

Water Quality Certification
(P.L. 92-500, Section 401)

In the matter of: Central Vermont Public Service
 Corporation
 77 Grove Street
 Rutland, Vermont 05701

APPLICATION FOR THE CAVENDISH
HYDROELECTRIC PROJECT

The Water Quality Division of the Vermont Department of Environmental Conservation (the Department) has reviewed a water quality certification application dated October 8, 1992 and filed by Central Vermont Public Service Corporation (the applicant). This application has been supplemented by a copy of the Federal Energy Regulatory Commission (FERC) license application filed with the FERC on December 31, 1991 and subsequent submittals from the applicant, including an August 1993 Additional Information Request (AIR) response to FERC. The Department, based on the application and record before it, makes the following findings and conclusions:

I. Background/General Setting

1. The applicant has applied to the FERC for relicensure of the Cavendish Hydroelectric Project located on the Black River at river mile 20.8 approximately one mile downstream of the village of Cavendish.
2. The Black River, a tributary to the Connecticut River, originates at the outlet of Black Pond in the Town of Plymouth. The Black River drains a total area of 202 square miles in Rutland and Windsor Counties. The main stem is approximately 38 miles long, from its source to its confluence with the Connecticut River. The valley of the Black River is generally narrow with the surrounding drainage composed of hilly and mountainous terrain.
3. The upper reaches of the basin are forested and support a wide range of recreational activities that are important to the local economy. The village of Cavendish, located upstream of the Cavendish impoundment, historically was a manufacturing community and some of the mill buildings that remain continue in industrial use.

Springfield, downriver of the project, is the largest community in the basin. It is primarily a manufacturing center for the machine tool industry.

4. The Cavendish Project is the most upstream hydroelectric facility on the river and the only one that is utility owned. Several facilities have been privately developed downstream in Springfield during the last decade: Fellows, Gilman (construction commenced in fall 1992), Comtu Falls, Slack Dam, and Lovejoy.
5. The Cavendish hydroelectric facility was originally developed by the Claremont Power Company and began operation in 1907.
6. Three municipal wastewater treatment facilities discharge to the Black River. The Ludlow treatment facility is located five miles upstream of the Cavendish Project and has a design discharge of 600,000 gpd. Downstream facilities include Cavendish, which discharges to the Black River 800 feet below the project at a 100,000 gpd design, and Springfield which discharges just downstream of Springfield village at a 2.2 mgd design.

II. Project and Civil Works

7. The dam is founded on rock and consists of two sections of overflow spillway. The north section is 90 feet long, and the crest elevation 878.13 feet (msl) is 25 feet above the lowest foundation level. The south section is 21 feet long and includes a 6-foot pier that separates the north and south section of the dam. The crest elevation of the south section of the dam is 881.63 feet (msl) and is only about two feet above the bedrock foundation. The north section of the dam is fitted with 6-foot high, hinged flashboards. The flashboards on the south section are 2.5 feet high and are designed to fail during periods of high flow. The normal headwater elevation is 884.13 feet (msl), and the normal tailwater elevation is 764.6 feet (msl), providing a gross head of 120 feet.
8. The impoundment has a surface area of 10 acres, a useable storage capacity of 800,000 cubic feet

(three-foot drawdown), and a normal backwater influence of 3,000 feet.

9. The concrete intake structure is located on the north bank and serves as the north abutment of the dam. The intake configuration consists of a submerged entrance set parallel to the flow of the river, manually operated headgates, and an inclined trashrack.
10. A power tunnel parallel to the river carries the plant flow 180 feet from the intake to the penstock. The 6-foot diameter penstock is 1,250 feet long. A penstock manifold located adjacent to the powerhouse divides the flow and distributes it to the turbines.
11. The powerhouse contains three horizontal-shaft Francis turbines, manufactured by the Pelton Water Wheel Company. The turbines are coupled to two 520 kw generators and one 400 kw generator. The units have adjustable wicket gates operated by a headwater float control or remote control from the applicant's dispatch office. Except for routine monitoring, inspection, and maintenance, the plant operates automatically and unattended.
12. The estimated average annual generation is 6,108,500 kwh based on the last twenty years of record.
13. The powerhouse substation is located adjacent to the access road almost directly across from the entrance to the powerhouse. The existing substation includes a 3-way transformer which steps up the voltage from 11 kv to 12.5 kv and 44 kv for distribution.

III. Flow Regime

14. The project hydraulic capacity is 19 cfs to 226 cfs.
15. The drainage area at the dam is 83 square miles. A gaging station has been operated by the U.S. Geological Survey on the Black River at North Springfield since October 1929. The drainage area at the gage is 158 square miles. Several of the flow parameters for the project have been estimated using the gage data and are shown in the

following table. Some parameters may be influenced by the artificial flow regulation caused by the Cavendish Project and the U.S. Corps of Engineers flood control reservoir at North Springfield. The 7Q10 estimate is based on the flow record preceding the construction of North Springfield Reservoir (November 1960).

Parameter	Value
Mean runoff	154 cfs (25.27 in/yr)
7Q10	9 cfs
95% Exceedance	16 cfs
50% Exceedance	72 cfs
10% Exceedance	370 cfs

16. Present operation is as a daily peaking plant with headpond drawdown from storage of 3.0 feet.
17. The applicant proposes to operate the project in a true run-of-the-river mode and maintain the impoundment level one foot (plus or minus six inches) below the top of the flashboards, except during periods of flooding and emergency local energy demand. A true run-of-river project is one which does not operate out of storage and, therefore, does not artificially regulate streamflows below the project's powerhouse. Outflow from the project is equal to inflow to the project's impoundment on an instantaneous basis. The flow regime below the project will essentially be the river's natural regime, except under special circumstances, such as following the reinstallation of flashboards and project shutdowns.
18. Routine monitoring, inspection and maintenance will continue as in the past. The plant will operate in a semi-automatic and unattended mode. The project would operate with all three units as inflows allow. As inflows to the project's impoundment diminish, a flow sensor will adjust load between the units. As flows continue to recede, two of the units would sequentially be removed from the line leaving only the most efficient turbine generator unit on line. This

turbine would also eventually be removed from service when river flows became less than the minimum operating point of 19 cfs. The applicant states that all river flow would then pass over the boards and downstream.

19. Under the applicant's operating proposal, a lag time will occur between turbine shutdown and restoration of natural flows below the powerhouse. The lag time would be a function of 1) the time required to fill the storage between the operating level and the dam surcharge necessary to spill at the reservoir inflow rate and 2) the travel time for the spillage flow to reach the project tailrace. The time alone required to refill the impoundment when the plant shuts down under low flow is over seven hours. During the lag time, below-project flows would be substantially curtailed. The applicant proposes no means of resolving this issue for all incidents, purportedly because it would occur infrequently (letter from applicant to Department, July 17, 1993). The Department reviewed streamflow records collected at the Ayers Brook gage in Randolph to estimate how frequently the transition from generation to no generation would occur as a result of low natural flows. Based on water years 1987 to 1991, the lag time and consequent flow interruption would occur 0 to 9 times per year.
20. According to September 16, 1993 comments filed by the applicant in response to the draft certification notice, a small stoplog section at the dam is removed, prior to an intentional shutdown, to release flows into the bypass. This dam release is maintained until bypass flows stabilize at the project tailrace at which point the gates to the turbines are closed and flows through the powerhouse cease. With a full pond, the applicant reports that this release equates to about 15 cfs; this is somewhat less than the 19 cfs minimum capacity of a project turbine. The applicant estimates that it takes approximately 40 to 50 minutes for the 15 cfs release to stabilize at the powerhouse. At impoundment levels less than full pond, the release through the stoplog section would be less, and the time it would take for releases at the dam to stabilize at the powerhouse would be longer. This special

operating protocol somewhat reduces the number of flow interruptions that occur.

21. No special protocols are in place or proposed to offset flow interruptions that result from non-intentional plant shutdowns.
22. The hinged flashboards are frequently dropped to reduce the upstream effect of the dam on flooding due to storm events or snowmelt runoff. The decision to lower the flashboards is based on the judgement of the operator and central dispatch, taking into consideration river conditions at the time and forecasted weather. Of the 18 panels, six to eight are usually lowered. After highwater, flashboards are typically reset when the water recedes to a two-to-four-foot surcharge over the dam crest.

With the impoundment operating level set at one foot below the top of the boards, highwater events and flashboard management would result in a one to three foot drawdown of the impoundment. However, under some circumstances, greater drawdowns to below the dam crest are effected in order to insure worker safety. An example is when ice is moving in the river. (letter from applicant to Department, July 17, 1993)

23. The following table indicates the applicant-estimated frequency that the flashboards are dropped as a result of highwater events:

Period	Frequency (no. events)
November - February	1-2
March - April	10-12
May	3-4
June - August	0-1
September - October	2-3

24. The applicant states that below-project flow is not an issue when the flashboards are reset as the project is typically operating under a full load (226 cfs, or 2.7 csm) during that time. Also, the

applicant estimates that the flow through one downed panel at two feet of head is 50 cfs. A release of 276 cfs is well above the summer aquatic base flow of 0.5 csm prescribed by the U.S. Fish and Wildlife Service Flow Recommendation Policy for the New England Area (USF&WS Flow Policy) and the Agency of Natural Resources Interim Procedure for Determining Acceptable Minimum Stream Flows, July 1993 (Agency Flow Procedure). Brown and rainbow trout may spawn in the mainstem of the Black River below the project. The USF&WS Flow Policy and Agency Flow Procedure prescribe 1.0 csm for the fall/winter period and 4.0 csm for the spring period to protect spawning and incubation. The release of 226 cfs is higher than the fall/winter prescription but lower than the spring prescription.

25. The Cavendish station supplies up to 70% of the local load under emergency conditions, using up to five feet of the storage capacity in the impoundment. These events occur on a less than annual basis, but can result in extensive dewatering upstream.
26. The applicant proposes to continue the existing method of flashboard operation.
27. The project automation (SCADA) system has an accuracy of ± 1.0 inch, and will be set to the fixed level of one foot below the top of the flashboards. Occasional use of manual control due to SCADA loss would result in a six inch fluctuation in impoundment levels; the applicant estimates that the SCADA system would be non-functional for two or three events a year on the average, and the events would last less than an hour.

IV. Bypass

28. The bypassed stream section is 1,570 feet in length, and is a natural feature named the Cavendish Gorge. The gorge is a beautiful natural resource of high local, regional, and statewide importance. The historical operating mode of the project virtually dewateres the gorge for much of the year.

29. The Agency publication The Waterfalls, Cascades, and Gorges of Vermont (1985) describes the gorge as a large beautifully sculptured gorge with pools and cascades:

Visually it is a striking place; the rocks and the mosses are beautiful, the water is clean, and there are high walls and handsome pools. You cannot hear cars from the gorge, and because it is narrow and winding you have a strong sense of privacy and isolation. A lovely and satisfying place and in good condition. (pages 219-220)

The report describes the gorge as averaging 50-100 feet wide at the base with slanting or shear rock walls from 50-80 feet high. The rock is a hard quartzite schist with garnets and quartz veins and is mapped as Cambrian Hoosic schist on the "Centennial Geologic Map of Vermont". The rock does not contain limestone. There are boulders 10 to 20 feet high in the stream channel, and many of these have potholes cut into them in the lower part of the gorge. Some are cut almost entirely away.

30. The channel consists of a series of cascades or chutes linking pools of various sizes. The largest and finest of these is about 70 feet by 40 feet with a depth of nine feet at low water. There are no sand and gravel deposits at the base of the walls, and no areas that support woody plants. Because of the lack of soil, all of the vascular plants in the gorge are confined to ledge tops and cracks in the walls. Large areas of the walls are covered with mosses and liverworts. (ibid)
31. In the lowest third of the bypass, the pools are connected by channel sections that are best characterized as riffles.
32. According to its response to FERC AIR No. 3 (August 1993), the applicant proposes to release 10 cfs into the bypass continuously from April 15 to October 31. During the remainder of the year, except when inflows either are too low for operation or exceed project capacity, the bypass would be subject to leakage flow conditions. (Leakage is supplemented by a very small amount of direct drainage.) Leakage flows are estimated by the applicant to be 3 to 5 cfs, although leakage

was measured at 2.3 cfs just before a special study in 1993.

V. Standards Designation

33. The Black River is designated as Class B waters for its full length. Recent legislation eliminated Class C zones and substituted waste management zones in Class B waters. The 16.5 mile reach of the river from the northern limits of Ludlow Village to the North Branch in Weathersfield is a waste management zone that receives the discharges from the Ludlow and Cavendish municipal wastewater treatment facilities. The Water Resources Board has designated the entire Black River as cold water fisheries habitat.

The lengths of waste management zones are being reviewed by the Department and will be reset based on rules to be promulgated by the Water Resources Board. The Agency plans to reset waste management zones for streams at the time discharge permits for treatment facilities located on those streams come up for renewal. The existing discharge permits for the Ludlow and Cavendish facilities are up for renewal in September 1996.

34. Class B stream reaches are managed to achieve and maintain a high level of quality compatible with certain beneficial values and uses. Values are high quality habitat for aquatic biota, fish and wildlife and a water quality that consistently exhibits good aesthetic value; uses are public water supply with filtration and disinfection, irrigation and other agricultural uses, swimming, and recreation. (Standards, Section 3-03)
35. Waste management zones, although Class B waters, present an increased level of health risk to contact recreational users due to the discharge of treated sanitary wastewater.
36. The project reach is a substantial distance below the Ludlow municipal facility outfall. Dieoff of pathogenic organisms over the section of river from the outfall to the head of the project impoundment minimizes the risk to contact recreationalists using the project reach. The project reach will probably be removed from the

waste management zone. (pers. comm. Peter LaFlamme, Agency Water Quality Engineer)

37. The dissolved oxygen standards for cold water habitat streams are 6 mg/l or 70 percent saturation, unless higher concentrations are imposed for areas that serve as salmonid spawning or nursery areas important to the establishment or maintenance of the fishery resource. The temperature standard limits increases from background to 1.0°F. (Standards, Section 3-01(B)) The turbidity standard is 10 ntu. (Standards, Section 3-03(B))
38. Under the general water quality criteria, all waters, except mixing zones, are managed to achieve, as instream conditions, aquatic habitat with "[n]o change from background conditions that would have an undue adverse effect on the composition of the aquatic biota, the physical or chemical nature of the substrate or the species composition or propagation of fishes." (Standards, Section 3-01(B)(5))
39. Section 2-02 Hydrology of the Vermont Water Quality Standards requires that "[the] flow of waters shall not be controlled or substantially influenced by man-made structures or devices in a manner that would result in an undue adverse effect on any existing use, beneficial value or use or result in a level of water quality that does not comply with these rules." The project dam is a man-made structure that artificially regulates streamflow.

VI. Water Quality

a. Chemical

40. The applicant collected temperature and dissolved oxygen data in 1986 and 1988 under the project's cycling mode of operation. The applicant then collected data under run-of-river conditions in June and August 1991 to evaluate the expected water quality effects of the project in the proposed operational mode. In 1989, an independent fisheries enhancement study was initiated by the applicant. Water temperature was monitored continuously during the summer of 1989 as part of this study.

41. The application indicates temperature data collection in August 1989 revealed that the impoundment thermally stratifies during the summer months. At a location 200 feet upstream of the dam, an 8° F difference was recorded between the surface temperature and bottom temperature.
42. The Department collected temperature and dissolved oxygen data in 1986 under run-of-river flows at stations above and below the project to evaluate conditions under summer low flows.
43. Data collected over the 1986-1991 period indicates the influence of algal activity on dissolved oxygen concentrations in the project's impoundment. Critical summer low flow conditions did not occur during the majority of the sampling days, the lowest flow sampled being 16 cfs (roughly twice 7Q10).
44. On July 15 and July 16, 1993, the applicant performed an around-the-clock study of dissolved oxygen and temperature conditions in the bypassed reach pursuant to a FERC additional information study request. Samples were collected at the project intake, directly below the dam, and just upstream of the powerhouse. Total river flow was estimated at 15 to 25 cfs during the study.

Surface samples taken at the intake station were at or above saturation throughout the sampling day, even in the nighttime, when deficits are usually expected due to algal respiration. Some samples directly below the dam exhibited dissolved oxygen concentrations that were less than saturation, but characteristically lower in temperature. This may be attributable to the source of the leakage being from groundwater or seepage from greater reservoir depths, although some samples were supersaturated like the impoundment surface samples. Water at the lowest station displayed cooler temperatures of as much as 2°C. All samples were well above minimum dissolved oxygen standards.

45. The applicant indicates that the impoundment becomes thermally stratified under summer low flow conditions. The project intake is located at a reservoir depth of about 25 to 28 feet. Because the penstock and turbines convey water in a closed

system, the water is not exposed to the atmosphere and reaerated. The powerhouse discharges water that is equivalent in dissolved oxygen concentration to the concentration that exists at the intake. Should substandard conditions occur in the reservoir, these conditions would be passed downstream.

46. Water spilled at the dam benefits from reaeration at the dam and through the gorge. It is likely that the water would rapidly attain saturated concentrations. This water would mix with the turbine discharge and result in an increased concentration of oxygen downstream in the zone affected by the Cavendish wastewater treatment facility discharge.
47. The applicant proposes to maintain a 10 cfs bypass release during the critical summer water quality period (the months of June through October). This flow is slightly higher than the 7Q10 drought flow condition (9 cfs) at the project. Spillage of 10 cfs during operation can reasonably be expected to maintain dissolved oxygen standards below the project, after mixing with the turbine discharge. Further, when flows recede to 29 cfs (the minimum plant capacity of 19 cfs plus the dam release), the project would suspend operation in order to maintain the run-of-the-river conditions, and all inflows would be released at the dam. Consequently, under summer low flow conditions, all flows would be released at the dam and benefit from reaeration.
48. Details on how the water would be released at the dam have not been provided. The design for the release mechanism may affect the efficiency of reaeration and the temperature of the water.
49. The conversion of the project to a true run-of-river facility is expected to improve water quality below the project, as downstream flows will no longer be subject to peaking flows and artificial drought conditions.
50. The shallow, wide impoundment causes an increase in water temperature over what would have naturally occurred; however, an impoundment or reservoir is considered a "natural" condition once constructed, for the purposes of Standards review.

Although data is limited, the low elevation of the intake probably draws water that is lower in temperature than water at the surface of the impoundment. Water discharged at the dam benefits from the cooling that occurs through the gorge, as shown by the 1993 study. Run-of-river conditions will prevent elevated temperatures attributable to unnaturally low flows downstream of the project.

51. Because natural river flows will be continuously available downstream, the impact of the project on concentrations or levels of the following parameters will not be significant:

Phosphorus
Nitrates
Settleable, floating or suspended solids
Oil, grease, and scum
Alkalinity
pH
Toxics
Turbidity
Escherichia coli
Color
Taste and odor

b. Aquatic Biota

52. Aquatic biota are defined in Standards Section 1-01(B) as "organisms that spend all or part of their life cycle in or on the water." Included, for example, are fish, aquatic insects, amphibians, and some reptiles, such as turtles.
53. Game species including brown, rainbow and brook trout, northern pike, large and smallmouth bass, and walleye are found in the Black River basin. The Black River mainstem supports wild populations of brown and brook trout.
54. The application indicates that the mainstem cannot be classified as a trout stream because of excessive summer water temperatures. Although Agency biologists as recently as 1976 believed that this was the case, the Agency now believes that the regulation of the river, with its consequent elevated water temperatures and reduced flows, was the dominant factor impacting the

density of the trout population. (August 12, 1991
Agency letter to applicant)

Below Project

55. Flows below the tailrace will essentially be unregulated. This proposed flow regime will optimize conditions for fish life downstream of the project powerhouse.
56. The station's deep water intake and use of this cooler water for the discharge at the tailrace, combined with a true run-of-river operating mode, will reduce high summer water temperatures in the Black River when the station is operating.
57. Artificial flow regulation below the tailrace is anticipated to occur during impoundment refilling following flashboard reinstallation. The applicant proposes to release half of inflows during the refill period. Artificial flow regulation below the tailrace will also occur as a result of lag time.
58. The USF&WS Flow Policy and the Agency Flow Procedure prescribe minimum flows for the perpetuation of indigenous fish species. The minimums are 4.0 csm for spring spawning and incubation, 1.0 for fall/winter spawning and incubation, and 0.5 csm for the remaining period and in cases where there is no use for spawning and incubation. When instantaneous inflows are less than these values, the inflow must be passed. At the Cavendish Project, these values are 332 cfs (4.0 csm), 83 cfs (1.0 csm), and 42 cfs (0.5 csm). Reduction of flows substantially below these minimums for the purpose of refilling the impoundment may imperil fish below the project.
59. Continuous release of the USF&WS flows or 90% of inflows, where the inflow is less than the USF&WS flow, would protect downstream fish and other aquatic organisms during the refill period.

Bypass (Cavendish Gorge)

60. The primary value of the fish habitat in the gorge is holding cover with little or no spawning use expected. Pool habitat exists at frequent intervals throughout the entire bypass reach. The

lower third of this reach has pools which are accessible to trout present in the river below the powerhouse, provided adequate flow is maintained through the riffles that connect pools in this reach. The upper two thirds of the bypass provide habitat for fish that enter the bypass via downstream movement from above the dam.

61. The applicant, with Agency participation, conducted a flow demonstration of the project bypass on December 13, 1990. Observed flows were 10, 20, 25, and 35 cfs; these flows included dam leakage. At 10 cfs, pool habitats appeared very calm with a slightly perceptible laminar flow on the water surface, or an almost stagnant quality. At a flow release of 20 cfs, surface turbulence increased only very slightly. Water depth increased 2 to 3 inches. The third flow release, 35 cfs, created a noticeable change in the character of the pools. Water depth increased several inches and the flow through the pools was distinct. The upper end of the pools in association with cascades was turbulent, but not excessive, and the pool water surface was obviously laminar and rippled. The final test involved backing off from 35 cfs to 25 cfs. The character of the pools at 25 cfs was hardly distinguishable to the eye from conditions under the higher 35 cfs flow.

Based on this demonstration, a flow range of 25 to 35 cfs provides conditions in the bypass most suitable to trout. Aeration and the exchange rate in the pools is adequate, and the degree of surface turbulence provides an additional element of fish cover without being excessive. Water velocities may approach the upper limit for trout at flows much in excess of 35 cfs. (Department of Fish and Wildlife memorandum from Kenneth Cox to Roderick Wentworth, December 28, 1990) The applicant's consultant categorized the fisheries habitat as "excellent" when flows were increased to the 20 to 25 cfs range. The consultant's opinion was that a flow of 10 cfs provided "less than optimal" habitat and that a flow of 13 to 16 cfs provided reasonable turnover of pools, adequate pool volumes, and a significant improvement over the 10 cfs condition. (letter of February 22, 1991 from Aquatec Inc. to the applicant)

62. Aquatic insects are an important component of the food chain and a primary food source for fish. With sufficient flow, the gorge reach provides habitat that supports use by aquatic insects (macroinvertebrates).
63. The applicant's proposed bypass flow regime, a seasonal release of 10 cfs, would not restore fish habitat quality in the 1,570-foot section of river. Upstream and downstream fish movement through the bypass would continue to be restricted; the quality of the pool habitat as holding cover would be poor; and no flow would be provided for over-wintering fish, insect life, and other aquatic organisms.
64. The USF&WS Flow Policy prescribes 0.5 csm, the regional average August median flow, as the flow standard for protection of indigenous fish species where higher flows are not warranted to protect spawning and incubation. The August median flow at the Cavendish site, based on the regional average, is 42 cfs. The Agency Flow Procedure states that bypass minimum streamflows at hydroelectric projects shall be set based on case-specific analysis of the bypass's potential or existing uses and values, but that prescribed flows shall generally be no less than 7Q10 in order to protect dissolved oxygen levels and aquatic habitat.
65. A spillage flow in the bypass reach of 25 cfs, or instantaneous inflow, if less, would be sufficient to support fish residence in the riffle and pool habitats; enable upstream and downstream fish movement; and provide habitat for macroinvertebrates. Year-round minimum flows set at less than 25 cfs, but greater than 3 cfs, would result in sub-optimal habitat conditions but constitute an improvement over present leakage conditions.

Impoundment

66. Fisheries habitat that was formerly riverine (lotic) has been transformed into lacustrine habitat due to the impounding of water by the dam. The quality of the impoundment as lacustrine habitat is poor. The impoundment depths are

shallow, except at the dam, relative to natural lakes and ponds, and retention times short.

67. By letter dated August 3, 1990, the Agency requested bathymetric information for the impoundment in order to study habitat availability and wetland conditions at different impoundment levels and the effects of drawdowns. As the applicant failed to furnish the bathymetric information, the assessment of project impacts on river habitat and wetlands is difficult.
68. Flashboard collapse causes dewatering of the riparian-zone habitat. Fish and other aquatic organisms that use the impoundment are subject to stranding or freezing when major drawdowns occur.

Fish Passage

69. A Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River Basin (1982) identifies the Black River as potential non-natal smolt production habitat for stocking consideration at such time in the future that the program's hatchery fry production capacity expands to meet the needs of non-natal streams. The plan estimates that there are 2,700 units (one unit = 100 sq. yards) of salmon nursery habitat upstream of the project. The Black River was stocked with 23,124 salmon fry on July 1, 1993, distributed in the 4.6 mile reach directly upstream of the project impoundment. The fry were surplus stock from the White River National Fish Hatchery. Under the plan, the river was tentatively scheduled to be stocked with 90,000 parr this fall; however, the number may be reduced somewhat due to the fry stocking. Present plans are to continue fry stocking above the project on an annual basis, barring hatchery catastrophes such as disease problems. Most salmon stocked as fry emigrate from river systems two years following stocking. (March 25, 1993 and May 14, 1993 memorandums from Roderick Wentworth, Department of Fish and Wildlife to Laurence Becker, Water Quality Division; July 1, 1993 memorandum from District Biologist James McMenemy to Roderick Wentworth)
70. Operational downstream passage facilities for Atlantic salmon will be necessary at the project

by the spring of 1995. Passage facilities should include structures or devices to safely convey fish downstream of the dam. This may include screening to minimize entrainment and impingement and a conveyance conduit. Standard design for downstream passage facilities utilize operating flows equivalent to 2% of the plant hydraulic capacity, or the flow through a 3x2 foot rectangular weir, whichever is greater. For this project, the flow need would equate to about 20 to 25 cfs. It will be necessary to operate these facilities continuously during the period April 1 - June 15 and September 15 - November 15. These periods are subject to adjustment based on knowledge gained about migration periods for salmon in the Connecticut River basin. (March 25, 1993 and May 14, 1993 memorandums from Roderick Wentworth, Department of Fish and Wildlife to Laurence Becker, Water Quality Division)

71. The applicant has agreed to provide downstream passage if the river upstream is used for annual stocking in accordance with a revised restoration plan. (license application, Page E-53)
72. The Strategic Plan was last revised in September 1982 and is presently being revised once again.
73. By letter dated September 7, 1993, the USF&WS required the installation and operation of downstream passage facilities at the project.

General

74. The applicant's consultant, Aquatec, studied the macroinvertebrate population at stations in the bypass and downstream. Aquatec classifies the water quality below Cavendish station as "good" based on the biotic index (BI) value of 2.3.
75. The mean EPT value and community richness values (biological indicators of water quality) for the site are in the "good" range. The BI value is a 2.25, indicating good water quality exists at the site in terms of organic enrichment. The EPT/Chiro ratio (4.86) shows that the sensitive EPT orders outnumber the tolerant Chironomidae family four to one. The percent composition of the major orders show the Ephemeroptera, Trichoptera and Coleoptera to dominate the stream

community. The functional groups within the community are dominated by the scraper group, with all groups being represented. The scraper group dominance probably means non-filamentous diatom/green algae is a primary food source in the stream. The collector/filterer groups are not overly dominant indicating that these generalist-type feeding strategies are not well represented, depressing community functional diversity. (May 3, 1991 memorandum to the record from Steven Fiske, Water Quality Division)

76. Aquatec sampled a pool station in the bypass. The numbers and diversity of macroinvertebrates were reduced from the values sampled in the below-project riffle. This may be more attributable to the difference in physical habitat type than the lack of sufficient bypass flows. The riffle in the lower end of the gorge above the plant was not sampled. Had it been sampled, the data collected could have been compared to the downstream riffle data in order to evaluate the impact of reduced flows on macroinvertebrate productivity.
77. An increase in minimum flows in the bypass and the resultant expansion of constantly wetted streambed would substantially improve the macroinvertebrate productivity of the bypass riffle habitat.
78. The biological integrity below the Cavendish facility was good in 1990. The data are illustrative of conditions that existed during a year when run-of-the-river flows predominated and thus represent the potential of the biological community in the Black River.
79. The river water quality and institution of a true run-of-river flow regime with continuous spillage will protect the biological integrity in the Black River below the Cavendish facility, including macroinvertebrates, fish, and other aquatic organisms.
80. Prescription of an appropriate minimum flow for the bypass is important to project economics. AIR No. 3(c) relates to the cost of alternative minimum streamflow releases into the bypass. Table 2 of the August 1993 filing indicates the production losses associated with special releases from 10 to 35 cfs. The releases are in addition

to the 4 cfs leakage flow. A continuous special release of 21 cfs (25 cfs total) would reduce project output by about 942 mwh, or 15% of the average annual energy output, for the 30-year term of the federal license; a special release of 10 cfs year round, would result in about a 300 mwh, or 5%, reduction in output. The applicant indicates that the production loss for its proposal would be 270 mwh; however, this estimate is actually for a 10 cfs special release in addition to the 4 cfs leakage.

81. The water use as proposed, with the imposition of special conditions related to operating level, and release of minimum flows, will not impair the viability of the existing population of aquatic biota and fish. The use will neither significantly impair growth or reproduction nor cause an alteration of the habitat which impairs the viability of the existing population.

c. Wildlife and Wetlands

82. Vermont Water Quality Standards requires the Agency Secretary to identify and protect existing uses of state waters. Existing uses to be considered include wetland habitats and wildlife that utilize the waterbody. Class II wetlands exist within the influence of the dam backwater zone.
83. An area of meadows is located approximately 1,400 feet upstream of the Cavendish Dam where conditions are favorable to the development of emergent wetlands. Much of the wetland complex is a shallow marsh dominated by cattail, great bulrush, and other graminoids. Some aquatics such as pickerelweed and water-plantain occur as well. These areas are continuously inundated except during periods of downed flashboards, when they may become dewatered.

Large open meadows very thickly vegetated with Joe-Pye weed, Virgin's bower, reed-canary grass and brambles are raised slightly above the shallow marsh on old river terraces and are perhaps inundated occasionally. Only a few specimens of purple loosestrife, a nuisance aquatic plant, are found. Alder thickets in the old river channels

and backwaters contain herbaceous plants in openings which are flooded on an annual basis.

84. A true run-of-river operation will, in part, eliminate several environmental concerns associated with impoundment water level fluctuations, including wildlife. However, the loss of flashboards and their anticipatory lowering prior to flood events remains a serious concern. (reference Finding 22) Lowering the pond elevation would have a detrimental effect on fish and wildlife residing in the pond or using the upstream wetland during critical seasons of the year, such as times of fish spawning and incubation, waterfowl nesting, and periods of hibernation of reptiles and amphibians.

Regarding wetland vegetation, flashboard loss could result in the dewatering of root stocks. Winter drawdowns expose rootstocks of perennial plant species in the drawdown zone to freezing conditions which prevent the further establishment of certain species. Winter drawdowns can also cause "freeze-outs" of hibernating amphibians and wintering aquatic furbearers and drawdowns during the spring and early summer can cause loss of cover and increased predation of young waterfowl broods.

85. The applicant notes concerns about herptile hibernacula in the application. A single loss of the boards during the December-to-March period could be sufficient to cause mortality to hibernating species.
86. Reducing the frequency of flashboard collapse and resultant lowering of impoundment levels, particularly in the winter months, would increase the functional value of impoundment wetlands, especially for wildlife habitat, shoreline stabilization, and food chain production.
87. To maximize wildlife utilization of emergent wetland habitat in the impoundment during the summer months, the applicant originally proposed to maintain the impoundment six inches below the top of the boards during the period June 1 - October 1. From October 2 to May 31, the impoundment would be maintained at a lower level, one foot from the top of the boards, to prevent an

ice cap that could prevent lowering of boards during a flood event. Because of the Agency's interest in stable water levels, the proposal was modified to maintain the impoundment at the minus one foot level year round.

88. Many herps begin selection of hibernacula during September, and therefore, would not be served by reduced impoundment levels in the winter months. (January 29, 1991 letter from Jim DiStefano, Department of Fish and Wildlife to Jeff Wallin)
89. A constant year round water level will protect the wetland and the wildlife that utilize the water body.
90. Institution of a run-of-the-river operating mode will protect downstream wetlands that may exist and wetlands present in the backwater zone.
91. Wildlife that use the riparian zone and river will be better supported by the improved operating regime. Typical wildlife would include furbearers such as otter, beaver, muskrat, mink, and deer and birds such as kingfisher, herons, ducks, and osprey.
92. The water use as proposed, with the conditions imposed below, will not impair the viability of the existing population of wildlife. The use will neither significantly impair growth or reproduction nor cause an alteration of the habitat which impairs the viability of the existing population.

**d. Rare and Endangered Plants and Animals;
Outstanding Natural Communities**

93. On May 28, 1991, the applicant conducted a study to assess the impact of variable flows on the bryophyte communities at Cavendish Gorge. The results of this study are presented in a report "The Impact of Variable Flows on Bryophyte Communities at Cavendish Gorge, Cavendish, Vermont" (Cyrus B. McQueen, with addendum, no date). Four sites of bryophyte communities near the current water level along the west side of the gorge were examined. These communities were selected for study based on their accessibility;

the applicant did not attempt to inventory the full extent of bryophytes in the gorge.

The four sites examined included a rare boreal species known as Scapania umbrosa. One site was found to be located within a few inches of the water surface. The other three sites, downstream from the first, contained Scapania umbrosa (one site with two colonies of plants more than 12 inches above the current water level).

94. The extent of inundation of the four bryophyte sites was observed at flows of 10.5 cfs, 14.5 cfs and 29.5 cfs. The first site with Scapania umbrosa was submerged by about 6.5 inches of water at 10.5 cfs, 10 inches at 14.5 cfs, and 15 inches at 29.5 cfs. The latter flow was observed to be more turbulent. This site is in a narrower portion of the gorge compared to the other sites. The applicant concludes that the bryophytes at this site, and particularly the Scapania umbrosa, would not survive a year round flow of 29.5 cfs. The other three sites were not submerged at any of the flows observed.
95. FERC requested, through FERC AIR No. 9, an inventory and further evaluation of the impact of minimum flows on the bryophyte. A copy of the study report was filed with the Department on July 28, 1993 and is based on field work done June 30, 1993.
96. In the report, McQueen states that Scapania umbrosa was found at six sites, including three of the original sites; the new sites were in close proximity to the original sites. One of the original sites is gone.
97. Cavendish Gorge is presently the only known location of Scapania umbrosa in Vermont. A subarctic-subalpine species, Scapania umbrosa is found from the northern limit of the spruce-fir biome to nearly its southern limit and has been collected in Labrador, Newfoundland, Nova Scotia, Quebec, Maine (Mt. Katahdin), New Hampshire (Mt. Washington and Mt. Lafayette), New York (Mt. Marcy), and on the shores of Lake Superior (Wisconsin and Ontario). Most potential habitat for the species in Vermont has been searched. The habitat of the species is in areas of continual

high humidity, commonly along wet, rocky mountain streams. It is found on rotted logs at higher elevations, but can also occur on rocks in cool, wet situations such as associated with ice caves or gorges. In gorges, it typically grows near the water level, but as with all liverworts, it is a poor competitor, slow growing, and is often abraded away by the scouring action of a stream. Liverworts can colonize by fragmentation or spore release. (McQueen 1993 report and pers. comm. with Robert Popp, Agency Heritage Program)

98. Scapania umbrosa probably represents a relict, subarctic population of bryophytes that date back to a period of time after the continental glacier retreat. Because it has a limited and disjunct distribution in North America, it is not likely that it colonized the gorge in recent time. (McQueen 1993 report)
99. The areal extent of the Scapania umbrosa population was measured as part of the second study, and trial flows were released to determine submergence. The gorge was also fully mapped and the pools given number designations starting with Pool 1 just above of the powerhouse and ascending in number to Pool 9 at the base of the dam.
100. Half of the total population of Scapania umbrosa was submerged at a flow of 12 cfs. At flows of 20 cfs and 25 cfs, 62% and 66% of the population was flooded, respectively. At 25 cfs, three sites would be inundated; a fourth would be reduced in size by 54%; a fifth would be reduced by 31%; and a sixth was postulated to be lost over time even though not flooded during the study. The remaining area projected not to be inundated over time at 25 cfs was estimated at 2.7 square feet.
101. The six sites of Scapania umbrosa are located in the area of pools 4 and 5. The extent of inundation of the plant can be controlled through modifications to the pool outlets. For example, the elevation of the water surface at a release of 12 cfs can be reduced to be equivalent to the leakage water surface elevation. For Pool 4, this would involve lowering the pool by 9 inches, and for Pool 5, 7 inches. If the scope of the work is limited to minor modifications, then such action would not be unduly intrusive to the natural

values of the gorge. Either or both outlets could be modified.

102. The distribution and size of bryophyte colonies in the gorge is dynamic, as evidenced by the loss of one site subsequent to the May 1991 survey and the existence of the bryophyte under both pre-project and post-project conditions. The pool outlets are composed of cobbles and boulders that can move during extreme flow events, naturally changing the hydraulic conditions at the pool outlets under base-flow conditions.
103. If the outlet to Pool 4 is modified, the 50% inundation estimate under 12 cfs flow can be reduced to 34%.
104. Site 1, the second largest of the six sites, comprising an area of 2.37 square feet, is directly below the outlet of Pool 6 and at the head of Pool 5. Increased flows surcharge a portion of the pool control on river left and flood Site 1. This site could be protected by either modifying the outlet of Pool 6 or selecting a base flow that is slightly below the flow that surcharges the left portion of the control. Protection of this site would further reduce the loss of the bryophyte population from 34% to 23%.
105. Jerry Jenkins, in The Waterfalls, Cascades, and Gorges of Vermont, notes that the gorge walls at the largest pool in the gorge are covered with liverworts Marsupelia emarginata and Scapania nemorosa to heights of 40 to 60 feet above the river. The authors of that publication considered Cavendish Gorge to be an important bryophyte habitat, having seen few Vermont gorges with bryophytes so lush or extending up the walls to such heights.
106. The six sites studied by McQueen are close to the level of leakage flow; it cannot be predicted with certainty how the bryophytes may redistribute in the gorge in reaction to a change in the base-flow regime and whether Scapania umbrosa would persist. Minor modification of the pool outlets may be feasible and result in close to status quo conditions for one or more of the plant sites.

107. Scapania umbrosa is not protected under Vermont's endangered species law. McQueen states that more information on its number of populations in Vermont and research on its ecology and reproductive biology are needed before it can be considered for listing as rare or endangered. The Agency will ask that the Endangered Species Committee consider the plant's eligibility for listing.
108. McQueen recommended a trial period at a minimum flow of not more than 10 cfs during which extensive research would be done on the reaction of the several bryophyte species to the change in gorge hydrology; he recommended four to five years of flow manipulation and experimentation. If Scapania umbrosa were able to recover its lost habitat (total area), then further experimentation at higher flow levels could go forward. Loss of areal coverage beyond his projected levels would be cause for considering a reduction in base flows.
109. A conservatively designed study would allow research on the ability of the plant to adapt to changes in the gorge base flow with minimal risk of large loss or extirpation from the gorge. The study components should include initial examination of non-intrusive minor modification to pool controls, implementation of any feasible modifications, and staged increases in base flows with ongoing evaluation of bryophyte community distribution and strength, which would be the factor upon which to base any changes in minimum flows. Coupled with the study would be the determination of the plant's listing qualifications.
110. No endangered or threatened plants or animals are known to inhabit the project reach.

e. Shoreline Erosion and Impoundment Desilting

111. The application indicates no areas of severe shoreline erosion within the Cavendish impoundment that need correction in order to prevent excessive turbidity and sedimentation. The applicant's fisheries, archeological, and botanical consultants substantiate this claim. The applicant's proposed operating mode will minimize

the potential for new problems to develop in the future.

112. Impoundment desilting can result in significant degradation of water quality if not executed properly. Due to the deep intake, desilting has been neither severe or frequent at this project according to the applicant. Development of a desilting plan is, therefore, unnecessary at this time. Should the need to desilt arise in the future, the applicant should seek review by and approval from the Agency under the existing Agency desilting policy.

f. Recreation and Aesthetics

113. The river in the project vicinity is popular for several recreational uses, including fishing, swimming, sunbathing, boating, photography and viewing. Reference also Finding 28, which describes the gorge as reported in the publication The Waterfalls, Cascades, and Gorges of Vermont.
114. The area surrounding Cavendish hydroelectric project is largely undeveloped. Neighboring the project and approximately 3,000 feet to the southwest is the Proctor-Piper State Forest, a public landholding of 1,513 acres. To the northeast is the Hawk Mountain Wildlife Management Area, which borders the project. The area provides for hunting and hiking opportunities.
115. Access to the waters within the project has always been free and open to the public, whether for fishing in the impoundment or downstream of the station or for sightseeing in the gorge. Established paths lead through the woods to the pool and riffle area below the station and are used on occasion by fishermen and picnickers. An undeveloped maintenance road exists into the dam/impoundment area from the west and offers car-top boating access. There is also a pathway leading from the powerhouse to a scenic overlook onto the gorge, as shown on a site assessment concept proposal provided to the Department in a June 3, 1993 letter.
116. From the Agency's site investigation, it is evident that a substantial amount of recreational activity occurs in the area of the undeveloped

access road on the south side of the river. This use will increase in the future after the implementation of environmental constraints related to project operation and with the general trend towards increased public use of parks and natural areas.

117. The uncontrolled use of the area, at this time, is causing some degradation of the site. This was evident in the number of trails criss-crossing the area, presence of fire rings, and the lack of sanitation. Without proper controls and management, further degradation will occur and the "wild and pristine" character of the site will be compromised. (August 12, 1991 Agency letter to applicant)
118. Vermont Water Quality Standards require the protection of existing water uses, including the use of the water for recreation. The Standards also require the management of the waters of the State to improve and protect water quality in such manner that the beneficial values and uses associated with a water's classification is attained.
119. Beneficial values and uses of Class B waters include water that exhibits good aesthetic value and use for swimming and recreation. Section 2-02 of the Standards prohibits regulation of river flows in a manner that would result in an undue adverse effect on any existing use, beneficial value or use.
120. The river is a navigable and boatable water of the State.
121. The applicant presents a site assessment concept proposal in a June 3, 1993 letter to the Department ("Site Assessment Concept Proposal - Cavendish Gorge Hydroelectric - Visual Aesthetic Evaluations", rev. October 30, 1992). This proposal includes development of a parking and picnic area below and north of the powerhouse. Understory planting between existing trees and around the substation will help to reduce visual prominence from the proposed public parking and picnicking areas. From the parking area, a trailhead and directional signs to the river are proposed and a winding trail to a hemlock grove

along the river below the powerhouse for river access. The applicant proposes to allow continued access via the undeveloped maintenance road into the dam/impoundment area from the west for cartop boating and viewing the gorge. A canoe access site is proposed on the east side of the gorge from a point directly upstream of the dam. The canoe access point was originally proposed in the license application as the take out for a canoe portage on the east side of the gorge.

122. The applicant proposes to develop and maintain the proposed recreational facilities at the site. Should vandalism become a problem, however, the applicant states such facilities would be removed and open access may be restricted. (Page E-58 of license application)
123. By letter dated August 12, 1991, the Agency recommended that the undeveloped maintenance road be maintained to allow vehicle access and limited parking and that the road should remain primitive but use of a four wheel drive vehicle should not be a prerequisite for access. The Agency also recommended that a vehicle turn around be provided at the end of the road, within easy foot access to the eastern side of the gorge below the dam. The applicant stated that it would accommodate the Agency's recommendations to the extent acceptable to the town of Cavendish.
124. The Appalachian Mountain Club River Guide - New Hampshire/Vermont (second edition, 1989) indicates that the Black River provides good runs on easy to moderate rapids, although sectioned by dams. The Black River from the lake reach above Ludlow through Perkinsville supports boating up to a Class III level over a length of 25 miles. Take-out above the dam is difficult, and a carry of one quarter mile is necessary. Reentry below the dam is also a problem.
125. One of the most limiting factors to boating the river is the lack of provisions for portaging the applicant's dam. The dam, therefore, impairs boating on a navigable river. Recreation and recreational boating are designated uses for the Black River. Where designated uses have been impaired or eliminated, all reasonable steps should be taken to restore such uses.

126. On June 6, 1989, the Agency commented on the applicant's FERC initial consultation document for relicensing. The Agency stated "[c]onvenient portage routes should be provided where there are none presently."
127. On June 14, 1993, the Agency participated in a site recreational evaluation with the applicant and Cavendish town manager. It was determined that a feasible portage route exists on the east side of the gorge and that provision of a portage would necessitate minimal improvements--signage, limited trail brushing, and other minor work. However, the applicant stated that a portage was not a desirable amenity for the site and that it did not plan to provide one. Instead, it offered an ingress point below the powerhouse and on the west bank of the river. (memorandum to the file from William Martinez, June 23, 1993)
128. The applicant has not committed to providing a portage at its dam.
129. According to staff observation and the publication The Waterfalls, Cascades, and Gorges of Vermont, the gorge is a popular local swimming area. Changes in the minimum flow through the gorge will affect the character of the gorge pools for swimming. The significance of this issue has not been explored, but can be addressed in concert with the bryophyte study that is being required as a condition of this certification.
130. In the absence of the conditions below, the proposed project would result in a significant degradation of the existing use of water for recreation in or on the water and for fishing. These uses depend on the preservation of the existing level of water quality.
131. The area is highly scenic with a number of hiking trails. The dam, powerhouse, and penstock are not visible from most of the gorge and much of the gorge is undisturbed and secluded.
132. The project's civil works alter the morphological and physical character of the river. The adverse impacts on river aesthetics that have occurred can be mitigated in part through the establishment of an adequate minimum flow.

133. Spillage of flows over the dam and through the gorge is a significant aesthetic component of the project setting. The gorge appears bare and lifeless under existing leakage flow conditions. The sight and sound of flowing water is essential to the character and visual enjoyment of the area.
134. The applicant conducted a flow demonstration to document on video-cassette tape various flow releases through the gorge for aesthetics. The applicant's consultant, New England Land Plan, determined based on this demonstration that a flow of 10 to 20 cfs "provides adequate visual relief to compliment the more dominant geological features of the gorge area." (license application, Page E-36)
135. It is the opinion of the Agency's landscape architect that a minimum flow release of at least 15 cfs is needed to satisfy aesthetic concerns in the bypass. Anything less would be lost in the boulders and crevices of the gorge. (Rodney Barber memorandum, June 24, 1991)
136. In 1993, the Agency contracted with a independent landscape architect, Robert White, to review the issue of site aesthetics, especially with respect to bypass flows. Mr. White filed his report, Aesthetic and Recreation Facility Analysis of the Cavendish Dam and Hydroelectric Station, by letter dated August 30, 1993. Mr. White reviewed the applicant's flow-demonstration video and visited the site on August 27, 1993. During the site visit, the station was down, and the flow in the bypass was about 14 to 20 cfs according to the plant manager, who was at the site. In completing his assessment, he considered several variables: the sound level, which increased with rising flows; visual quality of the water falling into the series of pools; the visual quality of water flowing through the cascades or riffles connecting pools; and the visual quality of water spilling uniformly over the dam as opposed to a weir discharge.
137. Mr. White recommends a flow of 15 cfs to support the aesthetic qualities of the gorge and suggests the investigation of measures to pass the flow uniformly over the dam. His report includes a tabular evaluation of the visual and aural

qualities from three vantage points at the several flows video taped (a leakage of 2 cfs to 38 cfs). At each of the three vantage points, all of which are on the top of the north gorge wall, good visual qualities were attained when flows increased to the 12 to 17 cfs range from the low of 2 cfs. Further enhancement continued as flows increased above that range.

138. The applicant's proposal to spill 10 cfs, or instantaneous inflow if less, during the period of mid-April through October, and leakage flows the remainder of the year would be sufficient to support the intrinsic value of the gorge and user enjoyment when most public use occurs. Leakage flow through the remainder of the year would not support the gorge's intrinsic values, including aesthetics.

VII. Other Uses

139. Downstream, the river is used for wasteload assimilation at the Cavendish Wastewater Treatment Plant. If the project is operated run-of-the-river with adequate bypass flows, the river as a receiving water will have sufficient dissolved oxygen concentrations and dilution capability to assimilate Cavendish's wastewater. The river is also used for electrical production at several hydroelectric projects in the Springfield. The proposed project, as conditioned below, is compatible with this use.

VIII. Other Applicable State Laws

Vermont Endangered Species Law (Title 10, Sections 5401 to 5403)

140. The Vermont Endangered Species Law (Title 10, Sections 5401 to 5403) governs activities related to the protection of endangered and threatened species. Generally, a person shall not "take, possess or transport wildlife or plants that are members of an endangered or threatened species." (Title 10, Section 5403(a)) Disturbance of a endangered or threatened species is considered a taking. (Title 10, Section 4001)
141. The applicant does not propose any construction or operational activities at the site that would

impact any endangered or threatened species. Although it is known only from this single site in Vermont, the liverwort Scapania umbrosa is not currently listed on the Vermont Endangered and Threatened Species list. The applicant proposes protection of this plant. The Department agrees that protection is desirable and is so conditioning the certification, along with initiating further investigation of eligibility for listing.

Agency Regulatory Powers over Fish and Wildlife

142. Under 10 V.S.A. Chapter 103, "[i]t is the policy of the state that the protection, propagation control, management and conservation of fish, wildlife and fur-bearing animals in this state is in the interest of the public welfare, and that safeguarding of this valuable resource for the people of the state requires constant and continual vigilance."
143. The water use as proposed, with the conditions imposed below, will be consistent with this state policy.

IX. State Comprehensive River Plans

The Agency, pursuant to 10 V.S.A. Chapter 49, is mandated to create plans and policies by which Vermont's water resources are managed and uses of these resources are defined. These plans implement the Agency policy. The Agency must, under Chapter 49 and general principles of administrative law, act, when possible, consistently with these plans and policies.

Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities

144. The Department's publication Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities is a state comprehensive river plan. The hydropower study, which was initiated in 1982, indicated that hydroelectric development has a tremendous impact on Vermont streams. Artificial regulation of natural stream flows and the lack of adequate minimum flows at the sites were found to have reduced to a large extent the success of the state's initiatives to restore the

beneficial values and uses for which the affected waters are managed.

At the Cavendish project, the plan recommends that studies be conducted to evaluate project impact on downstream fish and macroinvertebrates; project impact on water quality; impact of leakage flows on fisheries, aesthetics and recreational values in the project's bypass. Mitigation recommendations were to be based on the results of such studies. A specific recommendation of the plan is that minimum flow requirements be established for this project in order to improve the downstream fishery, water quality, and aesthetics.

1988 Vermont Recreation Plan

145. The 1988 Vermont Recreation Plan (Department of Forests, Parks and Recreation), through extensive public involvement, identified water resources and access as top priority issues. The planning process disclosed that, while Vermonters and visitors focus much of their recreational activities on surface waters, growing loss of public visual and recreational access to those waters causes substantial concern to the users. The plan projects that access is "likely to become the critical river recreational issue of the 1990s." The need for development of portage trails and canoe access sites is cited as among the major issues relative to canoe trails in Vermont.

146. The Water Resources and Access Policy is:

It is the policy of the State of Vermont to protect the quality of the rivers, streams, lakes, and ponds with scenic, recreational, and natural values and to increase efforts and programs that strive to balance competing uses. It is also the policy of the State of Vermont to provide improved public access through the acquisition and development of sites that meet the needs for a variety of water-based recreational opportunities.

147. Enhancement of access, provision of a portage, and improved flow management would be compatible with this policy and balance competing uses of the river for recreation and hydropower. Nonassurance of access or failure to provide a convenient

portage trail would exacerbate a critical state recreational problem.

148. Another priority issue identified in the Recreation Plan is the loss or mismanagement of scenic resources. The plan notes "[few] recreational activities in Vermont would be the same without the visual resources of the landscape," and that protection of those resources is "necessary if the state is to remain a desirable place to live, work, and visit."

149. The Scenic Resources Protection and Enhancement Policy is:

It is the policy of the State of Vermont to initiate and support programs that identify, enhance, plan for, and protect the scenic character and charm of Vermont.

150. Landscaping, provision of dam spillage, and maintenance of bypass and downstream flows will protect the scenic characteristics of the shoreline area and river.

Vermont Comprehensive Energy Plan

151. Pursuant to Executive Order No. 79 (1989), the Department of Public Service produced the Vermont Comprehensive Energy Plan, January 1991. This plan sets out an integrated strategy for controlling energy use and developing sources of energy. Several goals of the plan are to reduce global warming gases and acid rain precursors by 15% by the year 2000 through modified energy usage; to reduce by 20% by the year 2000 the per capita consumption of energy generated using non-renewable energy sources; and to maintain the affordability of energy.

152. The loss of electrical power production associated with mitigation needed to meet water quality standards will have a negligible effect on overall power availability and rates.

The expected regional power surplus from the New England and New York power pools is 13,389 megawatts for Winter 2002-2003. Because the facility would be operated in a base-load fashion (run-of-the-river), no operating reserve (storage function) is available. The applicant has large

amounts of base-load power at its disposal.
(testimony of Robert Howland, Central Vermont
Power's Manager of Power Supply, before the State
Public Service Board in Docket No. 5171)

153. Continued availability of electricity generated by this renewable source, with proper environmental constraints in place, is consistent with the State energy plan.

ACTION OF THE DEPARTMENT

Based on its review of the applicant's proposal and the above findings, the Department concludes that there is reasonable assurance that operation of this project as proposed by the applicant and in accordance with the following conditions will not cause a violation of Vermont Water Quality Standards and will be in compliance with sections 301, 302, 303, 306, and 307 of the Federal Clean Water Act, P.L. 92-500, as amended, and other appropriate requirements of state law:

- A. The applicant shall operate and maintain this project as set forth in the findings of fact and conclusions above and these conditions.
- B. Except as allowed in Condition F below, the facility shall be operated in a true run-of-the-river mode where instantaneous flows below the tailrace shall equal instantaneous inflow to the impoundment at all times. When the facility is not operating, all flows shall be spilled at the dam.

The applicant shall, within 90 days of issuance of this certification, furnish a description, hydraulic design calculations, and plans for the measure to be used to maintain true run-of-river flows below the project tailrace. This plan shall include operating protocols or measures that will eliminate or substantially reduce the effects of lag time and deviations from true run-of-the-river conditions below the project.

- C. 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. Within 90 days of the issuance of this certification, the applicant shall furnish a description, hydraulic design calculations, and plans for the measure to be used to pass this minimum flow.

- D. Except during periods when the project's control system is down or the flashboards have failed, the level of the impoundment shall be maintained no lower than 6 inches below the design crest of the flashboards. When the control system is down, the impoundment shall be maintained no lower than 12 inches below the crest of the boards.
- E. The applicant shall manage impoundment levels such that deviations in excess of minus two feet from the normal operating level are eliminated. The applicant shall develop and propose for Department approval a management plan for such controls within 90 days of issuance of this certification. Consideration may be given to a permanent reduction in the normal operating level of the impoundment; however, such an option would have to include an assessment of the impact on upstream wetlands and their values.
- F. Following the reinstallation of flashboards or an approved special maintenance operation necessitating a drawdown, the impoundment shall be refilled by reducing downstream flows, but to no less than 42 cfs from June 1 to September 30, 83 cfs from October 1 to March 31, and 332 cfs from April 1 to May 31. Under circumstances where the natural inflow to the project is insufficient to permit both passage of these minimum flows and refilling of the impoundment, the impoundment can be refilled while releasing 90% of instantaneous inflow downstream at all times.
- G. The applicant shall file for review and approval, within 90 days of the issuance of this certification, a plan for monitoring instantaneous flow releases at the project, both in the bypass and below the tailrace. Following approval of the monitoring plan, the applicant shall then measure instantaneous flows and provide records of discharges at the project on a regular basis as per specifications of the Department. Upon receiving a written request from the applicant, the Department may waive, all or in part, this requirement for flow monitoring at this project provided the applicant satisfactorily demonstrates that the required flow will be discharged at all times.

H. On or before April 1, 1994, the applicant shall submit a plan for downstream fish passage to the Department of Fish and Wildlife for review and written approval. Downstream passage shall be provided April 1 - June 15 and September 15 - November 15 and shall be functional with and without flashboards in place, with the period subject to adjustment by the Department based on knowledge gained about migration periods for migratory salmonids. Unless deferred by the Agency, the approved plan shall be implemented by April 1, 1995. The plan shall include provisions to:

1. minimize passage of fish into the generating unit(s);
2. minimize impingement of fish on trashracks or on devices or structures used to prevent entrainment; and
3. convey fish safely and effectively downstream of the project, including flows as necessary to operate conveyance facilities.

I. The applicant shall file with the Department for prior review and approval within 90 days of issuance of this certification, a plan of study for assessing the impact of alternative bypass minimum flows on Scapania umbrosa. The results of the study will be used to assess the environmental feasibility of increasing the minimum flow to a level not to exceed 20 cfs and the effects of the interim minimum flow set in Condition C above. The applicant shall work closely with the Agency during the development and implementation of this study, which shall include, but not be limited to, the following steps:

1. A feasibility analysis and plan to protect Site 1 (located at the head of Pool 5) at a flow release of 10 cfs, including a determination of the threshold flow (between leakage and 12 cfs) at which the site becomes inundated.
2. A feasibility analysis and plans to modify the outlet controls of pools 4 and 5 to protect existing populations of Scapania

umbrosa within the backwater influence of the pools.

3. A maintenance plan to include annual inspections of any measures undertaken to protect Scapania umbrosa in accordance with the plans referenced in nos. 1 and 2 above.
4. A plan for a long term study of the gorge to assess a) the size and distribution of the Scapania umbrosa population under staged alternative minimum flows, the study to include other factors that may affect bryophyte distribution and b) any impairment of swimming use that may occur due to increases in the minimum flow through the gorge.
5. Annual reporting to the Department of study progress and findings.
6. A five-year report summarizing the findings of the study and recommending action to be taken or study continuation.

Plans for protective measures are subject to prior review and approval by the Department and shall be implemented before passage of minimum flows in accordance with Condition C above.

During the fall period, the fish passage conveyance structure shall be operated at 10 cfs until sufficient information is available to determine whether or not operation at higher flows would be detrimental to Scapania umbrosa. When the dam release exceeds 10 cfs, such as during high flow periods, the conveyance structure shall be operated at its design capacity, inflow permitting.

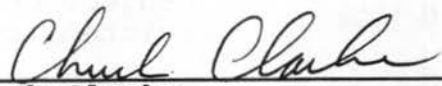
The analyses and plans referenced in nos. 1-3 above shall be filed with the Department on or before June 1, 1994, with completion of any approved modifications by October 1, 1994. The bryophyte study shall be initiated on or before July 1, 1994.

- J. The applicant shall provide the Department with a copy of the turbine rating curves, accurately depicting the flow/production relationship, for

the record within one year of the issuance of this certification.

- K. Within 90 days of the issuance of this certification, the applicant shall submit a plan for proper disposal of debris associated with project operation, including trashrack debris, for written approval by the Department.
- L. Any proposals for project maintenance or repair work involving the river, including desilting of the dam impoundment, impoundment drawdowns to facilitate repair/maintenance work, and tailrace dredging, shall be filed with the Department for prior review and approval.
- M. The applicant shall provide a canoe portage at Cavendish Dam by May 1, 1994. The applicant shall consult with the Recreation Section of the Department of Forests, Parks and Recreation in the design of the portage. Design plans for the portage shall be filed with the Department of Environmental Conservation and the Department of Forests, Parks and Recreation for review and approval before construction of the portage.
- N. The applicant shall allow continued public access to the river for utilization of the public resources, subject to reasonable safety and liability limitations.
- O. The applicant shall allow the Department to inspect the project area at any time to monitor compliance with certification conditions.
- P. A copy of this certification shall be prominently posted within the facility.
- Q. Any change to the project that would have a significant or material effect on the findings, conclusions, or conditions of this certification, including project operation, must be submitted to the Department for prior review and written approval.

R. The Department may request, at any time, that FERC reopen the license to consider modifications to the license necessary to assure compliance with Vermont Water Quality Standards.



Chuck Clarke
Secretary
Agency of Natural Resources

Dated at Waterbury, Vermont
this 7th day of October, 1993.

cc: distribution list

AMD/9J_CAV.401