SHG	9/7/2016	Very Good-Excellent	Good
Bingo Brook	1.8	SHG	9/17/2013	Very Good-Excellent	
Bingo Brook	1.8	SHG	9/4/2014	Very Good	
Bingo Brook	1.8	SHG	9/2/2015	Very Good	Very Good
Bingo Brook	1.8	SHG	9/8/2016	Very Good-Excellent	Good
Bingo Brook	1.8	SHG	8/31/2017	Very good-Good	
Breakneck Brook	0.2	SHG	9/4/2014	Very Good-Excellent	Very Good
Breakneck Brook	0.2	SHG	9/3/2015	Very Good	Very Good
Breakneck Brook	0.2	SHG	9/7/2016	Good	Very Good
Button Brook	0.3	SHG	9/2/2014	Good	
Chittenden Brook	2.4	SHG	9/4/2014	Very Good-Excellent	
Chittenden Brook	2.4	SHG	9/2/2015	Very Good	
Chittenden Brook	2.4	SHG	9/8/2016	Very Good	
Corporation Brook	1.1	SHG	9/4/2014	Good-Very Good	
Corporation Brook	1.1	SHG	9/2/2015	Very Good	
Corporation Brook	1.1	SHG	8/11/2016		Very Good
Corporation Brook	1.1	SHG	9/8/2016	Good	
Deer Hollow Brook	0.9	SHG	9/2/2015	Very Good	
First Branch White River	17.1	MHG	9/2/2014	Very Good-Excellent	
Foundry Brook	0.8	SHG	9/2/2014	Very Good	
George Brook	0.1	SHG	9/8/2016	Excellent	
Grindstone Brook	0.1	SHG	9/7/2016	Good-Very Good	
Hancock Branch	3.9	SHG	8/31/2017	Good	
Happy Hollow Brook	0.4	SHG	9/5/2014	Good	Excellent
Liberty Hill Brook	0.1	SHG	9/4/2014	Good-Fair	
Liberty Hill Brook	0.1	SHG	9/3/2015	Good	
Liberty Hill Brook	0.1	SHG	10/7/2016	Fair-Poor	
Marsh Brook	1.0	SHG	9/4/2014	Excellent	Very Good
Marsh Brook	1.0	SHG	9/2/2015		Excellent
Marsh Brook	1.0	SHG	9/3/2015	Good	
Marsh Brook	1.0	SHG	9/7/2016	Very Good-Excellent	Very Good
Podunk Brook	0.9	SHG	9/8/2014	Very Good-Excellent	
Robbins Branch	1.4	SHG	8/31/2017	Good	
Second Branch White River	18.5	MHG	9/2/2014	Very Good-Excellent	Very Good

Location Name	River Mile	Stream Type	Date	Macroinvertebrate Community Assessment	Fish Community Assessment
Smith Brook (Randolph)	0.1	SHG	9/2/2014	Poor	Poor
Smith Brook (Rochester)	1.3	SHG	9/17/2013	Very Good-Excellent	
	1.3	SHG	9/4/2014	Very Good	
	1.3	SHG	9/3/2015	Very Good	
	1.3	SHG	9/8/2016	Excellent	
	1.3	SHG	8/31/2017		Excellent
Stoddard Brook	0.5	SHG	9/5/2014	Excellent	
Third Branch White River	8.5	MHG	9/2/2014	Good	
Third Branch White River	9.5	MHG	9/2/2014	Good	
	9.5	MHG	8/31/2015	Fair	
Third Branch White River	9.7	MHG	9/2/2014	Good	
	9.7	MHG	8/31/2015	Good	
White River	15.4	WWMG	9/2/2014	Very Good	
White River	21.8	WWMG	9/2/2014	Very Good	
White River	32.4	MHG	9/17/2013	Excellent	
	32.4	MHG	9/5/2014	Very Good	
	32.4	MHG	9/3/2015	Very Good	
	32.4	MHG	9/2/2016	Very Good	
White River	43.7	MHG	9/4/2014	Very Good	
Wing Brook	0.2	SHG	10/2/2014	Excellent	
	0.2	SHG	9/17/2014		Very Good
	0.2	SHG	9/2/2015	Good	
	0.2	SHG	9/8/2016	Very Good-Excellent	

*Empty white boxes indicate no sampling event.

Appendix D. Lakes in the White River Watershed



Map ID	Lake or Pond Name	Acres	Map ID	Lake or Pond Name	Acres	Map ID	Lake or Pond Name	Acres	Map ID	Lake or Pond Name	Acres
0	Ansel Pond	3	10	Lamson Pond	27	20	Skylight Pond	2	30	Blair	4
1	Beaver Meadows	5	11	Lake Mitchell	28	21	South Pond	17	31	No name	7
2	Lake Champagne	3	12	Mud Pond	5	22	Standing Pond	12	32	Downer	3
3	Colton Pond	26	13	North Pond	28	23	Staples Pond	12	33	Fay	6
4	Crescent Lake	18	14	North Pond	5	24	Sunset Lake	25	34	Strafford	2
5	Hancock Moun-tain	7	15	Pickles Pond	15	25	Tunbridge Trout Pond	7	35	Hutchinson	2
6	Holdens Pond	7	16	Randolph	8	26	Twin Ponds	15	36	Sharon	9
7	Jones Pond	1	17	Rood Pond	24	27	Royalton	9	37	McIntosh Pond	21
8	Keyser	6	18	Roxbury Flat	3	28	Babcock	5	38	Ainsworth	4
9	Kings Pond	5	19	Silver Lake	81	29	Pomfret	4	39	No name	5

Figure D1. Lakes and ponds in Basin 9 from the VT Lakes Inventory.

Appendix E. Dams in the White River Watershed

Table E1. Active dams in the White River basin organized by town name. These dams are either in service, partially breached, or drained.

# on Map (Figure 8)	Dam Name	Town	Stream	Owner	Owner Type	Resource Type	Drainage Area (mi^2)	Dam Status	Dam Type	Dam Length (ft)	Dam Height (ft)	Year Built	Current Purpose	Original Purpose	Regulatory Agency	Federal Regulation	Dam Hazard Class
50	Silver Lake	Barnard	Pond Brook	State of Vermont - VDEC	State	Natural with Artificial Control	1.7	In Service	Earth, Gravity	100	30	1968	Recreation	Recreation	DEC	None	High Hazard Potential
48	Barnard-2	Barnard	Pond Brook - OS			Artificial	0	In Service	Earth	180	10		Recreation		None	None	Low Hazard Potential
33	Bethel Mills	Bethel	Third Branch White River	Bethel Mills Inc	Private	Artificial	137.97	In Service	Concrete, Gravity	150	17	1941	Hydroelectric	Hydroelectric	PSB	FERC	Low Hazard Potential
26	Hyde Mill	Bethel	Second Branch White River	Samuel Lincoln	Private	Artificial	64.84	In Service	Concrete, Gravity	45	14			Mill Power	DEC	None	Low Hazard Potential
27	Kellogg	Bethel	Third Branch White River-TR	T.H. Kellogg	Private		0.19	Drained	Earth	0	20				None	None	Low Hazard Potential
31	Ansel Pond	Bethel	White River-TR	State of Vermont - DFW	State		0.18	In Service	Earth	470	14	1969		Recreation	DEC	None	Low Hazard Potential
11	Rose	Braintree	Flint Brook	Gilbert Rose	Private		0.51	In Service	Earth	225	23	1985	Recreation		None	None	Low Hazard Potential
12	Braintree-5	Braintree	Ayers Brook-TR				0.06	In Service		0	0				None	None	Low Hazard Potential
13	Bass	Braintree	Spear Brook					In Service		0	0				None	None	
18	Wain	Braintree	Riford Brook-TR					In Service		0	0				None	None	Low Hazard Potential
20	Delaney	Braintree	Riford Brook-TR					In Service		0	0				None	None	Low Hazard Potential
4	Sunset Lake	Brookfield	Sunset Brook	Jane Doerfer	Private	Natural with Artificial Control	4.16	In Service	Earth, Stone, Masonry	100	12	1850	Recreation	Mill Power	DEC	None	Significant Hazard Potential
5	Holdens Pond	Brookfield	Sunset Brook-TR	Mike Palmer	Private	Artificial	0.52	In Service	Earth, Stone, Masonry	215	16	1932	Recreation	Hydroelectric	DEC	None	Significant Hazard Potential
7	Brookfield-10	Brookfield	Sunset Brook - TR					In Service	Earth	0	0				None	None	Low Hazard Potential
8	Brookfield-7	Brookfield	Second Branch White River-TR					In Service	Earth	0	0				None	None	Low Hazard Potential
6	Brookfield-12	Brookfield						In Service		0	0				None	None	Low Hazard Potential
16	Keyser	Chelsea	Bicknell Brook	Keyser Limited Partnership	Private		0.84	In Service	Earth	225	44	1963	Recreation	Recreation	DEC	None	High Hazard Potential
10	Lyons Mill	Chelsea	Jail Brook	Unknown	Private			Breached (Partial)	Concrete, Stone	0	8				None	None	Low Hazard Potential
9	Reed Mill	Chelsea	First Branch White River					Breached (Partial)	Stone, Concrete	150	12				None	None	Low Hazard Potential
21	Camp Killooleet	Hancock	Hancock Branch-TR	Seeger Valley, Inc.	Private	Artificial	0.13	In Service	Earth, Timber Crib	165	14	1987	Recreation	Recreation	DEC	None	Significant Hazard Potential
52	Podunk Brook	Hartford	Podunk Brook -TR					In Service	Earth	200	6				None	None	Low Hazard Potential
56	Colton Pond	Killington	South Branch Tweed River	State of Vermont - DFW	State	Artificial	0.77	In Service	Earth, Gravity	140	19	1964	Recreation	Recreation	DEC	None	Significant Hazard Potential
53	Sherburne-2	Killington	South Branch Tweed River-TR					In Service		0	0				None	None	Low Hazard Potential

# on Map (Figure 8)	Dam Name	Town	Stream	Owner	Owner Type	Resource Type	Drainage Area (mi^2)	Dam Status	Dam Type	Dam Length (ft)	Dam Height (ft)	Year Built	Current Purpose	Original Purpose	Regulatory Agency	Federal Regulation	Dam Hazard Class
54	Sherburne-1	Killington	South Branch Tweed River-TR					In Service		0	0				None	None	Low Hazard Potential
51	Johnson	Pomfret	Mill Brook	John Moore	Private	Artificial	1.5	In Service	Earth	160	15	1966	Recreation	Recreation	DEC	None	Low Hazard Potential
46	McCord	Pomfret	Mill Brook-TR	Ron Galotti	Private		0.27	In Service	Earth	340	15	1963	Recreation		DEC	None	Low Hazard Potential
49	Freeman	Pomfret	Mill Brook-TR	Freeman Farm Trust	Private		0.27	In Service	Earth	240	16		Recreation	Wildlife/Recreation	DEC	None	Low Hazard Potential
55	Bunker Hill	Pomfret						In Service	Stone, Earth	50	10				None	None	Low Hazard Potential
17	Lake Champagne	Randolph	Penny Brook	Clark Campbell		Artificial	0.33	In Service		560	15	1964		Recreation	DEC	None	Low Hazard Potential
19	Gulf Road	Randolph	Second Branch White River					In Service	Concrete, Gravity	55	8				None	None	Low Hazard Potential
15	Harvey	Randolph	Adams Brook-TR					In Service		252	10				None	None	Low Hazard Potential
22	Eller	Rochester	Howe Brook	Food medicine Farm, LLC	Private		0.07	In Service	Earth	500	10		Recreation		None	None	Low Hazard Potential
25	McIntyre	Rochester	White River -TR	Royce McIntyre	Private			In Service	Earth	200	12	1983	Recreation		None	None	Low Hazard Potential
34	Eaton (Upper)	Royalton	First Branch White River	David Roller and Margaret Vincent	Private		104	Breached (Partial)	Concrete, Gravity	100	8			Mill Power	DEC	None	Low Hazard Potential
35	Eaton (Lower)	Royalton	First Branch White River	David Roller and Margaret Vincent	Private		104	Breached (Partial)	Concrete, Gravity	230	15			Mill Power	DEC	None	Low Hazard Potential
36	McIntosh Pond	Royalton	White River-TR	State of Vermont - DFW	State	Artificial	1.09	In Service	Earth	485	25	1964	Recreation	Recreation	DEC	None	Significant Hazard Potential
39	Lake Casper	Royalton	White River-TR	South Royalton Fire Dist. No. 1	Local Government	Artificial	0.28	In Service	Earth	100	17	1880	Water Supply	Water Supply	None	None	Significant Hazard Potential
41	Clark	Royalton	Cleveland Brook-OS	Lincoln Clark	Private		0.2	In Service	Earth	0	0	1982	Recreation		DEC	None	Low Hazard Potential
38	Lake John	Royalton	White River-TR	South Royalton Fire Dist. No. 1	Local Government	Artificial	0.08	In Service	Earth	240	27	1900	Water Supply	Water Supply	DEC	None	Significant Hazard Potential
32	Walsh	Royalton	Whitewater Brook - OS	Fraser Walsh	Private		0	In Service	Earth	20	0	1992	Recreation		None	None	Low Hazard Potential
45	Lake Mitchell	Sharon	Mitchell Brook	Lake Mitchell Trout Club	Private	Artificial	7.27	In Service	Earth, Stone, Concrete	291	20	1890	Recreation		DEC	None	Low Hazard Potential
40	Crescent Lake	Sharon	Quation Brook-TR	Shawn & Emily O'Leary	Private	Natural with Artificial Control	1.44	In Service	Gravity, Earth	100	16	1920	Recreation	Mill Power	DEC	None	Significant Hazard Potential
43	Johnson Real Estate	Sharon	Mitchell Brook-TR	Richard W. and Lydia Johnson	Private	Artificial	0.45	In Service	Earth	222	28	1967	Recreation	Recreation	DEC	None	Significant Hazard Potential
37	Standing Pond	Sharon	Fay Brook-TR	High Lake Club Inc.	Private		0.19	In Service		50	5	1930	Recreation		DEC	None	Low Hazard Potential
47	Sharon-12	Sharon						In Service	Earth	500	5				None	None	Low Hazard Potential
42	Baribeau	Sharon	Quation Brook-TR	Byron Baribeau	Private			In Service		195	8				DEC	None	Low Hazard Potential
44	Stockbridge - 1	Stockbridge	White River-TR					In Service	Earth	0	0				None	None	Low Hazard Potential
30	Day-Bruorton	Strafford	Fay Brook-TR	Susan Lee & Tim Bergeron	Private	Artificial	0.32	Drained	Earth	155	14	1929	Recreation	Recreation	DEC	None	Significant Hazard Potential
29	Kratky	Strafford	Fay Brook	Ken Alton	Private	Artificial	0.31	In Service	Earth	363	25	1966	Recreation	Recreation	DEC	None	Significant Hazard Potential

# on Map (Figure 8)	Dam Name	Town	Stream	Owner	Owner Type	Resource Type	Drainage Area (mi^2)	Dam Status	Dam Type	Dam Length (ft)	Dam Height (ft)	Year Built	Current Purpose	Original Purpose	Regulatory Agency	Federal Regulation	Dam Hazard Class
24	Haywood and Noble	Tunbridge	First Branch White River	Tunbridge Mill Corp	Private	Artificial	78	In Service	Concrete, Gravity	95	18				None	None	Low Hazard Potential
28	Tunbridge Trout Pond	Tunbridge	First Branch White River-TR	Tunbridge Trout Club	Private	Artificial	0.35	In Service	Earth	120	20	1925	Recreation		DEC	None	Low Hazard Potential
14	Lafogg	Tunbridge	Dickerman Brook				0.15	In Service	Earth	75	10				None	None	Low Hazard Potential
23	Farnham Bros.	Tunbridge	First Branch White River					Breached (Partial)	Concrete, Gravity	75	10				None	None	Low Hazard Potential
3	Washington-5	Washington	First Branch White River-TR					In Service		0	0				None	None	Low Hazard Potential
2	Rood Pond	Williamstown	Second Branch White River-TR	State of Vermont - DFW	State	Natural with Artificial Control	0.54	In Service	Earth	270	13		Recreation		DEC	None	Low Hazard Potential
1	Goyette	Williamstown	Second Branch White River	Michael Lamberton	Private		0.43	In Service	Concrete, Gravity, Earth	160	9		Recreation		DEC	None	Low Hazard Potential

Table E2. Historical dams in the White River basin organized by town name. These dams are either breached, removed or deleted.

# on Map (Figure 8)	Dam Name	Town	Stream	Dam Status
29	Barnard-1	Barnard	Pond Brook	Breached
3	North Pond (Upper)	Brookfield	Sunset Brook-TR	Breached
4	North Pond (Lower)	Brookfield	Sunset Brook-TR	Breached
5	Chase	Brookfield	Sunset Brook-TR	Breached
7	Tannery Dam	Brookfield	NA	Breached
8	Buxtonssaes Mill	Brookfield	Sunset Brook	Breached
9	Sunset Brook	Brookfield	Sunset Brook	Breached
6	Jones Pond	Chelsea	First Branch White River-TR	Breached
12	Chelsea-8	Chelsea	Meadow Brook-TR	Breached
13	Whitney	Chelsea	First Branch White River	Breached
16	Camp Killooleet Diversion	Hancock	Hancock Branch	Breached
31	Hartford Woolen Co.	Hartford	White River	Breached
30	Sherburne-12	Killington	W Branch Tweed River	Breached
17	Playground	Randolph	Third Branch White River	Breached
21	Bethel	Royalton	White River	Breached
23	Day Farm Pond Lower	Sharon	Quation Brook-TR	Breached
24	Day Farm Pond Middle	Sharon	Quation Brook-TR	Breached
25	Day Farm Pond Upper	Sharon	Quation Brook-TR	Breached
26	Sharon Power Co.	Sharon	White River	Breached
27	Stockbridge - 2	Stockbridge	White River -TR	Breached
14	Grants Mill	Tunbridge	First Branch White River	Breached

# on Map (Figure 8)	Dam Name	Town	Stream	Dam Status
1	Staples Pond	Williamstown	Second Branch White River	Breached
28	North Pond	Chittenden	Townshend Brook	Deleted
18	Kings Pond	Rochester	West Branch-TR	Deleted
2	Matson	Williamstown	NA	Deleted
10	Bobbin Mill	Chelsea	First Branch White River	Removed
11	Chelsea Mill	Chelsea	First Branch White River	Removed
15	Sargent, Osgood and Roundy	Randolph	Third Branch White River	Removed
20	Royalton-5	Royalton	Second Branch White River	Removed
22	Wright	Sharon	Fay Brook	Removed
19	South Tunbridge	Tunbridge	First Branch White River	Removed

Appendix F. Municipal Water Quality Protectiveness Table

Table F1. Municipal Water Quality Protectiveness Table for the White River Basin.

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Barnard	Unified Zoning and Subdivision: Flood Hazard Overlay District	Encroachments and development prohibited	New development, new fill, and storage prohibited. Non-substantial improvements allowed.	2012	Yes	Yes	Interim	35 feet vegetated buffer for rivers or perennial streams	Yes	Yes	4/26/2022	Yes	17.5	The Zoning Bylaw prohibits digging or creating pits on steep slopes, it says that "disturbance of steep slopes greater than 25% shall be minimized," and it requires subdivisions on slopes greater than 25% to require a licensed professional engineer to certify that they do not pose a landslide or erosion risk.	Subdivisions standards state that stormwater shall be handled by an erosion control plan prepared by a licensed professional engineer for control of erosion, sediment, and runoff during and following development. Conditional use development standards require stormwater and erosion control and state that drainage must control stormwater runoff, prevent erosion, and protect neighboring land and roads from undue impacts. No increase is allowed in off-site stormwater runoff in terms of volume or peak discharge.
Bethel	Zoning Ordinance and Land Subdivision Regulations	Development prohibited except for minor improvement to existing structures relating to bridges, culverts, roads, stabilization projects, public utilities, or health and safety measures	Conditional Use Approval by the Development Review Board for development requires all development have its lowest floor elevated 1 foot above base flood elevation. Residential development shall be reasonably safe from flooding; designed and anchored to prevent floatation, collapse, or lateral movement; constructed with materials that are resistant to flood damage; constructed by methods that minimize flood damage; and constructed so service facilities are designed to prevent water from entering and accumulating during flooding. Accessory structures do not need to be elevated above BFE.	2008	Yes	Yes	In Progress	In Resource Conservation Zoning District: No structure shall be placed 50 feet from the top of the bank of any river or perennial stream bank.	Yes	Yes	6/24/2021	Yes	12.5	Bethel Zoning Ordinance includes a Steep Slopes District that states, no building or structure shall be permitted on slopes greater than 25% gradient unless Development Review Board determines it will not result in unreasonable soil erosion, or reduction in the capacity of the land to hold water so that a dangerous or unhealthy condition may result.	Zoning permits contain site reclamation standards that require stormwater runoff, erosion, and sedimentation control to prevent erosion, debris, and other loose material from filling drainage courses, streets, and private property.

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Braintree	Unified Bylaw: Zoning and Subdivision	New developments and encroachments are prohibited in floodway. Improvement to existing structures in floodway require a conditional use permit.	Unified Bylaw contains Floodplain Overlay District: New structures are prohibited in the SPHA. All development shall be reasonably safe from flooding; shall be deigned, operated, maintained, modified, or anchored to prevent flotation, collapse, release or lateral movement; shall be constructed with materials resistant to flood damage; shall be constructed with methods that minimize flood damage; shall be adequately drained to reduce exposure to flood hazards; and shall be located so to minimize conflict with changes in channel location over time. In SPHA zones where BFE has not been determined, development shall not be permitted unless it has been determined that the effect of the proposed development will not increase BFE more than 1 foot. Substantial improvements must have the lowest floor designed so that two feet above BFE the structure is watertight and impermeable to water passage. Small accessory structures of 500 square foot or less need not be elevated.	2010	Yes	Yes	Interim	50 feet streambank buffer requirement for rivers and streams that appear on USGS topographical maps. No structures within 50 feet No ground disturbance within 35 feet	Yes	Yes	6/13/2019	Yes	17.5	Zoning bylaw determines steep slopes, or areas that have a 15% or higher gradient, are determined to be areas of public values. Areas of steep slopes shall not ordinarily be subdivided.	Major subdivisions must have a stormwater drainage plan which shall indicate methods of collecting and discharging of drainage, as well as methods for temporary and permanent erosion control. A general conditional use standard under Braintree's Zoning Bylaw includes a standard for stormwater and erosion control, stating that appropriate drainage must control stormwater runoff, prevent erosion and protect neighboring land, water, and roads from undue impacts.
Brookfield	Flood Hazard Area Bylaws	New developments are prohibited.	All development shall be designed and anchored to prevent flotation, collapse, and lateral movement during base flood; shall be constructed with materials resistant to flood damage; shall be constructed by methods that minimize flood damage; and shall be constructed so service facilities are located to prevent water from entering. New construction and substantial improvements of residential and commercial structures shall have their lowest floor elevated to or above base flood elevation	2007	Yes	yes	No	75-foot building or structure setback for rivers, streams, ponds, class 1 wetlands, and class 2 wetlands.	Yes	Yes	6/24/2021	Yes	12.5	Brookfield's Conservation District includes lands with slopes of 25% or greater. The town considers slopes that are 25% gradient or greater "steep".	Policy 7 of the Brookfield Town Plan's Water Resources section aims to "Maintain appropriately scaled and designed structures that can handle flood events, stormwater runoff, promote fish passage, and minimize erosion."

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Chelsea	Flood Hazard Area Bylaw	New development, construction, fill, or substantial improvement is prohibited.	Structures shall be designed to minimize flood damage; shall be designed to provide adequate drainage to reduce exposure to flood hazards; shall be designed and anchored to resist flotation, collapse, or lateral movement; shall be constructed with materials resistant to flood damage; shall be constructed by methods that minimize flood damage; and shall be constructed so service facilities are designed/located to prevent water from entering or accumulating. The lowest floor of all new building or substantial improvements shall be elevated at or above base flood elevation.	2009	Yes	Yes	No	35-foot setback for buildings or structures from upper edge of streambank.	Yes	Yes	11/20/2020	Yes	12.5	No language in flood hazard area bylaws, zoning ordinance, or town plan.	No language in flood hazard area bylaws, zoning ordinance, or town plan.
Chittenden	Flood Hazard Regulations; no zoning	Development or other encroachments prohibited unless proposed development will result in no increase in flood levels during the occurrence of the base flood. Junkyards, on-site wastewater disposal systems, and storage facilities for floatable materials, chemicals, explosives, flammable liquids, or other hazardous or toxic materials, are prohibited.	All development shall be reasonably safe from flooding; New construction and existing buildings to be substantially improved that are located in Zones A, A1-30, AE and AH shall have the lowest floor, including basement, elevated to or above the base flood elevation; New construction located in Zones A, A1-30, AE and AH shall have the lowest floor, including basement, elevated to or above the base flood elevation; New subdivision proposals and other proposed development (including proposals for manufactured home parks and subdivisions) that are greater than 50 lots or 5 acres shall include base flood elevation data; Enclosed areas below the lowest floor which are subject to flooding shall be used solely for parking of vehicles, building access, or storage.	2012	Yes		No	No	Yes	Yes	1/22/2021	Yes	12.5	No	No

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Granville	Flood Hazard Area Regulations	Encroachments or development above grade and below the elevation of the floodway are prohibited, unless hydrologic and hydraulic analysis determine that proposed development will not result in increased flood levels and will not increase any risk to surrounding properties from erosion or flooding.	New residential or non-residential structures and new fill are prohibited from the special flood hazard area. Conditional use review for proposed development with SFHA can be issued for substantial improvements, elevation, relocation, or flood proofing of existing structures in the special flood hazard area or floodway. Substantial improvements to existing structures must be elevated 2 feet above base flood elevation.	2009	Yes	Yes	Interim	Town Plan Policy: Preservation of natural state of streams should be encouraged by maintenance of existing streambank and buffer vegetation including trees, together with wildlife habitat.	Yes	Yes	7/22/2019	Yes	17.5	No language in flood hazard area bylaws or town plan.	No language in flood hazard area bylaws or town plan.
Hancock	Inundation Hazard Area Regulations	New residential or non-residential structures are prohibited.	New residential or non-residential structures are prohibited.	2009	Yes	No: 2017	No	Town Plan advocates the maintenance of riparian buffers.	Yes	Yes	8/4/2020	Yes	12.5	No language in inundation hazard area bylaws or town plan.	No language in inundation hazard area bylaws or town plan.

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Hartford	Flood Hazard Area Regulations	Development prohibited.	New development and substantial improvements must elevate lowest floor 1 ft above BFE. All development shall be reasonably safe from flooding: designed and anchored to prevent flotation, collapse, and movement of the structure; constructed with materials resistant to flood damage; construction methods that minimize flood damage; and service facilities located in areas to prevent water from entering.	2007	Yes	Yes	No	100 Feet: Connecticut, Ottauquechee, and White 30 feet from streams and surface water on Hartford NR Resources Map. Buffer includes area between river and top of bank	Yes	Yes	7/23/2019	Yes	12.5	Hartford's Zoning Ordinance contains the Rural Lands, Agricultural Lands, and Wildlife Connector Overlay District which state that development should be located down-slope of ridgelines and prominent hills in areas where ridgelines and hillsides are easily visible from existing roadways, and development shall be considered relative to the availability of less visible locations on-site.	Hartford's Zoning Regulations require a conditional use permit which will be issued given that a proposed project disturbs the least possible riparian vegetation, erosion and sediment control methods are followed, and development manages and treats stormwater runoff to filter pollutants. Specific applications for development must include a description of the practices that will be used to protect water quality of stormwater runoff and an erosion control plan. Hartford's subdivision regulations require: a project provide an adequate stormwater drainage system with culverts and drainage areas that accommodate runoff from the development's upstream drainage area or a 25 year storm event (a 4% chance of occurring annually); a project expose the smallest possible area possible at any one time during development; land should not be left exposed during winter months; temporary vegetation or mulching and structural measures may be required to protect exposed areas; sediment basins shall be installed and maintained to remove sediment from entering runoff; 4 inches of topsoil shall be provided to cover all finished slopes; and embankments are to be planted with stabilizing ground cover and seeded with grass to prevent erosion.

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Norwich	Zoning Regulations: Flood Hazard Overlay District and Shoreland Protection Overlay District	Conditional Use: minor development of 500 square feet or less.	New principal residential or nonresidential structures are prohibited. Conditional uses can be issued for small accessory structures less than 600 square feet, substantial improvements to existing structures, and fill or excavation. The lowest floor of building to be substantially improved must be 1 foot above base flood elevation. The Shoreline Protection Overlay requires 100-foot riparian buffers for the Connecticut River, Ompompanoosuc River, and Blood Brook, 50-foot buffers for streams and lakes outlined in the SPO, and 25-foot buffers for all other streams.	2008	Yes	No: 2017	No	Connecticut and Ompompanoosuc: 100 Feet Blood brook from Connecticut River to New Boston Road: 100 Feet. Streams and lakes on the Shoreline Protection Overlay District Map: 50 feet Streams not shown on Shoreline Protection Overlay District: 25 Feet	Yes	Yes	8/4/2020	Yes	12.5	General Standards of Norwich's Zoning Regulations include a provision for Protection of Natural Resources, which includes steep slopes. The Zoning Regulations also include a Ridgeline Protection Overlay which requires forest cover around structures within this district and may require additional planting and forest management plan to ensure ridges and hilltops remain wooded.	Excavation and filling in areas of slopes greater than 15% require an erosion and control plan for disturbed areas. General Standards of Norwich's Zoning Regulations include a provision for stormwater management: Development shall be sited and designed to minimize stormwater runoff and prevent erosion during all phases of development. Land development shall incorporate Low Impact Development (LID) stormwater management and erosion control practices where feasible. The Development Review Board may require the preparation and implementation of a stormwater management plan as appropriate for the setting, scale, and intensity of the proposed development. Site Plan approval granted if development will conserve and protect natural hydrologic assets and function of a site; create opportunities to retain runoff on site; minimize impacts of development at all stages; and use a decentralized stormwater management system of small-scale controls that are located near the sources of runoff generation.
Pittsfield	Flood Hazard Area Regulations	Development or any encroachments except for minor improvements to existing structures is prohibited.	New principal residential structures are prohibited. Substantial improvements to residential structures must be elevated 1 foot above base flood elevation. New non-residential development and substantial improvements to buildings of this nature must be elevated 1 foot above BFE. Pittsfield's Flood Hazard Bylaw also establishes a 25-foot riparian buffer from the top of bank of all perennial streams.	2014	Yes	Yes	Interim	25-foot riparian buffer from the top of banks for all perennial streams as identified by the Vermont Hydrography Dataset.	Yes	Yes	8/21/2020	Yes	12.5	One of the Purposes and Objectives of the Pittsfield Town Plan is "to protect steep slopes, soils, forests, water quality, water courses, and other natural resources, and to provide open space for wildlife habitat".	A recommendation in the Pittsfield Town Plan states that the Town will work with the regional planning commission to understand the impact stormwater runoff has on the Town and then work to address impacts from impervious surfaces through increased retention and infiltration.

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Pomfret	Flood Hazard Area Regulations	Development prohibited, and only minor improvements allowed.	New development and substantial improvements must elevate lowest floor 1 ft above BFE. All development shall be reasonably safe from flooding: designed and anchored to prevent flotation, collapse and movement of the structure; constructed with materials resistant to flood damage; construction methods that minimize flood damage; and service facilities located in areas to prevent water from entering.	2007	Yes	No: 2017	No	No	Yes	Yes	4/26/2022	Yes	12.5	Pomfret's Zoning Ordinance consists of a Ridgeline and Hillside Conservation Area, which includes all land within 750 feet from primary ridges. The Ordinance identifies the importance of ridges and hillsides to the scenic quality of Pomfret, the rural and pastoral character and personality of the Town, and to the current and future well-being of Pomfret's residents. It states that the preservation and conservation of Pomfret's ridges and hillsides are essential to maintaining Pomfret's rural and pastoral character, and that the protection of this natural beauty in Pomfret's landscape is a matter of public use. Development and use of these areas should be in a manner which will not detract from nor adversely affect the scenic qualities of the Town, and development should take place in a manner compatible with important natural environmental assets of the Town.	No
Randolph	Randolph Land Use Regulations: Flood Protection Overlay District	Encroachments, development, or ground disturbance are prohibited.	In Zones A, AE, AH, and A1-30 where BFE limits have not been determined, development shall not be permitted unless it is demonstrated that the cumulative effect of the proposed development, when combined with existing encroachment, does not increase BFE more than 1 foot anywhere in the community. All development shall be designed to prevent flotation, collapse, or lateral movement, constructed by methods and practices that minimize flood damage, be constructed with materials that are resistant to flood damage, and shall maintain the same flood carrying capacity in the watercourse. Structures in the SFHA to be constructed, placed, or substantially improved shall be located such that the lowest floor is one foot above BFE. Non-residential structures to be substantially improved shall have the lowest floor two feet above BFE.	2016	Yes	No: 2017	No	75-foot buffer from top of streambank of Second and Third Branches of the White River and Ayers Brook (part of the Water Conservation Overlay).	Yes	Yes	8/25/2020	Yes	12.5	Randolph's Interchange District has a provision limiting maximum slope: No slope shall be created that is over a 50% grade unless if required for stormwater management or landscaping features, and no development shall take place on any natural slope over 30%. The Interchange District includes two provisions to Topography and Grading: The visual and environmental impacts of development on hillsides shall be minimized by limiting the extent of site clearing and disturbance, and by retaining existing vegetation when possible or re-vegetating cleared areas. Changes to the natural topography shall be minimal and cut and fill shall be limited to the minimum area necessary. Where construction on steep slopes is necessary to ensure compliance with other standards of these regulations, grading for access roads shall allow existing contours.	Landscaping shall be installed within and contiguous to parking areas to avoid large expanses of parking, [and] to facilitate stormwater management.

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Rochester	Rochester Zoning Regulations: Flood Hazard Overlay District	Encroachments or development above grade and below the elevation of the floodway are prohibited, unless hydrologic and hydraulic analysis determine that proposed development will not result in increased flood levels and will not increase any risk to surrounding properties.	All development shall be designed and anchored to prevent flotation, collapse, and lateral movement during base flood; shall be constructed with materials resistant to flood damage; and shall be constructed by methods that minimize flood damage. New residential and non-residential development shall have lowest floor elevated 1 foot above BFE. Enclosed areas below BFE shall be used only for parking vehicles, building access, or storage.	2009	Yes	No: 2017	No	Town Plan Policy: no structures shall be allowed within 50 feet of the top of the bank of designated permanent streams, except those that by their nature must be located near streams. No ground disturbance or removal of vegetation is allowed within 35 feet, excepting that incidental to bridge or culvert construction, or permitted bank stabilization.	Yes	Yes	6/16/2019	Yes	12.5	Zoning design requirement: Towers, antennas, and any necessary support structures shall be designed to avoid having an undue adverse aesthetic impact on prominent ridgelines and hilltops. The Town Plan states that the conservation-residential zoning district is characterized by steep slopes, shallow and fragile soils, high elevations and remote locations.	No
Roxbury	No zoning; Stand-alone Flood Hazard Area Ordinance	No new structures, allows for parking, grading and road related improvements	No new structures, allows for new small accessory structures, parking, grading and road related improvements	2010	Yes	Yes	Interim	No	Yes	Yes	4/9/2012 (Update done, FEMA reviewing)	Yes	17.5	No	No
Royalton	Royalton Flood Hazard Area Regulations	Proposed development will result in no increase in flood levels during the occurrence of base flood.	All development shall be designed and anchored to prevent flotation, collapse, and lateral movement during base flood; shall be constructed with materials resistant to flood damage; and shall be constructed by methods that minimize flood damage. New residential and non-residential development shall have lowest floor elevated 1 foot above BFE. Enclosed areas below BFE shall be used only for parking vehicles, building access, or storage.	2007	Yes	Yes	No	Town Plan Policy: Vegetated buffer strips should be maintained in riparian zones surrounding streams and rivers. Rock rip-rap and retaining walls should only be used to the extent necessary and when bioengineering techniques may not be adequate to prevent significant loss of land or property. Town Plan Policy: new development must preserve vegetated riparian buffer zones that are consistent with state riparian buffer guidelines.	Yes	Yes	8/4/2020	Yes	12.5	Town Plan Language: Steep slopes on the Southwestern side of the Village, coupled with the White River and the Flood Hazard Area to the northeast limit areas for expanded growth.	No

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Sharon	Flood Hazard Area Bylaw	Encroachments or development are prohibited.	New residential or non-residential structures are prohibited from the Special Flood Hazard Area, Fluvial Erosion Hazard Zone, and stream buffer.	2010	Yes	Yes	Interim	Zoning prohibits new structure in the stream buffer area, which includes lands within 50 feet of Broad Brook, Mitchell Brook, High Pole Branch, and Honey Brook; as well as 25 feet of all other perennial streams. The Town Plan includes a recommendation that states: the town should adopt a Riparian Buffer bylaw.	Yes	Yes	8/4/2021	Yes	17.5	The Sharon Town Plan states that locating buildings at the top of ridgelines or at the brows of hills where land is open, and sites would be highly visible from nearby public roads is prohibited. The Town Plan considers ridgelines a scenic resource. It is the policy of Sharon to restrict land development on ridgelines and that any structures or buildings shall be located away from ridgelines, and shall be built lower on the hillsides, hidden within wooded areas when possible. Sharon's Ridgeline Protection goals: Restrict ridgeline development which would threaten or harm ridgeline ecology and the critical biodiversity which it supports; restrict ridgeline development which would have an adverse impact on the scenic character of Sharon; and promote sensitive development which would not diminish the scenic or ecological value of ridgelines. Sharon's Ridgeline Protection policies: not to allow the removal or thinking of existing forest cover on ridgelines unless it is done as part of a regularly scheduled forestry maintenance; direct development away from the fragile environments of ridgelines; and to evaluate critically any proposed ridgeline development. Another policy states: It is the policy of the Town to manage human access points on the White River and its tributaries to prevent soil erosion, loss of vegetative cover, and unnecessary disruption of riparian habitats. Foot access paths shall not be excessively wide or steep (greater than 15% slope).	It is the policy of the town to limit encroachments on the riparian corridor by limiting and by careful siting and setback of roads, paved paths, parking lots, buildings and structures where streamside vegetation exists or has reasonable potential for restoration and maintenance. The following principles shall be observed for any new development adjacent to riparian buffers: provide for sufficient on-site pervious surface cover so that runoff onto adjacent buffers is minimized; limit loss size and density levels of development so that riparian buffer is not adversely impacted; cluster development in such a manner as to concentrate any new construction away from the riparian buffer and on land with less conservation value; provide for open space and non-commercial recreational use; and prohibit uses with a high potential for pollution in buffers including gas stations, bulk fuel storage facilities, hazardous materials handling facilities, and other commercial development.

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Stockbridge	Stockbridge Zoning Bylaws: Special Flood Hazard Area Zoning District	Development and encroachments are prohibited.	All development shall be designed and anchored to prevent flotation, collapse, and lateral movement during base flood; shall be constructed with materials resistant to flood damage; and shall be constructed by methods that minimize flood damage. New residential and commercial development shall have lowest floor elevated 1 foot above BFE. Enclosed areas below BFE shall be used only for parking vehicles, building access, or storage.	2011	Yes	Yes	No	Zoning Buffer Strip: If any If any commercial or industrial use abuts a residential property or body of water, there shall be maintained a buffer strip of land not less than ten (10) feet in depth along such common boundary excepting points of access. The strip shall be used and maintained only for a fence or natural plantings to include coniferous trees or shrubs. Town Plan Policy: 35-foot buffer from top of bank of permanent streams	Yes	Yes	8/3/2020	Yes	12.5	Town Plan Goal: To protect steep slopes, soils, forests, water, and other natural resources, and to provide open space and wildlife corridors for wildlife habitat. Town Plan Policy: Large scale or large tract land developments or subdivision are not appropriate in areas where steep slopes, wet, or shallow soils are predominant, unless it can be demonstrated that such developments or subdivisions will not be unduly detrimental to the environment. Where this can be adequately proven, density of settlement should be relatively low Zoning provision: Excessively steep slopes: Access roads across a slope a slope exceeding 25% may be permitted provided the road itself does not have a slope in excess of 15% and that adequate erosion control measures are followed. The extraction of gravel, sand, soil, and rock shall be managed to prevent the creation of excessively steep slopes.	No
Strafford	Strafford Flood Hazard Area Zoning Ordinance (should be updated)	Same as SFHA conditions	The lowest floor, including basement, of all new buildings shall be at or above base flood elevation. Existing buildings to be substantially improved for residential purposes shall be modified to be at or above base flood elevations. Existing non-residential buildings to be substantially improved shall either be at or above BFE or be designed to be watertight below BFE.	1993	Yes	No: 2017	No	Town Plan Policy: Preservation of the natural state of streams should be encouraged by maintenance of existing stream bank and buffer vegetation including trees, together with wildlife habitat. Town Plan Recommendation: Planning Commission should develop buffer zones for floodplains.	Yes	In Progress	2/3/2022	Yes	12.5	Town Plan policy: To encourage preservation of open land, farms, forests, wetlands, scenic ridgelines, wildlife habitat, and outdoor recreation. Town Plan recommendation: Planning Commission should consider adding language to the Strafford Bylaw which addresses lighting, viewsheds, and residential construction on ridgelines.	NA

Town	Flood Regulations	Floodway Conditions	Special Flood Hazard Area Conditions	Flood Regulations Last Updated	NFIP	Flood Resiliency Element	River Corridor Protection	Streambank Setback	Road and Bridge Standards	Local Hazard Mitigation Plan	LHMP Expiration Date	LEOP	ERAF Rate (%)	Steep Slope/Ridgeline Development	Stormwater/LID Requirements
Tunbridge	Tunbridge: Flood Hazard Ordinance	Encroachment or development prohibited unless development will not increase flood levels or not increase risk to surrounding properties.	All structures shall be designed to minimize flood damage to development; to provide adequate drainage; shall be designed/anchored to resist flotation, collapse, or lateral movement; constructed with materials and methods that minimize flood damage; and the flood carrying capacity within any altered or relocated portion of a watercourse shall be maintained. The lowest floor of new buildings shall be elevated 1 foot or more above BFE. Fully closed areas below BFE and subject to flooding shall be used solely for parking of vehicles, storage, building access.	2014	Yes	No: 2017	No	Town Plan Policy: Preservation of the natural state of streams should be encouraged by maintenance of existing stream bank and buffer vegetation including trees, together with wildlife habitat. Town Plan Recommendation: Planning Commission should consider creating a policy regarding development and riparian buffer zones in future versions of [the Town] plan. Act 250 Requirement regarding commercial development along Route 110: Maintain trees and existing vegetation adjacent to Route 110. A generously landscaped buffer (using native plants and trees) shall be part of any new construction adjacent to Route 110.	Yes	Yes	3/2/2020	Yes	12.5	Act 250 Lot Layout: Locating buildings at the top of ridgelines or at the brows of hills where land is open, and sites would be highly visible from nearby public roads is prohibited.	Town Plan Policy: Developments, and their associated stormwater discharges, that are adjacent to wetlands should be planned so they do not cause undue disturbance to wetland areas. Maintenance of a naturally vegetated buffer strip between a wetland and the project site is encouraged to prevent groundwater pollution and direct discharges into a wetland.
Washington	Stand-alone Flood Hazard Area regulations (should be updated)	Allows for development with a No Rise certification	Allows for development with NFIP minimum requirements	1998	Yes	No: 2017	No	Section C in in zoning regulations applies to streams, rivers and shores of naturally occurring lakes and ponds. 50 ft setback.	Yes	Yes	9/21/2019	Yes	12.5	No	No
Williamstown	No zoning. Stand alone Flood Hazard Area Bylaws (should be updated)	NA	NA	NA	Yes	Yes	No	Williamstown does not have zoning regulations, except those for the special hazard flood zones	Yes	Yes	6/7/2018	Yes	7.5	No	No

Appendix G. Updates to Forestry AMPs

The VDFPR updated the AMPs for Maintaining Water Quality on Logging Jobs in Vermont effective as of October 22, 2016. Subsequent updates have occurred spring of 2018 (expected approval in May or June 2018) to include standards for permanent crossing on intermittent streams. Key modifications include:

- Required compliance with standards set forth in the VDEC Stream Alteration General Permit for actions including the installation and sizing of permanent stream crossing structures on perennial streams.
- Required compliance with standards set forth in the AMP rules' Table 2a or 2b when installations require replacement or new installations. Culvert may also be sized to accommodate the active channel as observed at the crossing site on intermittent streams.
- Strengthening of standards pertaining to temporary stream crossing practices on logging operations. The standards include:
    - Better management of ditch water on approaches to stream crossings. The proposal is to prohibit drainage ditches along truck roads from terminating directly into streams and to specify a minimum distance for installing turn-outs. Drainage ditches approaching stream crossings must be turned out into the buffer strip a minimum of 25 feet away from the stream channel, as measured from the top of the bank.
    - Better management of surface water runoff from skid trails, truck roads and temporary stream crossings on logging operations. The proposal is to prevent surface runoff from entering the stream at stream crossings from skid trails and truck roads and to specify a minimum distance for installing surface water diversion practices, such as drainage dips. Surface runoff is to be diverted into the buffer strip at a minimum distance of 25 feet from the stream channel, as measured from the top of the bank.
    - Better management of stream crossings after logging. The proposal is to prevent erosion and to specify a minimum distance from the stream for diverting runoff. Upon removal of the temporary stream crossing structures, the site is to contain water bars 25 feet from the stream channel on downhill approaches to the stream crossing to divert runoff into the buffer to capture sediment before entering the stream. Additionally, all exposed soil, at a minimum of 50 feet on each side of the crossing, must be stabilized with seed and mulch according to application rates specified in the AMPs.
- A new AMP to address the management of petroleum products and other hazardous materials on logging operations. Such materials must be stored in leak-proof containers, place outside of buffer strips, and must be removed when logging is completed.
- Enhanced stream buffer guidance in the AMPs and established metrics for minimum residual stand density, stand structure and crown cover.
- Enhanced options and guidance with metrics provided for soil stabilization to establish temporary and permanent ground cover.
- Better clarification provided for selection and spacing of water diversions on skid trails and truck roads both during and immediately after logging.
- Increased seeding/mulching of exposed soil adjacent to streams and other bodies of water from 25 feet to 50 feet