Basin 10

Black & Ottauquechee Watersheds Water Quality & Aquatic Habitat Assessment Report

Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division

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Contents

*General Description of the Basin**

Basin 10 consists of two major watersheds in eastern Vermont - the Ottauquechee River watershed and the Black River watershed. Both rivers flow into the Connecticut River. Most of the Black and Ottauquechee Rivers drainage is located in Windsor County, but the basin also includes lands in Rutland County. Following are brief descriptions of each of these two major rivers and their significant tributaries.

Ottauquechee River watershed

The Ottauquechee River has a mainstem length of 38 miles and drains an area of 223 square miles in east central Vermont. The Ottauquechee River valley is extremely narrow with few large meadows, and the surrounding terrain is rugged and hilly with precipitous slopes. For most of its course, the mainstem is moderately swift with a total fall of 1,485 feet from its source to mouth. Most of its tributaries are flashy mountain streams. Precipitation in the basin averages over forty inches per year, ranging from about forty-five inches in the mountains of Killington to thirty-seven inches at the river mouth in North Hartland.

The Ottauquechee River originates on the eastern slopes of the Green Mountain Range in the town of Killington in Rutland County. From its source, the river flows northeasterly down the mountainside, to the valley floor where its course changes to a near southerly direction. At river mile 32.2, the Ottauquechee flows through the community of South Sherburne and continues its southerly course into the town of Bridgewater. In the community of West Bridgewater, the Ottauquechee is joined by Woodward Brook, which enters from the south.

Reservoir Brook, which is 3 miles long and drains an area of 7 square miles, begins in the town of Plymouth. Immediately below its source, the brook enters Woodward Reservoir, which has a surface area of 106 acres and is one of the largest bodies of water in the Ottauquechee River watershed. From Woodward Reservoir, Reservoir Brook flows rapidly northward into the town of Bridgewater where it enters the Ottauquechee River.

From Reservoir Brook, the Ottauquechee River winds in a generally eastward course to Bridgewater Corners where, at river mile 22.3 it is joined by the North Branch from the north.

The North Branch, which has a length of 8.5 miles, originates on the southern slope of Bull Hill in the town of Bridgewater. It flows southerly to the nearly abandoned hamlet of Chatauguay and then southeasterly and southerly, passing through Bridgewater Center, to its confluence with the Ottauquechee River.

*The description taken largely from the 1976 Black and Ottauquechee River Basins Management Plan.

After being joined by the North Branch, the Ottauquechee continues easterly through Bridgewater Corners. Immediately downstream of that community at river mile 21.8, Broad Brook enters from the south.

Broad Brook has a length of 8 miles and a drainage area of 27 square miles. Broad Brook rises on the southwestern slopes of Long Hill, in the town of Reading, and flows westerly into the town of Plymouth, passing through the hamlet of Five Corners, where its course changes to a generally northerly direction, and then flows into the town of Bridgewater. At a point 1.3 miles from its mouth, Broad Brook is joined by Pinney Hollow Brook from the west.

Pinney Hollow Brook, which is 6 miles long and has a drainage area of 12 square miles, has its source on the northern slopes of Soltudus Mountain in the town of Plymouth. From its source, this brook flows northerly through the community of Plymouth, and then northeasterly and easterly to its confluence with Broad Brook. After being joined by Pinney Hollow Brook, Broad Brook continues northerly to its confluence with the Ottauquechee River.

From Broad Brook, the Ottauquechee River continues its easterly course, passing through the village of Bridgewater and entering the town of Woodstock, where it alters direction to a northeasterly course. It then flows through the village of West Woodstock and enters Woodstock Village, where at river mile 13.5 it is joined by Kedron Brook, which enters from the south.

Kedron Brook is 9 miles long and has a drainage area of 16 square miles. From its source in Reading Gulf in the town of Reading, Kedron Brook flows northeasterly into the town of Woodstock. It winds through the open Kedron Valley and, after passing through South Woodstock, the stream turns northerly for the remainder of its course to the Ottauquechee River.

From its confluence with Kedron Brook, the Ottauquechee continues northeasterly to river mile 12.7, where it is joined by Barnard Brook, which enters from the northwest.

Barnard Brook, which has a length of 8.5 miles and a drainage area of 38 square miles, rises in the hills about one mile east of Silver Lake in the town of Barnard. From its source, this brook tumbles down through hardwood forests or winds through small alder and willow wetlands southeasterly into the town of Pomfret. In a somewhat wider, flatter valley, it passes through the community of South Pomfret and enters the town of Woodstock. At a point 1.3 miles from its mouth, Barnard Brook is joined by Gulf Stream, which enters from the west.

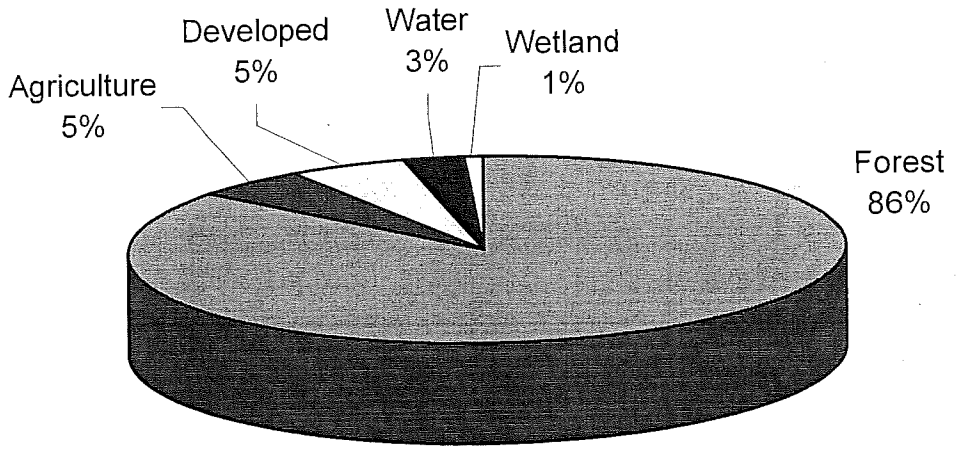
Gulf Stream, which begins in Barnard Gulf in the town of Barnard, is 7.5 miles long and has a drainage area of 18 square miles. From its source, Gulf Stream flows southeasterly through the town of Pomfret into the town of Woodstock, where it enters the community of Prosper. From this community, Gulf Stream flows easterly to its confluence with Barnard Brook. Barnard Brook then continues southerly to its juncture with the Ottauquechee River.

The Ottauquechee River flows easterly from its confluence with Barnard Brook, passing through the community of Taftsville, where the course of the river changes to a northeasterly direction for about 3 miles, skimming the edge of the town of Hartland and entering the town of Hartford. After returning to a southeasterly course, the Ottauquechee River flows through Quechee to the Deweys Mills dam at river mile 5.4.

Passing over this dam, the river flows southeasterly into the North Hartland Flood Control Reservoir, formed by the North Hartland Dam at river mile 1.5. From this dam, the Ottauquechee River flows southeasterly to its confluence with the Connecticut River, at the northern extremities of North Hartland village.

According to a land use/land cover analysis of the Ottauquechee River watershed, 86% or over 124,000 acres of the watershed area is forested -- a high percentage for a single land cover type. Only 5% of the land area (7,139 acres) is in agriculture and another 5% is developed land (7,798 acres), which includes residential, commercial and transportation uses. Surface waters account for only 3% of the watershed (4,100 acres) and wetlands only 1% (1,106 acres).

Figure 1. Land Use/Land Cover in the Ottauquechee River watershed*



* Vermont Land Cover Classification Project, 1997 (based on satellite photographs from 1991-1993).

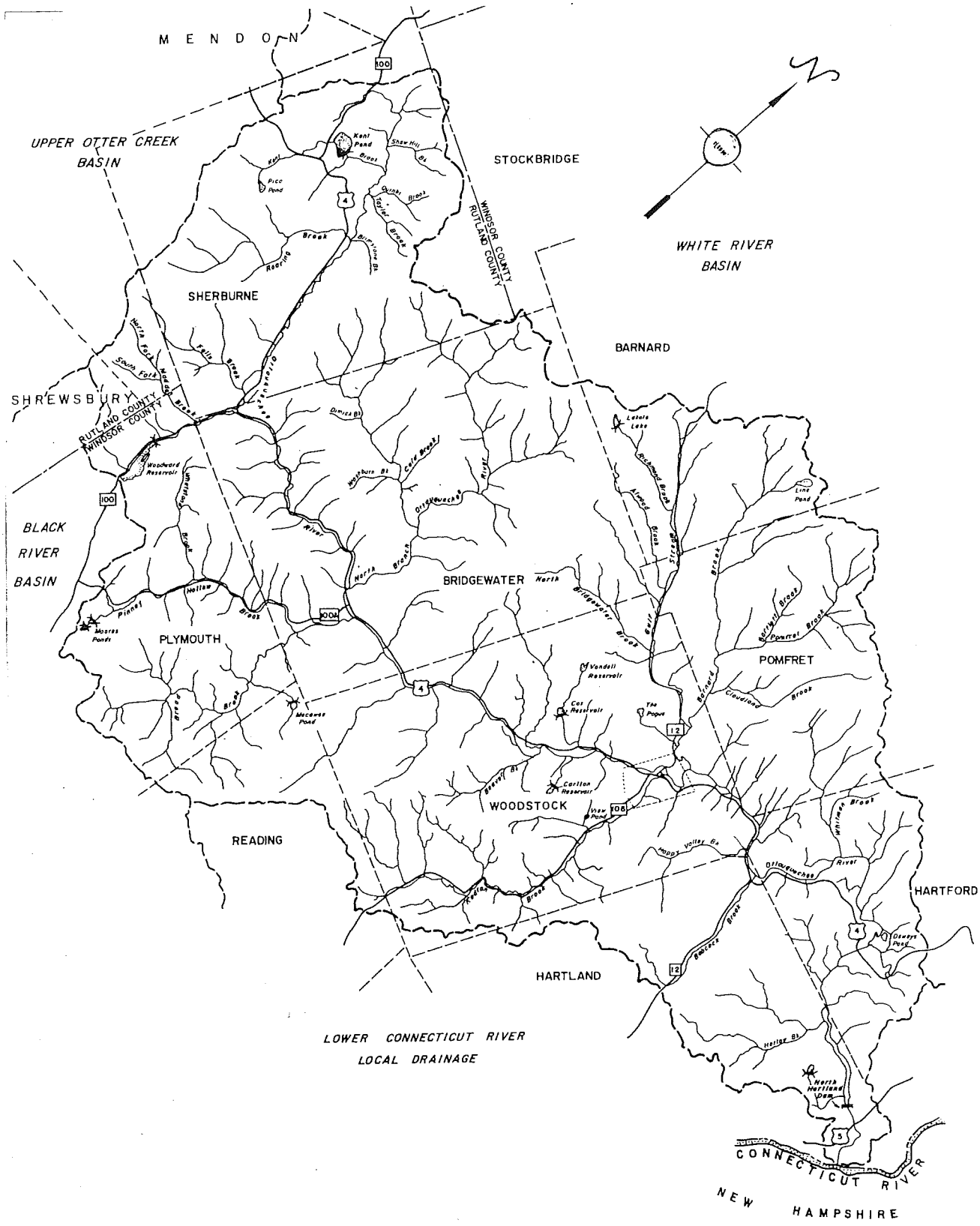


Figure 2. Ottauquechee River Watershed

Black River Watershed

The Black River, which has a mainstem length of 40 miles, is formed at the outlet of Black Pond in the town of Plymouth. With its tributaries, the Black River drains an area of 202 square miles in Rutland and Windsor Counties. The valley of the Black River is generally narrow, as is characteristic of the rivers in eastern Vermont. The surrounding drainage basin is composed of hilly and mountainous terrain.

From its source at the outlet of Black Pond, the Black River flows southeasterly through the town of Plymouth passing into and through Amherst and Echo Lakes to a point 0.1 mile north of the Ludlow town line where it is joined by Patch Brook, which enters from the west. This confluence is 7.1 miles from the source of the Black River at Black Pond.

Patch Brook begins at the outlet of Lake Ninevah in the town of Mt. Holly and is a flashy stream with a length of 3.0 miles and a drainage area of 5.5 square miles. The Black River then continues southerly for a distance of 3.5 miles to its juncture with Branch Brook, about 1.5 miles north of the village of Ludlow. In this stretch, the Black River passes through Rescue Lake and Reservoir Pond, both in the town of Ludlow.

Branch Brook, which enters from the west, is the first major tributary of the Black River. A flashy stream with a length of 8.0 miles and a drainage area of 16.0 square miles, Branch Brook rises in the town of Mt. Holly and passes through the community of Healdville before entering the Black River just downstream from the community of Grahamville.

From Branch Brook, the Black River continues southerly for 1.7 miles into the village of Ludlow where it is joined by Jewell Brook which enters from the south.

Jewell Brook, which is 4.5 miles long and has a drainage area of 9.5 square miles, rises in the southwestern part of the town of Ludlow and flows northerly, quite precipitously, to the village of Ludlow where it enters the Black River.

From its confluence with Jewell Brook, the Black River flows easterly through the communities of Ludlow and Smithville, both in the town of Ludlow, and the communities of Proctorsville and Cavendish, both in the town of Cavendish. One-half mile east of Cavendish, the Black River turns northerly at the Cavendish Gorge. At a point 6.1 miles downstream from its confluence with Jewell Brook, the Black River is joined by Twenty Mile Stream which enters from the northwest.

Twenty Mile Steam, which rises in the town of Reading on the westerly side of The Alps, is 8.5 miles long and has a drainage area of 15.5 square miles. Twenty Mile Stream flows southerly from its source, for about half its length and then southeasterly for the remainder to its juncture with the Black River at the village of Whitesville, in the town of Cavendish.

The Black River then meanders through its steep, narrow valley, flowing generally easterly and passing through Perkinsville in the town of Weathersfield before being joined by the North Branch at a point 8.9 miles downstream from Twenty Mile Stream.

The North Branch, which enters from the north, is the largest single tributary of the Black River, with a length of 11.0 miles and a drainage area of 33.0 square miles. The North Branch rises in the town of Reading on the east side of the Alps and flows southeasterly through the communities of South Reading and Felchville, both in the town of Reading, and the communities of Greenbush and Amsden, both in the town of Weathersfield, before it enters Stoughton Pond, the upper pool of the North Springfield Flood Control Reservoir. After leaving this pool, the North Branch flows southerly a short distance to its confluence with the main stem of the Black River.

From the mouth of the North Branch, the Black River flows southwesterly through the North Springfield Flood Control Reservoir in the towns of Weathersfield and Springfield. Shortly after leaving the reservoir, the Black River enters North Springfield where, at a point 3.2 miles below the North Branch, it is joined by Great Brook from the west.

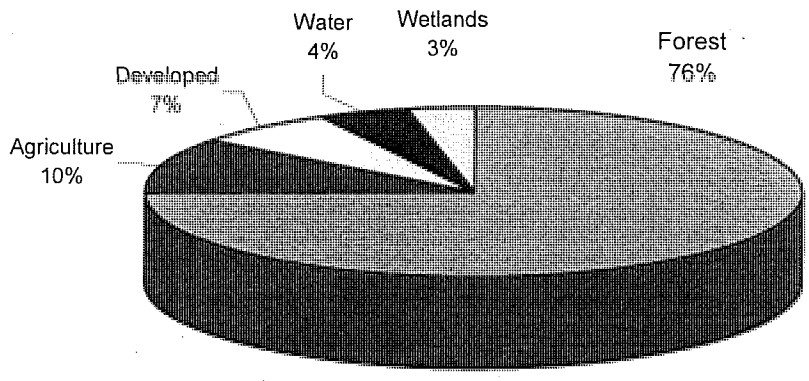
Great Brook emanates from the hills adjacent to the Duttonsville Gulf in the town of Cavendish. After leaving Cavendish and entering the town of Chester, Great Brook changes its course from a southerly to an easterly direction and enters the town of Springfield, flowing through North Springfield to its confluence with the Black River.

For the remaining 7.6 miles of its length below North Springfield, the Black River flows southeasterly through the village of Springfield and past the hamlet of Goulds Mill, entering the Connecticut River 1/4 mile downstream from the Cheshire Toll Bridge.

The Black River watershed is less forested than the Ottauquechee River watershed but nonetheless, 75% or 161,375 acres are deciduous or coniferous forest in the Black River's drainage area. Twice as much land is in agriculture in the Black River watershed as compared to the Ottauquechee River watershed with 10% or 22,609 acres in some form of agricultural activity. Developed land accounts for 7% or over 15,000 acres, surface water accounts for 4% or 9,512 acres and wetlands cover 3% or 7,395 acres.

There are a total of 19 lakes and ponds 20 acres or larger in the Ottauquechee and Black River Basins totaling approximately 1,610 acres. North Springfield Reservoir, North Hartland Reservoir, Rescue Lake, Lake Ninevah and Woodward Reservoir are the largest bodies of water in Basin 10, each being at least 100 acres in area.

Figure 3. Land Use/Land Cover in the Black River watershed (1997)



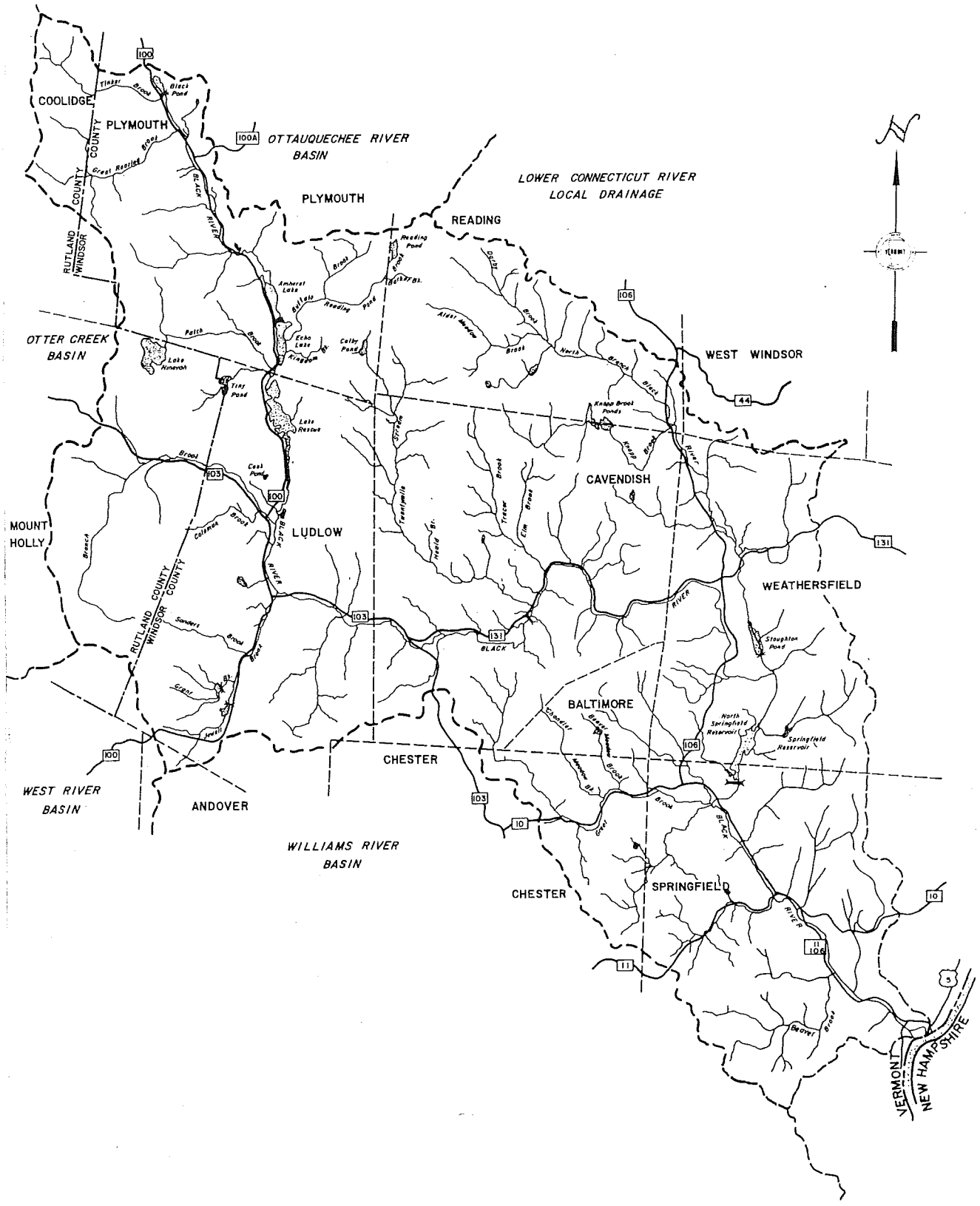


Figure 4. Black River Watershed

Wetland Communities

A review of the Vermont Significant Wetland Inventory Maps for the Black River and Ottauquechee River watersheds reveals that the predominant wetland type is shrub swamp, a rather common wetland community type. The dominant shrub species in these wetlands are alders and willows. In general, the wetlands in Basin 10 are relatively small in size with few areas that are large wetland complexes. There are many man-made ponds scattered thoughout the Ottauquechee watershed, making them perhaps the second most common wetland type.

The largest wetland complex in the basin is found along the Ottauquechee River in the town of Killington. From its headwaters almost to the West Bridgewater town line, the river flows through five and one half miles of shrub swamp and emergent marsh. Even though there has been encroachment in various spots along its length, and invasive exotic plants (purple loosestrife and phragmites) have colonized some areas, the wetland complex is highly important to protect water quality, control erosion, store flood and stormwater, and provide open space, and wildlife and fish habitat. Other isolated large swamp complexes are found in the towns of Cavendish and Weathersfield. Little is know about these swamps, and a field inventory would be needed for more information.

Developed areas of the basin follow the major road ways: routes 100, 131, 106, and 11, which follow the Black River from Plymouth to Springfield. Routes 100 and 4 follow the Ottauquechee from Killington to Hartland. Consequently, most of the wetland projects reviewed by the Vermont Department of Environmental Conservation (DEC) Wetlands Office staff have been concentrated along these corridors. Within the last few years, there has been very little known loss of wetland area or loss of wetland function and values in this basin. Projects have involved mostly buffer encroachment or disturbance to Class Three wetlands. Most of the wetland loss in the Black River watershed has been associated with the Okemo golf course and ski area expansion. However, known functions have been maintained, and critical wetlands along the Black River have been protected as has a vernal pool as part of the Okemo golf course project. The vernal pool was monitored in Spring of 2000 to assess its biological health before the golf course opened. Projects in the Ottauquechee watershed have been primarily pond projects, projects in buffer zones, or minor direct impacts for property access.

Beaver-human conflicts have been numerous in the North Springfield area, both along Route 106 north of the village, and along Route 10 which parallels Great Brook and its alder-dominated swamps. The protocols outlined in the draft best management practices (BMPs) for beaver management have been useful in dealing with some of these situations; other situations have been problematic when dams were removed improperly.

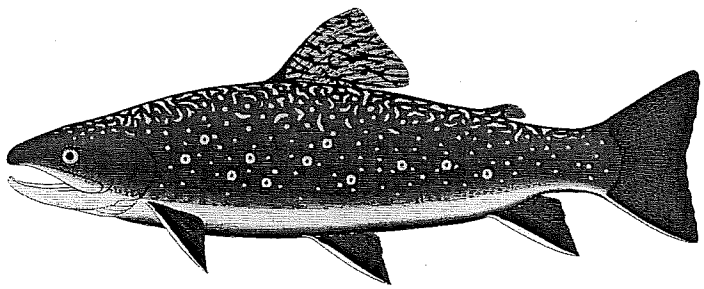
Fisheries of Basin 10

The fishery of the Ottauquechee River and its tributaries

The Vermont Department of Fish and Wildlife (VDFW) has conducted trout population surveys of the Ottauquechee River mainstem since 1982. These surveys are the source of the information below. The very uppermost station surveyed on the Ottauquechee River (at elevation 1260) supports a relatively low density population of brook trout in contrast with other Vermont streams of similar size and elevation. Brown trout and rainbow trout were first observed just below this station at elevation 1180. From this station downstream to elevation 1055 (junction of Routes 4 & 100), the trout population includes brook and brown trout with lower numbers of rainbow trout. Trout populations in this reach are moderate, and reflect the highest levels observed in the Ottauquechee mainstem from the sampling. Trout population sampling conducted below this area, from elevation 1010 to 740, revealed relatively low populations of brown and rainbow trout, although brook trout were also observed. Trout populations and habitat were also investigated in this reach by a private consultant in 1983 for the John Wheelock Titcomb Ottauquechee River Restoration organization. That study concluded that trout abundance in this reach is probably limited by temperature and physical habitat. The river channel is very wide and shallow in this stretch, which promotes solar heating and elevated temperatures and provides poor instream cover for trout.

The size and depth of the river below Woodstock are too great to permit trout population estimates. A series of dams and impoundments, including Taftsville, Simon Pierce, Deweys Mills, North Hartland and White Current, have had an impact on water quality, physical instream habitat and fish movement in varying degrees. In some reaches where the river is not influenced by instream impoundments, physical habitat for trout appears good and there is anecdotal evidence from anglers that "pocket populations" of trout provide good fishing opportunities. This is the case for the following reaches: Woodstock Village to the sewage treatment plant, Taftsville Dam to the Quechee Lakes golf course and the Quechee Gorge.

Vermont Department of Fish and Wildlife survey data confirms trout reproduction on the mainstem as far downstream as the Lincoln Covered Bridge in Woodstock (elevation 735). Surveys below this elevation have been limited due to river size. Trout reproduction in these lower unsurveyed areas should not, however, be ruled out. Trout spawning is also known to occur on Babcock, Barnard, Broad, Curtis Hollow, Falls, Happy Valley, Harlow, Kedron, Kent Pond, North Branch, Roaring, Whitman and Reservoir Brooks based on VDFW survey data.



Black River fishery

The Black River main stem supports populations of Atlantic salmon, brown trout, rainbow trout, and brook trout. The distribution and abundance of individual species in the river is dictated by environmental factors (e.g., water temperature) and fishery management activities (e.g., stocking). Much of the Black River main stem, such as downstream of Cavendish to the Connecticut River, must be classified as largely marginal habitat for wild trout populations and even for sustaining stocked fish through the year. Summer water temperatures in this portion of the river frequently exceed 27°C, the upper limit for even the most temperature tolerant trout species. Consequently, large sections of the lower Black River are unable to support trout on a sustainable basis except in localized areas, such as at ground water seeps or at the mouths of cold water tributaries. Unlike trout, Atlantic salmon are more tolerant of warm water temperatures and appear to thrive in the Black River, especially above North Springfield Reservoir. Despite less than optimal habitat conditions for trout, the Black River every now and again yields trophy size brown trout. The river, particularly downstream of Springfield, is frequented by smallmouth bass and other warmwater fishes.

Above Cavendish, habitat for trout improves somewhat with wild populations of brown and brook being more abundant, although habitat is generally less than optimal for salmonids and thermal conditions are still harsh. The only portion of the Black River main stem supporting a sizable wild rainbow trout population is located above Amherst Lake in Plymouth. Other small populations can be found in some tributaries. Sections of the main stem are stocked annually in the spring with catchable-size brown and rainbow trout to provide additional fishing recreation.

The several large lakes on the upper portion of the main stem have a negative effect on the river downstream. All of these lakes, totalling over 380 acres, have discharges of surface water which elevate river water temperatures during the summer. In addition, the river has six hydroelectric power generation facilities, one flood control project, two old mill dams, and two major population centers on the main stem which have modified the river environment.

At the present time, Atlantic salmon occur in the Black River solely as a result of annual stocking of fry into suitable juvenile nursery habitat. This stocking is being done as part of the multi-state and federal fishery agency program for the restoration of anadromous Atlantic salmon to the Connecticut River basin. Fry stocking in the Black River makes use of abundant juvenile habitat for producing salmon smolts, which will migrate out to sea and contribute to increasing adult salmon returns to the Connecticut River.

The North Branch is the largest tributary of the Black River main stem. It supports wild populations of both brook and brown trout. Brook trout are also stocked in some reaches of the North Branch. Like the main stem, much of the North Branch experiences high summer water temperatures. There are also extensive areas where streambank erosion is occurring and introduces significant quantities of sand to the stream degrading aquatic habitat.

Special Features,Uses and Values of Basin Rivers and Streams

Although many stretches of stream in the Ottauquechee River watershed and Black River watershed are likely to have some special feature or value, those briefly described below are features or special places that were identified in one or more of three state studies: *The Waterfalls, Cascades, and Gorges of Vermont* (1985), *Vermont's Whitewater Rivers* (1989) and *Vermont Swimming Hole Study* (1992).

Cavendish Gorge on the Black River in Cavendish is a large and beautifully sculptured gorge containing a series of small falls or chutes linking pools of various sizes. It is 50 to 100 feet wide at the base with sheer rock walls 50 to 80 feet high. There is a dam at the upper end of the gorge and a powerplant at the lower end.

Below Cavendish Gorge, from Whitesville to Perkinsville, there is a Class II whitewater run that includes a short stretch of Class III water. The run is approximately seven miles long and has a lot of rocks and holes and some interesting ledges and waves. The stretch has been described as a "fine, varied beautiful whitewater run of medium difficulty, widely known to boaters and receiving considerable use."

Buttermilk Falls is on Branch Brook (Black River watershed) in Ludlow and consists of a series of three falls with a large, shallow pool below each. There are a lot of sunny cobble and gravel shores and this stretch of stream is a popular swimming and bathing area.

Quechee Gorge on the Ottauquechee River in Hartford is the state's longest and deepest gorge. The gorge is about a half mile long, 50 to 100 feet wide at the bottom and 200 feet wide at the top. The greatest depth is about 150 feet. It is a popular tourist stop although most visitors stay on the bridge or trails and do not go far into the gorge itself.

North Hartland Falls on the Ottauquechee River in Hartland consists of two 25 foot high cascades on either side of a rocky island below a covered bridge and dam. The area is used for swimming, fishing and as a gathering place.

Special Uses and Values of Basin Lakes and Ponds

The Vermont DEC Lake Protection Classification System is a framework within which lakes can be evaluated for their significance when compared to other lakes statewide. The system identifies unique lakes based on their wilderness status, the occurrence of scenic and natural features, the existence of very high water quality, and the presence of rare, threatened and endangered species. Several of the lakes in Basin 10 are notable in their Lake Protection Classification System ranking, or due to recent improvements in water quality.

Black Pond, Plymouth: This 20 acre private pond constitutes the headwaters of the Black River. Despite being relatively close to VT Route 100, it has a secluded feeling, and the majority of the shoreline is forested. There exists an unusual cluster of boulders on the shoreline which provide for scenery of statewide significance.

Echo Lake, Plymouth: This lake supports two rare species of watermilfoil: *Myriophyllum alterniflorum*, which was last observed in 1985, and *M. farwelli*, which was last seen in 1990.

Kent Pond, Killington: At one time, Kent Pond was characterized by poor water quality, with algae growth identified throughout the pond. However, the water in Kent Pond has improved in recent years. During an assessment performed in 1998, far better water quality conditions were observed than had been noted during prior assessments. Indeed, a sediment delta, which had been forming during the 1980's, appears to have stabilized. These observations of improved water quality are corroborated by a review of available spring phosphorus monitoring data, which show a decrease in recent years (Figure 5).

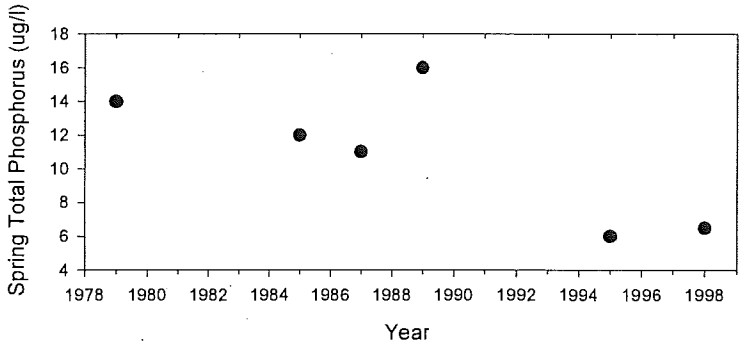


Figure 5. Spring total phosphorus concentrations measured from Kent Pond, Killington, VT

Woodward Reservoir, Plymouth: This impounded lake has an adjacent palustrine wetland characterized by a floating bog mat. This is a significant feature, and is rare in the Black and Ottauquechee River Basin.

Ninevah Lake, Mount Holly: This 171 acre high elevation (1,755 ft above m.s.l) lake is significant for a variety of reasons. While the lake is developed along approximately one third of its northern shoreline, the remainder is undeveloped forested land. The watershed of the lake is also completely forested. The southern portion of the lake is bordered by a 56 acre wetland. This mixed lacustrine/openwater and emergent palustrine system has significant habitat value for both wildlife and other aquatic biota. Indeed, the lakeward margins of the wetland are documented long-term loon (*Gavia immer*) nesting sites. In 1986, the rare watermilfoil *M. farwelli* and the rare pondweed *Potamogeton obtusifolius* were also observed in Lake Ninevah.

The Pogue, Woodstock: This small pond has become part of the new Marsh-Billings-Rockefeller National Historic Site, and as such is now under the protection and stewardship of the National Park Service.

Deweys Mills Pond, Quechee: This impoundment was originally created by construction of a dam on the Ottauquechee River in the early 1900s. In the 1970s, a dike was built to separate the impoundment from the river. The current 56 acre impoundment is managed specifically to support waterfowl and wildlife uses. The pond is characterized by dense macrophyte cover, with significant shallow areas.

Reading Pond, Reading: This small 22 acre pond is considered a high quality wilderness lake by the Lake Protection Classification System.

Population and Housing Growth in Basin Towns

The five towns that comprise most of the Ottauquechee River watershed experienced huge population growth rates from 1970 to 1980. The growth rates ranged from 11% in Bridgewater to 60% in Killington. The average population growth rate for the towns in the watershed from 1970 to 1980 was approximately 29%. (This is approximate because some of the towns listed are not entirely within the watershed and small portions of other towns are not included in the tables in Appendix C). The next decade, 1980 to 1990, showed a different situation with Killington experiencing a substantial drop in population (-17%), Woodstock showing a stable population, and Plymouth having the highest growth rate at 9%. The average watershed growth rate in this decade was 1%. Despite the more moderate population growth rate in the Ottauquechee watershed from 1980 to 1990, the number of housing units still increased markedly in this decade. Housing units in Woodstock increased 13%, the lowest rate of the five towns, while the housing units in Killington more than doubled with a 122% growth rate. The average growth rate for the watershed was 49% (from 4,044 units to 6,022 units).

The population growth rates in Black River watershed towns were less dramatic than those of the Ottauquechee River watershed although the rate from town to town varied widely. Ludlow's population declined 2% from 1970 to 1980 while Weathersfield and Plymouth's populations grew 24% and 43%, respectively. The average population growth rate for the watershed from 1970 to 1980 was 5%. The population declined in four of the seven watershed towns from 1980 to 1990 resulting in an average watershed population growth rate of 0.3%. Housing units, however, grew substantially in the decade 1980 to 1990. In Ludlow, where the population reportedly declined over the past two decades, the housing units increased 55% from 1980 to 1990. Vacation or second home development appears to account for the majority of this growth. The average housing unit growth for the watershed is 21% from 1980 to 1990.

Permitted Discharges

Six wastewater treatment facilities discharge treated effluent to the Ottauquechee River (Bridgewater, Taftsville, Quechee, Woodstock, Sherburne Fire District #1) or its tributaries (South Woodstock), and three wastewater treatment facilities discharge to the Black River (Springfield, Cavendish, Ludlow). Two industries and another business also have direct discharges to the Black River. There are over thirty-one permitted stormwater permits issued in the basin; some of the permits cover multiple discharges. Fifteen of the stormwater permits are for discharges in the Ottauquechee River watershed and sixteen are for stormwater discharges in the Black River watershed.

Table 1. Municipal Wastewater Treatment Facilities in Basin 10

WWTF	Permitted Flow (gallons/day)	Annual Average Flow (gallons/day)
Bridgewater	43,000	10,300
Taftsville	10,000	2,500
Quechee	300,000	154,600
Woodstock	450,000	214,100
Sherburne FD1	300,000	106,100
South Woodstock	50,000	9,100
Springfield	2,200,000	1,434,800
Cavendish	150,000	71,300
Ludlow	700,000	372,300

Dams of Basin 10

There are eighty-nine (89) dams identified in the Vermont Agency of Natural Resources dam database that are on the rivers and streams of Basin 10. Of the eighty-nine dams identified, forty-two are known to be in service, fifteen are breached, two are not in use, one has been drained, one is "deleted", and for twenty-eight of them the status is not known. A complete list of the dams, the streams on which they are located, and their status if known, are given in a table in Appendix D.

River Water Quality or Aquatic Habitat Impacts or Threats

The Ottauquechee River is affected by a range of activities and uses from the dams and manifestations of dense human settlements (WWTFs, roads, golf courses) in the lower portion of the river to past channelization, loss of riparian vegetation and ski area water withdrawals as one progresses upstream. Loss of riparian or streamside trees and shrubs is a widespread problem for the river and its tributary streams: yards, roads, pasture, recreational areas all encroach on the riparian vegetation leaving narrow lines of trees and shrubs at the top of the banks or no buffer at all. Road maintenance practices are also a problem for the Ottauquechee tributary streams' health and integrity.

The Black River is a heavily used river with three wastewater treatment plants, many combined sewer overflows, six hydroelectric dams, a flood control dam, a number of hazardous waste sites from earlier industrial activity, and urban runoff all affecting its health. These sources of impact or threat are in addition to the effects of riparian vegetation loss, road maintenance and runoff, and development.

Following is a presentation of the identified causes (pollutants or conditions) and sources (land uses or activities) of problems for the Ottauquechee and Black Rivers water quality and the effects of these causes and sources on various designated uses of the waters.

Designated Use Support Status

There are six designated uses of rivers and streams identified in the Vermont water quality standards (dated June 10, 1999) as well as one use that the U.S. Environmental Protection Agency expects the states will track. The seven uses include aquatic biota and habitat, contact recreation (swimming, wading, tubing), secondary contact recreation (boating, fishing), aesthetics, public water supply, agricultural water supply (crop irrigation and other uses), and fish consumption. As part of the assessment process, the Vermont DEC Water Quality Division determines whether each use is fully supported, fully supported but threatened, partially supported, or not supported. Uses that are not fully supported (i.e. partially or not supported) are impaired.* To the extent possible, the Division also determines the causes and sources of the threatened, partial or non-support status.

Overall, 86% of the river miles in basin 10 fully support the designated uses while 12% of the assessed miles are partially supported and less than 2% are not supported. Roughly one-third of the miles fully supported are threatened by an identified pollutant, condition, or activity.

* In the 305(b) assessment process, partial or non-support of uses is considered an impairment of those uses. The determination of partial or non-support is made using a wide range of information and data from best professional judgement to modelling to rigorous biological monitoring. In the 303(d) listing process, a subset of the 305(b) waters identified as not fully supporting or impaired is called out. The stretches of river and stream that are partially or not supported as determined with sound and recent monitoring data (biological, chemical or physical) are those considered impaired for inclusion on the Vermont 303(d) List of Impaired Waters. See also the section on 303(d) Listed Waters on page 23.

Aquatic biota and/or habitat is the use impaired over the greatest number of miles in Basin 10. Over twenty-nine (29.4) miles of river and stream do not fully support the aquatic community or its habitat in these two watersheds. Identified threats exist for over ninety-three (93.5) miles.

Secondary contact recreation, which is fishing in this situation, is impaired over the second greatest number of miles with 17.6 miles not fully supporting this use. Another 44 miles are threatened.

Swimming is not fully supported on at least fourteen (14.2) miles. These areas are stretches where it is known that there are numbers of *E. coli* above the standard. There are threats to the use of swimming on another forty-six (46.3) miles at least. Threats to swimming are identified where there are likely sources of pathogens discharging to the river but there are no data showing high E. coli levels.

Aesthetics are not fully supported on almost ten (9.8) miles and threatened on another fifty-six (56.2) miles. Stretches with turbid or oily water, algae-dominated channel bottoms, stained rocks, raw streambanks or other characteristics that are not natural or healthy are judged impaired or at least threatened for aesthetics.

Unless there are known toxics in a river or stream, drinking water and agricultural water supply uses are not assessed for use support at this time.

Table 2. Support Status of Basin 10 River and Streams Uses in Miles

Use	Degree of Use Support (miles)				
	Full Support	Threat	Partial Support	Non Support	Not Assessed
Overall	155.5	88.2	33.7	4.6	0
Aquatic biota/habitat	159.1	93.5	27.7	1.7	0
Fish Consumption	282.0	0	0	0	0
Swimming	221.5	46.3	9.9	4.3	0
Secondary Contact Recreation	220.4	44.0	16.1	1.5	0
Aesthetics	216.0	56.2	5.4	4.4	0
Drinking Water	46.0	2.4	0	1.5	232.1
Agricultural Water Supply	0	2.0	0	0	280.0

Causes and Sources of Problems and Threats to Basin 10 Rivers

The major cause of impacts to river and stream aquatic habitat in Basin 10 is flow alteration from snowmaking water withdrawals and the two flood control dams. Sedimentation is the second greatest cause of impairment but it is by far the largest threat to stream and aquatic community health. At least eighty miles of river and stream aquatic habitat are threatened by sedimentation. Bank erosion, land development, road runoff, and removal of riparian vegetation all are sources of increased sedimentation.

The presence of pathogens as indicated by *E. coli* bacteria impair the third greatest number of miles and threaten the fourth greatest number. The use affected by this pollutant is swimming. Municipal point sources and combined sewer overflows with some agricultural land use activities are the sources of the bacteria and pathogens.

Thermal modifications and nutrients are responsible for documented problems on a handful of miles but these two causes also threaten many miles (45-50 miles identified). Loss of riparian vegetation, developed land runoff, and water held behind dams result in thermal modifications.

The wastewater treatment facilities, developed land runoff, and agricultural land runoff result in nutrient inputs to surface waters. Other problems listed below include organic enrichment as well as habitat alterations from channelization work in past years.

Tables 3 and 4 below list the causes and sources of either impairments or threats to the rivers and streams of Basin 10.

Table 3. Causes of Impacts or Threats to Basin 10 Rivers and Streams

Causes of Impacts or Threats	Degree of Impact or Threat (in miles)			
	High	Moderate/Minor	Total	Threat
Flow Alterations	17.3	3.2	20.5	9.5
Sediments	6.2	5.8	12.0	79.8
Pathogens	6.0	5.8	11.8	33.5
Thermal Modifications	0	6.1	6.1	49.1
Nutrients	0	5.8	5.8	46.6
Organic Enrichment/Low D.O.	0	5.0	5.0	21.5
Habitat Alterations	0	1.5	1.5	14.0

Table 4. Sources of Impacts or Threats to Basin 10 Rivers and Streams

Sources of Impact or Threat	Degree of Impact or Threat (in miles)			
	High	Moderate/Minor	Total	Threat
Flow Regulation/Alteration	17.3	4.1	21.4	0
Bank Erosion	0	6.5	6.5	27.2
Land Development	5.2	0	5.2	58.3
Recreation Activities	6.5	0	6.5	5.5
Upstream Impoundment	1.0	4.1	5.1	0
Highway/Road/Bridge Runoff	0	2.8	2.8	59.3
Municipal Point Sources	0	2.8	2.8	22.0
Removal of Riparian Vegetation	0	2.0	2.0	56.7
Channelization	0	1.5	1.5	28.0
Agriculture	0	0	0	25.7
Developed Land Runoff	0	0	0	11.6

Lake Water Quality and Aquatic Habitat Impairments and Threats

There are 49 lakes and ponds in the Black and Ottauquechee Rivers watersheds, comprising 1807 acres. Of the total 1807 acres, 1,755 of these have been assessed. Of the 1,755 assessed acres, 1,468 acres are monitored, while 287 acres are evaluated.

Only five lakes out of the thirty-nine assessed are identified as having partial or non-support of some uses. The two 'lakes' whose acres are in the non-support category are actually flood control reservoirs.

Designated Use Support

A total of 1,068 lake and pond acres in Basin 10 support all designated uses. There are 505 lake acres (29%) in Basin 10, which do not support one or more uses, and 182 acres (10%) which partially support one or more uses. Table 5 provides an accounting of lake acres which support, threaten or do not fully support designated uses.

Table 5. Support Status of Basin 10 Lake Uses in Acres.

Use	Full Support	Threatened	Partial Support	Non Support	Not Assessed
Overall Uses	908	160	182	505	10
Aesthetics	1002	228	10	505	10
Aquatic Life Use Support	757	301	182	505	10
Agricultural Water Supply	0	0	0	0	1755
Drinking Water Supply	0	0	0	0	10
Fish Consumption	1745	0	0	0	10
Filtered Water Supply	0	0	0	0	1755
Industrial Water Supply	0	0	0	0	1755
Secondary Contact Uses	1003	227	10	505	10
Swimming Uses	998	232	10	505	10

Causes and Sources of Problems and Threats to Basin Lakes

The principal cause of impacts to lakes in Basin 10 is flow alteration, which affects several uses on two flood control facilities as discussed below. Critically low pH of several lakes and ponds impairs 171 lake acres, and threatens an additional 145 lake acres. The presence of exotic species causes impacts to 11 lake acres. Table 6 lists the causes of impacts to lakes in this basin.

Table 6. Causes of Impacts or Threats to Basin 10 Lakes

Cause of Impact	Magnitude of Impact (acres)			Total Acres Not Fully Supporting	Total Acres Threatened
	High	Moderate	Minor		
0500 Metals	365	0	0	365	0
0560 Mercury	365	0	0	365	0
0900 Nutrients	0	0	0	0	123
1000 pH	171	0	0	171	145
1100 Siltation	0	0	0		132
1500 Flow alteration	505	0	0	505	0
2200 Noxious aquatic plants - Native	0	0	0	0	123
2210 Noxious aquatic plants - Algae	0	0	0	0	128
2600 Exotic Species	11	0	0	11	208

The major sources of these impairments are flow regulation/modification, which precludes support of 505 acres, and atmospheric deposition, which impairs 536 acres and threatens 145 acres, respectively. Table 7 summarizes the sources of impacts to designated uses in the Black and Ottauquechee Rivers Basin.

Table 7. Sources of Impacts or Threats to Basin 10 Lakes

Source of Impact	Magnitude of Impact (acres)			Total Acres Not Fully Supporting	Total Acres Threatened
	High	Moderate	Minor		
3000 CONSTRUCTION	0	0	0	0	132
3100 Highway/Road/Bridge Construction	0	0	0	0	4
3200 Land Development	0	0	0	0	132
7000 HYDROMODIFICATION	505	0	0	505	0
7400 Flow Regulation/Modification	505	0	0	505	0
7600 Removal of Riparian Vegetation	0	0	0	0	19
7900 MARINAS and BOATING	10	0	0	10	208
7910 In-Water releases	10	0	0	10	208
8100 ATMOSPHERIC DEPOSITION	536	0	0	536	145
8300 ROAD MAINTENANCE /RUNOFF	0	0	0	0	123
8600 NATURAL SOURCES	171	0	0	171	145

To provide background information on individual lakes in this basin, a summary of overall use support by individual lake is provided in Table 8. The majority of lakes in the basin are considered monitored, meaning that some new water quality data, in addition to any observational or other information, is available from within the past five years.

Table 8. Overall Use Support by Individual Lake in Basin 10

Lake Name	Lake Area (ac)	Last Assessed (YYYYMM)	Assessment Type	Acres Fully Supporting	Acres Partially Supporting	Acres Not Supporting
AMHERST	81	199904	Monitored	81	0	0
BLACK (PLYMTH)	20	199904	Monitored	20	0	0
CARLTON	4	199904	Evaluated	4	0	0
COLBY	20	199904	Evaluated	20	0	0
COOK	3	199904	Monitored	3	0	0
COX	2	199904	Evaluated	2	0	0
CRYSTAL (HARTLD)	2	199904	Evaluated	2	0	0
DEWEYS MILL	56	199910	Evaluated	56	0	0
ECHO (PLYMTH)	104	199812	Monitored	104	0	0
GRAHAMVILLE;	8	199909	Evaluated	8	0	0
JEWELL BK #1;	14	199904	Evaluated	14	0	0
JEWELL BK #2;	17	199904	Evaluated	17	0	0
JEWELL BK #3;	18	199909	Evaluated	18	0	0
KENT	99	199912	Monitored	89	10	0
KNAPP BROOK #1	25	199909	Monitored	25	0	0
KNAPP BROOK #2	35	199904	Monitored	35	0	0
LAKOTA	20	199904	Monitored	20	0	0
LOWER MOORE	5	199904	Evaluated	5	0	0
MECAWEE	11	199909	Evaluated	11	0	0
NINEVAH	171	199904	Monitored	0	171	0
NORTH HARTLAND	215	199910	Monitored	0	0	215
NORTH SPRINGFIELD	290	199912	Monitored	0	0	290
PICO	12	199904	Evaluated	12	0	0
PINNEO	50	199909	Monitored	50	0	0
READING	22	199904	Monitored	22	0	0
RESCUE	180	199904	Monitored	180	0	0
RESERVOIR	32	199904	Evaluated	32	0	0
SOUTH MECAWEE;	2	199909	Evaluated	2	0	0
SPOONERVILLE;	8	199904	Evaluated	8	0	0
SPRINGFIELD	10	199904	Evaluated	0	0	0
STOUGHTON	56	199912	Monitored	56	0	0
THE POGUE	11	199904	Monitored	11	0	0
TINY	29	199904	Evaluated	29	0	0
UPPER MOORE	3	199904	Evaluated	3	0	0
VIEW	4	199904	Evaluated	4	0	0
VONDELL	10	199904	Evaluated	10	0	0
WOODWARD	106	199912	Monitored	105	1	0

The following paragraphs describe the most important impacts and threats to specific Basin lakes.

Colby Pond, Plymouth: This small 20 acre pond was assessed in the mid-1980's. At that time, its low alkalinity of less than 12.5 mg/l (as $CaCO_3$) was determined to threaten aquatic life uses on the pond. Further assessment of the present acidification status of this pond is needed.

Echo Lake, Plymouth: This 104 acre recreational lake has experienced significant shoreline development in the past decade. At last count, there were 34 houses within 100 feet of the shoreline, many of which have unbuffered shorelines. While water quality remains good and stable as measured by the spring phosphorus sampling (mean spring total phosphorus is 7 ug/l), the level of development on Echo Lake poses a threat to this high quality. Correspondingly, aesthetic, swimming, boating, and aquatic life uses are considered threatened for the lake's entire acreage. This lake has a coldwater fishery including lake trout.

Kent Pond, Killington: This 99 acre lake has a 10 acre infestation of Eurasian watermilfoil. As the infestation in these acres is very dense, aesthetics, swimming, boating, and aquatic life uses are only partially supported.

Knapp Brook Ponds 1 and 2, Cavendish: These two undeveloped ponds (25 and 35 acres) are characterized by alkalinity values below 12.5 mg/l (as $CaCO_3$). Correspondingly, due to acid sensitivity, aquatic life uses are considered threatened for the full acreage of each lake.

Ninevah Lake, Mt. Holly: This 171 acre lake is characterized by an alkalinity of less that 12.5 mg/l (as $CaCO_3$). Aquatic life uses are considered partially supported for the entire lake acreage due to acid sensitivity.

North Hartland Reservoir, Hartland: This 215 acre flood control reservoir is operated by the U.S. Army Corps of Engineers. Due to extreme water level fluctuations which result from the reservoir's operations, aquatic life uses are not supported.

North Springfield Reservoir, Springfield: This 290 acre flood control reservoir is operated by the U.S. Army Corps of Engineers. Due to extreme water level fluctuations which result from the reservoir's operations, aquatic life uses are not supported.

Reading Pond, Reading: This small 22 acre pond was assessed in the mid-1980's. At that time, its low alkalinity of less than 12.5 mg/l (as $CaCO_3$) was determined to threaten aquatic life uses on the pond. Further assessment of the present acidification status of this pond is needed.

Rescue Lake, Plymouth: Eurasian watermilfoil was found in this lake in 1998. Presently, the infestation is categorized by the Vermont DEC Water Quality Division as light. Correspondingly, 36 of the lakes 180 acres are considered threatened for aesthetic, aquatic life, boating, and swimming uses. Rescue Lake has a coldwater fishery.

303(d) Listed Waters in Basin 10

There are six separate segments of river and stream and one wetland in five different waterbodies on the EPA-approved 1998 Vermont List of Impaired Surface Waters (the Clean Water Act section 303(d) list). Waters that are included on this list are a subset of the waters described elsewhere in this report as impaired or not fully supporting their uses. The 303(d) listed waters are those determined to be impaired based on data from biological, chemical and/or physical monitoring work. The listed river or stream segments include the East Branch Roaring Brook (10-06), Roaring Brook (10-06), the Black River near the mouth (10-11), the Black River near Ludlow (10-14), Soapstone Brook (10-14) and a tributary to Jewell Brook (10-14). The wetland is located adjacent to an unnamed tributary to the Ottauquechee River in Bridgewater (10-04). All miles of river and stream are impaired for fish consumption due to mercury. For the causes of impairment and status of the problems on these stretches, see the approved 1998 303(d) list available from the Water Quality Division.

There are no lakes from Basin 10 on the 1998 303(d) list.

Specific Projects or Water Quality Protection Efforts in the Basin

Killington/Pico Upland Stream Study

A four year study is being conducted from 1997 through 2000 by a consulting firm for Killington, Ltd. to "quantify biologic and hydrologic impacts to Class A water from upland ski trail and lift construction." The streams being evaluated include Pico Pond Inlet, Roaring Brook, Kent Brook tributary, North Fork of Madden Brook, Rams Head, Carpenter Brook, Falls Brook and Falls Brook tributary in the Ottauquechee River watershed; Tinker East in the Black River watershed; and Sargent Brook and Pico West in the Otter Creek watershed. The study is evaluating the following parameters and conditions: stream chemistry, water temperature, stream morphology, land use, hydrology and aquatic biota in 11 streams between elevation 2,300 and 2,600 feet. A full report with the data and an evaluation of the data is expected in Spring 2001.

North Hartland Reservoir Phosphorus Study

In August and September 1997, the U.S. Army Corps of Engineers (ACOE) noticed signs of nutrient enrichment in the upper reaches of North Hartland Reservoir: "billowing clouds of the filamentous algae *Oedogonium* were in the water column and covering vegetation." In fiscal year 1998 (October 1, 1997 - September 30, 1998), the ACOE began collecting samples upstream of the area it had sampled in the past; however, laboratory errors made all the samples from FY98 and the initial samples from FY99 invalid. Following identification of the laboratory errors, the phosphorus numbers from the samples were high but not unrealistically high as they had been previously reported. The Vermont DEC Water Quality Division plans to work with the ACOE to continue investigating the enrichment problem at North Hartland and find ways to address it.

Barnard Brook Watershed Mapping Project

The Two River/Ottauquechee Regional Planning Commission has done a land use/land cover analysis and map for the Barnard Brook watershed. Following production of the map, the Commission held a public meeting to solicit comments about the brook's special areas, threats and obvious problems. The Vermont DEC Water Quality Division has and will be following up on issues, comments, and questions raised at the meeting. The Water Quality Division will also use the mapping project's results in its larger Ottauquechee Basin Planning Process.

Town of Barnard Wetland Protection Work

The Barnard Conservation Commission has been concerned about potential impacts to wetlands within its town. The Commission especially wants to protect those significant wetlands that are not well protected by the State of Vermont (Class Three wetlands) and provide better protection to Class Two wetlands. The Commission has been drafting a section entitled "Wetlands Overlay Area" for addition to their zoning regulations.

Black River Contact Recreation Use Study

In the summer of 1999, the Southern Windsor County Regional Planning Commission (SWCRPC) completed a study of contact recreational use (swimming, wading, bathing) of the Black River between the Ludlow Wastewater Treatment Facility (WWTF) and the Cavendish WWTF. The Regional Planning Commission staff developed an inventory of swimming areas based on interviews and public meetings. Staff then counted swimmers at these areas on three sunny Saturday afternoons. The report found that on the swimming hole just above the Cavendish WWTF was very popular as were several swimming holes on Twentymile Stream.

Southern Windsor County Water Quality Plan

In 1999 and 2000, the SWCRPC updated the map of uses and threats to surface waters in southern Windsor County and produced a report which synthesizes planning and assessment work completed on surface waters in the region to date. Recommendations for future projects on the Black River generated at public meetings include: starting a watershed group on the Black River; developing an ongoing monitoring program to educate people about swimming conditions; and continuing to look at erosion and urban runoff issues. Recommendations for the North Branch of the Black River include completing an erosion study and following up on water quality issues on Stoughton Pond.

Discussion and Recommendations

The dominant threats and impacts to water quality and aquatic habitat in Basin 10 identified during this assessment process are discussed below. Some initial recommendations for state, regional or local agencies, organizations, or programs are also presented - recommendations that will result in some immediate protection or restoration of the surface waters in the two major watersheds of this basin. These are considered initial recommendations, however, because they will be developed further during the basin planning process - a process, which has an important public participation component. Nonetheless, there are actions that state, regional, and local entities can take now based on the assessment findings and these are identified in italics in the paragraphs below.

Instream/Onstream Concerns

The issues and problems in the Ottauquechee River watershed and the Black River watershed are not unlike those in many other watersheds in Vermont. However, in these two watersheds, instream and onstream sources cause the primary impacts on, and threats to, water quality and aquatic habitat. These instream and onstream sources include combined sewer overflows, municipal wastewater treatment facility discharges, flow alterations, and dams for hydroelectric use, recreational impoundments, flood control, and other purposes. Eighty-nine dams are identified in the basin, which is the third highest number of dams per basin out of the seventeen Vermont basins. In addition, the Black River has two substantial population centers located on it, Springfield and Ludlow, with the resulting containment and channelization of the river and its tributaries through these urban areas. Woodstock has an impact on the Ottauquechee River and tributaries in a similar manner.

Ludlow and Springfield are in the process of developing applications to expand their wastewater treatment facilities on the Black River and, as part of each expansion, phosphorus removal capabilities are proposed. The phosphorus removal should reduce the nutrient enrichment problems identified in the stretches below the plants. *The State should continue to provide technical assistance and funding to Springfield and Ludlow as they pursue phosphorus removal at their wastewater treatment facilities.*

Land Runoff Concerns

The same land runoff problems and threats that dominate in other Vermont watersheds are a secondary, but critical issue in these two watersheds. Springfield, Ludlow, and Woodstock are population centers that result in polluted runoff, which comes from a relatively high concentration of impervious surface. Additionally, both watersheds have ski resorts in their steep, upper reaches and both resorts have expansion plans. In the suburban and rural portions of the watersheds, gravel road runoff, loss of riparian vegetation due to yards, pasture, and recreational activities, and scattered housing development all cause impacts or pose threats to water quality and aquatic habitat.

The Killington Ski Resort is in the Ottauquechee River watershed and Okemo Mountain Resort is in the Black River watershed. The former affects the tributary streams and the Ottauquechee with snowmaking water withdrawals as well as the land clearing and development of trails and residential units. Okemo, which is smaller, affects tributaries to the Black River due to land development. Both ski resorts have developed master plans and, as a part of that process, are implementing water quality studies. The four year study mentioned earlier is being done on upland streams in the area of the Killington ski resort. The results will lead to a more definitive picture of what ski area activities are having an impact on upland stream aquatic habitat and integrity and how to avoid or mitigate those impacts. The Okemo Jackson Gore development proposal also has a water quality monitoring plan. *Results from the various ski area water quality studies should be evaluated and summarized and used to protect these and other streams in appropriate forums and regulatory processes.*

Runoff from roads, sedimentation from road maintenance practices, and loss of riparian vegetation along roads are significant threats to basin rivers and streams and especially those in the Ottauquechee River watershed. The problem is both a state and local issue. *The State should be careful to set a good example with its road and bridge construction and maintenance projects. The State also needs to review its vegetation management practices when the work is within 50 feet of a river or stream.* Municipalities and their road crews need to know the availability of best management practice guidance, technical assistance, training opportunities, and grants for road projects. *The State, regional planning commissions, watershed groups, local commissions or a partnership of groups should take the lead in education efforts for town road crews.*

Both watersheds in the basin experienced substantial development of new housing in the decade 1980 to 1990: the Ottauquechee River watershed housing unit growth rate was 49% (4,044 units to 6,022 units). The Black River watershed growth rate was 21% (8,447 units to 10,185 units) in the same period. Housing unit growth is a good indicator of threats and possible impacts to surface waters because of the soil exposure, change in topography and drainage, and loss of vegetation. The towns in Basin 10 need to have strong, clear town plan goals and zoning regulations that protect surface waters and riparian habitats to prevent further impacts from housing unit additions, Local setback and buffer requirements along rivers, streams, lakes, and ponds is a critical first step for water quality protection. *The State or the regional planning commission should review the effectiveness of current plans and zoning and offer planning and zoning technical assistance to watershed towns.* The priority should be those towns with the fastest housing unit growth.

High temperatures are a problem for the fishery on both the Black and Ottauquechee Rivers due to the loss of riparian vegetation and alterations to the river channels and flow. *The State along with a local fishing or watershed organization should identify priority areas for buffer re-establishment and habitat enhancement.* An appropriate starting place might be Kedron Brook - a key tributary where buffers are few or lacking.

The Army Corps of Engineers (ACOE), as part of the National Environmental Policy Act (NEPA) process, is currently updating the Environmental Assessments done in the 1970's for their flood control reservoirs. The ACOE will review the operation of North Springfield Reservoir and North Hartland Reservoir as part of this update process.

The focus of the basin water quality and aquatic habitat assessments has been to identify and describe problems and threats. The DEC Water Quality Division is working to include more identification and description of high quality waters so we afford protection to these waters through the appropriate classification.

References and Resources

The Killington/Pico Upland Stream Study - 1997 and 1998 Summary, July 1999. Pioneer Environmental Associates, LLC for Killington, Ltd., Killington, Vermont.

Black and Ottauquechee River Basins Water Quality Management Plan, Agency of Environmental Conservation, Department of Water Resources, May 1976.

Two Rivers-Ottauquechee Regional Plan (2 volumes), May 1999. Two Rivers-Ottauquechee Regional Commission, The King Farm, Woodstock, Vermont.

Upper Ottauquechee River Basin Water Quality Management Plan, Final Draft, July 1984. Agency of Environmental Conservation, Department of Water Resources and Environmental Engineering.

Vermont Lake Protection Classification System, September 1994. Lakes and Ponds Unit, Vermont DEC Water Quality Division.

Vermont Swimming Hole Study, March 1992. Jerry Jenkins, Deborah Benjamin and Jane Dorney for the Vermont Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division.

Vermont's Whitewater Rivers: Their Geology, Biology, and Recreational Use, January 1989. Jerry Jenkins and Peter Zika for the Vermont Agency of Natural Resources, Department of Environmental Conservation.

Waterfalls, Cascades and Gorges, September 1985. Jerry Jenkins and Peter Zika for the Vermont Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division.

Appendix A

Land Use and Land Cover

Basin 10 Watersheds

Table A.1. Land Use/Land Cover of the Ottauquechee River Watershed (1997)

Land Use[1]	Acres	% of Total
Forested	124,093	86
Agriculture	7,139	5
Transportation	5,860	4
Surface Water	4,099	3
Wetlands	1,106	1
Developed Land[2]	1,938	1
Total:	144,235	100

Table A.2. Land Use/Land Cover of the Black River Watershed (1997)

Land Use	Acres	% of Total
Forested	161,375	75
Agriculture	22,609	10
Transportation	9,906	5
Surface Water	9,512	4
Wetlands	7,395	3
Developed Land	5,145	2
Total:	215,942	99

1 Doesn't include "brush or transitional land" or "barren land"

2 Developed land = residential, commercial, industrial, all but transportation

Appendix B

Stream Macroinvertebrate Sample Sites

Results Since 1992

Table B.1. Basin 10 River or Stream Macroinvertebrate Sampling Sites (1992 - 1999)

Id #	Stream or River Name	Town	Mile-point	Date	Assessment
VT10-05	Ottauquechee River	Bridgewater	27.5	10/15/92	excellent
VT10-06	Roaring Brook	Sherburne	1.4	10/15/92	fair
VT10-06	Roaring Brook	Sherburne	1.4	10/02/97	fair
VT10-06	East Trib Roaring Brook	Sherburne	0.5	8/29/95	fair
VT10-07	Kedron Brook	Woodstock	5.2	10/13/94	excellent
VT10-11	Black River	Springfield	2.4	9/17/92	good
VT10-11	Black River	Springfield	2.4	10/03/95	good
VT10-11	Black River	Springfield	2.4	10/08/97	good
VT10-11	Black River	Springfield	2.4	9/13/99	good-
VT10-14	Black River	Ludlow	25.3	9/01/99	good-
VT10-14	Black River	Ludlow	25.6	9/01/99	good
VT10-14	Black River	Ludlow	25.8	9/01/99	good
VT10-15	Black River	Plymouth	36.4	10/15/92	good

Appendix C

Population and Housing Data

for Basin 10 Watersheds Towns

Table C.1. Population Data for Ottauquechee River Watershed Towns*

Town	1970 Population	1980 Population	Change 1970-1980	1990 Population	Change 1980-1990
Woodstock	2,603	3,214	23%	3,212	0%
Pomfret	620	856	38%	874	2%
Bridgewater	783	867	11%	895	3%
Plymouth	283	405	43%	440	9%
Killington	558	891	60%	738	-17%
Total	**4,847**	**6,233**	**29%**	**6,159**	**1%**

Table C.2. Housing Data for Ottauquechee River Watershed Towns*

Town	1980 Housing Units	1990 Housing Units	Change 1980-1990
Woodstock	1,548	1,755	13%
Pomfret	404	490	21%
Bridgewater	486	571	17%
Plymouth	495	736	49%
Killington	1,111	2,470	122%
Total	**4,044**	**6,022**	**49%**

*Towns whose land area is completely or substantially within the watershed

Table C.3. Population Data for Black River Watershed Towns*

Town	1970 Population	1980 Population	Change 1970-1980	1990 Population	Change 1980-1990
Springfield	10,063	10,190	1.3%	9,579	-6%
Baltimore	170	181	6%	190	5%
Weathersfield	2,040	2,534	24%	2,674	6%
Cavendish	1,264	1,355	7%	1,323	-2%
Ludlow	2,463	2,414	-2%	2,302	-5%
Plymouth	283	405	43%	440	9%
Reading	564	647	15%	614	-5%
Total	**16,820**	**17,726**	**5%**	**17,122**	**0.3%**

Table C.4. Housing Data for Black River Watershed Towns*

Town	1980 Housing Units	1990 Housing Units	Change 1980-1990
Springfield	4,076	4,256	4%
Baltimore	78	88	13%
Weathersfield	1,069	1,249	17%
Cavendish	649	785	21%
Ludlow	1,726	2,677	55%
Plymouth	495	736	49%
Reading	354	394	11%
Total	**8,447**	**10,185**	**21%**

*Towns whose land area is completely or substantially within the watershed

Appendix D

Dams in Basin 10

Table D.1. Dams on Rivers and Streams in Basin 10

Dam Name	Stream	Town	Status	Use*	Built	Re-built	State ID
Rockefeller	Woodward Reservoir	Plymouth	In Service	R	1970		156.07
Mirror Lake	Roaring Brook	Killington	In Service	O	1973	1990	188.06
Snowshed Pond	Roaring Brook TR	Killington	In Service	O	1970	1993	188.07
Gray Camp Pond	Barnard Brook-TR	Barnard	Unknown				11.02
Klose	Barnard Brook - TR	Barnard	In Service	R	1968		11.03
Sonnenberg Ski Area	Barnard Brook-TR	Barnard	Unknown		1969		11.04
The Pogue	Barnard Brook TR	Woodstock	In Service	R	1895	1990	254.08
Billings Pond	Barnard Brook	Woodstock	In Service	R	1890		254.01
Upper Moore Pond	Pinney Hollow Brook	Plymouth	In Service	R	1974	1987	156.04
Pinney Hollow Brook	Pinney Hollow Brook	Plymouth	Drained				156.09
Mecawee Pond	Broad Brook- TR	Reading	In Service	R	1920	1978	163.01
Lakota Lake	Richmond Brook	Barnard	In Service	R	1891	1983	11.05
Johnson	Ottauquechee River	Killington	Unknown	R	1965		188.08
Woodward Reservoir	Reservoir Brook	Plymouth	In Service	R	1983		156.01
Cox Reservoir	Ottauquechee River	Woodstock	In Service	S	1930		254.03
Carlton Reservoir	Ottauquechee River	Woodstock	Unknown	S	1948		254.04
Taftsville	Ottauquechee River	Woodstock	In Service	H	1905	1910	254.05
Deweys Pond	Ottauquechee River	Hartford	In Service	RO	1973		94.07
North Hartland	Ottauquechee River	Hartland	In Service	RC	1961		95.01

Dam Name	Stream	Town	Status	Use	Built	Re-built	State Id
White Current	Ottauquechee River	Hartland	In Service	H	1900	1988	95.05
Crystal Pond	Happy Valley Brook	Hartland	Unknown				95.08
Jewel Brook Site No. 1	Jewell Brook	Ludlow	In Service	C	1969		117.07
Jewel Brook Site No. 2	Grant Brook	Ludlow	In Service	C	1969		117.06
Jewell Brook Site No. 3	Jewell Brook-TR	Ludlow	In Service	CR	1970		117.12
Jewel Brook Site No. 3	Parker Brook	Ludlow	In Service	CR	1970		117.04
Jewel Brook Site No 5	Sanders Brook	Ludlow	In Service	C	1972		117.05
Okemo Snow Pond	Black River -OS	Ludlow	In Service	R	1994		117.13
Reservoir Pond	Black River	Ludlow	In Service	R	1920	1978	117.02
Lake Ninevah	Patch Brook	Mount Holly	In Service	R	1920		135.01
Black Pond	Black River	Plymouth	In Service	R	1897	1952	156.02
Amherst Lake	Echo Lake-TR	Plymouth	In Service	R	1950		156.05
Colby Pond	Twenty mile Stream	Plymouth	In Service	R	1959		156.06
Martin	Cloudland Brook -T	Pomfret	In Service	R	1969	1988	157.02
Reading Pond	Reading Pond Brook	Reading	Breached				163.02
Pico Pond	Kent Pond-TR	Killington	Unknown				188.17
Kent Pond	Kent Brook	Killington	In Service	R	1965		188.09
Sunrise village Lagoon	Falls Brook-TR	Killington	Unknown		1983		188.15
Lake Rescue	Black River	Ludlow	In Service	RS	1978		117.01
North Springfield	Black River	Springfield	In Service	CR	1960		194.01
Fellows	Black River	Springfield	Not in Use	H	1900	1936	194.02
Gilman	Black River	Springfield	In Service	H	1913		194.03
Slack (Lower)	Black River	Springfield	In Service	H			194.05

Dam Name	Stream	Town	Status	Use	Built	Re-built	State id
Lovejoy	Black River	Springfield	Unknown	H	1912		194.06
Cavendish	Black River	Cavendish	In Service	H	1907		44.01
Muckross	Black River-TR	Springfield	In Service	R	1900		194.08
Carey	Black River-TR	Springfield	In Service	R	1968		194.12
Knapp Brook Site No. 1	Knapp Brook	Cavendish	In Service	R	1958		44.04
Knapp Brook Site No 2	Knapp Brook	Cavendish	In Service	R	1961		44.05
Stoughton Pond	North Branch Black	Weathersfield	In Service	R	1960		229.01
Widow Hill	North Branch Black	Cavendish	Unknown				44.06
Line Pond	Barnard Brook - TR	Barnard	Deleted				11.06
Bridgewater Woolen Mill	Ottauquechee River	Bridgewater	Breached	O	1936		28.01
Murdock	Black River	Cavendish	Breached				44.02
Kenwood Mills	Black River	Cavendish	Breached				44.03
Gay Bros.	Black River	Cavendish	Breached				44.08
Parker Bros.	Black River	Cavendish	Breached				44.09
Black Bear Woolen Co.	Black River	Cavendish	Breached				44.10
Quechee Mills	Ottauquechee River	Hartford	In Service	O	1900		94.01
Deweys Mills	Ottauquechee River	Hartford	In Service	H	1900		94.02
Hartland	Ottaquechee River	Hartland	Unknown				95.06
Village	Black River	Ludlow	Breached				117.03
Verd Mont Mills	Black River	Ludlow	Breached				117.08
American Woolen Co.	Black River	Ludlow	Breached				117.09
Smithville	Black River	Ludlow	Unknown				117.11
Grist Mill	North Branch Black	Reading	Unknown				163.07

Dam Name	Stream	Town	Status	Use	Built	Re-built	State Id
Lower Moore Pond	Pinney Hollow Brook	Plymouth	Unknown	R	1974		156.03
Plymouth - 8	Patch Brook - TR	Plymouth	Unknown				156.08
Sherburne - 5	Kent Pond - TR	Killington	Unknown				188.05
Chevalier	Ottauquechee River	Killington	Unknown				188.10
Briggs	Ottauquechee River	Killington	Breached				188.11
Sherburne - 12	Ottaquechee River	Killington	Breached				188.12
Sherburne - 14	Reservoir Brook - TR	Killington	Unknown				188.14
Bear Pond	Falls Brook - TR	Killington	Unknown				188.16
Springfield - 9	Black River - TR	Springfield	Unknown				194.09
Springfield - 10	Black River - TR	Springfield	Unknown				194.10
Springfield - 11	Black River - TR	Springfield	Unknown				194.11
Powerhouse	Black River	Springfield	Breached				194.13
Vermont Snath	Black River	Springfield	Breached				194.14
Slack (Upper)	Black River	Springfield	Unknown				194.15
Springfield Reservoir	Black River - TR	Weathersfield	Not in Use	SO	1903	1970	229.02
Soapstone	Black River	Weathersfield	Unknown				229.03
Perkinsville	Black River	Weathersfield	Unknown				229.04
Amsden	North Branch Black	Weathersfield	Unknown				229.05
Tolles Hill	Black River	Weathersfield	Unknown				229.06
Vondell Reservoir	Vondell Brook	Woodstock	In Service	S	1962		254.02
Woodstock Mills	Ottauquechee River	Woodstock	Unknown				254.06
Bridgewater Woolen Co.	Ottauquechee River	Woodstock	Unknown				254.07

* H = hydroelectric, R = recreation, C = flood control, S= water supply, O = other

Appendix E

Individual River and Stream Waterbody Reports for Basin 10

Lower Ottauquechee River

Assessment Report

Waterbody No: VT10-01

River Length (mi.): 16.5 **Classification:**

Description: Lower Ottauquechee River mainstem from the mouth to the confluence of Kedron Brook excluding North Hartland Reservoir

Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999

Date Last Updated: 11/22/1999

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination

Assessment Types

Surveys of fish and game biologists or other professionals

Land use information and location of sources

Occurrence of conditions judged to cause impairment

Discharger self-monitoring data (effluent)

Toxics Testing

Waste Management Zone - Miles: 2.60 **Description:** 1,1,0.6 mi.below Woodstock,Quechee,Taftsville

Assessment Comments

NON-SUPPORT MILES

Ottauquechee River: 0.1 - below White Current hydro - non-support of aesthetics due to de-watering of waterfall. c(1500) s(7410)

PARTIAL SUPPORT MILES

Ottauquechee: 0.9 below N. Hartland Dam - partial support of aquatic biota/habitat, aesthetics, and contact and non-contact recreation due to pathogens from unknown sources, and fluctuating flows and warm, turbid water releases from dam. c(1100,1400,1500,1700) s(7350,7410,9000)

THREATENED MILES

Ottauquechee River: 9.5 - from the iron bridge in Woodstock downstream to North Hartland Reservoir (which is assessed by the Lakes section) - threats to contact recreation, non-contact recreation, aquatic biota/habitat and aesthetics due to pathogens, nutrients, organic enrichment, temperature increases, and sediments from periodic WWTF discharge violations, CSOs, agricultural land use runoff, golf course runoff, road runoff, development, and loss of riparian vegetation. c(900,100,1200,1400,1700) s(200,1000,3200,4500,7600,8700)

Lower Ottauquechee River **VT10-01**

COMMENTS

Field observations in October 1997 corroborates concerns about nutrient and organic enrichment and other threats listed above. The river substrate was covered with algae through much of, and below, the Quechee Lakes golf course. Rocks were algae-covered upstream of Whitman Brook confluence to the Taftsville hydro dam as well. Buffers were lacking or narrow in many stretches.

"Towards the end of FY97, indications of eutrophication were noticed in the upper reaches of North Hartland lake in Vermont. Sampling in 1998 found very high levels of phosphorus, up to 2.7 mg/liter...The upper part of North Hartland lake had billowing clouds of the filamentous algae Oedogonium in the water column and covering vegetation, as evidence of the effects of this nutrient enrichment." (Army Corps reference below).

Gerrish Motors in Woodstock has been a hazardous waste site project for a number of years and has posed at least a threat to an onsite stream from petroleum and BTEX. There is a passive recovery system in place at this time. The case had been in litigation but is settled now. The state will receive a payment to fix the situation. The money will either go to pay back a new owner of the property if one buys the site, cleans it up and re-develops it or the State will use the money and clean it up.

The Quechee WWTF had a number of permit violations during the second half of 1997 involving BOD, TSS, and TRC. A July 1998 inspection of the plant gave the plant a rating of unacceptable due to the BOD violations. Violations have been resolved at this facility as of Spring 2000. Taftsville WWTF had E. coli violations in 1997 as well but nothing has been noted since.

INFORMATION SOURCES

Peter DesMueles - below North Hartland Dam always turbid; golf course in floodplain; COE operation leaves 1/4 inch of silt through entire gorge after drawdown (1994).

Mark Rosenthal, Army COE - sedimentation severe throughout reservoir, bass fishing low, approx. 3" deposition in 5 years, suspended solids and loss of habitat/cover next severe problem, DO appears ok, slumping of streambank in reservoir especially following high pools (1994).

Connecticut River Watch Program - sampled eight stations along waterbody for E.coli (1993)

Jeff Cueto, Vermont DEC Water Quality Division - status of hydroelectric projects (1999).

Vermont DEC Wastewater Management Division files - information on operation and violations of wastewater treatment facilities (1998).

Army Corps of Engineers 1998 Annual Water Quality Report - recent information on North Hartland Reservoir.

Jerry McArdle, Vermont DEC Water Quality Division - October 1997 field survey information. (1999)

Marty Banek, Trout Unlimited - has fished the river for 20 years, noted the river beginning to recover from past gravel mining and post-flood (70s) bulldozer work instream. Also noted possible impacts from golf courses and a farm. (1999)

Brian Woods, Vermont DEC Waste Management Division - information on the Gerrish Motors case (87-023). (1999)

Vermont DEC Wastewater Management Division - information on WWTFs

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	6.0	9.5	0.9	0.1	0.0
20	Aquatic biota/habitat	6.1	9.5	0.9	0.0	0.0
21	Fish consumption	16.5	0.0	0.0	0.0	0.0
42	Contact recreation	6.1	9.5	0.9	0.0	0.0
44	Noncontact recreation	6.1	9.5	0.9	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	16.5
62	Aesthetics	6.0	9.5	0.9	0.1	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	16.5
82	Industry water supply	0.0	0.0	0.0	0.0	16.5

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	9.00

Lower Ottauquechee River		**VT10-01**
Siltation	M	0.90
Siltation	T	9.50
Organic enrichment/Low D.O.	T	9.50
Thermal modifications	M	0.90
Thermal modifications	T	9.50
Flow alterations	H	0.10
Flow alterations	T	9.50
Pathogens	T	9.50

Impairment Source	**Magnitude**	**Size (mi.)**
Municipal point sources	T	9.50
Agriculture	T	3.00
Land development	T	9.50
Highway/road/bridge runoff	T	9.50
Upstream impoundment	M	0.90
Flow regulation/modification	M	0.90
Flow mod. - hydroelectric	H	0.10
Removal of riparian vegetation	T	9.50

Point Source Description	**NPDES No.**
Hartford-Quechee WWTF 0.30mgd	VT0100978
Woodstock WWTF 0.450mgd	VT0100757
Woodstock Bypass & Overflow	VT0100757
Taftsville WWTF 0.01mgd	VT0100765
SW - Hartland Crossing shopping center	1-0768
SW - Quechee Inn	1-0950
SW - Mid Vermont Christian School	1-1042
Quechee CSO - CSO - Ottauquechee R. - Ma	
Woodstock CSO - CSO - Black R. - W. Wood	
Taftsville Hydro - Hydropower Dam - CVPS	
Downers Mill Hydro - Hydropower Dam - Pr	
Deweys Mill Hydro - Hydropower Dam - Pri	
White Current Hydro - Hydropower Dam - P	

Minor Tribs - Lower Ottauquechee

Assessment Report

Waterbody No: VT10-02

River Length (mi.): 21.5 **Classification:**

Description: Tributaries draining into the Lower Ottauquechee including Babcock, Happy Valley, Harlow and Whitman Brooks

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 11/22/1999 Surveys of fish and game biologists or other professionals

Land use information and location of sources

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

Waste Management Zone - Miles: **Description:**

Assessment Comments

THREATENED MILES

Whitman Brook: 1.0 - from mouth upstream - threats to aquatic biota/habitat and aesthetics due to possible nutrient enrichment and temperature increases from land development (golf course and development) and riparian vegetation removal. c(900,1400) s(3200,7600)

COMMENTS

The following information comes from observations during a field survey in early October 1997:

Happy Valley Brook - clear water, no signs of enrichment, wooded buffers greater than 50 feet for much of its length, no obvious impacts or threats. Temperature 54°F at mouth.

Babcock Brook - clear water, some fuzzy rocks and siltation but no obvious sources. Alder swamp at upper end so maybe above is natural condition. Buffer width 20 feet at least and often greater. Temperature 60°F at mouth.

Whitman Brook - the lower part of this brook is bordered by golf course with no buffer. Rocks were covered with algae. Temperature 54°F. Biological monitoring here is recommended. Upstream there is more of a buffer and the stream show no sign of any impacts.

Hollow Brook - clear water, no signs of any impacts or threats. Good buffers because land cover is predominantly forest.

Minor Tribs - Lower Ottauquechee **VT10-02**

Fulling Brook - clear water, no signs of impacts or threats. Temperatures at 2 locations 50°F and 52°F . A small gorge and cascades was seen.

INFORMATION SOURCES

John Claussen, Vermont Dept of Fish and Wildlife - noted threats to aquatic biota/habitat due to riparian alteration and development impacts on Whitman Brook (1996).

Jerry McArdle, Vt DEC Water Quality Division - noted instream conditions and adjacent land uses of the tributaries described above from field surveys in the summer of 1997. (1999)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	20.5	1.0	0.0	0.0	0.0
20	Aquatic biota/habitat	20.5	1.0	0.0	0.0	0.0
21	Fish consumption	21.5	0.0	0.0	0.0	0.0
42	Contact recreation	21.5	0.0	0.0	0.0	0.0
44	Noncontact recreation	21.5	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	21.5
62	Aesthetics	20.5	1.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	21.5
82	Industry water supply	0.0	0.0	0.0	0.0	21.5

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	1.00
Thermal modifications	T	1.00

Impairment Source	Magnitude	Size (mi.)
Land development	T	1.00
Removal of riparian vegetation	T	1.00
Recreational activities	T	1.00

Point Source Description	NPDES No.
SW - Hartland Crossing Shopping Center	1-0768
SW - Post Office & Apt bldg in Quechee	1-1029
SW - Quechee School	1-1111
Woodstock Inn - golf course	
Quechee Lakes - golf course	

Mid-Ottauquechee River
Assessment Report

Waterbody No: VT10-03

River Length (mi.): 10 **Classification:**

Description: Main Stem - Confluence of Kedron Brook to confluence of Broad Brook

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999

Date Last Updated: 1/5/2000

Assessment Types

Surveys of fish and game biologists or other professionals

Non-fixed station chemical/physical monitoring-conventional and tox

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination

Toxics Testing

Metals in water column

Waste Management Zone - Miles: 1.00 **Description:** below Bridgewater WWTF outfall

Assessment Comments

THREATENED MILES

Ottauquechee River: 10.0 - between Bridgewater Corners vicinity and Woodstock - threats to aquatic biota/habitat, aesthetics, secondary contact recreation and contact recreation due to the physical alteration of the channel making it wide and shallow, temperature increases and pathogens due to channelization and instream alteration in the 1970's, and unknown sources. c(1400,1600,1700) s(7100,7600,9000)

INFORMATION SOURCES

John Claussen, Vermont Dept of Fish & Wildlife - noted temperature increases from lack of streambank vegetation as predominent problem (1996).

River Watch Network - Ottauquechee River data from 1992 and 1993 found a number of violations of E. coli standards (11 violations/21 samples) (1994).

Denis Bryer, Vt DEC Public Facilities Division - Bridgewater WWTF had problems in the past with the disinfection system but improvements were made and there shouldn't be pathogen problems. However, an effluent quality problem (organic enrichment/high BOD) is ongoing due to loading from a local brewery (1994

Brian Kooiker, Vermont DEC Wastewater Management Division - noted that the brewery mentioned above is no longer online with the WWTF but has an indirect discharge. The Bridgewater WWTF went through an upgrade and refurbishment in the summer of 1998. (1999)

Mid-Ottauquechee River **VT10-03**

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	0.0	10.0	0.0	0.0	0.0
20	Aquatic biota/habitat	0.0	10.0	0.0	0.0	0.0
21	Fish consumption	10.0	0.0	0.0	0.0	0.0
42	Contact recreation	0.0	10.0	0.0	0.0	0.0
44	Noncontact recreation	0.0	10.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.2	0.0	0.0	9.8
62	Aesthetics	10.0	0.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	10.0
82	Industry water supply	0.0	0.0	0.0	0.0	10.0

Impairment Cause	Magnitude	Size (mi.)
Thermal modifications	T	10.00
Other habitat alterations	T	10.00
Pathogens	T	10.00

Impairment Source	Magnitude	Size (mi.)
Channelization	T	10.00
Removal of riparian vegetation	T	10.00
Unknown source	T	10.00

Point Source Description	NPDES No.
Bridgewater WWTF 0.043mgd	VT0100846
SW - Mountain Brewers to Ottauquechee R	1-1212
none	

Minor Tribs - Mid Ottauquechee

Assessment Report

Waterbody No: VT10-04

River Length (mi.): 5.7 **Classification:**

Description: Tributaries draining to the Mid-Ottauquechee River including Beaver Brook and Curtis Hollow Brook

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 11/22/1999 Surveys of fish and game biologists or other professionals

Water Quality Limited?

On 303(d) List? Y

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

Waste Management Zone - Miles: **Description:**

Assessment Comments

PARTIAL SUPPORT MILES
Unnamed tributary to Ottauquechee: 0.2 (arbitrary distance) - partial support of aquatic biota/habitat due to high iron levels from landfill leachate. c(500) s(6300)

COMMENTS
The Woodstock aqueduct used to take water from the Cox Reservoir as a water supply. Now the primary supply is groundwater and Cox Reservoir is only an emergency supply. The impact to the unnamed tributary that flowed from Cox Reservoir has been removed.
Surface water adjacent to the Bridgewater landfill has been monitored biannually since the spring of 1996. Total iron has been detected above the standard in 6 of the 20 samples collected from the three sampling locations. Nickel, lead, and zinc levels above standard were cited in past assessments but the 1998-1999 test results indicated the standards for these metals were not exceeded.

The following information came from observations during a field survey in early June 1998:
Beaver Brook - clear water, no sign of impacts to water quality or aquatic habitat. Road close to brook in some locations - there is a small buffer in these areas, residential and forest land are the land uses.
Unnamed tributaries - several unnamed tributaries were surveyed and no impacts were noted on any of

Minor Tribs - Mid Ottauquechee **VT10-04**

them. Threats noted were areas where roads were close to streams and banks were steep. Also development in the headwaters of some of these brooks pose a threat.

INFORMATION SOURCES

Rodney Pingree, Vermont DEC Water Supply Division - noted change with respect to Cox Reservoir as a water supply source on May 21, 1998 (1999).

Jerry McArdle, Vermont DEC Water Quality Division - June 1998 field survey information (1999).

Bryan Harrington, Vermont DEC Waste Manangement Division - information on monitoring results from the Bridgewater landfill in a memo to Rick Hopkins date February 10, 2000.

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	5.5	0.0	0.2	0.0	0.0
20	Aquatic biota/habitat	5.5	0.0	0.2	0.0	0.0
21	Fish consumption	5.7	0.0	0.0	0.0	0.0
42	Contact recreation	5.7	0.0	0.0	0.0	0.0
44	Noncontact recreation	5.7	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	5.7
62	Aesthetics	5.7	0.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	5.7
82	Industry water supply	0.0	0.0	0.0	0.0	5.7

Impairment Cause	Magnitude	Size (mi.)
Metals	H	0.20

Impairment Source	Magnitude	Size (mi.)
Landfills	H	0.20

Point Source Description	NPDES No.
none	
none	

Upper Ottauquechee River
Assessment Report

Waterbody No: VT10-05

River Length (mi.): 12 **Classification:**

Description: Ottauquechee River mainstem from confluence of Broad Brook up to confluence of Roaring Brook

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999

Date Last Updated: 11/30/1999

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Assessment Types

Surveys of fish and game biologists or other professionals

RBP III or equivalent benthos surveys

Fish surveys

Aquatic Contamination

Fish abnormalities

Toxics Testing

Waste Management Zone - Miles: **Description:** below Sherburne FD1 WWTF

Assessment Comments

PARTIAL SUPPORT MILES

Ottauquechee River: 12.0 - from confluence with Roaring Brook downstream (overlap with 12 miles below) - partial support of aquatic biota/habitat and non-contact recreation due to flow alterations and water withdrawals for snowmaking. c(1500) s(7420)

THREATENED MILES

Ottauquechee River: 12.0 - from Sherburne Center (confluence of Roaring Brook) to confluence of Broad Brook - threats to aesthetics, aquatic biota/habitat, and non-contact recreation (fishing) due to sedimentation, turbidity, thermal modifications, and nutrient & organic enrichment from riparian vegetation removal, ski area related development, road maintenance practices, streambank erosion and channelization, allegedly failed/poor septic systems, WWTF and land disposal systems. c(900,1100,1200,1400) s(200,3200,6200,6500,7100,7600)

COMMENTS

The upper five miles of this waterbody stretch is strongly influenced by beaver ponds and wetlands. Snails are the intermediate host of black-spot disease in fish and the snails are more common in ponded areas. This is the suspected reason for the black-spot disease in trout noted by John Claussen.

Upper Ottauquechee River **VT10-05**

The Ottauquechee River was sampled at milepoint 27.5 in Bridgewater in October 1992. The macroinvertebrate community health and integrity was found to be excellent.

The Department of Fish and Wildlife has conducted trout population surveys on the Ottauquechee mainstem from 1982 to 1996. This summary is from the memo referenced below. "The very upper station, at elevation 1260 (probably wb 10-06), supported a relatively low population of brook trout in contrast with other Vermont streams of similar size and elevation. Brown trout and rainbow trout were first observed just below this station at elevation 1180. From this station downstream to elevation 1055 (junction of Routes 4 & 100), the trout population is generally comprised of brook and brown trout with lower contributions of rainbow trout. Trout populations in this reach are moderate, and reflect the highest levels observed in the Ottauquechee mainstrem from our sampling. Trout population sampling conducted below this area, from elevation 1010 to 740 (probably wb 10-03), revealed relatively low population levels comprised primarily of brown and rainbow trout, although brook trout were also observed."

INFORMATION SOURCES

Brian Kooiker, Vermont DEC Wastewater Management Division - noted that the permit for the Sherburne FD1 WWTF has still not been renewed (expired in 1989, administratively renewed in 1990 but issues not resolved and the plant does not have a permit from Wastewater). (1999)

Use Attainment for Streams affected by Snowmaking Water Withdrawals in Vermont, David Bottamini, for Vt ANR DEC Water Quality Division, 1996 - water withdrawal impact calculations for Ottauquechee (see also VT10-03) (1998)

Memorandum from Rich Kirn, Vermont Dept of Fish & Wildlife to Cathy Kashanski, Vermont DEC Water Quality Division re: Ottauquechee River mainstem fish populations, November 10, 1998.

John Claussen, Vermont Dept of Fish & Wildlife - noted streambank erosion, black-spot disease in fish (from Mission House bridge upstream to Sherburne), reduced fisheries habitat, sedimentation, increases in water temperature (1988,1996,1998).

Connecticut River Watch Program - monitored eight location along the waterbody in 1992-93 for E. coli - noted improvements from 84-86 citizen collected data (1994).

Rick Carbin, Vermont Land Trust - noted degrading downstream effects; problems associated with flood repair work following 1976 flooding; suspects continued gravel mining in Bridgewater. (1988)

Barry Cahoon, DEC steam alteration engineer - cited Upper Ottauquechee as impacted from development activities. (1988)

Tim Blake, Vt. DEC water resources investigator - noted sediment and land development impacts to river. (1988)

Jerry McArdle, Vermont DEC Water Quality Division - field observations on Upper Ottauquechee in summer of 1997. (1999)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	0.0	0.0	12.0	0.0	0.0
20	Aquatic biota/habitat	0.0	0.0	12.0	0.0	0.0
21	Fish consumption	12.0	0.0	0.0	0.0	0.0
42	Contact recreation	12.0	0.0	0.0	0.0	0.0
44	Noncontact recreation	0.0	0.0	12.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	12.0
62	Aesthetics	0.0	12.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	12.0
82	Industry water supply	0.0	0.0	0.0	0.0	12.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	12.00
Siltation	T	12.00
Organic enrichment/Low D.O.	T	12.00
Thermal modifications	T	12.00
Flow alterations	H	12.00

Upper Ottauquechee River **VT10-05**

Impairment Source	Magnitude	Size (mi.)
Municipal point sources	T	12.00
Land development	T	12.00
Highway/road/bridge runoff	T	12.00
Wastewater (WWTFs)	T	12.00
Channelization	T	12.00
Flow mod.- snowmaking water withdrawal	H	12.00
Removal of riparian vegetation	T	12.00
Streambank modification/destabilization	T	12.00

Point Source Description	NPDES No.
Sherburne FD#1 WWTF 0.30 mgd	VT0101141
Sunrise Spray Disp. - Indirect Discharge	

Minor Tribs - Upper Ottauquechee

Assessment Report

Waterbody No: VT10-06

River Length (mi.): 20 **Classification:**

Description: Ottauquechee River headwaters upstream of Roaring Brook confluence and tributaries including Kent, Roaring, Falls, and Reservoir Brooks

Location Identifiers

NRCS District: 9

ANR Enforcement District: 1 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999

Date Last Updated: 12/30/1999

Assessment Types

Surveys of fish and game biologists or other professionals

RBP III or equivalent benthos surveys

Modeling

Water Quality Limited?

On 303(d) List? Y

Monitored for Toxics? N

Aquatic Contamination

Toxics Testing

Waste Management Zone - Miles: **Description:**

Assessment Comments

NON-SUPPORT MILES

Roaring Brook: 1.5 - from approximate elevation 2240 ft. downstream - non-support of all uses due to flow alteration from a snowmaking water withdrawal. c(1500), s(7420)

PARTIAL SUPPORT MILES

Roaring Brook: 2.1 - from end of non-support stretch to 1.1 miles above Ottauquechee River - partial support of aquatic biota due to flow alteration from a snowmaking water withdrawal. c(1500) s(7420)

Roaring Brook: 1.5 - from milepoint 1.5 to mouth at Ottauquechee River (0.4 miles are an overlap with above just different cause and source) - partial support of aquatic biota and aesthetics due to sedimentation, turbidity, nutrient enrichment, oil, iron precipitate from land development/construction, road runoff, and streambank destabilization. c(500,900,1100,1900), s(3100,3200,4500,7700)

East Branch Roaring Brook: 0.2 - within and below Killington Golf Course - partial support of aquatic biota due to enrichment from golf course runoff. The habitat assessment for this site also indicates that sand and iron bacteria cover the substrate in several areas. c(1100,1200) s(3200,8700)

Falls Brook and a tributary: 1.6 - from Ottauquechee River upstream to a point at elevation 2200 feet on Falls Brook and 2040 on the tributary - partial support of aquatic biota due to flow alterations from a snowmaking water withdrawal. c(1500) s(7420)

THREATENED MILES

Falls Brook: 3.0 - upstream from mouth (overlaps with the 1.6 miles above) - threats to aquatic biota/habitat, aesthetics, and contact recreation (swimming) due to turbidity, moderate sedimentation, nutrient enrichment, and pathogens from upland related land development/construction, streambank destabilization, and allegedly failed septic systems. c(900,1100,1700) s(3100,3200,6500,7700,8700)

Ottauquechee River: 2.7 - above confluence of Roaring Brook to Kent Pond - threats to contact recreation and aquatic biota from sedimentation and turbidity, nutrient & organic enrichment, habitat and thermal modifications, acidity and pathogens from upland area land development/construction, urban area runoff, stump dump leachate, allegedly failed septic systems, and natural causes. c(900,1000,1100,1200,1400,1700) s(3200,4300,6300,6500,8700)

Kent Brook: 1.5 - above Kent Pond - threats to aquatic biota/habitat and contact recreation due to sedimentation and pathogens from upland area development/construction and allegedly poor/failed septic systems. c(1100,1700) s(3200,6500,8700)

COMMENTS

Reservoir Brook, which was listed in past assessments as threatened, has been given full support status for this assessment. Conditions in the permits issued for Woodward Reservoir take care of the downstream conservation flow issues that were the cause for Reservoir Brook's listing in the first place. Reservoir Brook is considered a productive brown trout brook for the Ottauquechee River watershed.

There is a stormwater permit for Trail Creek Condos that allows for the discharge from a swimming pool, hot tubs, and overflow from a potable water tank. The permit requires dechlorination but no results of monitoring or follow-up were found in the permit file during a review of the files in 1998. Staff in the DEC Wastewater Management Division Stormwater Program are following up on it at this time. (1999)

A study by Pioneer Environmental Associates for Killington Ltd. is being done on upland streams in the areas where Killington's ski trails exist. Preliminary results show some streams in good condition while others are threatened or impacted by sediments and/or loss of riparian vegetation. Final results of the 4 year study (last data to be collected in 2000) will be incorporated into the assessment database.

INFORMATION SOURCES

Vermont DEC Wastewater Management Division files (1998)

Use Attainment for Streams affected by Snowmaking Water Withdrawals in Vermont, David Bottamini for Vt ANR DEC Water Quality Division, 1996 - provided information on flow alterations on Roaring and Falls Brooks (1998)

Jeff Cueto, Vt DEC Water Quality Division hydrologist - water withdrawal information in addition to report cited below, status of Reservoir Brook. (1999)

Steve Fiske - Vt. DEC Aquatic Biologist, Ambient Biomonitoring Program - monitoring from 1992 and 1997 led to a "fair" community assessment at milepoint 1.4 on Roaring Brook. "The community is often poor-fair in richness and EPT values. The habitat evaluation showed high levels of sand and embeddedness of the substrate and fair immediate bank conditions. Blue green algae was significant at the site. The fair biological condition of Roaring Brook appears to primarily be a factor of poor habitat caused by streamside erosion and runoff from development." (1998)

Tim Blake, Vt DEC Water Resources Investigator - noted sediment from erosion in Roaring Brook and presence of stump dump along access road. (1988)

Paul Cummings - Vt. DEC Water Resources Investigator - noted construction related erosion impacts to Falls Brook and snowmaking. (1988)

Jonathan Gibson, area resident - noted erosion from construction sites associated with ski area. (1988)

John Claussen, Vt Dept of Fish & Wildlife fisheries biologist - noted loss of fish habitat and fish population; noted parasites and black spot disease in fish. Noted partial use support to uppermost Ottauquechee and threats further downstream. (1988)

Study on the Productivity of Vt. Upland Streams. Vt. DEC 6/82 - noted high to moderate productivity and evidence sedimentation to Roaring Brook. (1988)

The Killington/Pico Upland Stream Study, Pioneer Environmental Associates. (1999)

Minor Tribs - Upper Ottauquechee **VT10-06**

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	0.0	9.6	8.9	1.5	0.0
20	Aquatic biota/habitat	0.0	9.6	8.9	1.5	0.0
21	Fish consumption	20.0	0.0	0.0	0.0	0.0
42	Contact recreation	11.3	4.2	3.0	1.5	0.0
44	Noncontact recreation	18.5	0.0	0.0	1.5	0.0
50	Drinking water supply	18.5	0.0	0.0	1.5	0.0
62	Aesthetics	12.1	4.4	2.0	1.5	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	20.0
82	Industry water supply	0.0	0.0	0.0	0.0	20.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	M	3.00
Siltation	H	5.20
Organic enrichment/Low D.O.	M	2.20
Thermal modifications	S	2.00
Flow alterations	H	5.20
Pathogens	S	3.00

Impairment Source	Magnitude	Size (mi.)
Highway/road/bridge construction	M	3.00
Land development	H	5.20
Onsite wastewater systems (septic tanks)	S	3.00
Flow mod.- snowmaking water withdrawal	H	5.20
Removal of riparian vegetation	M	2.00
Streambank modification/destabilization	M	5.00
Recreational activities	H	6.50

Point Source Description	NPDES No.
SW trib Roaring Brook-Trail Creek Condos	1-0357
SW Mendon Brook - Pico Peak Ski Resort	1-0997
SW Roaring Brook-Grand Hotel & Conf Ctr	1-1288
Killington LTD#1 - Indirect Discharge -	
Killington LTD#2 - Indirect Discharge -	
Killington Hydro - Hydropower Dam - Priv	

Kedron Brook
Assessment Report

Waterbody No: VT10-07

River Length (mi.): 15.4 **Classification:**

Description: Mouth to headwaters and tributaries including Long Hill Brook

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999

Date Last Updated: 12/21/1999

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination

Assessment Types

Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Monitoring data collected by other agencies or organizations

Toxics Testing

Waste Management Zone - Miles: 1.00 **Description:** below South Woodstock WWTF outfall

Assessment Comments

PARTIAL SUPPORT MILES

Kedron Brook: 6.0 - one mile above South Woodstock WWTF downstream to mouth - partial support of contact recreation due to pathogens from horse recreational area, pastures, and stables, also possibly WWTF discharges at times. c(1700) s(1400,8700)

THREATENED MILES

Kedron Brook: 6.0 - from one mile above South Woodstock to mouth (same miles as above) - threats to aquatic biota/habitat, secondary contact recreation and aesthetics from sedimentation, turbidity, thermal modification and nutrient enrichment from horse pastures and facilities, golf course, land development, loss of riparian vegetation, de-stabilized banks and road runoff. c(900,1100,1400) s(1400,3200,7600,8300,8700)

COMMENTS

South Woodstock dechlorination process was operational as of 12/1/91. The South Woodstock WWTF has violated limits for TRC, E. coli and pH during 1996-1997. These violations have not occurred in the last few years.

Overflows from the Woodstock Main WWTF located on Pleasant Street contribute raw sewage to the

Kedron Brook **VT10-07**

stream. These overflows have been "corrected" but not eliminated. "Corrected" in this situation means that an overflow occurs only when a storm event causes an exceedance of the design flow, but they still occur.

1990 River Watch data for Kedron Brook found 6 of 19 sampling sites with one or more fecal coliform violations. Most of the sites with violations are clustered in the South Woodstock area. (1992)

Woodstock Union High School E. coli data from 1999 and 1997 had high numbers from samples taken on Kedron Brook among other locations. Reports and data from the mid-1980's to the present consistently have found fecal coliform or E. coli above standards in most of the samples taken on Kedron Brook. (1999)

Macroinvertebrate sampling in October 1994 at milepoint 5.2 resulted in a community assessment rating of excellent.

Field observations of Kedron Brook in October 1997 included the following:

Lowest 2 miles includes a channelized stretch through Woodstock village and then a stretch along the Woodstock Country Club golf course. The water temperature was 60°F at the golf course on 10/07/97 and the stream substrate in this area was covered with silt and sediment. Little to no buffers were along this stretch adjacent to the golf course.

Further upstream the adjacent land uses include the village of South Woodstock, rural residences, and many acres of horse pasture, stables and a horse association recreational area. A loss of riparian vegetation and algae on rocks in this upper stretch as well as de-stabilized banks indicate threats from the land use activities.

INFORMATION SOURCES

Ottauquechee Conservation District Kedron Brook Project with River Watch Network (1992)

Woodstock Union High School teacher and students - E. coli data (1995,1997,1999) from sites on the Ottauquechee River and tributaries including Kedron Brook. (1999)

John Claussen, Vermont Dept of Fish & Wildlife - confirms threats to Kedron Brook. (1996)

Vermont DEC Water Quality Division biomonitoring data and analysis

Jerry McArdle, Vermont DEC Water Quality Division - field observations on the brook in October 1997.

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	9.4	0.0	6.0	0.0	0.0
20	Aquatic biota/habitat	9.4	6.0	0.0	0.0	0.0
21	Fish consumption	15.4	0.0	0.0	0.0	0.0
42	Contact recreation	9.4	0.0	6.0	0.0	0.0
44	Noncontact recreation	9.4	6.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	15.4
62	Aesthetics	9.4	6.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	15.4
82	Industry water supply	0.0	0.0	0.0	0.0	15.4

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	6.00
Siltation	T	6.00
Thermal modifications	T	6.00
Pathogens	H	6.00

Impairment Source	Magnitude	Size (mi.)
Agriculture	T	6.00
Land development	T	6.00
Highway/road/bridge runoff	T	6.00
Removal of riparian vegetation	T	6.00
Recreational activities	H	6.00

Kedron Brook **VT10-07**

Point Source Description	NPDES No.
Woodstock WWTF Overflow	VT0100757
S. Woodstock WWTF 0.50mgd	VT0100749
S. Woodstock Bypass	VT0100749
Woodstock Golf & Tennis Club - Kedron Br	SW 1-0212
Woodstock Sports Center - Kedron Brook	SW 1-0687
Woodstock CSO - CSO - Kedron Brook - 2	

Broad Brook

Assessment Report

Waterbody No: VT10-08

River Length (mi.): 14 **Classification:**

Description: Mouth to Headwaters & Tribs

Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 12/30/1999 Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

None detected

Waste Management Zone - Miles: 0.00 **Description:**

Assessment Comments

PARTIAL SUPPORT MILES

Broad Brook: 1.5 - below Pinney Hollow to Ottauquechee - partial support of aquatic biota/habitat and aesthetics from sedimentation, and habitat modification caused by streambank erosion and channelization following 1973 flooding. c(1100,1600) s(7100,7700)

COMMENTS

In April 1998, the legislature passed Act 106 that banned the use of suction dredges in any watercourse; required a permit for operation of sluice boxes in any watercourse; exempted hand panning prospecting; and imposed a fee of $30.00 for a resident and $100.00 for a nonresident to operate mineral prospecting equipment. According to Fred Nicholson (see below) who issues permits for the southern part of the state, the number of permits for gold mining is down significantly. Where he might have issued 300 or so permits in his district prior to the legislation and fees, he may issued +/- 10 permits this past year (1999). Still "quite a little" handpanning in the usual places but Fred felt the threat to a stream such as Broad Brook that experienced a lot of gold mining in the past is pretty much gone.

Bridgewater Landfill that was listed here in past assessments is discussed in waterbody 10-03 as its leachate goes to a wetland that is adjacent to the Ottauquechee River itself.

Pinney Hollow Brook was investigated in June 1998. No impacts or threats were noted. The water was

clear even after several days of rain.

Field observations of Broad Brook were also made in June 1998. A sewage odor was noted near the mouth of Broad Brook in a field below a new building. A gravel crushing operation near the bank just up from the mouth was also seen as a possible threat. Further upstream no problems or threats were noted.

INFORMATION SOURCES

Fred Nicholson, Vermont DEC Water Quality Division, Stream Management Program - noted that since the passage of legislation in April 1998 that banned dredges and imposed a fee for use of sluices for gold mining that there is little threat from this activity on Broad Brook. (1999)

Jerry McArdle, Vermont DEC Water Quality Division - field observations of Broad Brook, Pinney Hollow Brook, unnamed tributaries in June 1998. (1999)

John Claussen, Vermont Dept of Fish & Wildlife - noted partial support of fishery for 1.5 miles from erosion/sedimentation and channelization following 1973 flooding. (1988) (still impacts from this activity confirmed 1996)

Tim Blake, Vermont DEC Water Resources Investigator - noted an increase in mining intensity and number of permits. (1988)

Rich Langdon, Vermont DEC Aquatic Biologist in a memorandum dated 1/88 - results of a field study on Broad Brook found: 19 panners, 1 dredge; noted streambank destabilization and turbidity.

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	12.5	0.0	1.5	0.0	0.0
20	Aquatic biota/habitat	12.5	0.0	1.5	0.0	0.0
21	Fish consumption	14.0	0.0	0.0	0.0	0.0
42	Contact recreation	14.0	0.0	0.0	0.0	0.0
44	Noncontact recreation	14.0	0.0	0.0	0.0	0.0
50	Drinking water supply	14.0	0.0	0.0	0.0	0.0
62	Aesthetics	12.5	0.0	1.5	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	14.0
82	Industry water supply	0.0	0.0	0.0	0.0	14.0

Impairment Cause	Magnitude	Size (mi.)
Siltation	M	1.50
Other habitat alterations	M	1.50

Impairment Source	Magnitude	Size (mi.)
Channelization	M	1.50
Streambank modification/destabilization	M	1.50

Point Source Description	NPDES No.
none	

North Branch Ottauquechee River
Assessment Report

Waterbody No: VT10-09

River Length (mi.): 13.5 **Classification:**

Description: Mouth to Headwaters & Tribs

Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 12/30/1999 Surveys of fish and game biologists or other professionals

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

Waste Management Zone - Miles: **Description:**

Assessment Comments

THREATENED MILES

North Branch: 1.0 - in upper reaches where steep slopes drop from road to brook - threat to aquatic biota/habitat, secondary contact recreation and aesthetics due to sediment from road maintenance and runoff, possibility of road failure. s(1100) s(4500)

COMMENTS

A past impact of 0.1 miles due to illegal channelization was removed because the source of the information did not remember the situation and felt it must be recovered by now.

The threats due to pathogens was removed because the latest data from Connecticut RiverWatch in 1992 showed low levels (below the standard) of E. coli not a problem or threat.

Field observations in June 1998 were that the North Branch had no problems and no severe threats. Road placement and road maintenance were identified as somewhat of a threat, however, because of the proximity of the road to the stream and the steepness of the slope to the stream from the road.

INFORMATION SOURCES

Jerry McArdle, Vermont DEC Water Quality Division - field observations of the North Branch Ottauquechee River in June 1998.

North Branch Ottauquechee River **VT10-09**

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	12.5	1.0	0.0	0.0	0.0
20	Aquatic biota/habitat	12.5	1.0	0.0	0.0	0.0
21	Fish consumption	13.5	0.0	0.0	0.0	0.0
42	Contact recreation	13.5	0.0	0.0	0.0	0.0
44	Noncontact recreation	12.5	1.0	0.0	0.0	0.0
50	Drinking water supply	13.5	0.0	0.0	0.0	0.0
62	Aesthetics	12.5	1.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	13.5
82	Industry water supply	0.0	0.0	0.0	0.0	13.5

Impairment Cause	Magnitude	Size (mi.)
Siltation	T	1.00

Impairment Source	Magnitude	Size (mi.)
Highway/road/bridge runoff	T	1.00

Point Source Description	NPDES No.
none	
none	

Barnard Brook

Assessment Report

Waterbody No: VT10-10

River Length (mi.): 30.3 **Classification:**

Description: Barnard Brook from mouth to headwaters and tributaries including Gulf Stream, Richmond Brook

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** WO

Fish and Wildlife District: 3

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 1/10/1999 Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

Waste Management Zone - Miles: **Description:**

Assessment Comments

PARTIAL SUPPORT MILES

Barnard Brook: 1.0 - from dam at Billings Farm upstream one mile - partial support of aquatic habitat and aesthetics due to silt settling out in impoundment. c(1100) s(8800)

THREATENED MILES

Gulf Stream Brook: 4.2 - from Barnard/Pomfret town line to confluence with Barnard Brook - threats to aquatic biota/habitat, secondary contact recreation and aesthetics due to siltation and nutrient enrichment from streambank erosion, road maintenance and runoff, land development near Woodstock, agricultural land uses and removal of riparian vegetation. c(900,1100) s(1000,3200,4500,7600,7700)

Barnard Brook: 2.0 - from South Pomfret downstream (to about the one mile upstream of dam in partial support above) - threats to aquatic biota/habitat, secondary contact recreation and aesthetics due to siltation and nutrient enrichment from loss of riparian vegetation and streambank erosion. c(900,1100) s(7600,7700)

Unnamed tributary to Barnard Brook: 1.0 - threats to aquatic biota/habitat from sediment to brook from town road maintenance. c(1100) s(4500)

INFORMATION SOURCES

Jerry McArdle, Vermont DEC Water Quality Division - field observations on Barnard Brook, Gulf Stream

Barnard Brook **VT10-10**

and their tributaries in October 1997 and May 1998. (1999)

John Claussen, Vt. F&W fisheries biologist - noted impairment to Gulf Stream Brook (1990) and few trout in Barnard Brook in 1996 survey. (1998)

Rick White, Vt Dept of Forests and Parks, 9/24/97 memo - inspected Gulf Stream Brook on 7/23/97 and observed no problems from logging. (1997)

Kevin Kaija, SCS - noted poor gravel road maintenance near Gulf Stream and unnamed tributary as well as bank erosion problems. (1994)

Gordon Lewis, Ottauquechee NRCD Board of Directors - Gulf Stream watershed - ag and residential land use; sees the need to correct streambank erosion/ sedimentation in order to correct/avoid larger problems. (1988)

John Bouton, Windsor Co. forester - noted greater level of impairment at higher flows, also noted streambed scouring problems, noted increased rate and amount of deposition over the past 5-6 years. (1988)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	22.1	7.2	1.0	0.0	0.0
20	Aquatic biota/habitat	22.1	7.2	1.0	0.0	0.0
21	Fish consumption	30.3	0.0	0.0	0.0	0.0
42	Contact recreation	30.3	0.0	0.0	0.0	0.0
44	Noncontact recreation	24.1	6.2	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	30.3
62	Aesthetics	23.1	6.2	1.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	30.3
82	Industry water supply	0.0	0.0	0.0	0.0	30.3

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	6.20
Siltation	H	1.00
Siltation	T	7.20

Impairment Source	Magnitude	Size (mi.)
Agriculture	T	4.20
Land development	T	4.20
Highway/road/bridge runoff	T	5.20
Upstream impoundment	H	1.00
Removal of riparian vegetation	T	6.20
Streambank modification/destabilization	T	6.20

Point Source Description	NPDES No.
Twin Farms Development - UT Barnard Brk	1-1080
none	

Lower Black River
Assessment Report

Waterbody No: VT10-11

River Length (mi.): 8.6 **Classification:**

Description: Black River mainstem from mouth to dam at North Springfield Reservoir

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 2 **Regional Planning Commission:** OW

Fish and Wildlife District: 1

Assessment Information

Assessment Date: 1999

Date Last Updated: 12/8/1999

Water Quality Limited?

On 303(d) List? Y

Monitored for Toxics?

Aquatic Contamination

Assessment Types

Land use information and location of sources

Non-fixed station chemical/physical monitoring-conventional polluta

RBP III or equivalent benthos surveys

Modeling

Discharger self-monitoring data (effluent)

Toxics Testing

Waste Management Zone - Miles: **Description:**

Assessment Comments

NON-SUPPORT MILES

Black River: 2.8 - from mouth upstream - non-support of contact recreation and aesthetics due to organic and nutrient enrichment, pathogens and thick algae growth from CSOs, municipal WWTF, and road runoff. c(900,1200,1700,2210) s(200,400,4500)

PARTIAL SUPPORT MILES

Black River: 3.2 - from North Springfield flood control dam downstream to Fellows dam - partial support of aquatic habitat and secondary contact recreation due to fluctuating flows, temperature increases and siltation from the dam and its impoundment. c(1100,1400,1500) s(7350,7400)

THREATENED MILES

Black River: 2.8 - from mouth upstream (same miles as in non-support) - threats to aquatic biota/habitat, contact recreation, secondary contact recreation and drinking water supply due to nutrient and organic enrichment, suspended solids, pH and toxic compounds from CSOs, WWTF, urban and road runoff and a hazardous waste site. c(900,1000,1200,2100,2210) s(200,400,4500)

Black River: 2.6 - from 2.8 to 5.4 miles above the mouth - threats to aquatic biota/habitat, aesthetics, and contact recreation from nutrients, sediments, temperature increases, oil, grease and metals from urban

Lower Black River **VT10-11**

runoff, road runoff, land development, CSOs, and an impoundment. c(500,900,1100,1400,1900) s(400,3200,4000,4500,7350)

Black River:0.2 - below Springfield Landfill (subset of lowest 2.8 miles) - threats to drinking water and aquatic biota due to priority organics in seep from Old Springfield Landfill. c(300) s(6300)

COMMENTS

Springfield WWTF issues: combined sewer overflows result in discharges of raw sewage from as many as 26 locations in Springfield. Likewise, pump station overflows cause similar impairment. There were permit violations for TRC, settable solids, total suspended solids, and E. coli during 1996-1997. There were 149 days with pH violations from Sept 1997 to June 1998.

Phosphorus samples were taken three times in the summer of 1999 from three stations on the lower Black River. The total phosphorus results were as follows: upstream site (above WWTF & near fire station) = .012mg/liter, .027mg/liter and .018 mg/liter; midway site (below the WWTF about 1/2 mile) = .115mg/liter, .127mg/liter and .101mg/liter; and downstream site (just upstream of Route 5 bridge)= .086mg/liter, .108mg/liter and.101mg/liter. These results were used as to check the ballpark accuracy of estimated upstream and downstream concentrations that were generated using the WWTF effluent phosphorus concentrations, effluent flows, and river flows. Results from the modelling are available from the Water Quality Division.

Macroinvertebrate sampling at milepoint 2.4 resulted in the following community assessments: 1986-fair; 1989-good; 1991-fair; 1992-good/fair; 1995-good; 1997-good; 1999-good. In 1999, a site above the WWTF as well as site 2.4 below were sampled. "The Richness, EPT, PPCS-F and the Bio Index metrics all do indicate that moderate changes have occurred to the macroinvertebrate community at both sites. The richness and EPT index from both sites was just above the Class B biocriteria for VAL (higher order, lower elevation, large rivers or streams) streams. These relatively low values for the numbers of taxa present at both sites indicates a moderate level of impairment to the community." Some level of toxic urban impact is suspected because a moderately enriched community would normally have an increased number of taxa and and increase in algal shredders and scrapes whereas the shredder functional groups were absent from this sample.

Flow fluctuations and other impacts from the North Springfield flood control dam are listed for 3.2 miles from the dam to the first dam in Springfield. Likely the impacts continue on downstream but other pollutants and impacts come into play in Springfield and these are the problems listed from the Fellows dam downstream.

The Jones & Lamson site in Springfield had contaminants of concern including PCBs, VOC, lead, and #6 fuel on its 2 sites in Springfield. Some clean-up work has been done but it is not clear if the floor drains from one of the plants have been cleaned and sealed. These drains presumably connected to outfall pipes are one of the potential sources of pollution to the Black River.

INFORMATION SOURCES

Steve Fiske, Vermont DEC Water Quality Division Biomonitoring Section - macroinvertebrate monitoring data from 1989 to 1999 and analysis of macroinvertebrate community integrity (1992, 1999)

Ken Cox, Vermont Dept of Fish & Wildlife - impacts from North Springfield flood control dam (1996, 1999)

Connecticut River Watch - data from 1990, 1992, and 1993 included violations of E. coli standards in most samples. Samples taken in the lower 3 miles consistently ranged between 300-10,000 counts/100 ml over the 1992-1993 sampling periods (1994).

NH DES Ambient Monitoring Program - high E coli numbers in 92-93 seasons (1994).

George Desch, Vt. DEC Hazardous Materials - noted that remediation has occurred at the Old Springfield Landfill this past season (1993). The landfill has been capped and there is a groundwater intercept pump and treatment system in place (1994).

Matt Germon - noted that a seep with volitiles and semi-volitiles was not addressed by the remediation. Contains vinyl chloride (13 ppb) and other organics. About 300 feet from the Black River. Most probably volatilize before reaching the river. (1994)

Vermont Waste Management Division Sites Management Section files, 1998

Jerry McArdle, Vermont DEC Water Quality Division - field assessment of the Lower Black River in Autumn 1998, (1999)

Lower Black River **VT10-11**

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	0.0	2.6	3.2	2.8	0.0
20	Aquatic biota/habitat	0.0	5.4	3.2	0.0	0.0
21	Fish consumption	8.6	0.0	0.0	0.0	0.0
42	Contact recreation	3.2	2.6	0.0	2.8	0.0
44	Noncontact recreation	2.6	2.8	3.2	0.0	0.0
50	Drinking water supply	0.0	0.2	0.0	0.0	8.4
62	Aesthetics	3.2	2.6	0.0	2.8	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	8.6
82	Industry water supply	0.0	0.0	0.0	0.0	8.6

Impairment Cause	Magnitude	Size (mi.)
Priority organics	T	0.20
Nutrients	M	2.80
Nutrients	T	5.40
Siltation	M	3.20
Siltation	T	2.60
Organic enrichment/Low D.O.	M	2.80
Thermal modifications	M	3.20
Thermal modifications	T	2.60
Flow alterations	M	3.20
Pathogens	M	2.80
Oil and grease	T	2.60
Suspended solids	T	2.80

Impairment Source	Magnitude	Size (mi.)
Municipal point sources	M	2.80
Combined sewer overflows	M	2.80
Land development	T	2.60
Urban runoff/storm sewers	T	2.60
Highway/road/bridge runoff	S	2.80
Highway/road/bridge runoff	T	2.60
Landfills	T	0.20
Upstream impoundment	M	3.20
Flow regulation/modification	M	3.20

Point Source Description	NPDES No.
Springfield WWTF 2.20mgd	VT0100374
Springfield WWTF bypass	VT0100374
Springfield Electroplating	VT0000272
Springfield Mun Swimming Pool	3-0313
Springfield Elderly Housing Project	1-1081
Community College of Vermont	1-1115
Grappone Industrial Facility	1-1211
Springfield State Office Building	1-1303
Springfield CSO - CSO - Black River - 21	
Comtu Falls Hydro - Hydropower Dam - Pri	
Gilman Hydro - Hydropower Dam - Priv - R	
Lovejoy Hydro - Hydropower Dam - Priv -	

Lower Black River	**VT10-11**
N. Springfield Dam - Flood control dam -	
Slack Dam Hydro - Hydropower Dam - Priv	
Fellows Dam Hydro - Hydropower Dam - Pri	
Old Sprgfld Lndfl - Hazardous Waste Site	

Minor Tribs - Lower Black

Assessment Report

Waterbody No: VT10-12

River Length (mi.): 29 **Classification:**

Description: Tributaries draining into lower Black River including Great, Schoolhouse, Chester and Seaver Brooks

Location Identifiers

NRCS District: 9

ANR Enforcement District: 2 **Regional Planning Commission:** OW

Fish and Wildlife District: 1

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 12/13/1999 Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? Y

Aquatic Contamination

Toxics Testing

Pesticides in sediments

Metals in sediments

Waste Management Zone - Miles: **Description:**

Assessment Comments

THREATENED MILES

Great Brook: 6.0 - upstream from mouth - threats to aquatic biota/habitat due to sedimentation from road runoff, encroaching residential yards and homes, channel alterations. c(1100), s(3200,7100,8300)

Spoonerville Brook: 3.0 - threats to aquatic biota/habitat due to sedimentation, turbidity from periodic industrial site discharges (concrete production and storage). c(1100), s(4000)

Chester Brook: 3.0 - threats to aquatic biota/habitat due to sedimentation and turbidity from bank erosion, road runoff, encroaching development. c(1100), s(3200,4500,7700)

Seaver Brook: 3.5 - threats to aquatic biota/habitat due to sedimentation from encroaching development. c(1100), s(3200)

Tribs east of Black River: 6.0 - threats to aquatic biota/habitat due to sedimentation from erosion due to ag runoff, urban runoff, private ponds. c(1100), s(1000,4000)

COMMENTS

Sediment samples were taken by EPA consultants in Baltimore Brook (a trib. to the Black River in North Springfield) as part of sampling program for Johnson & Dix site. One pesticide (29 ppb methoxychlor) was found as well as cobalt (4.9 ppm), silver (1.5 ppm) and sodium (111 ppm). Not likely related to the Johnson & Dix site.

Minor Tribs - Lower Black **VT10-12**

Great Brook appears fairly well shaded in the length observed (approximately 4 miles from North Springfield upstream) due to tree cover or overhanging alder. However, numerous yards, lawns, and residential activity encroach on the riparian zone up to the streambank top or to the brook's edge. From its headwaters to North Springfield, roads cross the brook sixteen times (DeLorme Vermont Atlas & Gazetteer Ninth Edition 1996) and at three places where roads off Route 10 crossed the brook, there were concrete bridges with no edge or barrier to keep sand, debris or other substances from going directly to the brook. (1998)

INFORMATION SOURCES

Ken Cox, Vermont Dept of Fish & Wildlife - noted potential impacts from land development, road runoff... on brooks listed above. (9401) (1998)

Mike Young - Vt. DEC Hazardous Materials Division - Site Inspection Final Report, March 1993 for Johnson & Dix Site, Springfield, Vt.

Cathy Kashanski, Vermont DEC Water Quality Division - field observations of Great Brook. (1998)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	7.5	21.5	0.0	0.0	0.0
20	Aquatic biota/habitat	7.5	21.5	0.0	0.0	0.0
21	Fish consumption	29.0	0.0	0.0	0.0	0.0
42	Contact recreation	29.0	0.0	0.0	0.0	0.0
44	Noncontact recreation	29.0	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	29.0
62	Aesthetics	29.0	0.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	29.0
82	Industry water supply	0.0	0.0	0.0	0.0	29.0

Impairment Cause	Magnitude	Size (mi.)
Siltation	T	21.50

Impairment Source	Magnitude	Size (mi.)
Agriculture	T	6.00
Land development	T	12.50
Urban runoff/storm sewers	T	9.00
Highway/road/bridge runoff	T	9.00
Channelization	T	6.00
Streambank modification/destabilization	T	3.00

Point Source Description	NPDES No.
Fellows Corp-non-contact CW - UT Great	VT0020907
Double Four Orchards Subdiv- UT Black R	1-0537
Pine Brook Town House Dev-UT Baltimore	1-0866
Residential Subdiv-Great Brook& UT Black	1-0986
Pine Brook Condos - UT Baltimore Brook	1-1118
Springfield CSO - CSO - Valley St Brook	

Mid-Black River

Assessment Report

Waterbody No: VT10-13

River Length (mi.): 19 **Classification:**

Description: Dam at North Springfield Reservoir upstream to Cavendish Dam and tributaries including Twenty Mile Stream and Tracer Brook

Location Identifiers

NRCS District: 9

ANR Enforcement District: 2 **Regional Planning Commission:** OW

Fish and Wildlife District: 1

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 12/14/1999 Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

Waste Management Zone - Miles: 1.00 **Description:** downstream from Cavendish WWTF outfall

Assessment Comments

THREATENED MILES

Black River: 9.0 - from Cavendish downstream to Perkinsville - threats to contact recreation because of pathogens from unknown sources. c(1700) s(9000)

Black River: 6.5 - from Cavendish downstream to Downers (subset of 9 miles above) - threats to aquatic biota/habitat and aesthetics due to sedimentation from road maintenance and repair. c(1100) s(4500)

Black River: 1.5 - above No. Springfield Res. - threats to aquatic biota/habitat, secondary contact recreation, and aesthetics due to sedimentation, turbidity, and temperature stress from agricultural land use, construction, and riparian encroachment. c(1100,1400,2500) s(1000,3200,7600)

Chapin Brook: 1.5 - whole length - threats to aquatic biota/habitat due to sediments, nutrients, and temperature from loss of riparian vegetation and road maintenance and runoff. c(900,1100,1400) s(4500,7600)

COMMENTS

The impacts from the Cavendish hydroelectric facility were removed because of the change in operation of the project as described in the findings and conditions in the Water Quality Certification issued in 1993. Following are portions of the Water Quality Certification: "Except as allowed in Condition F below (which addresses special drawdown situations), the facility shall be operated in a true run-of-the-river mode where

Mid-Black River **VT10-13**

instantaneous flows below the tailrace shall equal instantaneous inflow to the impoundment at all times."

"When available from inflow, a minimum instantaneous flow of 10 cfs shall be released at the dam at all times. If the instantaneous inflow falls below the hydraulic capacity of the turbine unit plus this spillage requirement, all flows shall be spilled at the dam... Spillage of 10 cfs during operation can reasonably be expected to maintain dissolved oxygen standards below the project, after mixing with the turbine discharge."

Temperatures will still be affected by the impoundment but should be better because of increased flow and cooling opportunities through Cavendish Gorge.

River Watch Network sampled the Black River in at least 1989,1990,1992,1993 and found fecal coliform (1989) and E. coli (other years) concentrations well above standards in most of the samples taken. Sample sites BIR090 to BIR120. The status was moved from partial support to threatened because there are no more recent data.

The Cavendish WWTF had pump station failures in 1/95, 10/96 and 12/96. A Notice of Alleged Violation (NOAV) was issued in 2/97 for the pump station failures. No failures have occurred since 1996.

Field observations on the Black River between Cavendish and Perkinsville in October 1998 noted silt on the channel bottom as well as a dense cover of algae on the instream rocks.

INFORMATION SOURCES

Ken Cox, Vermont Dept of Fish & Wildlife - provided comments for early assessment on hydro impacts and noted improvements due to the new (1993) operation of the Cavendish facility (1996).

River Watch Network - data from four seasons of sampling (1989,1990, 1992,1993).

Vermont Dept of Environmental Conservation Water Quality Division files - copy of 401 Water Quality Certification for Cavendish Hydroelectic Facility, 1993.

Cathy Kashanski, Vermont DEC Water Quality Division - noted threats from Route 131 closely following a stretch of the Black River and work along the road threatening water quality. (1998)

Jerry McArdle, Vermont DEC Water Quality Division - field observations on the Black River in October 1998. (1998)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	9.5	9.5	0.0	0.0	0.0
20	Aquatic biota/habitat	9.5	9.5	0.0	0.0	0.0
21	Fish consumption	19.0	0.0	0.0	0.0	0.0
42	Contact recreation	10.0	9.0	0.0	0.0	0.0
44	Noncontact recreation	17.5	1.5	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	19.0
62	Aesthetics	11.0	8.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	19.0
82	Industry water supply	0.0	0.0	0.0	0.0	19.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	1.50
Siltation	T	9.50
Thermal modifications	T	3.00
Pathogens	T	9.00
Turbidity	T	1.50

Impairment Source	Magnitude	Size (mi.)
Agriculture	T	1.50
Land development	T	1.50
Highway/road/bridge runoff	T	8.00
Removal of riparian vegetation	T	3.00
Unknown source	T	9.00

Mid-Black River **VT10-13**

Point Source Description	NPDES No.
Cavendish WWTF 0.10mgd	VT0100862
Cavendish 2 Emer-o-flow	VT0100862
Cavendish Hydro - Hydropower Dam - CVPSC	

Upper Black River
Assessment Report

Waterbody No: VT10-14

River Length (mi.): 22 **Classification:**

Description: Cavendish Dam to Confluence of Branch Brook & tributaries

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 2 **Regional Planning Commission:** OW

Fish and Wildlife District: 1

Assessment Information

Assessment Date: 1999

Date Last Updated: 12/16/1999

Assessment Types

Surveys of fish and game biologists or other professionals

RBP V or equivalent fish surveys

Water Quality Limited?

On 303(d) List? Y

Monitored for Toxics? Y

Aquatic Contamination

Toxics Testing

Metals in water column

Metals in discharges

Waste Management Zone - Miles: 4.40 **Description:** downstream of Ludlow WWTF outfall

Assessment Comments

PARTIAL SUPPORT MILES

Soapstone Brook: 0.2 - below Luzenac America Ludlow operations - partial support of aquatic biota due to silt/sand, high iron and arsenic from talc mine drainage. c(500,1100) s(5000)

THREATENED MILES

Black River: 0.5 - from Ludlow WWTF downstream - threats to aquatic biota due to nutrient enrichment from the wastewater treatment plant.
c(900) s(200)

Black River: 3.0 (overlaps with 0.5 mile of threat above) - from bridge above Ludlow WWTP to Route 131 turn-off above WWTP in Cavendish - threats to contact recreation due to high E. coli levels in most samples taken. c(1700) s(9000)

Jewell Brook: 2.0 - upstream from mouth - threats to drinking and agricultural water supplies, aquatic biota, contact and secondary contact recreation due to unknown toxicity factors, other unknown inorganics, and/or dissolved solids from landfill leachate reaching surface water. c(300,800) s(6300)

Unnamed trib to Black River: 0.5 - threats to aquatic biota and water clarity due to sedimentation from parking lot runoff at Okemko Ski Area. c(1100) s(8700)

Upper Black River **VT10-14**

COMMENTS

Ludlow unlined landfill was closed in 1975 before the Solid Waste Rules. It received construction waste until 1991. A site closure plan was approved in 1992 by the Department of Environmental Conservation (DEC), which called for surface water monitoring annually at three sites. (Leachate had been observed to seep from the landfill along a stream.) The town is not required, however, to implement the plan and so no sampling or capping or anything has been done to date (1999).

Ludlow Wastewater Treatment Facility (WWTF) currently treats waste with oxidation canals, three clarifiers and chlorination. It discharges about 350,000 gallons per day with a permit limit of 750,000 gallons per day. The plant however is looking to expand to 1,050,000 gallons per day.

Macroinvertebrate sampling above and below the Ludlow WWTF was done in 1999 at three sites. Two of these sites had been sampled in 1987 and 1991. In 1987 and 1991, the macroinvertebrate community at the site below the WWTF (milepoint 25.6) was somewhat impaired due to nutrient enrichment. In 1999, the biometrics from the 3 sites' samples indicate that "the river is slightly enriched above the WWTF when compared to the reference stream data and increases in productivity below the WWTF. The increase in productivity due to the WWTF, however, does not impair the community to below Class B biocriteria values."

INFORMATION SOURCES

Steve Fiske, Vermont DEC Water Quality Division - macroinvertebrate sampling data from Black River and discussion of results in a memo dated November 1, 1999 to Tim Clear, TMDL Coordinator, DEC Water Quality Division.

Connecticut River Watch Network - E. coli data from 1990,1992, and 1993.

Ken Cox - Vt. F&W fisheries biologist

Bryan Harrington, Vermont DEC Waste Management Division - no new information on the Ludlow landfill. Re-iterated info we have had from past assessments. (1999)

Vermont DEC Wastewater Management Division files

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	16.3	5.5	0.2	0.0	0.0
20	Aquatic biota/habitat	18.8	3.0	0.2	0.0	0.0
21	Fish consumption	22.0	0.0	0.0	0.0	0.0
42	Contact recreation	17.0	5.0	0.0	0.0	0.0
44	Noncontact recreation	20.0	2.0	0.0	0.0	0.0
50	Drinking water supply	0.0	2.0	0.0	0.0	20.0
62	Aesthetics	21.5	0.5	0.0	0.0	0.0
72	Agriculture water supply	0.0	2.0	0.0	0.0	20.0
82	Industry water supply	0.0	0.0	0.0	0.0	22.0

Impairment Cause	Magnitude	Size (mi.)
Priority organics	T	2.00
Metals	H	0.20
Other inorganics	T	2.00
Nutrients	T	0.50
Siltation	M	0.20
Siltation	T	0.50
Pathogens	T	3.00

Impairment Source	Magnitude	Size (mi.)
Municipal point sources	T	0.50
Resource extraction	H	0.20
Landfills	T	2.00
Recreational activities	T	0.50

Upper Black River		**VT10-14**
Unknown source	T	3.00

Point Source Description	**NPDES No.**
Ludlow WWTF 0.70mgd	VT0100145
Ludlow Bypass	VT0100145
Mine Water TF - Luzenac America/0.075mgd	VT0020231
Luzenac Mines - Mine Runoff - Soapstone	
Ludlow Landfill - Landfill - Surface Wat	

Black River Headwaters

Assessment Report

Waterbody No: VT10-15

River Length (mi.): 25.5 **Classification:**

Description: Confluence of Branch Brook to headwaters and tributaries including Patch Brook, Reading Pond Brook and Buffalo Brook

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Location Identifiers

NRCS District: 9

ANR Enforcement District: 3 **Regional Planning Commission:** OW

Fish and Wildlife District: 1

Assessment Information

Assessment Date: 1999 **Assessment Types**

Date Last Updated: 12/20/1999 Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination **Toxics Testing**

Waste Management Zone - Miles: **Description:**

Assessment Comments

THREATENED MILES

Black River: 4.0 - between Lake Amherst and headwaters - threats to aquatic biota/habitat due to erosion, sedimentation, watershed hydrology changes caused by development especially on steep slopes (vacation homes, resort) c(1100), s(3200,7500,7600,8700)

COMMENTS

Buffalo Brook was removed from the threatened category due to the new legislation in effect that bans gold dredging

Field observations of the upper Black river in October 1998 found no obvious impacts to the river's water quality or aquatic habitat from Hawk Mountain Resort upstream. In the area of hawk Mountain Resort, algae was noted on the rocks instream and some bank erosion was observed.

INFORMATION SOURCES

John Claussen, Vermont Dept of Fish & Wildlife (1990)

Jerry McArdle, Vermont DEC Water Quality Division - field observations on the Black River in October 1998 (1999)

Black River Headwaters **VT10-15**

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	21.5	4.0	0.0	0.0	0.0
20	Aquatic biota/habitat	21.5	4.0	0.0	0.0	0.0
21	Fish consumption	25.5	0.0	0.0	0.0	0.0
42	Contact recreation	25.5	0.0	0.0	0.0	0.0
44	Noncontact recreation	25.5	0.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	25.5
62	Aesthetics	25.5	0.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	25.5
82	Industry water supply	0.0	0.0	0.0	0.0	25.5

Impairment Cause	Magnitude	Size (mi.)
Siltation	T	4.00
Other habitat alterations	T	4.00

Impairment Source	Magnitude	Size (mi.)
Land development	T	4.00
Watershed hydrological changes	T	4.00
Removal of riparian vegetation	T	4.00
Recreational activities	T	4.00

Point Source Description	NPDES No.
none	
Lake Ninevah Hydro - Hydropower Dam - Pr	

North Branch - Black River

Assessment Report

Waterbody No: VT10-16

River Length (mi.): 19 **Classification:**

Description: Mouth to Headwaters & tributaries including Knapp Brook, Alder Meadow Brook, Darby Brook

Location Identifiers

NRCS District: 9

ANR Enforcement District: 2 **Regional Planning Commission:** OW

Fish and Wildlife District: 1

Assessment Information

Assessment Date: 1999

Date Last Updated: 12/20/1999

Assessment Types

Surveys of fish and game biologists or other professionals

Occurrence of conditions judged to cause impairment

Water Quality Limited?

On 303(d) List? N

Monitored for Toxics? N

Aquatic Contamination

None detected

Toxics Testing

Waste Management Zone - Miles: **Description:**

Assessment Comments

THREATENED MILES

North Branch: 6.0 - from Felchville area downstream to Stoughton Pond - threats to aesthetics, aquatic biota and habitat, swimming and fishing due to sedimentation, turbidity, nutrient contributions, temperature stress and pathogens from streambank erosion, road maintenance, riparian encroachment, suspected septic system problems and agricultural land uses on highly erodable soils. c(900,1100,1400,2500) s(1000,4500,7600,7700)

Knapp Brook: 1.0 - from confluence with North Branch upstream one mile - partial support of aquatic biota due to sedimentation from town road maintenance. c(1100) s(8300)

COMMENTS

Field observations in November 1998 noted no obvious problems or impacts to the North Branch of the Black River. However, roads, field, lawns encroach on the riparian buffer and corridor.

INFORMATION SOURCES

Mark Rosenthal, Army Corps of Engineers - noted 15 acre zone of deposition to north end of Stoughton Pond over last 22 years; attributes much of the problem to natural streambank erosion with some cropland and animal induced erosion. (1988)

North Branch - Black River **VT10-16**

Ken Cox, Vermont Dept of Fish & Wildlife (1988,1990,1999)

Connecticut River Watch Network - data from 1990, 1992, and 1993 showed high levels of E. coli at sample site at Little Ascutney Road bridge in Weathersfield. (1992,1994)

Kevin Kaija, Natural Resource Conservation Service (1994)

Jerry McArdle, Vermont DEC Water Quality Division - field observations on the North Branch in November 1998. (1999)

Use No.	Use Description	Fully	Threat	Partial Support	Non Support	Not Assessed
01	Overall	12.0	7.0	0.0	0.0	0.0
20	Aquatic biota/habitat	12.0	7.0	0.0	0.0	0.0
21	Fish consumption	19.0	0.0	0.0	0.0	0.0
42	Contact recreation	13.0	6.0	0.0	0.0	0.0
44	Noncontact recreation	13.0	6.0	0.0	0.0	0.0
50	Drinking water supply	0.0	0.0	0.0	0.0	19.0
62	Aesthetics	13.0	6.0	0.0	0.0	0.0
72	Agriculture water supply	0.0	0.0	0.0	0.0	19.0
82	Industry water supply	0.0	0.0	0.0	0.0	19.0

Impairment Cause	Magnitude	Size (mi.)
Nutrients	T	6.00
Siltation	T	7.00
Thermal modifications	T	6.00
Pathogens	T	2.00
Turbidity	T	6.00

Impairment Source	Magnitude	Size (mi.)
Agriculture	T	6.00
Land development	T	6.00
Highway/road/bridge runoff	T	7.00
Onsite wastewater systems (septic tanks)	T	1.00
Removal of riparian vegetation	T	6.00
Streambank modification/destabilization	T	6.00
Natural sources	T	6.00

Point Source Description	NPDES No.
none	
none	