Draft Water Quality Certification
(33 U.S.C. §1341)

In the matter of: Morrisville Water & Light Department
Village of Morrisville
857 Elmore Street
Morrisville, VT 05661-8408

APPLICATION FOR MORRISVILLE HYDROELECTRIC PROJECT

Section 401 of the federal Clean Water Act requires that any applicant for a federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may result in any discharge into the navigable waters, shall provide the licensing or permitting agency a certification from the State in which the discharge originates that any such discharge will comply with other substantive provisions of the Clean Water Act. 33 U.S.C. § 1341(a)(1). The certifying state may set forth any effluent limitations and other limitations, and monitoring requirements necessary to assure that any applicant for a federal license will comply with the Clean Water Act and with any other appropriate requirement of state law. 33 U.S.C. § 1341(d). In Vermont, the Agency of Natural Resources is the certifying agency of the state for purposes of Section 401 of the Clean Water Act. 10 V.S.A. § 1004. The Secretary of Natural Resources has delegated the authority to make certification determinations to the Department of Environmental Conservation (Department).

The Department has reviewed a water quality certification application dated November 7, 2014 and filed by the Village of Morrisville (MWL or the Applicant) for the Morrisville Hydroelectric Project (the project). The supporting documentation for the application includes the Applicant's Federal Energy Regulatory Commission (FERC) license application (FERC No. 2629) filed with FERC under a cover letter dated April 25, 2013 and other supporting documents filed by the Applicant in support of the application. The record for this decision includes the September 26, 2013 FERC Additional Information Request (AIR) response; the FERC Environmental Assessment (EA) dated December 16, 2014; and many other documents related to the project and its relicensing filed through December 29, 2015.

The current application is subject to review under the Vermont Water Quality Standards promulgated by the Agency of Natural Resources and effective beginning October 30, 2014 (Standards). (Standards, Section 1-01(A) Applicability).

Findings

Background and General Setting

1. The Morrisville Hydroelectric Project is an existing, licensed hydroelectric project located on the Lamoille River and tributaries in north-central Vermont. The Lamoille River is a major tributary to Lake Champlain, flowing 84.9 miles in a generally westerly direction from its origin at Horse Pond in the northwest corner of the Town of Wheelock to its terminus in outer Mallets Bay of Lake Champlain. From its headwaters to the mouth, the Lamoille River descends approximately 1,200 feet and has been heavily developed for hydroelectric power generation with seven active hydroelectric dams on the mainstem.

2. The project consists of four developments; the Morrisville and Cadys Falls developments located on the mainstem of the Lamoille River in Morristown, the Lake Elmore development located on Elmore Brook, a tributary to the Lamoille River, in Elmore; and the Green River development located on the Green River, a tributary to the Lamoille River, in Eden and Hyde Park (Figure 1).

3. The Lamoille River basin drains a 706 square mile watershed. The Cadys Falls, Morrisville, Green River, and Lake Elmore developments utilize runoff from areas of 268, 240, 14.6, and 8.39 square miles, respectively.

4. The Cadys Falls and Morrisville developments were built in the late nineteenth century in order to provide power to the customers within the Licensee's service territory. The Cadys Falls development was originally constructed in 1894, and was reconstructed in 1906, 1914, and 1947. The Morrisville development was built in 1924. The Green River Reservoir development was originally constructed in 1947 as a water storage facility. The Federal Energy Regulatory Commission (FERC) permitted up to 2.0 MW of generation capacity in 1981 and 1.89 MW of generation capacity was installed in 1984. Lake Elmore is a natural lake that has been raised approximately four feet by the Lake Elmore dam to provide water storage to augment hydroelectric production downstream. The Lake Elmore Dam was constructed in 1943.

5. The project was first granted a license by the FERC on August 21, 1981 as Project No. 2629, with the term of the license running through April 30, 2015.

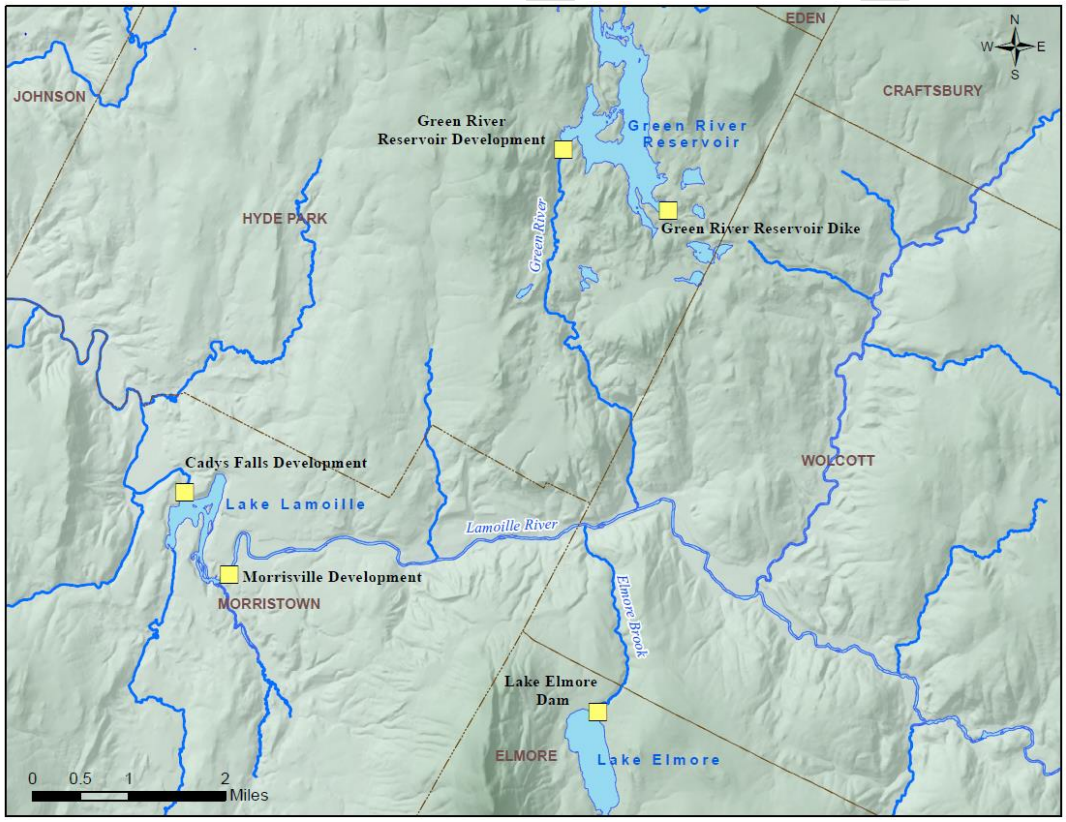

Figure 1: Map of the Cadys Falls, Morrisville, Green River Reservoir, and Lake Elmore developments that comprise the Morrisville Hydroelectric Project.

Project and Civil Works

Existing Developments

Morrisville

6. The Morrisville development is manually operated and does not have equipment necessary to operate or monitor the development remotely. The development consists of a 384 foot long concrete, gravity type dam consisting of two spillways, a gatehouse, and a retaining wall. The main spillway is located between the store house and the intake structure; it is 37 feet high, 216 feet long, and has a crest elevation of 627.79 feet above mean sea level (msl). The main spillway is topped with Obermeyer inflatable crest gates, consisting of two sections that are each 4-feet high by 108-feet long; this structure brings the elevation of the main spillway to 631.79 feet msl. The secondary spillway is 60 feet long and built to an elevation of 629.78 feet msl; the secondary spillway is outfitted with 2-foot high wooden flash boards to an elevation of 631.78 feet msl.

7. The intake structures are located at the west end (river-right) of the main spillway and are covered by a brick building. The structure contains two wooden headgates operated by electrical hoist that are 12.58 feet by 11.75 feet and 9.58 feet by 8.17 feet, respectively. Trash racks, 30 feet long and 19 feet high with clear bar spacing of 2 inches, are located ahead of the gates; these are cleaned by an electrically operated Portland trash rake. Two 150 foot long penstocks extend from the intake to the powerhouse; one is 7 feet in diameter and the other 10 feet in diameter.

8. The powerhouse is a brick masonry structure built on a concrete foundation, measuring 54.5 feet by 30.5 feet. The powerhouse contains two turbine/generating units. Both units are direct drive, vertical Francis type turbines with installed capacities of 600 and 1,200 kW, totaling 1,800 kW. Each unit has an estimated minimum hydraulic capacity of 30 cfs and a maximum hydraulic capacity of 174 cfs and 348 cfs, respectively. The development has a combined operational hydraulic capacity of 60 – 522 cfs.

9. The generation output at 2,400 volts is stepped up to 12,000 volts by three 833 KVA transformers located in a substation adjacent to the power house. The span from the powerhouse to the substation is approximately 60 feet. From this location, the lines run approximately 375 feet to a substation located on the other side of the river, where the power is stepped up to 34.5 kV and delivered to the 34.5 kV regional transmission grids.

10. The dam creates a 15 acre impoundment with a 72 acre-foot storage capacity at the normal maximum water surface elevation of 631.79 feet msl. The development has two bypassed reaches, with the primary bypass[1] extending 380 feet from the dam to the powerhouse and the secondary bypass extending 900 feet from impoundment right to the powerhouse.

Cadys Falls

11. The Cadys Falls development is manually operated and does not have equipment necessary to operate or monitor the development remotely. The development consists of a concrete, gravity

[1] The bypass or bypass reach is the section of the river between the headworks (dam) and tailrace where a portion of the river flow is diverted through the penstock.

type dam that is approximately 364 feet long, including the wing wall, and is approximately 41 feet high. The structure includes a 186-foot long spillway with a crest elevation of 576.89 feet msl. The crest of the spillway is normally fitted with 3.5 foot wooden flashboards to an elevation of 580.39 feet.

12. The intake structures are located at the west (river-left) end of the spillway and are covered by a wood frame building. The intake structures include two wooden headgates, 10 feet-wide by 10 feet high. The trash racks are 18 feet long and 25 feet high with clear bar spacing of 2 inches. A buried, steel penstock, 9 feet in diameter, extends 1110 feet downstream to a 35.6 foot high, 29.7 foot in diameter concrete surge tank. The penstock bifurcates into a 90 foot long, 8 foot in diameter section and a 30 foot long, 9 foot in diameter section.

13. The brick powerhouse is 96 feet long by 46 feet wide and contains two turbine-generator units, a 600 kW direct drive horizontal Francis turbine and a 700 kW vertical Kaplan turbine. The total installed capacity of the development is 1,300 kW. Each turbine has an estimated minimum hydraulic capacity of 30 cfs and maximum hydraulic capacities of 210 cfs and 245 cfs, respectively. The development has a combined operational hydraulic capacity of 60 – 455 cfs.

14. The 2,400 volt generation output is stepped up to 34.5 kV volts by a 2000 kV pad mount transformer located adjacent to the powerhouse. The 2,400 volt generation leads run approximately 75 feet from the powerhouse to the transformer. The power is then delivered another 75 feet to the 34.5 kV regional transmission grid that serves the area.

15. The dam creates an impoundment, known as Lake Lamoille that has a surface area of 150 acres, a 525 acre-foot storage capacity, and a maximum depth of 15 feet at the normal maximum water surface elevation of 580.39 feet msl. The development creates a 1,690 foot long bypass reach extending from the impoundment to the powerhouse tailrace.

Green River

16. The Green River development is a manually operated facility and does not have equipment necessary to be operated remotely, but the reservoir level can be monitored remotely by the Applicant. The dam consists of a 360 foot long, 105 foot high concrete arch dam located at the outlet of the reservoir in a narrow gorge that is 163 feet deep. The dam is 91 feet above the tailwater elevation (1134 feet msl) at an elevation of 1225 feet msl. A 60 foot long un-gated "ogee" shaped spillway is located near the center of the arch dam with a crest elevation of 1220 feet msl.

17. A stilling pool is formed by a weir located approximately 180 feet downstream from the arch dam. The weir is a small concrete gravity dam, about 45 feet in length and 15 feet in height with a 40-foot spillway equipped with wooden boards one foot above the crest. This creates a stilling pool 180 feet long and 11 feet deep.

18. The Green River Reservoir is also impounded by a 200 foot long, 16 foot high earthen dike with a crest elevation of 1230 feet msl. The dike is located at the southeast corner of the reservoir, approximately 1.25 miles to the southeast of the arch dam. A wave barrier consisting of wooden boards is located atop the crest of the earth dike. The top of the wave barrier is at elevation 1,232 feet msl.

19. The intake for the powerhouse is located on the arch dam. The intake feeds into a 6-foot in diameter penstock. The penstock enters the intake valve house, which is located on the downstream side of the dam. The intake opening is located at elevation 1148 feet msl, 72 feet below the normal maximum water surface elevation. At the intake valve house, a 45 degree elbow splits the intake pipe to divide flow between the powerhouse and a 30 inch outlet pipe. A 30 inch Dow valve is located within an outlet valve house, which is located approximately 25 feet downstream of the intake valve house. The Dow valve, when open, discharges into the stilling basin. The outlet valve is rated at 373 cfs under a head of 85 feet (to crest of spillway). From the intake valve house, water is delivered to the powerhouse via a 6-foot diameter buried penstock that runs approximately 94.5 feet to a point of bifurcation. From the bifurcation, two 3-foot diameter pipes each extend 21.5 feet to the powerhouse.

20. A 37 foot long by 32 foot wide concrete powerhouse is located approximately 130 feet downstream of the dam on the river-right. The powerhouse contains two turbine-generator units. The turbines are vertical Francis units manufactured by the James Leffel Company, each with a minimum hydraulic capacity of 60 cfs and maximum hydraulic capacity of 156 cfs for a combined maximum hydraulic capacity of 312 cfs. The generators have a total installed capacity of 1,890 kW. The minimum downstream conservation flow of 5.5 cfs is passed through an eight inch diameter steel pipe near the powerhouse.

21. The generation output at 4,160 volts is stepped up to 34.5 kW by three 833 kV transformers located in a substation approximately 1500 feet to the south of the powerhouse. A 34.5 kV transmission line proceeds from the substation along the Green River and Garfield Road approximately 4.75 miles where it connects to the 34.5kV power grid that serves the area.

22. The dam creates an approximately 653 acre impoundment with a useable storage capacity of 17,400 acre-feet at the normal maximum water elevation of 1220 feet msl. The reservoir is relatively deep with a maximum and average depth of 93 feet and 35 feet, respectively. The reservoir has more than 17 miles of highly irregular and undeveloped shoreline.

Lake Elmore

23. The concrete dam is 26 feet long and 10 feet high with a spillway crest is built to an elevation of 1139 feet. The dam includes two concrete retaining walls, one approximately 90 feet long at the west end of the dam and one approximately 30 feet long at the east end of the dam.

24. The intake works are comprised of a brick building on the end of the dam which contains two manually-operated wooden headgates, each with dimensions of 2.5 feet high by 2.5 feet wide. The gates discharge into Elmore Brook, a tributary of the Lamoille River.

25. Lake Elmore, a natural lake, was raised four feet by the construction of the concrete gravity dam in 1943. Lake Elmore has a surface area of approximately 300 acres with a 1,000 acre-feet storage capacity at the normal maximum water surface elevation created by the dam crest. Lake Elmore is relatively shallow with a maximum depth of 17 feet.

Proposed Developments

26. MWL has not proposed any new developments or changes as part of their FERC application.

27. In subsequent filings with the Department, MWL has indicated possible intent to install a low flow turbine at the Green River development.[2] The proposal to install a low flow turbine at the Green River facility is similar to upgrades that were identified by the Applicant in their Pre-Application Document (PAD).[3]

River Hydrology and Streamflow Regulation

28. For the years 1912, 1913, and continuously since 1929, the U.S. Geological Survey (USGS) has operated a surface water gaging station (No. 04292000) on the Lamoille River in Johnson. The Lamoille River is highly regulated upstream of the gage, as the unlicensed Wolcott hydroelectric development, the Morrisville development, and Cadys Falls development all alter the natural flow regime. The Johnson gage is 7.3 miles downstream of the Cadys Falls Dam and 8.7 miles downstream of the Morrisville Dam. The drainage area measured at the gage is 310 square miles.

29. For the periods 1916 through March 1921 and December 1923 through June 1932, the USGS operated a surface water gaging station (No. 04291000) on the Green River in Garfield. The Green River was unregulated during this period, as the dam was built in 1947. The gage was 2.8 miles upstream of the confluence with the Lamoille River. The drainage area measured at the gage is 18 square miles. Monthly median flow values for this gage standardized for the drainage area at the location of the dam are shown below.

Month	Flow at Gage (cfs)	Flow at Dam (cfs)	Flow at Dam (csm)
Jan	13.0	10.2	0.7
Feb	9.8	7.7	0.5
Mar	14.0	11.0	0.8
Apr	88.0	68.9	4.9
May	36.0	28.2	2.0
Jun	17.0	13.3	0.9
Jul	11.0	8.6	0.6
Aug	8.6	6.7	0.5
Sep	9.8	7.7	0.5
Oct	17.0	13.3	0.9
Nov	25.0	19.6	1.4
Dec	17.0	13.3	0.9

30. Hydrologic information is tabulated below for the four developments associated with the Morrisville hydroelectric project. The estimates of the hydrological statistics for the Morrisville and Cadys Falls developments are derived from data collected at the most proximate gaging station operated by the U.S. Geological Survey on the Lamoille River in Johnson (No. 04292000). The estimates of the hydrological statistics for the Lake Elmore and Green River developments are derived from the historical data collected at the Green River surface water gaging station (No. 04291000).

[2] Letters from Meddie J. Perry, Vanasse Hangen Brustlin, Inc. on behalf of Morrisville Water and Light, to Jeff Crocker, Vermont Department of Environmental Conservation, June 4, 2014 and October 31, 2014 (on file with Department). Filed with FERC as comments on the draft Environmental Assessment, July 24, 2014.
[3] Village of Morrisville, Pre-Application Document for the Morrisville Hydroelectric Project (FERC No. 2629), Filed with FERC on April 26, 2010.

Hydrologic Statistic	Facility			
	Lake Elmore	Green River	Morrisville	Cadys Falls
Drainage Area (sq/miles)	8.39	14.6	240	268
Mean annual flow (cfs)	16.2	28.2	429	479
Annual runoff (inches)	26.2	26.2	18.8	21.0
10 percent exceedance (cfs)	39.2	68.1	937	1046
50 percent exceedance (cfs)	7.5	13.0	240	268
90 percent exceedance (cfs)	3.2	5.6	105	118
7Q10 (cfs)	1.31	2.28	50.3	56.2

Current License Conditions and Existing Operations

Morrisville

31. Inflows to the Morrisville impoundment are regulated by water level management activities at the unlicensed Wolcott hydroelectric project approximately 9 miles upstream.

32. Under the existing license, the Morrisville facility is licensed to operate in a modified run-of-river mode, with the Applicant required to maintain 135 cfs below the tailrace at all times.

33. By order dated September 15, 2011, the Applicant is required to maintain a bypass flow of 12 cfs in the primary bypass channel. There is no required bypass flow release for the secondary bypass channel.

34. The impoundment is equipped with a mechanical float device located at the intake structures. The float device monitors the water level of the impoundment and through the use of two actuator motors connected in parallel (one mounted to the float device and the other connected to the generator gate control) that adjusts the generator gate opening to alter the amount of water flowing through the turbines to maintain a stable water level.

Cadys Falls

35. Under the existing license, the Cadys Falls facility is licensed to operate in a modified run-of-river mode, which allows the impoundment, known as Lake Lamoille to be drawn down a maximum of 2 feet daily.

36. The Applicant is required to maintain 150 cfs in the tailrace at all times, or inflows if less. Currently, no flow is required to be released to the bypass reach under the current license.

37. The impoundment is equipped with a mechanical float device located at the intake structures. The float device monitors the water level of the impoundment and through the use of two actuator motors connected in parallel (one mounted to the float device and the other connected to the generator gate control), adjust the generator gate opening to alter the amount of water flowing through the turbines to maintain a steady water level.

Green River

38. The Green River development is operated as a store and release hydropeaking project utilizing storage from the Green River Reservoir.

39. Under the existing license, a continuous 5.5 cfs conservation flow is required. The conservation flow is released via an 8-inch diameter bypass flow pipe, split off the intake that draws from the hypolimnion[4] of the reservoir.

40. Instantaneous releases are limited year-round to 283 cfs or less, except in instances to prevent spillage. Further restrictions limit the maximum outflows to 160 cfs between May and October when necessary to prevent spillage due to high inflows.

41. During May through November period, there is a maximum allowable drawdown of one foot from the full reservoir elevation of 1220 feet msl. During December through April period, the maximum allowable drawdown is ten feet,

42. The typical summer operating regime consists of running one unit at 75-140 cfs for a period of hours, as to maintain the target reservoir elevation. During periods of high precipitation the second turbine is operated to prevent spillage. During the winter period, the utilization of the maximum allowable drawdown is based on snow sample calculations, with a normal winter drawdown below full reservoir of six feet. While maximum drawdown is still allowed in March and April, the Green River development is typically operated to allow the reservoir to refill in order to meet the minimum reservoir target elevation by May 1st.

43. MWL voluntarily attempts to maintain the reservoir water level 3 inches below the dam spillway from May 1 to August 1 to protect loon nesting in cooperation with the Vermont Center for Ecostudies Loon Recovery Program.

Lake Elmore

44. The Lake Elmore development is a hydro storage facility. There is no generation equipment associated with the development.

45. Under the existing license, the development does not have a minimum flow requirement into Elmore Brook and has an allowable drawdown of two feet. The Applicant, in an agreement with the Town of Elmore does not drawdown the lake between June 1 and September 1, but does drawdown the lake two feet in the fall at the request of Lake Elmore Resident Association.

46. The lake drawdown occurs by opening a low-level outlet which consists of two wooden gates. The gates are raised manually and then locked in place. Typically only one gate is operated during the fall drawdown. Refill is complete by lowering the low-level outlet gate until the water level has raised enough to begin spilling over the dam, and gate can be completely closed.

[4] The hypolimion is the dense bottom layer of water in a thermally-stratified water body that is typically the warmest layer in the winter months and coldest in the summer months.

Applicant Proposal for Licensing

Morrisville

47. MWL in their license application[5] to FERC proposes to operate the Morrisville development in run-of-river mode to maintain a minimum of 135 cfs in the tailrace, or inflow if less. The Applicant proposes a 12 cfs bypass flow in the primary bypass reach and a 4 cfs bypass flow in the secondary bypass reach which will be included in the 135 cfs minimum flow requirement. The Applicant proposes to continue releasing 12 cfs in the primary bypass through a 1-foot-high by 2-foot-wide, submerged rectangular orifice located inside the gatehouse structure. A submerged orifice at the crest of the dam at the secondary spillway will provide 4 cfs in the secondary bypass. The proposal did not address the elevation of the impoundment during operations.

48. In subsequent filings with the Department, MWL has proposed bypass flows of 28 cfs in the primary bypass and 8.5 cfs in the secondary bypass reach. The Applicant proposed to implement these higher bypass flows in five years after issuance of the water quality certification. In the interim, the Applicant proposed to maintain the existing 12 cfs and 0 cfs bypass flow requirements in the primary and secondary bypass reaches, respectively. [6]

49. The Applicant has further revised the timing and interim implementation of bypass flows to three years after license issuance. In the interim, the MWL proposes to maintain 12 cfs in the primary bypass reach and 3 cfs in the secondary bypass reach.[7]

Cadys Falls

50. MWL in its license application to FERC proposes to operate the Cadys Falls development in a run-of-river mode to maintain a conservation flow of 150 cfs in the tailrace or inflow if less. The Applicant proposes a 12 cfs flow, which will be included in the 150 cfs minimum flow requirement. The Applicant proposes to pass the bypass flow through an orifice in the forebay section of the intake structure. The proposal did not address the elevation of the impoundment during operations.

51. Similar to the Morrisville development, the MWL has subsequently revised its bypass flow proposal for this development. MWL currently proposes a 54 cfs bypass flow, which would be phased-in within 10 years of issuance of the water quality certification. In the interim, the Applicant proposes to operate the development without a bypass flow requirement.

52. The Applicant has further revised the timing and interim implementation of bypass flows to eight years after license issuance. In the interim, the Applicant proposes to implement a 12 cfs in the bypass reach.

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[5] Village of Morrisville Project (FERC No. 2629), Application for new license for major water power project greater than 5MW, Filed with FERC in April 25, 2013.
[6] Letters from Meddie J. Perry, Vanasse Hangen Brustlin, Inc. on behalf of Morrisville Water and Light, to Jeff Crocker, Vermont Department of Environmental Conservation, June 4, 2014 and October 31, 2014 (on file with Department). Filed with FERC as comments on the draft Environmental Assessment, July 24, 2014.
[7] Letter from Craig Myotte, Morrisville Water and Light to Jeff Crocker, Vermont Department of Environmental Conservation, December 29, 2015 (on file with Department).

Green River

53. In their FERC license application, MWL proposes to operate the development in a store-and-release mode. MWL proposes maintaining the current year-round conservation flow requirement of 5.5 cfs in the Green River. The Applicant proposes to increase the limit on flow releases from 160 cfs to 283 cfs from May 1 to October 31 to accommodate two scheduled whitewater releases of 6 hours occurring between April 1 and October 31. The proposed range of flows for the whitewater releases is 126 cfs to 280 cfs.

54. The Applicant proposes continuing the current water level management practices, which include a maximum allowable drawdown of 10 feet during the winter period from December 1 through April 30, maintaining the reservoir elevation 3-inches below the dam crest during the loon nesting period from May 1 to August 1, and maintaining the reservoir within one foot of the dam crest between August 2 and November 30.

55. Similar to the other generating facilities, MWL has subsequently revised its operation proposal since filing its FERC license application. The revised proposal would implement seasonal conservation flows of 7.0 cfs in the summer, 7.9 in the fall/winter period, and 47 cfs in the spring. The Applicant proposes to implement a year-round 7.0 cfs conservation flow within eight months of the issuance of the water quality certification. MWL proposes to phase-in the seasonal conservation flows after five years. The Applicant also proposes to implement a ramping protocol for generation flows and has revised the generation limits during peaking operations to 160 cfs from May to October. The water level management practices proposed in the FERC license application was not revised. Additionally, in subsequent communications with FERC the Applicant has proposed to develop a dissolved oxygen monitoring and improvement plan to address the dissolved oxygen issues downstream of the release.

56. The Applicant has further revised the generation limits and water level management practices at the facility to limit generation to 160 cfs during peaking operations and decreased the magnitude of the winter drawdown to 6 feet.

Lake Elmore

57. MWL proposes to remove the Lake Elmore development from the project and operate the development in crest control run-of-river mode with a normal water surface elevation of 1,139 feet msl.

Standards Designation

58. The applicable 2014 Vermont Water Quality Standards (Standards) were adopted by the Secretary of the Agency of Natural Resources pursuant to 10 V.S.A. Chapter 47, Water Pollution Control. Section 1252 of the chapter provides for the classification of state waters as either Class A or Class B and authorizes the adoption of standards of water quality to achieve the purpose of classification.

59. The mainstem of the Lamoille River and its tributaries within the Project area are designated as Class B waters (Standards, Section 4-03). Class B waters are managed to achieve and maintain a high level of quality that fully supports designated uses, including aquatic biota, wildlife, and aquatic habitat, good aesthetic value, public water supply with filtration and disinfection,

irrigation and other agricultural uses, swimming, boating, and recreation. (Standards, Section 3-04(A)).

60. The mainstem of the Lamoille River and its tributaries within the Project area are designated as cold water fish habitat. The Green River Reservoir is also designated as cold water fish habitat. In contrast, Lake Elmore is designated as warm water fish habitat. (Standards, Section 3-05; Standards, Appendix A).

61. In Class B waters, the dissolved oxygen standard for cold water fish habitat streams is not less than 7 mg/L and 75 percent saturation at all times, nor less than 95 percent saturation during late egg maturation and larval development of salmonids in areas that the Secretary determines are salmonid spawning or nursery areas important to the establishment or maintenance of the fishery resource. (Standards, Section 3-04(B)(2)(a)). At all times in all other waters designated as cold water fish habitat, the standard is not less than 6 mg/L and 70 percent saturation. (Standards, Section 3-04(B)(2)(a)). In warm water fish habitat streams, the dissolved oxygen standard is not less than 5 mg/L and 60 percent saturation at all times. (Standards, Section 3-04(B)(2)(b)).

62. The temperature standard for cold water fish habitat limits the increase due to all discharges and activities to 1.0°F from ambient conditions. (Standards, Section 3-04(B)(2)(a)). The temperature standard for warm water fish habitat limits the total increase from the ambient temperature due to all discharges and activities to the values below. (Standards, Section 3-01(B)(1)(c)).

Ambient temperature	Total allowable increase above ambient temperature
Above 66°F	1°F
63° to 66°F	2°F
59° to 62°F	3°F
55° to 58°F	4°F
Below 55°F	5°F

63. The turbidity standard for Class B cold water fish habitat waters is none in such amounts or concentrations that would prevent the full support of uses, and not to exceed 10 NTU as an annual average under dry weather base-flow conditions. (Standards, Section 3-04(B)(1)(a)). The turbidity standard for Class B warm water fish habitat waters is none in such amounts or concentrations that would prevent the full support of uses, and not to exceed 25 NTU as an annual average under dry weather base-flow conditions. (Standards, Section 3-04(B)(1)(b)).

64. Settleable solids and total suspended solids cannot be present in such concentrations that would prevent the full support of uses. (Standards, Section 3-01(B)(5)).

65. Class B waters are managed to achieve and maintain a level of quality that fully supports aquatic biota and wildlife sustained by high quality aquatic habitat with additional protection in those waters where these uses were sustainable at a higher level based on Water Management Type designation. (Standards, Section 3-04(A)(1)).

66. Under the Class B criterion for aquatic biota, wildlife and aquatic habitat, the Standards require "[n]o change from the reference condition that would prevent the full support of aquatic biota, wildlife, or aquatic habitat uses. Biological integrity is maintained and all expected functional groups are present in a high quality habitat. All life-cycle functions, including overwintering and

reproductive requirements are maintained and protected." (Standards, Section 3-04(B)(4)). As the project waters have not been assigned a water management type, an additional criterion is "no change from reference 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 3-04(B)(4)(d)).

67. Class B waters are managed to achieve and maintain a level of quality that fully supports boating, fishing, and other recreational uses. (Standards, Section 3-04(B)(4)). The boating criteria in the Standards require that a high level of quality that is compatible with boating shall be achieved in Class B waters. (Standards, Sections 3-04(A)(6) and (B)(6)).

68. Class B waters are managed to achieve and maintain a level of quality that fully supports water character, flows, water level, bed and channel characteristics, and water of a quality that consistently exhibits good aesthetic value. (Standards, Section 3-04(A)(2) and (B)(6)(d)).

69. The Hydrology Policy states, "The proper management of water resources now and for the future requires careful consideration of the interruption of the natural flow regime and the fluctuation of water levels resulting from the construction of new, and the operation of existing dams, diversions, and other control structures." (Standards, Section 1-02(E)(1)). For Class B waters, "[a]ny change from the natural flow regime shall provide for maintenance of flow characteristics that ensure the full support of uses and comply with the applicable water quality criteria. The preferred method for ensuring compliance with this subsection is a site specific flow study or studies." (Standards, Section 3-01(C)(1)).

70. The Anti-Degradation Policy provides for protection of existing uses and high quality waters. (Standards, Section 1-03).

Present Status

71. On September 30, 2014, the U.S. Environmental Protection Agency approved a list of waters considered to be impaired based on water quality monitoring efforts and in need of total maximum daily load (TMDL) development to address the pollution. The Department submitted the list under Section 303(d) of the federal Clean Water Act. According to the State of Vermont's 2014 303(d) list of impaired surface waters (VTDEC 2014) in need of a TDML, there are no listed waters within or near the Project Area.

72. The Department concurrently issued a six-part list, List of Priority Surface Waters Outside the Scope of the Clean Water Act Section 303(d). Part E lists those surface waters assessed as altered to the extent that one or more designated uses are not supported due to the presence of invasive aquatic species. Lake Elmore is listed due to the possible impairment of aesthetics, aquatic life support, contact recreation, and secondary contact recreation due to the presence of Eurasian Watermilfoil. Part F lists those surface waters where aquatic habitat and/or other designated uses have been altered by flow regulation to the extent that one or more designated uses are not supported. The Lamoille River, from the tailrace of the Cadys Falls development upstream to the confluence with Elmore Brook, Elmore Brook, Lake Elmore, and Lake Lamoille are listed due to flow alteration from operations of the Morrisville hydroelectric project.

73. The Department has also documented several non-compliance events downstream of the Cadys Falls development under its current FERC license that result in a significant decrease in flow in the Lamoille River below the tailrace of the facility as shown on the USGS gaging station (No. 04292000) in Johnson. These non-compliance events that decrease the downstream flows at the

facility have the potential to cause degradation of water quality and aquatic habitat by interfering with or prevention of fish reproduction, dewatering nest with incubating eggs or interfering with or preventing of fish migration.

Water Chemistry

74. The water quality for the Lamoille River watershed generally meets or exceeds state standards for Class B waters. The primary water quality issue for Lamoille River watershed is excessive nutrients and sediment caused by agricultural, residential, and urban runoff in the watershed as determined by the Vermont Agency of Natural Resources. The affected reaches of the Lamoille River are not within project waters although Rodman Brook, which is impacted by landfill leachate and requires a TMDL for iron confluences with the Lamoille mainstem between the Morrisville dam and the Elmore Brook confluence.

75. There are six wastewater treatment facilities that discharge to waters of the Lamoille River watershed. These include the Morrisville wastewater treatment facility located at river mile 70.5. In addition, there are 62 permitted stormwater discharges in the basin.

Morrisville

76. MWL conducted water quality sampling for dissolved oxygen and temperature at six locations within the Morrisville development: above the impoundment, center of impoundment, bypass reach, below the dam, tailrace, as well as the penstock tap.[8] Instantaneous sampling occurred twice per month from May through October 2012. Over the course of the periodic sampling, water temperature ranged from 8.9°C (48°F) to 24.7°C (76.5°F) and dissolved oxygen concentrations ranged from a minimum of 8.5 mg/L (92 percent saturation) to a maximum of 11.74 mg/L (105.4 percent saturation). Temperature and dissolved oxygen profiles show that the impoundment is shallow and is well mixed.

Cadys Falls

77. The Applicant conducted water quality sampling for dissolved oxygen and temperature at four locations within the Cadys Falls development: above the impoundment, center of impoundment, tailrace, as well as the penstock tap. Instantaneous sampling occurred twice per month from May through October 2012. Over the course of periodic sampling, water temperature ranged from 9.1°C (48.4°F) to 25.8°C (78.4°F) and dissolved oxygen concentrations ranged from a minimum of 7.7 mg/L (87.4 percent saturation) to a maximum of 11.6 mg/L (105.7 percent saturation).Temperature and dissolved oxygen profiles show that the impoundment is shallow and generally well-mixed, though a gradient did exist at times.

[8] Water Quality Monitoring, Gomez and Sullivan Engineers, P.C., January 2013.

Green River

78. The Green River development has a deep-water intake that draws water from the hypolimnion, which leads to oxygen deficient water being discharged into the tailrace during periods of reservoir stratification.

79. MWL conducted water quality sampling for dissolved oxygen and temperature at six locations within the Green River development: center of impoundment, above dam, tailrace, two locations downstream, as well as the penstock tap. Instantaneous sampling occurred twice per month from May through October 2012. Over the course of the periodic sampling, water temperature ranged from 7.3°C (45.1°F) to 20.0°C (68°F) and dissolved oxygen concentrations ranged from a minimum of 1.25 mg/L (10.6 percent saturation) to a maximum of 11.55 mg/L (100.2 percent saturation). Continuous temperature monitoring occurred from April 26 – November 19, 2012 in the tailrace and the two downstream locations. Dissolved oxygen was continuously monitored in the tailrace from August 20-27 and September 6-15, 2012. During periods of non-operation dissolved oxygen concentration were typically 5.5-6 mg/L at a flow of 5.5 cfs. During periods of additional release (9-283 cfs), dissolved oxygen concentrations were reduced to 4 mg/L. Additional release did not affect temperature in the tailrace, but temperatures were reduced by 4-8°C at the downstream locations.

80. Temperature and dissolved oxygen profiles showed that the Green River Reservoir became thermally stratified at the thalweg and linear center locations during mid to late May. The thermocline became well developed my mid-June and remainder through mid-October. Temperatures in the epilimnion, the upper layer in the water column, which is completely mixed, reached nearly 25°C during the summer, with dissolved oxygen concentrations never falling below 7.9 mg/L. The metalimnion spanned ranged from 4-8 meters depth in July to 5-10 meters depth in the late summer. Starting in early August, the dissolved oxygen concentrations in the metalimnion became depleted. Dissolved oxygen concentrations in the hypolimnion dipped below 6 mg/L by July 23, 2012, below 3-4 mg/L in late August and early September, and were most severe in early October (0.88-2.12 mg/L).

Lake Elmore

81. MWL conducted water quality sampling for dissolved oxygen and temperature at three locations within the Lake Elmore development: deepest point of impoundment, above outfall, and downstream. Instantaneous sampling occurred twice per month from May through October 2012. Over the course of the periodic sampling, water temperature ranged from 9.2°C (48.6°F) to 26.3°C (79.3°F) and dissolved oxygen concentrations ranged from a minimum of 7.7 mg/L (92.2 percent saturation) to a maximum of 11.7 mg/L (105.9 percent saturation). The temperature and dissolved oxygen profiles in the Lake Elmore impoundment showed that the impoundment was shallow and did not stratify. Average water column temperatures ranged from 9.2°C (48.6°F) to 24.7°C (76.5°F).

Aquatic biota and habitat

82. Class B waters are managed to provide high quality habitat for aquatic biota and wildlife (Standards, Section 3-04(A)(1)). Aquatic habitat is defined as "the physical, chemical, and biological components of the water environment" (Standards, Section 1-01(B)(6)) including for example aquatic plants, woody debris, and an adequate flow regime. Aquatic biota are defined as

"organisms that spend all or part of their life cycle in or on the water," (Standards, Section 1-01(B)(5)) including, for example, fish, aquatic insects, amphibians, and some reptiles, such as turtles.

83. The Lamoille River is managed to support both cold water and warm water fish. Species found in the vicinity of the project in the mainstem of the Lamoille and tributaries include brook trout, brown trout, and rainbow trout. In addition, yellow perch, pumpkinseed, brown bullhead, white sucker, chain pickerel, northern pike, largemouth bass, and smallmouth bass are found in Lake Elmore, Green River Reservoir and the Lake Lamoille Impoundment. The Lamoille River within Project vicinity supports a popular trout fishery with the small cold water tributaries, including Green River, providing spawning habitat and cold water refugia from higher temperatures in the mainstem during the summer months.

Morrisville

84. The Lamoille River upstream of the development supports wild brook, brown and rainbow trout, which likely spawn primarily in small, cold water tributaries, but some spawning may also occur in the mainstem. High water temperatures in this portion of the Lamoille River could limit natural production of trout and force trout to seek cold water refuge in tributaries and spring seeps. Rainbow trout are also stocked in this portion of the river to support the fishery. The fish community in this reach of the Lamoille River also includes fallfish, white sucker, and brown bullhead.

85. Fisheries management goals for the Lamoille River upstream of the Morrisville development include: Encouraging wild trout production by protecting and enhancing access of Lamoille River trout to tributaries for spawning and thermal refuge; Supplementing wild trout fishery by providing put-and-take angling opportunities through the stocking of yearling rainbow trout; Providing adequate bypass flows below Morrisville Dam that provides sufficient water movement and circulation to maintain prevailing dissolved oxygen and water temperature conditions, provides sufficient water movement and circulation to provide suitable fish habitat, and minimizes the entrapment of fish; Minimizing impingement and entrainment of fish, especially trout, at the powerhouse.[9]

86. The 380 foot long primary bypass channel consists primarily of ledge-dominated pools and narrows. The 900 foot long secondary bypass channel begins with a ledge falls over the first 75 feet or so. The channel gradient then decreases but remains relatively steep with ledge and coarse substrate pool-drop sequences downstream to the vicinity of an old bridge.

Cadys Falls

87. The reach downstream of the development has populations of wild brook, brown, and rainbow trout and is one of the more popular fly fishing destinations in Vermont. Additionally, rainbow trout are stocked in this portion of the river. Access to cold water tributaries for spawning and thermal refuge is also important in this portion of the river for sustaining trout populations.

[9] Vermont Department of Fish and Wildlife. Fisheries Management Goals for Waters Influenced by the Morrisville Hydroelectric Project. 2011.

88. Fisheries management goals for the Lamoille River downstream of Lake Lamoille include: Encouraging wild trout production by protecting and enhancing access of Lamoille River trout to tributaries for spawning and thermal refuge; Supplementing the wild trout fishery by providing put-and-take angling opportunities through the stocking of yearling rainbow trout; Providing adequate bypass flows below the Cadys Falls Dam that will ensure adequate aquatic habitat, dissolved oxygen and temperature consistent with Vermont's Water Quality Standards, and minimize the entrapment of fish; Minimizing impingement and entrainment of fish, especially trout, at the powerhouse.

89. The Cadys Falls development bypasses about 1690 feet of a wide and relatively steep section of the Lamoille River. The bypass reach is dominated by bedrock with interspersed portions of boulders, cobbles, and some gravel. There is currently no conservation flow requirement for the bypass reach and it is frequently dry. Fish can and do become trapped in the large pool immediately downstream of the dam following high flow events.

90. The 150-acre Cadys Falls impoundment, known as Lake Lamoille, is relatively shallow, generally less than 15 feet in depth. The impoundment supports a largely warm water fish community dominated by yellow perch, pumpkinseed, brown bullhead, chain pickerel. Small numbers of brown trout and rainbow trout have also been collected in fish population surveys in the 1970s and 1980s. Largemouth bass were introduced into the impoundment in the late 1980s, but it is unknown if a significant population became established. In addition, northern pike have recently become established in the impoundment.

91. Fisheries management goals for Lake Lamoille include: Improving public fishing access; Managing for warm water fishing, and possibly for trout fishing near the tailwater inlet of Morrisville Dam.

Green River

92. The Green River Reservoir fishery includes smallmouth bass, chain pickerel, northern pike, yellow perch, brown bullhead, and pumpkinseed sunfish. The remote setting of this reservoir and the prohibition against internal combustion engines draw summertime anglers in search of the wilderness fishing experience.

93. Fisheries management goals for Green River Reservoir include: Maintaining a quality wilderness fishing experience; Protecting spawning fish, eggs, and fry from harmful water level fluctuations in spring and early summer; and maintaining the ecological integrity of littoral areas and their habitat value for fish populations.

94. Water level fluctuations at any time of the year can affect fish populations, but fluctuations in the spring and early summer affect spawning fish, their eggs, and fry, and can therefore, be especially harmful. The large winter drawdown dewaters shoreline areas and negatively affects the survival of aquatic plants and invertebrates, as well as amphibians and reptiles overwintering in the littoral zone. These plants and invertebrates provide food for other aquatic life, serve as spawning substrate for fish such as perch and pickerel, and provide cover for juvenile fish, forage fish and predator fish. As a result, the overall productivity of the reservoir may be negatively affected. The large winter drawdown also limits wintertime fishing as it can create unsafe ice conditions.

95. The Green River flows approximately 4.3 miles from Green River Reservoir to the Lamoille River. Overall, spawning and incubation habitat for a wide variety of fish species, particularly trout species, is relatively abundant in the Green River. Upstream of the culvert on Garfield Road, the river supports a self-sustaining population of brook trout. The portion of the river downstream of the culvert also supports a self-sustaining brook and brown trout population, and adult brown and rainbow trout from the Lamoille River also spawn successfully in the lower portion of the river. Because the Green River is cooled by the release of hypolimnetic water from the reservoir, it provides cool water to the Lamoille River, and during summer months, large trout in the Lamoille River may seek thermal refuge near the mouth of the Green River or in the Green River itself.

96. Fisheries management goals for the Green River include: Managing for wild brook, brown, and rainbow trout; and improving the flow regime to provide high quality aquatic habitat for all life stages of trout.

Lake Elmore

97. Lake Elmore is a popular year round fishing destination. Lake Elmore supports a warm water fishery, including northern pike, largemouth bass, smallmouth bass, yellow perch, pumpkinseed sunfish, and brown bullhead.

98. Lake Elmore flows into Elmore Brook which flows approximately 2.5 miles downstream to its confluence with the Lamoille River. Elmore Brook provide adequate spawning and incubation habitat for brook trout.

99. Fisheries management goals for Lake Elmore include: Ensuring that the lake level is not manipulated during the spring and early summer spawning period; Minimizing manipulation of the dam at other times of the year; and ensuring that dam releases do not result in sudden flow reductions or increases in Elmore Brook downstream of the dam.

Fish Passage and Movement

100. The Department of Fish and Wildlife does not believe at this time that downstream fish passage facilities are warranted at the project. The extent of fish movement in the vicinity of the project dams on the Lamoille River is not expected to be extensive enough to warrant the construction of passage facilities at this time. While the Lamoille River above and below the project area are managed as cold water fisheries, Lake Lamoille is characterized by warm water species including northern pike and is an impediment to downstream movement. Therefore, fish passage facilities are not deemed necessary at present.

101. Properly sized and positioned intake screening is necessary to minimize impingement[10] and entrainment[11] of resident fish. The Morrisville and Cadys Falls developments are equipped with trashracks with 2-inch clear bar spacing.

[10] Impingement refers to when a fish is held in contact with the intake screen by the flow of water and is unable to free itself.
[11] Entrainment refers to when a fish and other aquatic organisms is drawn into a water intake and travels through the turbine.

102. The US Fish and Wildlife Service typically requires angled trashracks with one-inch spacing (full depth) and an approach velocity of two feet per second or less, in conjunction with a conveyance device to provide a safe avenue of passage past the dam. This trashrack configuration (without the conveyance component) should also minimize impingement and entrainment of resident fish.

Flow Needs for Protection of Aquatic Habitat

Morrisville

103. Currently, bypass flow requirements for the primary bypass is 12 cfs while no bypass flow is required in the secondary bypass reach at the Morrisville development. The habitat characteristics of the Morrisville bypass reaches have the potential to provide high quality aquatic habitat for brook, brown and rainbow trout with an adequate flow regime. The primary bypass is dominated by bedrock with a large deep pool in the center of the reach. Fish could enter this pool during high flow conditions and become trapped if adequate flows to maintain connectivity are not maintained. The secondary bypass channel is characterized by a relatively wide, shallow, low gradient riffle in the upper section, while the lower section is dominated by bedrock and boulder substrate and has narrower wetted width and higher gradient. The lower section of the secondary bypass is semi constricted by bedrock and boulders and contains multiple small pools. The primary and secondary bypasses remain separated, entering the main stem of the river at different locations.

104. The Applicant conducted a habitat-flow study in the primary and secondary bypasses of the development to assess the relationship between flow and aquatic habitat for selected target organisms and determine the bypass flow regime necessary to meet Vermont Water Quality Standards.[12] Instream flow needs were evaluated using a demonstration flow assessment, in which experts view and evaluate a number of specific flows. The assessment team was made up of biologists with the Vermont Fish & Wildlife Department and the Applicant's consultant.

105. The study objectives for the primary channel study were to determine the flows necessary to provide: continuous downstream connectivity that will allow fish in the bypass to freely exit downstream; adequate water movement and circulation to maintain cover via a broken water surface; summer water temperatures that are not elevated; dissolved oxygen levels that are not depressed; and suitable habitat conditions for representative fish species.

106. The study objectives for the secondary bypass channel study were to determine the flows necessary to provide: continual habitat connectivity within the bypass and with the main river confluence, enabling fish movement; and suitable habitat conditions for representative fish species.

107. Numeric habitat suitabilities for each representative species and life stage were determined from a consensus rating and measurements of wetted channel width. Each rating was based on visual observations of conditions and how well they met numeric criteria for habitat suitability (defined in terms of water depth, velocity and substrate) within pre-selected study reaches. The assessment was performed for adult and juvenile life stages of rainbow trout (*Oncorhynchus mykiss*), brook trout (*Salvelinus fontinalis*), and brown trout (*Salmo trutta*). The observers also assessed whether

[12] Morrisville Bypass Flow Study Report, Gomez and Sullivan Engineers, P.C., January 2013.

each flow provided adequate downstream passage and habitat connectivity for fish (primary and secondary bypass) along with water movement and cover via broken water surface (primary bypass). Wetted width was measured at one reference transect within each study segment for every flow demonstration.

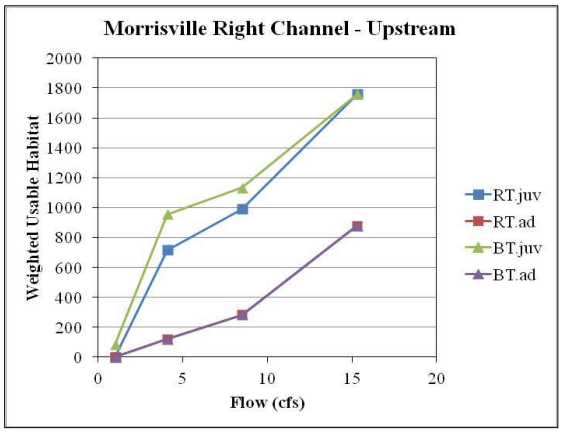
108. Flows of 4.5, 21, 59, and 91 cfs were evaluated in the primary bypass, while flows of 1.0, 4.1, 8.5, and 15.3 cfs were evaluated in the secondary bypass. The percentage of suitable habitat for all species and life stages was lowest during leakage. Increasing flow generally resulted in greater wetted widths and wetted area, especially within the primary bypass and the upstream section of the secondary bypass.

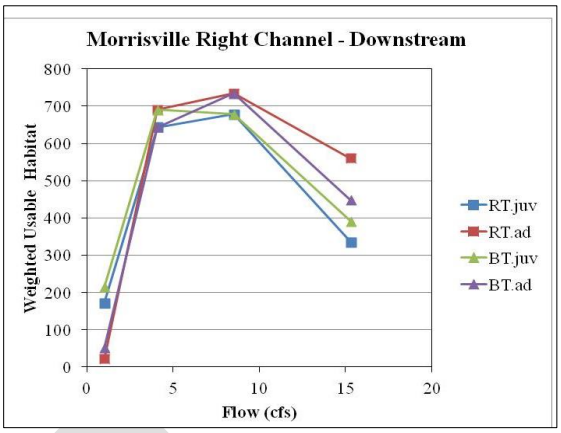
109. In the primary bypass, leakage flow provided sufficient water depth, but many areas of stagnant water led to low suitability values. The 21 cfs release increased velocity in many areas, which resulted in improving habitat suitability for each species and life stage. At 59 cfs, habitat suitability increased for all species, however it did not provide high quality habitat for juvenile and adult rainbow trout and there was very little water movement and circulation to maintain cover via a broken water surface in the large pool downstream of the bridge. The highest flow observed during the study of 91 cfs provided the best observed habitat conditions, but it is uncertain if a higher flow would improve habitat conditions. Habitat as a percentage of the maximum observed over the range of demonstration flows is summarized in the following table:

Habitat as a Percentage of the Maximum Observed				
Species/life stage	**Primary Bypass Flow (cfs)**			
	4.5	**21**	**59**	**91**
Brook/brown trout juvenile	72%	91%	95%	100%
Brook/brown trout adult	37%	70%	84%	100%
Rainbow trout juvenile	34%	66%	79%	100%
Rainbow trout adult	29%	58%	73%	100%
Most limiting habitat	29%	58%	73%	100%

110. The same flow demonstration methodology was used in the secondary bypass with the exception that habitat was assessed at two stations due to differing physical channel characteristics. In the upstream section, the 1.0 cfs demonstration flow resulted in a wide wetted width and shallow depth that provided very little suitable habitat. The 4.1 cfs demonstration flow provided increased depth, which resulted in suitable habitat for juvenile salmonids, however suitability for adults was limited. A flow of 8.5 cfs did not improve percent habitat suitability due to continued channel widening. Habitat suitability increased substantially at 15.3 cfs due to a considerable increase in depth.

111. The downstream section of the secondary bypass is constricted by bedrock shelves and boulders, which create small pools. This reach is relatively short and due to the constrictions, the overall wetted area is small compared to the upstream reach. The 1.0 cfs demonstration flow provided suitable habitat for juvenile salmonids, but little habitat for adults. Increasing the flow to 4.1 cfs increased habitat suitability for each species and life stage by increasing the size and depth of the pools. Habitat suitability peaked at 8.5 cfs and declined at 15.3 cfs because of increase velocity.





112. In its application for licensing, the Applicant proposed to continue spilling 12 cfs in the primary bypass and proposes to spill 4 cfs in the secondary bypass. In subsequent discussions, MWL has proposed to spill 28 cfs in the primary bypass and 8.5 cfs in the secondary bypass within five years is issuance of certification.

Cadys Falls

113. Currently there is no bypass flow requirement for the Cadys Falls bypass reach. The bypass has been identified as having the potential to provide high quality habitat for brook, brown, and rainbow trout, as well as support macroinvertebrates with an adequate flow regime. The bypass provides habitat types that are limited within this reach of the Lamoille River, and is attractive for aquatic biota. The reach provides habitat with higher velocities and a good mix of heterogeneous conditions in close proximity to one another.

114. MWL conducted a habitat-flow study in the bypass of the development to quantitatively assess the relationship between flow and aquatic habitat for selected target organisms.[13] The goal of this study was to determine the bypass flow regime necessary to support and sustain healthy aquatic habitat for selected organisms and minimize the negative impacts of project operations on water quality to mitigate for loss of degradation. Instream flow needs were evaluated using a transect-based modification to the Physical Habitat Simulation Model (PHABSIM) methodology. PHABSIM is part of the US Fish and Wildlife Service's Instream Flow Incremental Methodology (IFIM), used to negotiate flow regimes for activities that alter natural flows. PHABSIM is a model that simulates river hydraulics and habitat based on known species preferences for the specific physical habitat components of depth, velocity, and substrate. The end product is a set of weighted useable areas (habitat amount) as a function of streamflow at each life stage for an individual species of concern. A modified PHABSIM combines hydraulic information with aquatic habitat suitability index curves to develop a relationship between habitat and flow, similar to a traditional PHABSIM, however in the modified approach direct field-based measurements are utilized rather than modeled parameters.

115. Depth, velocity, and substrate measurements were collected at three transects for five study flows (48, 67, 98, 139, 163 cfs) to evaluate suitable habitat. The transects were chosen to target riffles because they are typically more flow-sensitive than pool areas and are thus better suited for

[13] Cadys Falls Bypass Reach Flow Study, Gomez and Sullivan Engineers, P.C., January 2013.

identifying an appropriate flow regime within the bypass. The target species for this study were macroinvertebrates, adult and juvenile life stages of brook trout, brown trout, , and rainbow trout. Flow requirements for spawning and incubation, which are typically higher, were not evaluated because the bypass does not contain spawning habitat.

116. For all target organisms, and life stages, the amount of suitable habitat increased with flow across the entire range of study flows. The maximum amount of habitat observed occurred at 163 cfs for all species and life stages included in the study. Whether or not habitat condition continued to improve with higher flows is unknown.

117. In order to optimize the habitat for all target species within the study, results were combined to determine which flow would provide the best overall habitat conditions for the group of species and life stages considered. This analysis aims to maximize habitat available for the species or life stage with the lowest weighted useable area (WUA) value relative to the maximum WUA, and is a technique used by other studies.[14] The peak of the resulting curve represents the optimum flow, although flow recommendations are based on the shape of the habitat-flow curve. When the habitat-flow relationships of all target organisms were combined, habitat is optimized at the highest study flow of 163 cfs which provided 100 percent of all available habitat measured. Flows of 139 cfs and 98 cfs provided 92 percent and 78 percent of the optimum, respectively, with habitat for adult rainbow trout being the most limiting. The table below shows the amount of habitat available for each target organism at each study flow, expressed as a percentage of that found at 163 cfs.

Habitat as a Percentage of the Maximum Observed					
Species/life stage	**Bypass Flow (cfs)**				
	48	**67**	**98**	**139**	**163**
Brook/brown trout juvenile	57%	73%	91%	95%	100%
Brook/brown trout adult	49%	66%	83%	93%	100%
Rainbow trout juvenile	47%	71%	89%	96%	100%
Rainbow trout adult	35%	57%	78%	92%	100%
Macroinvertebrates	37%	61%	84%	97%	100%
Most limiting habitat	35%	57%	78%	92%	100%

118. In its FERC license application, MWL proposed to provide a 12 cfs bypass flow. In subsequent discussions, the Applicant has proposed a 54 cfs bypass flow to be phased-in 10 years after issuance of the certification.

Green River

119. Flow releases from the Green River powerhouse affect the downstream reach to its confluence with the Lamoille River. The conservation flow requirement is 5.5 cfs year-round and there is extensive hydropeaking during a portion of the year. The conservation flow is equal to 0.38 csm or about 82% of the August median flow determined from the historic gage data. In addition, flow requirements during the fall, winter and spring are usually considerably higher to accommodate migration of fish species to spawning areas and incubation of eggs. As previously noted MWL

[14] Orth, D.J. and P.M. Leonard. 1990. Comparison of discharge methods and habitat optimization for recommending instream flows to protect fish habitat. Regulated Rivers: Research & Management 5:129-138.

proposes to operate the facility in a store-and-release mode with peaking operations characterized by low conservation flows during non-generation periods and by extremely high flows when generating.

120. The estimated minimum hydraulic capacity of the Green River development is 60 cfs, equal to 4.1 csm, which is a typical flow during April, and 10.9 times the current conservation flow of 5.5 cfs. The typical summer generating level of 140 cfs is 9.6 csm and 25 times the current conservation flow. It is well documented that the occurrence of frequent and rapid flow fluctuations of this magnitude can have a significant effect on fish populations.[15]

121. The Green River development has an unusually large hydropeaking capacity in relation to the size of its watershed as compared to other FERC jurisdictional hydropeaking projects in Vermont. The development has a maximum capacity that is 19.4 times area of the watershed, when both units are generating at maximum capacity and 9.6 when one unit is generating at maximum capacity. The ratio of maximum station capacity to drainage area is approximately four times the next largest ratio in the state.[16] A higher maximum capacity per watershed area ratio is more likely to result in over-watering the river channel and negatively affect aquatic habitat conditions and availability for fish populations.

122. The habitat-flow relationship was assessed using a one-dimensional transect-based Physical Habitat Simulation System (PHABSIM) model.[17] The objective of the study was to quantitatively assess the relationship between flow and aquatic habitat for selected target organisms so that the flows needed to provide suitable habitat conditions for representative fish species could be determined. The PHABSIM methodology combines transect hydraulic information (depth, velocity, substrate) with aquatic habitat suitability index (HSI) curves to develop weighted usable area (WUA) (i.e., habitat) versus flow relationships at representative transects within the river.

123. Mesohabitats of the entire Green River were mapped (e.g. riffle, run, pool) to assist in selection of transects. Based on the mesohabitat survey, the Green River consisted of 25.1% pools, 32.5% riffles, 16.3% runs and 26.1% "other" unmodeled types. The study included nine transects with six transects were located in riffles, two in runs, and one in a pool. Transect selection focused on riffle habitat, considering riffles to be "critical reaches". Five transects contained spawning habitat and were used to assess the flow-spawning habitat relationship. Two transects were included in the reach of the Green River close to its confluence with the Lamoille River, to represent the habitat available to fish entering the Green River from the Lamoille River, such as for spawning or thermal refuge. Habitat availability was evaluated at flows of 10 cfs, 75 cfs, and 160 cfs across all transects. The species and life stages included in the study were brook and brown trout (spawning and incubation, late fry, juvenile, adult), all trout (early fry), rainbow trout

[15] Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream of hydroelectric facilities. North American Journal of Fisheries Management 5:330-339.

Hunter, M.A. 1992. Hydropower flow fluctuations and salmonids: review pf the biological effects, mechanical causes, and options for mitigation. Technical Report 119. Washington Department of Fisheries, Olympia, Washington.

[16] Letter from Jeffrey Crocker, Vermont Department of Environmental Conservation, to Kimberly D. Bose, Secretary of FERC, Comments, Recommendations, Terms and Conditions for Morrisville Hydroelectric Project (FERC No. 2629), December 27, 2013

[17] Green River Flow Study, Gomez and Sullivan Engineers, March 2013.

(spawning and incubation, late fry, juvenile, adult), longnose sucker (spawning and incubation) and macroinvertebrates.

Steady state habitat modeling

124. Steady-state habitat modeling was performed by combining the hydraulic model, which simulates hydraulic conditions with a habitat model for each assessment transect using field-collected data. The model predicts water surface elevations, water depths and mean water column velocities across each modeled transect as a function of flow. The hydraulic data is then combined with habitat suitability data to determine usable habitat that exists at a specific flow.

125. The Instream Flow Study report presented "composite" habitat results by combining all transects as weighted by mesohabitat type, which is referred to as a "representative reach" approach. The transect selection focus on riffles was largely undone by the mesohabitat weighting, which essentially converted the more sensitive "critical reach" approach into a "representative reach" approach. Riffle areas are the most sensitive to flow changes and are also critical to the stream's ecological functions. A flow regime that is adequate for riffle areas is likely to satisfy the needs for food production, fish passage, spawning and rearing. Other habitat types (runs, pools) will also be protected since they are less sensitive to flow changes. The Department considers riffles to be critical habitat which should be studied using a "critical reach" approach.

126. The Department's findings relating to the steady state habitat model are based on the combined, unweighted results. For spawning and incubation life stages the results included only the spawning transects. The Department's findings include a "habitat optimization analysis" as a tool to determine what flow regime best accommodates the entire aquatic community. The steady state habitat results from PHABSIM provide the amount of habitat (measured as weighted usable area or WUA) that is available across a range of discharges. Various authors have presented methods to aggregate or combine multiple habitat-flow curves so that an "optimum" flow can be determined.[18] WUA values for each species or life stage are "normalized" so that the maximum value is 1. For each flow, the minimum normalized WUA value among the species or life stages is determined. The optimum flow is defined as that which provides the greatest WUA from among these minima. This method assumes that 1) the species/life stage with the lowest WUA value relative to the maximum WUA possible is the one most limited by physical habitat, and 2) the optimum flow provides the best overall habitat conditions for the group of species/life stages considered.[19]

[18]Aadland, L.P., C.M. Cook, M.T. Negus, H.G. Drewes and C.S. Anderson. 1991. Microhabitat preferences of selected stream fishes and a community-oriented approach to instream flow assessments. Minnesota Department of Natural Resources. Section of Fisheries. Investigational Report Number 406.

Bovee, K.D. 1982. A guide to stream habitat analysis using the Instream Flow Incremental Methodology. Instream Flow Information Paper 12. U.S.D.I. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-82/26.

Leonard, P.M., and D.J. Orth. 1988. Use of habitat guilds of fishes to determine instream flow requirements. North American Journal of Fisheries Management 8:399-409.

Loar, J.M., and M.J. Sale. 1981. Analysis of environmental issues related to small-scale hydroelectric development. V. Instream flow needs for fishery resources. Oak Ridge National Laboratory, Environmental Sciences Division Publication 1829.

[19]Orth, D.J. and P.M. Leonard. 1990. Comparison of discharge methods and habitat optimization for recommending instream flows to protect fish habitat. Regulated Rivers: Research & Management 5:129-138.

Spawning and Incubation

127. Rainbow Trout and Longnose Sucker spawning and incubation habitat were evaluated for the spring period. Rainbow trout spawning and incubation habitat increased with flow up to about 75 cfs and then declined with increasing flows. At least 80% of the maximum available habitat (WUA) occurred over the range 60-120 cfs. These results are consistent with the flows that would naturally occur during the spring spawning period. No suitable spawning habitat was found to occur at 5.5 cfs. The results of the study indicate the reach of the Green River available for rainbow trout entering from the Lamoille River to spawn are similar to other sections of the river with at least 80% of the maximum available habitat (WUA) occurred over the range 50-80 cfs. Longnose sucker spawning and incubation habitat increased sharply with flow up to about 40 cfs and then declined with increasing flows. At least 80% of the maximum available habitat (WUA) occurred over the range 30-120 cfs. The flow-habitat results for Longnose sucker in the reach of the Green River near the confluence were similar to other reaches of the river and for rainbow trout. The results suggest that operation of one turbine in a range of 60-125 cfs during the spring period would provide suitable spawning and incubation habitat for these species.

128. Brook and brown trout spawning and incubation habitat were evaluated for the fall period. Habitat is maximized at 15 cfs and exceeds 80% of the maximum at 10-30 cfs. Habitat declined at higher flows with only about 34% of the maximum available at 75 cfs. The results are similar for the reach of river near the confluence of the Lamoille River. These results are consistent with the flows that would naturally occur during the fall spawning period. Generation at the current minimum capacity of 60-75 cfs does not provide adequate spawning and incubation habitat for the fall. The study results are summarized in the following table.

Species	Season	Flow maximizing WUA	WUA > 80% of max
Rainbow trout Spn & Inc	Spring	75 cfs	60-120 cfs
Longnose sucker Spn & Inc	Spring	40 cfs	30-120 cfs
Brook/Brown trout Spn & Inc	Fall/Winter	15 cfs	10-30 cfs

Trout Early Life Stages

129. Survival of fish during their first season of life is often a bottleneck limiting population size. Small fish are not strong swimmers and can be very vulnerable to high flows and fluctuating flows. Consequently, it is important to provide a flow regime that accommodates these fish. In the Green River, a flow of 10 cfs optimizes late fry habitat for the three trout species taken together. The current conservation flow of 5.5 cfs does provide acceptable habitat for most of these life stages. The quantity of early fry habitat is much lower than that for late fry and decreases further at all generation flows. The study results are summarized below.

Species/life stage	Flow maximizing WUA	WUA > 80% of max
Trout species combined: early fry	4 cfs	4-5.5 cfs
Rainbow trout: late fry	15 cfs	10-40 cfs
Brook/brown trout: late fry	5.5 cfs	4-20 cfs

Other Fish Species and Life Stages

130. The study results indicate that a flow of 5.5 cfs does not provide good habitat conditions for the remaining species and life stages. A higher flow (20-30 cfs) significantly improves conditions. When the steady state habitat relationships of these species/life stages are combined using the optimization technique describe above, habitat is optimized at 60 cfs. These results suggest that summer low flows provide the lowest amount of steady state habitat. Generation with one unit can provide good steady state habitat conditions for these older fish (although not for fry). Results for these same life stages were examined for the transects that represent the habitat in the lower Green River that is used by both resident fish and fish from the Lamoille River. The results are similar. The study results for the remaining target species and life stages which are present in the river year round are summarized below.

Species/life stage	Flow maximizing WUA	WUA > 80% of max	% of max WUA at		
			5.5 cfs	20 cfs	30 cfs
Brook trout juvenile	40 cfs	20-70 cfs	41%	84%	99%
Brook trout adult	70 cfs	30-150 cfs	31%	67%	83%
Rainbow trout juvenile	60 cfs	30-110 cfs	31%	68%	85%
Rainbow trout adult	80 cfs	50-130 cfs	13%	44%	62%

Macroinvertebrates

131. Macroinvertebrates play a critical role in flowing water ecosystems in processing nutrients and in serving as a major food source for fish.[20] Therefore, it is important that a flow regime be established that accommodates their needs. Habitat (steady state, all transects combined) increased with flow up to a maximum at 90 cfs and then gradually declined as flow increased further. At least 80% of the maximum available habitat (WUA) occurred over the range 40-180 cfs. Habitat declines to a greater extent at the low flow end; 30 cfs, 10 cfs and 5.5 cfs provide 69%, 22% and 8%, respectively.

Hydropeaking and dual flow analysis

132. Hydroelectric peaking operations have the potential to cause impacts to aquatic habitat at both the low and high flow events. Low flow events mainly limit habitat by reducing both stream depth (dewatering habitat and stranding organisms) and water velocity. High flow events mainly limit habitat by increasing velocities beyond the suitability of organisms.[21]

133. Historically the Green River project has fluctuated flows between a very low base flow and a high generation flow. Rapid changes in flow cause corresponding rapid changes in aquatic habitat conditions which affect organisms depending in part on their mobility. Hydropeaking generally

[20]Hooper, D.R. 1973. Evaluation of the effects of flows on trout stream ecology. Pacific Gas and Electric Company. Emeryville, California. 97pp.

Gore, J.A., J.B. Layzer and J. Mead. 2001. Macroinvertebrate instream flow studies after 20 years: a role in stream management and restoration. Regulated Rivers: Research & Management 17:527-542.

[21]Thuemler, T.F., G.E. Whelan and J.D. Fossum. 1991. Assessment of the effects on aquatic habitat from a hydroelectric peaking project using the Instream Flow Incremental Methodology. Instream Flow Chronicle VIII(1):1-3.

forces mobile organisms to relocate since the locations of suitable habitat areas change. This frequent relocation exposes them to predation, expends additional energy needed for survival and growth, and may also cause other behavioral effects. Immobile species and life stages are affected to a greater extent since they cannot relocate or move to suitable habitat if it shifts in location between the base and generation flows.

134. Macroinvertebrates, mussels, fish eggs and small fish are generally assumed to be immobile within the context of a daily peaking environment. For immobile organisms, it is reasonable to assume that an organism is controlled by whichever flow (base or generation) provides poorer habitat conditions at its location. The "Dual Flow Analysis" or "Effective Habitat Analysis" uses this assumption to quantify the habitat that "remains available" under a peaking operation with a specified base flow and generation flow.[22] Under the Applicant's proposal, peaking would continue and the maximum generation flow would increase from 160 cfs to 283 cfs from May 1 to October 31.

135. The study results and the Agency's assessment[23] of those results indicate that peaking dramatically reduces the amount of habitat in the Green River compared to steady-state flow conditions. Flow variations associated with peaking causes locational shifts in the suitable habitat that further decrease the quantity of effective habitat.

Spawning and Incubation

136. Steady state habitat for rainbow trout spawning and incubation exceed 80% of maximum available with flows that are in the 60-120 cfs range. The dual flow analysis indicates that habitat declines quickly when either the base or peak flow moves further away from this range. The steady state habitat for longnose sucker spawning and incubation exceed 80% at 30-120 cfs and gradually decline as flow increases above this range, though not as quickly as for rainbow trout. A 30-75 cfs peaking regime results in only a small decrease in effective habitat for longnose sucker.

137. Steady state habitat for brook trout and brown trout exceeds 80% of the maximum at 10-30 cfs and declines sharply for all generation flows. As a result, effective habitat is very low for all hydropeaking scenarios.

Trout Early Life Stages

138. Steady state habitat for early fry trout exceeds 80% of the maximum at 4-5.5 cfs and declines rapidly as flows increase. As a result, any hydropeaking regime is problematic. Steady state habitat for late fry rainbow trout exceeds 80% of the maximum from about 10 to 40 cfs and declines sharply up to about 100 cfs (36% of maximum), beyond which it rate of decline lessens. A flow of 75 cfs provides only 48% of the maximum steady state habitat and hydropeaking regimes provides even less effective habitat. For example, a base flow of 10 cfs and peak of 75

[22]Milhous, R.T., M.A. Updike and D.M. Schneider. 1989. Physical habitat simulation system reference manual – version II. U.S. Fish and Wildlife Service Biological Report 89(16). Washington, D.C.

[23] Memorandum from Rod Wentworth, Vermont Fish and Wildlife Department to Jeff Crocker (VT DEC), Eric Davis (VT DEC), and Jud Kratzer (VT FWD), Morrisville Hydroelectric Project, FERC No. P-2629, Assessment of Aquatic Habitat and Instream Flow Needs in the Green River, October 22, 2014.

cfs provides only 36% of the effective habitat that would be available at a steady state flow of 10 cfs or 70% of that available at a steady state flow of 75 cfs. The results for brook and brown trout late fry are similar to those for rainbow trout. Higher flows such as those associated with generation at the development provide much less habitat than flows less than 30 cfs.

Other Fish Species and Life Stages

139. The dual flow or effective habitat analysis is most applicable to aquatic life that is immobile or cannot move readily, such as small fish, eggs or invertebrates. Adult brown trout are better able to cope with hydropeaking since they are stronger swimmers and also utilize habitat with higher velocities than fry do. The steady state habitat for adult brown trout exceeds 80% of the maximum from about 30 to 150 cfs. There are various base-peak flow combinations that provided effective habitat of at least 80% of the steady state maximum, for example: 30/60 cfs, 40/80 cfs, and 70/120 cfs. Some degree of peaking is not problematic for these species as long as the base flow is about 40 cfs or higher. A low base flow does more to limit habitat than peak flows of up to 140 cfs.

Macroinvertebrates

140. Most macroinvertebrates are riffle dwellers and are found in relatively fast-flowing environments. The steady state habitat results show that a relatively wide range of flows (50-190 cfs) provides at least 80% of the steady state maximum. Hydropeaking with one unit (140 cfs) has little effect on effective habitat. Peaking with two units (285 cfs) does provide less effective habitat. Habitat is driven more by the steady state flow than by locational shifting in habitat between the base and peak flows except for the higher peaking level.

Lake Elmore

141. The Lake Elmore development spills into Elmore Brook which extends approximately 2.5 miles downstream from the dam until its confluence with the Lamoille River. The Lake Elmore development has no minimum flow requirements. Typically the development is operated in crest controlled run-of-river mode except for the fall drawdown period. During the drawdown outflow exceed inflow while the lake is lowered by two feet. The drawdown typically occurs between mid-September and mid-October for a period of 2 to 4 weeks. During the refill outflow is reduced by approximately 80 percent until lake elevation reaches the spillway at 1,139 feet msl.

142. Elmore Brook provides suitable habitat for spawning and incubation for brook trout. Brook trout spawn in the fall and the drawdown typically overlaps with part of the spawning season. Fluctuation in flows can disrupt spawning activity and the amount of suitable spawning and incubation habitat.

143. A flow study was conducted in Elmore Brook with the goal of determining the impact of flow releases during the annual fall drawdown and refill has on the aquatic habitat.[24] The study quantified the relationship between flow and aquatic habitat with the intention of developing a flow and ramping regime that can be implemented during the Lake Elmore drawdown and refill. The field investigation documented a noticeable increase in turbidity at all five observation

[24] Elmore Pond Brook Flow Study, Gomez and Sullivan Engineers, P.C., January 2013.

points, as well as at the confluence of Elmore Brook and the Lamoille River after the gate at the dam was opened.

144. The Applicant has proposed to eliminate all drawdowns of the lake and operate the development in crest controlled run-of-river mode with a stable water elevation of 1139 feet msl under a new license.

Water-Level Management

Green River Reservoir

145. The current license for the Green River development has a one foot operating range from May 1 to November 30. During the winter period (December 1 to April 30), the pond is normally drawn six feet below the dam crest, with a maximum drawdown of ten feet permitted.

146. Shoreline areas act as a lake's "breadbasket" because of their high productivity. The penetration of sunlight into the shallow waters produces abundant plant growth. These plants provide food for other aquatic life, serve as spawning substrate for fish such as yellow perch, and provide cover for juvenile fish, forage fish and predator fish. Aquatic invertebrate production is greatest in this area. Many fish seasonally use shoreline areas for spawning.

147. The dewatering of near-shore areas resulting from fluctuating water levels caused by the winter drawdown subjects the reservoir ecosystem to a major, annual disturbance. Healthy and stable near-shore communities that provide habitat for fish and wildlife cannot develop, reducing the habitat value for a variety of species. Aquatic invertebrates that many fish rely on for food are greatly reduced. Fish that inhabit shoreline areas do not have the plant cover they need since many aquatic plants cannot become established due to the drawdown. These impacts may cause fish growth, survival and abundance to be low. Mortality of herptiles (e.g., frogs and turtles) that overwinter in the near-shore area is high due to exposure after hibernation has begun. Finally, the lack of aquatic vegetation can exacerbates the erosion previously described.

148. The Green River Reservoir is a deep, steep sided reservoir, which results in relatively narrow near-shore area suitable to support aquatic plants. The bathymetry of the reservoir results in a relatively small amount of area being dewatered under the normal one foot operating band, but a relatively large proportion of the near-shore area is dewatered during the winter drawdown. The bathymetry submitted by the Applicant, with subsequent analysis in ArcGIS and HydroCad, indicate that the extent of the reservoir at elevation 1220 feet msl is 610 acres, decreasing to 593 acres at elevation 1219 feet msl, 530 acres at elevation 1214 feet msl, and 479 acres at elevation 1210 msl. This analysis indicates that the normal winter drawdown dewaters approximately 80 acres of aquatic habitat, while the maximum allowable drawdown has the potential to dewater more than 131 acres.

149. The revised study plan for the project included an aquatic resource assessment of Green River Reservoir. The stated goal of the study was to evaluate the near-shore aquatic habitat of Green River Reservoir to assess the potential impact of the winter drawdown. The objectives of the study were to inventory existing riparian and near-shore aquatic habitats within the drawdown zone using the National Lakes Assessment methodology; quantitatively describe the acreage of

near-shore area available over the range of allowable drawdown; and assess whether project operations have any effect on the availability of aquatic habitat. [25]

150. The Departments review of the study report indicated that several of the objectives were not met by the Applicant's study. For example, only three of the twelve stations assessed were within the range of the currently licensed drawdown of 10 feet. No quantitative analysis or comparison to other lake in Vermont was done to determine available habitat over the range of the drawdown, and no summary or evaluation of the effect of the winter drawdown on the littoral habitat.[26]

151. The Department assessed the near shore habitat at Green River Reservoir in August 2014 to gather the information needed to inform decisions on project operations. The Department used a modified approach from National Lakes Assessment methodology. Ten sites were selected via desktop, in which a randomly selected shoreline point defined the first site and nine additional sites were located equidistantly around the shoreline of the reservoir (Sites A-J). Seven additional sites were selected in the field (Sites K-Q). At each site, a 10 meter (m) floating transect line was placed at the 0.5-m depth contour parallel to the shore. The transect was then divided into two 1-m wide by 5-m long plots. At sites A through K, transects were also laid at 1-m and 2-m depths. One snorkeler identified plants to species level, estimated their abundances, and estimated the percent cover of different sediment types, periphyton and aufwuchs.[27] A second snorkeler counted the pieces of large woody structure (> 10 cm diameter) and estimated the percent cover of medium (4- 10 cm diameter) and fine (< 4 cm diameter) woody structure. The second snorkeler also measured shading using a densiometer at one and five meters from the waterline, and estimated the percent cover of deciduous leaf litter and embeddedness of sediments. The assessment of near-shore aquatic habitat was paired with an assessment of the shoreline buffer at each site in a 7.6 m by 7.6 m plot, so that the aquatic habitat of Green River Reservoir could be compared with similar waterbodies (class, size, development). The shoreland assessment also included a search for odonate exuviae[28] at each plot. The results showed that the physical attributes, (woody debris, leaf litter, percent sand, percent embeddedness) were similar to other large, mesotrophic, undeveloped sites. However, both percent aquatic macrophyte cover and number of odonate exuviae per plot, 8 percent and 0.6, respectively, were significantly less than reference waterbodies, which were 21.6 percent and 19.6, respectively. Reduced aquatic plant cover at Green River Reservoir relative to reference waterbodies was consistent across transects. For the shallow (0.5 m), medium (1 m), and deep (2 m) transects the percent of aquatic plant cover at Green River Reservoir was 3.4, 14, and 7.9 percent, as compared to 21.6, 34.1, and 46.5 percent at the respective transects of the reference waterbodies.

152. Most bass spawning occurs from late May to early June. Nests are usually constructed in water at depths of 2 to 5 feet on gravel or broken rock and often near boulders, logs or other cover.[29] Male

[25] Aquatic Resources Assessment of the Morrisville Hydroelectric Project (FERC No. 2629), TRC, March 2012.
[26] Letter from Brian T. Fitzgerald, Vermont Agency of Natural Resources, to Kimberly D. Bose, Secretary of FERC, Comments on Morrisville Hydroelectric Project (FERC No. 2629) Study Reports, filed with FERC May 2, 2012.
[27] Aufwuchs is the small animals and plants that encrust hard substrates, such as rocks and woody debris in aquatic environments.
[28] Odonates are an order of carnivorous insects that rely on the aquatic environment during an aquatic nymph stage. Upon emerging from the aquatic environment to begin a terrestrial adult life stage, odonates leave their exoskeletons or exuvia on the shoreline.
[29] Edwards, EA., G. Gebhart, and O.E. Maughan. 1983. Habitat suitability information: smallmouth bass. USDI, FWS. FWS/ OBS-82/10.36. 47 pp.

bass guard their offspring from the egg stage until the young fry are ready to disperse, a period of a month or more. During this "black fry" stage, the fry are essentially helpless and remain over or near the nest site. Among common hazards to eggs and fry are temperature fluctuations, floods, and receding water levels.[30] Optimal spawning conditions are considered to be a relatively stable water level during spawning and for 45 days thereafter.[31] While a modest increase in water level generally does not cause problems for bass nesting, reservoir drawdowns may force guarding male fish from the nest site exposing the eggs and fry to predators or stranding. Since fry prefer shallow water associated with shoreline or marginal areas, they are especially vulnerable to stranding.

153. Reservoir water level fluctuations during the period from spawning through the early-fry stage can interfere with nest site selection and spawning; dewater nests, resulting in egg desiccation; cause the guardian male to abandon the nest or the black fry, resulting in high predation on the offspring; and force fry away from cover and subject them to predation. The proposed water level stabilization during the spring will help protect spawning, incubation, and the black fry of smallmouth bass.

154. MWL has proposed to continue the current winter drawdown of 6-10 feet from December 1 to April 30. MWL also proposes to maintain the reservoir elevation 3-inches below the dam crest during the loon nesting period from May 1 to August 1 and within one foot of the dam crest from August 2 to November 30.

Lake Elmore

155. The Lake Elmore is a natural lake that has been raised four feet by the dam for the purpose of hydroelectric storage. The development is operated in crest controlled run-of-river mode except for the fall drawdown period. During the drawdown, outflow exceeds inflow, while the lake is lowered by two feet. The drawdown typically occurs between mid-September and mid-October for a period of 2 to 4 weeks.

156. Lake Elmore is a 300 acre lake with moderate development around much of its shoreline. The lake is generally shallow with a maximum depth of 5.2 meters (17 feet) resulting in an extensive littoral zone. The Applicant conducted an assessment of the near-shore habitat and shoreline using the National Lakes Assessment methodology.[32,33] The near-shore area is typically silt/clay with some sand. All of the sampling stations had significant submergent macrophyte growth and floating macrophytes were present at some stations.

157. MWL has proposed to eliminate all drawdowns of the lake and operate the development in crest controlled run-of-river mode with a stable water elevation of 1139 feet under a new license.

[30] Coble, D. W. 1975. Smallmouth bass. Pages 21-33 in R.H. Stroud and H. Clepper, editors. Black bass management. National Symposium on the Biology and Management of the Centrarchid Basses, Tulsa, Oklahoma.
[31] Edwards et al., Op. cit.
[32] USEPA. 2007. Survey of the Nation's lakes: Field Operations Manual, EPA 841-B-07-004. U.S. Environmental Protection Agency, Washington, DC.
[33] Aquatic Resource Assessment for the Morrisville Project (FERC No. 2629). TRC. March 2012.

Wildlife and Wetlands

158. Several types of wetlands exist in close proximity to the project developments based on the National Wetland Inventory (NWI) classification system. Additionally, many of the wetlands are classified as Class II wetlands and are protected under 10 V.S.A. Chapter 37 and the Vermont Wetland Rules. They include lacustrine, riverine floodplain, palustrine freshwater emergent, palustrine freshwater forested, and palustrine scrub-shrub wetlands.

159. The Lamoille River and Lake Lamoille in the vicinity of the Cadys Falls and Morrisville developments consist of pockets of palustrine emergent and scrub-shrub wetlands.

160. The Green River Reservoir contains palustrine scrub-shrub and emergent wetlands at its northern edge where the Green River enters the reservoir. MWL conducted a wetland survey at the Green River development focused on the 1.25-mile section immediately downstream of the dam. The assessment identified 27 acres of emergent marsh, sedge meadow, and alder swamp wetlands.[34] The most abundant wetland type within the survey is shallow emergent marsh, which is dominated by herbaceous wetland species, including common bluejoint grass (*Calamagrostis canadensis*), common joe-pye weed (*Eupatorium maculatum*), common tussock sedge (*Carex stricta*), mannagrass (*Glyceria spp.*), and rough bedstraw (*Galium asprellum*). The sedge meadow community is similar to that of emergent marshes, but sedges such as lakeshore sedge (*Carex lacustris*) and common tussock sedge (*Carex stricta*) are dominant. Alder swamps are typically located in transitional areas between shallow emergent marshes and upland communities. This natural community is dominated by speckled alder, along with other woody species and herbaceous species found in the emergent marshes and sedge meadows. The survey also identified rare populations of muskflower (*Mimulus moschatus*), common watercrowfoot (*Ranunculus aquatilis var. diffuses*), and Hayden's sedge (*Carex haydenii*) downstream of the Green River development.

161. The Lake Elmore development has palustrine emergent and scrub-shrub wetlands at its southern edge where Elmore Brook enters the lake. A small pocket of palustrine forested wetland dominated by deciduous trees is present at the Western edge of Lake Elmore.

Common Loons

162. Common loons (*Gavia immer*) are an uncommon species and a species of greatest conservation need in Vermont due to their low fecundity. Loons nest on the water's edge where their reproductive success can be adversely affected by water level fluctuations.

163. The Green River Reservoir typically supports two or three territorial loon pairs during the nesting season. The Applicant has voluntarily stabilized the Green River Reservoir during the loon nesting season from May 1 to August 1 since 2003. During the nesting season, MWL attempts to maintain the reservoir 3 inches (1219.75 feet msl) below the crest of the dam. The Applicant is proposing to continue to maintain the reservoir at stable elevation at 1219.75 feet msl from May 1 to August 1 to protect nesting loons under the new license.

[34] Green River Wetland Study, Arrowwood Environmental & Gomez and Sullivan Engineers, P.C., January 2013.

Rare and Endangered Species and Outstanding Natural Resources

164. The U.S. Fish and Wildlife Service online Species Report indicates there are no federally listed or proposed rare, threatened or endangered species known to be present in the vicinity of the project.

165. There is one state-listed endangered freshwater mussel species, cylindrical papershell (*Anodontoides ferussacianus*), is known to occur in the Lamoille River above the first set of barrier falls upstream of Lake Champlain. A population of the cylindrical papershell has been documented approximately nine miles downstream of the Cadys Falls development in the Lamoille.

166. The Vermont Non-Game and Natural Heritage Program list seven rare vascular plant species that occur in the project vicinity. Water bur-reed (*Spargantium fluctuans*), Lesser bur-reed (*Sparganium natans*), Straight-leaf pondweed (*Potomogeton strictifolius*), and Vasey's pondweed (*Potamogeton vaseyi*) occur in the vicinity of Lake Elmore. Muskflower (*Mimulus moschatus*), and Hayden's sedge (*Carex haydenii*), and Whorled watermilfoil (*Myriophyllum verticillatum*) are found in the vicinity of the Green River development.

Shoreline Erosion

167. The Applicant conducted a shoreline erosion survey that indicates that erosion is not extensive within the project area. In general, the project impoundments are heavily vegetated and/or rock armored shorelines. [35]

168. Sections of the Morrisville impoundment are bedrock and the remainder is heavily vegetated. There are signs of minor erosion in small areas, but this is attributed to natural high flow events.

169. The Cadys Falls impoundment, Lake Lamoille, is characterized by an undeveloped, heavily vegetated shoreline. Lake Lamoille is located within a low grade, slow flowing reach of the Lamoille. There were several areas of significant erosion identified, but they were attributed to natural high flows, as in the Morrisville impoundment.

170. The Green River Reservoir has more than 17 miles of undeveloped, irregular shoreline. The shoreline is characterized by forest and steep bedrock banks. The reservoir is dominated by well drained, fine sandy loam. Despite the undeveloped shoreline, there are numerous areas of minor erosion that are attributed to foot traffic around campsites, human activity at private residences, or wind and wave action. The drawdown may potentially exacerbate erosion at Green River.

171. Lake Elmore is developed, with seasonal and year-round homes along much of the shoreline. The shoreline is armored by large rocks and vegetation. Developed areas are generally cleared for lawns to the edge of the lake, while undeveloped areas often have well established vegetation down to the edge of water. Virtually no erosion was found at Lake Elmore, aside from an area behind a deteriorating retaining wall associated with the dam.

[35] Shoreline Erosion Survey for the Morrisville Project (FERC No. 2629), TRC, March 2012.

Recreation Use

172. The project developments offer recreational opportunities for boating, fishing, hunting, camping, hiking, picnicking, and sightseeing. The river and reservoirs are enjoyed by both local residents and visitors to the area. In general, the recreational facilities at the Cadys Falls and Morrisville developments are not heavily utilized at present. The Green River Reservoir and Lake Elmore both have associated State Parks managed by the Vermont Department of Forest, Parks, and Recreation. The Applicant conducted a recreational site inventory to identify all project related recreation sites and identify options to meet future recreation capacity needs.[36]

Morrisville

173. At the Morrisville development there is one formal and one informal recreation site to access the impoundment and tailrace area. The formal recreational site is known as Clark Park and is managed by the Applicant. The park has a short walking trail around that park that offers views and access to the tailrace and the Cadys Falls impoundment, Lake Lamoille. There are no formal amenities at the park. Parking at the powerhouse is available to access the park.

174. There is an informal recreational site on the east side of the Morrisville tailrace which includes a parking area and trails to access the tailrace. This area is used for the purpose of fishing.

175. The portage take-out is located approximately 2,110 feet upstream of the dam and the portage route travels approximately one mile across town roads to the put-in located at the Cadys Falls boat launch on the Cadys Falls impoundment.

176. The Applicant proposes to improve the Clark Park day use area by providing public parking area, provide signage the trailhead and trail routes at the area, and to make necessary repairs to the amenities of Clark Park. In addition, an upstream facing sign will be erected identifying the canoe portage trail take-out at Morrisville Park and erect directional signage for the length of the portage trail.

Cadys Falls

177. There are three formal recreation sites associated with the Cadys Falls development. The Cadys Falls boat launch is single-lane gravel boat launch located approximately 2,700 feet upstream of the dam on the southern end of the impoundment. The launch occupies about 75 feet of shoreline and includes a small roadside parking area that can accommodate approximately three vehicles. This site also serves as the put-in for the Morrisville development portage route.

178. The existing Cadys Falls portage take-out is located on the river-left shoreline approximately 500 feet upstream of the dam. A short distance from the portage take-out is a roadside pull off with parking for two vehicles. The portage route travels approximately 2,200 feet across a wooded area and town roads to the put-in site about 1,500 feet downstream of the dam. An adjacent parking area can accommodate up to eight vehicles.

[36] Recreation Inventory Report for the Morrisville Project (FERC No. 2629), TRC, March 2012.

179. The Applicant proposes to relocate the Cadys Falls development canoe portage take-out site to the same location as the Morrisville development put-in site. MWL proposes to provide directional signage along the portage trail from the take-out site to the put-in site below the Cadys Falls powerhouse. Signage will also be erected at the Cadys Fall Launch identifying the site as the Morrisville development canoe portage trail put-in.

Green River

180. The Green River development is surrounded by the 5,053-acre Green River State Park, which is managed by the Vermont Department of Forests, Parks, and Recreation. The park is accessed at its southern end by Green River Dam Road and offers opportunities for boating, fishing, camping, picnicking, and swimming. The park includes three parking areas that can accommodate 67 vehicles, two hand-carry boat launches, 34 overnight campsites that are accessible only by boat, and five day use areas. Site closures are rotated throughout the campsites to protect from overuse and allow for rehabilitation. The park is open from Memorial Day to Columbus Day and access is limited by parking capacity, where access is no longer granted when capacity is reached. The park is designated as a "quiet lake" under Vermont's Use of Public Waters Rules and includes 19 miles of undeveloped shoreline, which is one of the longest stretches of undeveloped shoreline in Vermont.

181. The Applicant is proposing to provide two scheduled six hours releases between April 1 and October 31 on an annual basis for whitewater boating opportunities. MWL proposes to provide advance notification to American Whitewater of the release dates. In addition, to increase whitewater boating opportunities, MWL proposes to provide short-term notification by posting the time on its web site when releases from the Green River Reservoir are expected to be above the identified minimum flow requirement for boating (~130 cfs).

182. Ice fishing, a popular Vermont sport, is limited by the winter drawdown for safety and access reasons.

Lake Elmore

183. The Applicant provides an informal recreation site at the Lake Elmore development by providing access to an open area next to the gatehouse that is used as an informal fishing area. There is limited parking and no amenities are provided.

184. The development abuts recreation sites managed by the State of Vermont and the Town of Elmore. Lake Elmore State Park is managed by the Department of Forests, Parks, and Recreation and abuts the development 1,000 feet east of Lake Elmore Dam. The 940-acre park provides hiking trails with access to Elmore Mountain, a 60 site campground with restroom and shower facilities, and a day use area that includes a sandy beach, picnic facilities, and boat rentals. The Department of Fish and Wildlife maintains a boat launch that provides additional public access to the impoundment. This facility includes a single lane boat launch and parking for 20 vehicles and trailers. The Town of Elmore maintains a day use area immediately adjacent to the dam that includes two picnic tables, a bench, and parking for 7 vehicles.

Debris

185. The Applicant has not provided information on the handling and disposal of trashrack debris and other project-related debris.

Aesthetics

Morrisville

186. The Morrisville dam is a dominant feature of the Lamoille River in the town of Morristown. The dam is 37 feet high with a primary spillway of 216 feet and a secondary spillway of 60 feet. The primary spillway of the dam can be viewed from project recreational facilities and two side roads. Currently, a bypass flow requirement of 12 cfs is passed through a sluice gate near the intake with minimum flows passed through the powerhouse; as a result water is only spilled at the dam when flows are above the development maximum hydraulic capacity.

187. An aesthetics flow study assessed flows in the primary bypass of leakage, 21 (one-inch spill), 59, and 91 cfs, and in the secondary bypass flows of leakage, 4.1, 8.5, and 15.3 cfs were assessed.[37] A flow of 21 cfs over the primary spillway resulted in a veil over the dam face that provides good aesthetic value. Additionally, the aesthetic flow study results indicate that a flow of 59 cfs and 8.5 cfs, in primary and secondary bypass reach provide good aesthetics at the development.

188. The Applicant is proposing to release 12 cfs into the primary bypass reach and 4 cfs in the secondary bypass reach at the development. The Applicant has revised its proposal since filing its license application with FERC, increasing its bypass flows to 28 cfs in the primary and 8.5 cfs in the secondary bypass reach.

Cadys Falls

189. The Cadys Falls dam is 41 feet high and the development bypass reach is approximately 1690 feet in length. The dam and bypass can be viewed from public access areas and a town road that parallels on river-left shoreline. Currently, no bypass flow is required, and minimum flows at the development are released through the powerhouse with spillage over the dam only occurring when inflows are greater than the developments maximum hydraulic capacity.

190. The aesthetic flow study examined flows of 27.5-27.9 cfs, 76.8-78.4 cfs, and 131.7-134.8 cfs.[38] A flow of 27.5-27.9 cfs over the dam resulted in a good veil over the dam face that provided good aesthetics, but did not support aesthetics downstream.[39] The study results indicated that a flow between 76.8-78.4 cfs provided fair to good aesthetic value depending on the vantage point, where 131.7 – 134.8 cfs provided good to excellent aesthetic value.

191. The Applicant proposed to release 12 cfs into the bypass reach in its license application. MWL has since revised its proposal, increasing the bypass flow to 54 cfs to be phased-in after ten years.

[37] Morrisville and Cadys Falls Aesthetics Flow Study, Gomez and Sullivan Engineers, P.C., December 2012.
[38] Duplicate flow measurements were taken in the field. The results show the flow range between the two measurements.
[39] Morrisville Hydroelectric Project: Morrisville and Cadys Falls Aesthetic Flow Study; Appendix C, pg. 32 – 36, submitted to FERC February 6, 2013

State Comprehensive River Plans

192. The Agency's publication *Hydropower in Vermont, An Assessment of Environmental Problems and Opportunities* is a state comprehensive plan. The hydropower study, which was initiated in 1982, indicated that hydroelectric development has a significant 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 under the federal Clean Water Act and Vermont law.

193. The plan addresses the Morrisville Hydroelectric Project specifically, recommending minimum flows at the dams to meet standards for aquatic habitat and aesthetics and stabilization of the impoundments and reservoirs to protect wetland community and function.[40]

Analysis

194. A state's 401 certification determination shall include a statement from the state that "there is a reasonable assurance that the activity will be conducted in a manner which will not violate applicable water quality standards." 40 C.F.R. § 121.2(a)(3); Environmental Protection Chapter § 13.11(g). Accordingly, the Department may set forth limitations and other requirements necessary for it to find that there is reasonable assurance that the Project will be operated in a manner which will not violate the Vermont Water Quality Standards. The Lamoille River from immediately below the Cadys Falls dam to the confluence with Elmore Brook, Elmore Brook, Lake Elmore, and Lake Lamoille are listed as priority waters on Vermont's List of Priority Surface Waters outside the Scope of the Clean Water Act Section 303(d) Part F because they do not support all designated uses. Of particular concern are non-support of aquatic biota, wildlife, and aquatic habitat, aesthetics, and recreational uses, such as angling due to current flow and water-level management practices (Finding 72). A goal of the Standards and the Clean Water Act is to restore the biological integrity of waters such that aquatic biota and wildlife are sustained by high quality habitat.

Water Chemistry

195. Water quality data gathered in the vicinity of and at the project developments as part of the relicensing process indicate water quality standards for dissolved oxygen are being met at three of the four developments. Water quality sampling at the Green River development showed dissolved oxygen levels drop below Vermont standards for Class B waters during the late summer (Standards, Sections 3-04(B)(2) and 3-01(B)(1)). The reach that did not meet Vermont Water Quality Standards for dissolved oxygen levels, was lower at the project during generating flows than during periods of non-generation. Under existing conditions, water quality sampling at the Lake Elmore development and the reaches downstream of the Morrisville and Cadys Falls developments indicate that dissolved oxygen concentrations and water temperatures meet standards for Class B waters. (Standards, Sections 3-04(B)(2) and 3-01(B)(1)).

[40] Hydropower in Vermont: An Assessment of Environmental Problems and Opportunities, Vermont Agency of Natural Resources, Vol. II, pp 95-99, 1988.

196. In their license application, the Applicant proposes to maintain or increase conservation flows in the bypass reaches of the Morrisville and Cadys Falls developments. Specifically, the Applicant proposed to maintain a 12 cfs bypass flow in the primary bypass of the Morrisville development, while increasing conservation flows from leakage (approximately 1 cfs) to 4 cfs in the secondary bypass of the Morrisville development. At Cadys Falls, bypass flows would be increased from leakage (approximately 5.5 cfs) to 12 cfs. MWL has subsequently proposed higher bypass flows at the Morrisville of 28 and 8.5 cfs in the primary and secondary bypass, respectively. At Cadys Falls developments increase bypass flow proposal to 54 cfs. Any increase in bypass flows at the Morrisville and Cadys Falls developments needs to be greater than the 7Q10[41] drought flow to maintain dissolved oxygen concentration for aquatic life and provide reasonable assurance Vermont Water Quality Standards will be attained.

197. In order to meet dissolved oxygen standards for Class B coldwater habitat waters, the Applicant proposes to implement measures to increase dissolved oxygen and provide conservation flows during non-generation periods. The Applicant proposes to address dissolved oxygen conditions at Green River which is likely to improve existing water quality. By Condition G of this certification the Department is conditioning measures be implemented to address the dissolved oxygen levels and monitoring to ensure that waters below the Green River development meet dissolved oxygen standards after the proposed changes.

Flow and Water Level Management

Habitat protection

Morrisville

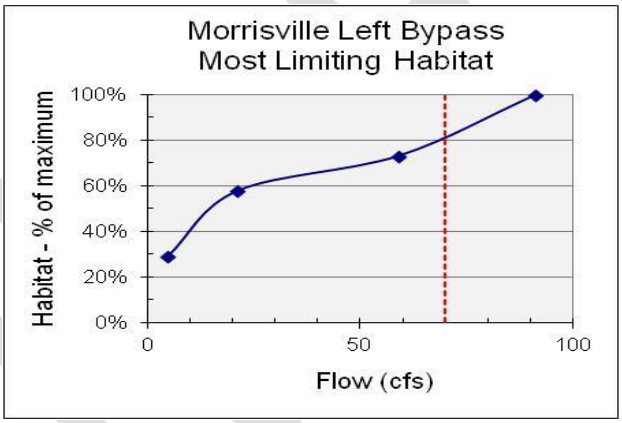
198. MWL proposes to operate the development in a run-of-river mode with a conservation bypass flow and a minimum of 135 cfs required in the tailrace, or inflow if less. The Applicant's proposal could result in modified run-of-river operations where hydrologic alteration would be permitted in the impoundment and downstream of the tailrace as long as the minimum flows below the tailrace were met. Instantaneous run-of-river operations would not necessitate a minimum flow in the tailrace. Under any flow scenario, conservation flows need to be released into the bypass reach first and remaining flows may be used for generation. Therefore, the existing and proposed minimum flow would not provide conditions consistent with high quality aquatic habitat. True run-of-river[42] operation will result in impoundment water levels that are maintained within a narrow range during normal operations, as well as minimal hydrologic alteration below the tailrace. True run-of-river operation will support aquatic habitat in the impoundment and below the tailrace (Standards, Sections 3-04(A)(1) and (2); 3-04(B)(4) and

[41] The period of lowest stream flow during a seven-day interval that is expected to occur once every 10 years. During this time of low flow, the amount of dissolved oxygen in the water would be expected to be the lowest encountered under normal conditions. Since such conditions are considered to be the worst natural case, the dissolved oxygen levels during such episodes are used to establish Ambient Water Quality Standards for that stream for wastewater discharges.

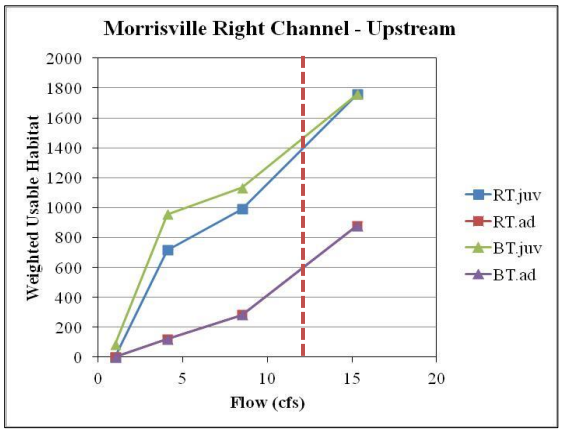
[42] A true run-of-river project is one which does not operate out of storage and, therefore, does not artificially regulate streamflows below the project's tailrace. Outflow from the project is equal to inflow to the project on an instantaneous basis. The flow regime below the project is essentially the river's natural regime, except in special circumstances, such as following the reinstallation of flashboards and project shutdowns. Under those circumstances when a change in storage content is necessary, and outflow is reduced below inflow for a period.

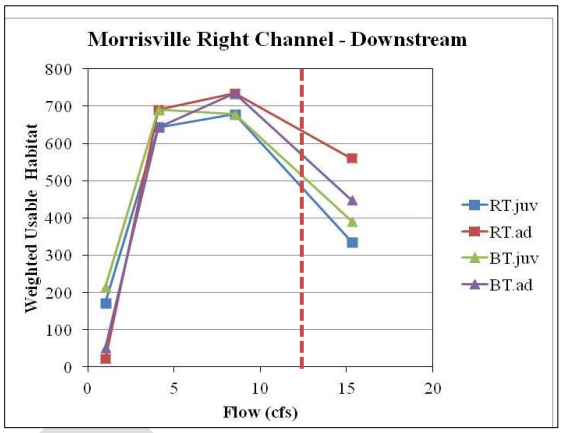
(5)). This certification is being conditioned such that the operating mode will become instantaneous run-of-river.

199. The Applicant conducted a study of the conservation flows needed for the bypass reach to determine the relationship between aquatic habitat and streamflow, to provide water movement and circulation, and to assure suitable conditions that would provide high quality aquatic habitat in the bypass reach pursuant to Section 3-01(C)(2) of the Standards. Based on the study results (Finding 109), the conservation flows proposed by the Applicant would not provide high quality habitat for all fish species of interest under Section 3-04(B)(4)). The Applicant in their FERC license application proposed a 12 cfs bypass flow in the primary channel. The Applicant has subsequently revised their proposal to phase-in 28 cfs in the bypass flow five years after the certification, maintaining 12 cfs until that time. The Applicant proposed flows correspond to approximately 42 and 61 percent of the maximum observed habitat provided for the most limiting species. The habitat flow study in the primary bypass reach at the Morrisville development indicates that a continuous flow of 70 cfs would provide availability to approximately 80% of the maximum observed habitat resulting in high quality habitat conditions. This certification is being conditioned such that the bypass flow regime will provide high quality aquatic habitat in the primary bypass. Therefore, Condition B requires a bypass flow of 70 cfs in the primary bypass.



200. The Applicant originally proposed a 4 cfs bypass flow in the secondary channel. MWL subsequently proposed a bypass flow of 8.5 cfs to be phased-in within three years and a 3 cfs conservation flow in the interim. The Department's analysis indicates a flow of 12 cfs provides high quality habitat conditions within the reach (Findings 111 and 112). Based on the significant improvement in habitat conditions in the upstream station between 8.5 and 15.3 cfs, along with the moderate decline of habitat conditions at the downstream station that occurred between at 8.5 cfs and 15.3 cfs. The downstream station was steep and velocities became excessive in some locations at higher flows, whereas the upstream station was a low gradient riffle where the suitability of both depth and velocity generally improved with increasing flow. This certification is being conditioned such that the bypass flow regime will provide high quality habitat in the secondary bypass. Therefore, Condition B requires a bypass flow of 12 cfs in the secondary bypass.





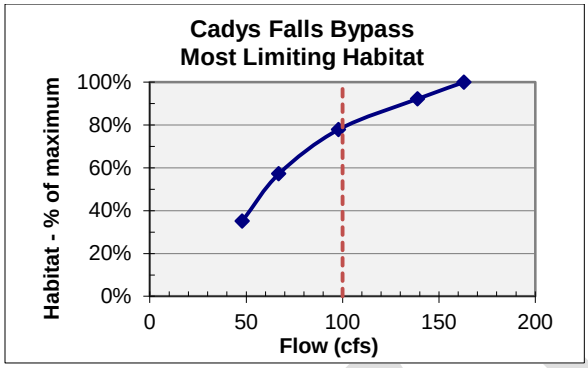
201. The Applicant, by Condition D and Condition E of this certification, will be required to develop a flow management and monitoring plan for the development that describes how the facility will operate in compliance with this certification and document compliance. The flow management plan shall address any equipment upgrades needed to provide continuous bypass flows and maintain a stable impoundment level. The flow monitoring plan shall address the methods for recording operations at the project on a continuous basis.

Cadys Falls

202. The Applicant proposes to operate the development in a run-of-river mode with a minimum of 150 cfs required in the tailrace, or inflow if less. The Applicant's proposal would result in modified run-of-river operations where hydrologic alteration would be permitted in the impoundment and downstream of the tailrace as long as the minimum flows below the tailrace were met. True run-of-river operations would not necessitate a minimum flow in the tailrace. Under any flow scenario, conservation flows need to be released into the bypass reach first and remaining flows may be used for generation. Existing and proposed minimum flow in the tailrace would not provide conditions consistent with high quality aquatic habitat. True run-of-river operation will result in impoundment water levels that are maintained within a narrow range during normal operations, as well as minimal hydrologic alteration below the tailrace. True run-of-river operation will support aquatic habitat in the impoundment and below the tailrace. (Standards, Sections 3-04(A)(1) and (2); 3-04(B)(4) and (5)). This certification is being conditioned such that the operating mode will become instantaneous run-of-river.

203. The Applicant conducted a habitat-flow study at the Cadys Falls development. Based on the study results (Finding 117), the bypass flows proposed by the Applicant would not provide high quality habitat for all fish species of interest. The Applicant originally proposed a 12 cfs bypass flow in the bypass channel. The Applicant subsequently revised their proposal to a bypass flow of 54 cfs which would be phased-in over eight years. The Applicant has proposed a flow of 12 cfs for the interim period. The Applicants proposed bypass flow correspond to approximately 42 percent of the maximum observed habitat provided for the most limiting species. The habitat-flow study in the bypass reach of the Cadys Falls development indicates that a continuous flow of 100 cfs would provide availability to approximately 80% of the maximum observed habitat resulting in high quality habitat conditions. The graph below illustrates the relationship between percent of maximum weighted usable habitat and flow observed. This certification is being conditioned such that the bypass flow regime will provide high quality aquatic habitat conditions in the Cadys Falls

bypass reach. Therefore, a flow of 100 cfs in the Cadys Falls bypass will be included as Condition B of this certification.



204. The Applicant, by Condition D and Condition E of this certification will be required to develop a flow management and monitoring plan for the development that describes how the facility will operate in compliance with this certification and document compliance. The flow management plan shall address any equipment upgrades needed to provide continuous bypass flows and maintain a stable impoundment level. The flow monitoring plan shall address the methods for recording operations at the project on a continuous basis. These conditions will aid in preventing future non-compliance events at the facility that have occurred in the past.

Green River

205. The Applicant proposes to operate the project in a store-and-release mode. This mode of operation will affect aquatic habitat by regulating the volume and timing of downstream flows and water-levels within the reservoir. The degree of such effects depends to a large extent on the timing, magnitude, and frequency of the fluctuations. The Applicant proposes a conservation flow of 5.5 cfs in the Green River and to increase the limit on flow releases from 160 cfs to 283 cfs from May 1 to October 31 to accommodate two scheduled whitewater releases of 6 hours occurring between April 1 and October 31. The proposed range of flows for the whitewater releases is 126 cfs to 280 cfs. The Applicant proposes to maintain the reservoir elevation at 1219.75 feet msl from May 1 to August 1 and within one-foot of the dam crest from August 2 through November 30. Additionally, MWL proposes to maintain the maximum allowable drawdown under the current license, 10 feet, from December 1 through April 30.

206. As described in findings 152 and 153, bass species begin spawning in mid-May and require a stable reservoir elevation to be maintained into July. Stable water levels during this period will maintain and protect reproductive requirements by promoting successful bass spawning and fry development (Standards, Sections 3-04 (A)(1) and (B)(4)). The Applicant's proposal to maintain a stable reservoir elevation at 1219.75 feet msl from May 1 to August 1 to support nesting loons will also support successful bass spawning. This time period coincides with the end of the spawning and incubation period for rainbow trout and longnose sucker downstream and the emergence of early fry life stages. For the period June 1 to September 30, the target elevation shall be maintained at 1219.75 feet msl. The development shall be operated in modified run-of-river mode where outflow equals inflow, but outflow shall not be less than 7 cfs. If the target water level decreases to 1219.5, outflows shall be reduced to 5.5 cfs until the target level is restored.

207. The annual winter drawdown causes an annual disturbance that prevents the establishment of a rich diversity of native aquatic plants that would provide a high quality habitat for fish and wildlife due to dewatering and freezing of the near shore area (Finding 151). A water level management scenario that more closely mimics a natural system would improve development of a healthy littoral plant community consistent with high quality aquatic habitat (Standards, Sections 3-04(A)(1) and (B)(4)). Therefore, Condition B of this certification limits the winter drawdown to 1218.5 feet msl.

208. Rainbow trout enter the Green River to spawn in the spring. The steady state habitat-flow results indicate that at least 80% of the maximum available habitat for rainbow trout spawning and incubation occurs over the range 60-120 cfs. The spawning and incubation needs for longnose sucker were similar with at least 80% of the maximum available spawning and incubation habitat occurring over the range 30-120 cfs. These results are consistent with the flows that naturally occur during the spring spawning period. Run-of-river operations during the spring spawning period will more closely resemble naturally occurring flows than a peaking regime. From April 1 to May 31, modified run-of-river operations that closely resemble the natural hydrologic regime will be necessary to protect the reproductive requirements of rainbow trout and longnose sucker (Standards, Sections 3-04 (A)(1) and (B)(4)). The reservoir elevation shall not be drawn down from peaking generation flows after April 1. The reservoir shall be refilled to 1219.75 feet msl by May 1, except when inflows beyond the hydraulic capacity of the project cause an unavoidable rise in pond level. When the target level exceeds 1219.75 feet msl, the development shall pass inflows or 60 cfs until the target level is restored.

209. The Green River downstream of the development supports self-sustaining populations of brook and brown trout. Adult brown trout from the Lamoille River also enter the Lamoille during the fall and spawn successfully in the lower portion of the river. The steady state habitat-flow results indicate that at least 80% of the maximum available spawning and incubation habitat for brook and brown trout occurs over the range 10-30 cfs. These results are consistent with the flows that naturally occur during the fall spawning period. From October 1 to December 15 modified run-of-river operations that closely resemble the natural hydrologic regime will be necessary to protect the reproductive requirements of brook trout and brown trout (Standards, Sections 3-04 (A)(1) and (B)(4)).

210. Due to current water level management practices, which hold the reservoir elevation at or near 1219 feet msl for much of the year to attenuate inflow, near-shore aquatic habitat has been precluded from developing in the areas between 1219 feet msl and 1220 feet msl. This band is characterized by transitional terrestrial-aquatic habitat including natural cover, bedrock, and terrestrial vegetation that can withstand periods of inundation. From December 16 to March 31 when a stable pool is not required to support bass spawning and loon nesting, and run-of-river operations are not required to support spawning, the project shall be permitted to operate in a 1.5 foot band between 1218.5 feet msl and 1220 feet msl with moderate adverse effects on aquatic habitat. During non-peaking operations, the project shall pass a conservation flow of 8 cfs downstream at all times. The maximum outflow should not exceed 110 cfs unless inflow is higher. While a hydropeaking regime is not optimal, fish utilize slow water habitats to a greater extent in the winter. Additionally, at this point in the season young of year fish will have grown enough to withstand generation flows of the specified magnitude.

211. MWL has indicated in filings with the Department their intent to install a low flow turbine and make additional upgrades at the facility. The low flow turbine would be used to pass the

conservation flows downstream to match inflows and maintain a stable reservoir elevation at the facility. Therefore, Condition B of this certification includes operating conditions for when the upgrades are completed at the facility.

212. The Applicant, by Condition D and Condition E of this certification will be required to develop a flow management and monitoring plan for the development that describes how the facility will operate in compliance with this certification and document compliance. The flow management plan shall address any equipment upgrades needed to provide continuous bypass flows and maintain a stable impoundment level. The flow monitoring plan shall address the methods for recording operations at the project on a continuous basis.

Lake Elmore

213. MWL proposes to operate the development in a crest controlled run-of-river mode and to discontinue the fall drawdown. The Applicant also proposes to remove the development from the hydroelectric project.

214. Crest control run-of-river operation will result in impoundment water levels that are maintained within a narrow range during normal operations, supporting aquatic habitat in the impoundment. (Standards, Sections 3-04(A)(1) and (B)(4)).

215. Elimination of the fall drawdown will restore flows in Elmore Brook to a natural pattern during the spawning and incubation period. As a result of restoring the natural flow regime, it will protect and support trout spawning in Elmore Brook. Run-of-river operations will also support aquatic habitat and aesthetics in the downstream reach. (Standards, Sections 3-04(A)(1) and (2); 3-04(B)(4) and (5)).

Aesthetics

216. The Applicant proposed conservation flows at each development were evaluated by the Department to determine if they met Standards for Class B waters for good aesthetic value. (Standards, Sections 3-04(A)(2) and (B)(5)).

Morrisville

217. At the Morrisville development, the aesthetics flow study demonstrated that one inch of spillage of 21 cfs over the primary spillway resulted in a veil over the dam face that provides good aesthetic value. Additionally, the aesthetic flow study results indicate that a flow of 59 cfs in the primary bypass and 8.5 cfs in the secondary bypass provide good aesthetics in the bypass reaches.

218. The Applicant in their FERC license application, proposed a 12 cfs bypass flow in the primary channel. The Applicant has subsequently revised their proposal to phase-in a 28 cfs bypass flow three years after the issuance of the FERC license, maintaining 12 cfs until that time. For the secondary bypass reach, the Applicant subsequently proposed a bypass flow of 8.5 cfs to be phased-in within three years with no flow required until that time. The Department's analysis indicates a flow of 28 cfs provide would not provide good aesthetic value within the primary bypass reach. The bypass flows proposed by the Applicant would not be adequate to support the aesthetics in the primary bypass and would not support aesthetics in the secondary bypass until the higher flows were phased in within three years.

219. The flows needed to meet Standards to protect aquatic biota, wildlife, and aquatic habitat and in both the primary and secondary bypasses reaches at the Morrisville development also meet Standards for aesthetics. This certification is being conditioned to provide good aesthetic value at the dam by requiring one-inch inch of spill to be passed over the dam crest.

Cadys Falls

220. At the Cadys Falls development, the aesthetics flow study demonstrated that one inch of spillage of 25 cfs provided a good veil over the dam face, thus providing good aesthetic value[43]. The aesthetic flow study found that a flow between 76.8 – 78.4 cfs in the bypass reach provided fair to good aesthetic value depending on the vantage point, where 131.7 – 134.8 cfs provided good to excellent aesthetic value in the bypass. A flow between 78.4 and 131.7 cfs is needed in the bypass reach to meet Standards for aesthetics.

221. In their license application, MWL proposes to release 12 cfs in the bypass reach. The Applicant subsequently revised their proposal to release a flow of 54 cfs in the bypass reach, which would be phased-in over eight years. A bypass flow of 12 cfs would be implemented in the interim. The bypass flows proposed by MWL would not be adequate to support aesthetics in the bypass reach.

222. The flows needed to meet Standards to protect aquatic biota, wildlife, and aquatic habitat in the bypass reach at the Cadys Falls development will also meet Standards for aesthetics. This certification is being conditioned to provide good aesthetic value at the Cadys Falls dam by requiring one-inch inch of spill to be passed over the dam crest.

Fish Passage, Impingement, and Entrainment

223. The Vermont Fish and Wildlife Department has determined that downstream fish passage is not warranted at project facilities at this time (See Findings 100-102). By Condition F of this certification, the Department reserves the ability to require development of passage in the future if the status of fish populations or fishery management objectives change.

224. The existing 2-inch clear spacing trashracks at the Morrisville and Cadys Falls developments may not adequately prevent impingement and entrainment of resident fish. Consideration should be given to using racks with a one-inch clear spacing at such time racks need replacement. By Condition H of this certification, the Applicant shall be required to consult the Department of Fish and Wildlife at the time the trashracks for the facilities are scheduled for replacement, and to obtain Department approval for the design.

[43] Gomez and Sullivan Engineers, P.C. December 2012. Morrisville and Cadys Falls Aesthetics Flow Study. p 33-36

Wildlife and Wetlands Habitat

225. MWL has voluntarily maintained the reservoir level 3 inches below dam crest at elevation 1219.75 feet msl from May 1 to August 1 to support nesting loons in cooperation with the Vermont Center for Ecostudies' Vermont Loon Recovery Program. The proposed water level management range for the loon is adequate for protection of nesting success. All reasonable measures should be instituted to reach a target elevation of 1219.75 feet msl by May 1. The water level should be maintained within 3 inches of the dam crest through August 1.

226. Wetlands at the Morrisville and Cadys Falls developments are generally limited due to shoreline topography with the exception of Lake Lamoille where more extensive emergent wetlands are present. Run-of-river operations at both facilities will avoid impacts on any wetlands that are located by those developments (Standards, Sections 3-04(A)(1) and (B)(4)).

227. The Green River Reservoir has extensive emergent wetlands at its northern edge where the Green River flows into the reservoir. The reduced magnitude of the winter drawdown as well as the expansion of run-of river operations will likely benefit wetlands surrounding the reservoir by more closely mimicking the natural flow regime (Standards, Sections 3-04(A)(1) and (B)(4)). The wetland survey conducted by the Applicant identified 27 acres of wetlands below the development on the Green River. The expansion of run-of-river operations at the development will avoid impacts on wetlands below the development (Standards, Sections 3-04(A)(1) and (B)(4)).

228. The Lake Elmore development has emergent vegetation along its southern and western edge. The discontinuation of the fall drawdown is likely to benefit wetlands and aquatic habitat located adjacent to Lake Elmore by restoring the natural flow regime and preventing the dewatering of the wetlands and aquatic habitat (Standards, Sections 3-04(A)(1) and (B)(4)).

Rare and Endangered Species and Outstanding Natural Resources

229. The state-listed freshwater mussel species, cylindrical papershell (*Anodontoides ferussacianus*), is known to occur in the vicinity of the Cadys Falls development. This certification is being conditioned such that the development operates in strict run-of-river mode so project operations will not impact water quality and habitat-flow conditions below the tailrace. (Standards, Sections 3-04(A)(1) and (B)(4)).

230. There are no designated Outstanding Resource Waters in the vicinity of the project developments.

Debris Disposal

231. The depositing or emission of debris and other solids to state waters violates Vermont's solid waste laws and Standards, Section 3-01(B)(5). Debris may also impair aesthetics and boating. A debris disposal plan is required by Condition L of this Certification.

Erosion

232. Erosion at the project facilities and along the impoundments' shorelines is limited and does not appear to be exacerbated by project operations.

Recreation Use

233. The Vermont Water Quality Standards require that Class B waters be managed to fully supports boating, fishing, and other recreational uses through the achievement and maintenance of a level of water quality that is suitable and compatible with these uses. (Standards, Sections 3-04(A)(6) and (B)(6)).

234. At the Morrisville facility, recreational improvements proposed by the Applicant include installation of trailhead and trail signs, and formal parking at the facility near the powerhouse. The current take-out for canoe/kayak portage trail around the Morrisville facility is located upstream at Morrisville Park and is not within the FERC project boundary. The portage route requires users to carry their canoe or kayak approximately one mile. The project boundary includes an area on river left known as Clark Park which the Applicant has proposed to improve for recreational purposes. As condition of this certification, the Applicant should develop a recreational plan that includes a formal take-out, portage trail, and put-in at the facility to assure downstream paddlers can take out their boats and bypass the dam. MWL is required to address this pursuant to Condition J of this certification.

235. At the Cadys Falls facility, recreational improvements proposed by the Applicant include to relocating the canoe/kayak portage take-out site to the same location as the Morrisville facility put-in site. Additionally, the Applicant proposes to provide directional signage along the portage trail from the take-out site to the put-in site below the Cadys Falls powerhouse. Signage will also be erected at the Cadys Falls Boat Launch identifying the site as the Morrisville facility canoe portage trail put-in. As condition of this certification the Applicant shall develop a recreational plan that includes formal canoe/kayak take-out and put-in at the Cadys Falls facility.

236. Morrisville has proposed to provide two scheduled six hours releases between April 1 and October 31 on an annual basis for whitewater boating opportunities. Morrisville proposes to provide advance notification to American Whitewater of the release dates. In addition, to increase whitewater boating opportunities, Morrisville proposes to provide short-term notification by posting the time on its web site when releases from the Green River Reservoir are expected to be above the identified minimum flow requirement for boating (~130 cfs).

237. As proposed, schedule whitewater releases will conflict with the operational regime being condition by this certification at the Green River development. However, by Condition B of this certification, facility operations will be closer to run-of-river operations which will help to restore the frequency of natural high flow events and allow for whitewater boating when natural flows are compatible with boating. The Applicant has proposed to install a notification system that will alert users of the outflows from the facility.

238. A stable reservoir will help improve winter conditions of the Green River Reservoir for anglers interested in ice fishing. Ramping protocols will provide greater public safety to anglers from rapid fluctuations in flow.

239. By Condition J of this certification, the Applicant is required to develop a recreation plan addressing construction, maintenance, and management of recreation facilities, including provisions for improving the portage trails around the Morrisville and Cadys Falls facilities, proper signage for trails and formal parking, and sanitation at all project facilities.

Anti-Degradation

240. Pursuant to the Anti-Degradation Policy set forth in Section 1-03 of the Standards and the Agency's 2010 Interim Anti-Degradation Implementation Procedure (Procedure), the Secretary must determine whether a proposed discharge or activities are consistent with the Policy by applying the Procedure during the review of applications for any permit for a new discharge if during the application review process compliance with the Standards is evaluated pursuant to applicable state or federal law. (Procedure III(A)). This includes water quality certifications required by Section 401 of the federal Clean Water Act for a federal license or permit for flow modifying activities. (Procedure III(B)(3)).

241. In making the determination that proposed activities are consistent with the Policy, the Secretary is required to use all credible and relevant information and the best professional judgment of Agency staff. (Procedure III(D)). Section VIII of the Procedure governs the Agency's review of Section 401 applications for flow modifying activities. (Procedure VIII(A)(1)). The Secretary may have to review a single waterbody under multiple tiers of review depending on whether a waterbody is impaired or high quality for different parameters.

242. Tier 3 review is required if the project will discharge to an Outstanding Resource Water. (Procedure VIII(D)). This project does not affect any Outstanding Resource Waters and therefore does not trigger a Tier 3 review under Section VIII of the Procedure.

243. This project affects Class B waters, which are high quality waters for certain parameters that trigger a Tier 2 review under Section VIII of the Procedure. (Procedure VIII(E)(1)(c)). Under Tier 2, the Secretary must determine whether the proposed discharge will result in a limited reduction in water quality in a high quality water by utilizing all credible and relevant information and the best professional judgment of Agency staff. (Procedure VIII(E)(2)(b)).

244. When conducting a Tier 2 review, the Secretary may consider, when appropriate, one or more of the following factors when determining if a proposed new discharge will result in a reduction in water quality: (i) the predicted change, if any, in ambient water quality criteria at the appropriate critical conditions; (ii) whether there is a change in total pollutant loadings; (iii) whether there is a reduction in available assimilative capacity; (iv) the nature, persistence and potential effects of the pollutant; (v) the ratio of stream flow to discharge flow (dilution ratio); (vi) the duration of discharge; (vii) whether there are impacts to aquatic biota or habitat that are capable of being detected in the applicable receiving water; (viii) the existing physical, chemical and biological data for the receiving water; (ix) degree of hydrologic or sediment regime modifications; and (x) any other flow modifications. (Procedure VIII(E)(2)(d)).

245. The Secretary considered the foregoing factors during the review of the project to determine if the project will result in a reduction of water quality at each development. The principal impact of the project at the Morrisville development is the flows in the primary and secondary bypass reaches. The principal impact of the project at the Cadys Falls development is the flows in the bypass reach and water level management in the impoundment at Lake Lamoille. The principal impact of the project at the Green River development is the water level management in Green River Reservoir and flows in the Green River downstream of the dam. The principal impact of the project at Lake Elmore is the water level management and downstream flows in Elmore Brook. The changes in project operation at all four developments will not result in a discharge of additional pollutants or change other ambient water quality criteria. As a result, factors (i), (ii),

(iii), (iv), (v), and (vi) are not an issue. The project has been impacting aquatic biota and habitat through inadequate bypass flows at Cadys Falls and Morrisville developments and through low conservation flows and high generation flows discharged to Green River. Additional impacts to aquatic biota and habitat associated with the project are the water level management practices at the Cadys Falls and, Lake Elmore, and Green River developments. Condition B requires the following operational changes for each development: true run-of-river operations at the Morrisville development with a conservation flow of 70 cfs at the Morrisville primary bypass reach and a conservation flow of 12 cfs at the Morrisville secondary bypass reach; true run-of-river operations at the Cadys Falls development with a conservation flow of 100 cfs; crest controlled run-of-river operations at Lake Elmore development with inflows equaling outflows; and modified run-of-river operations at the Green River development where seasonal outflow will be similar to inflow with a reduction in the magnitude of generation flows. These operational changes will reduce impacts to aquatic biota and habitat at all four facilities.

246. This Certification does not authorize any activities that would result in a lowering of water quality for those parameters that are exceeding water quality standards.

247. For those parameters for which project waters not exceeding water quality standards, the Secretary must conduct a Tier 1 review. (Procedure VIII(F)).

248. Under Tier 1 review, the Secretary may identify existing uses and determine the maintenance necessary to protect these uses. (Procedure VIII(F)). In determining the existing uses to be protected and maintained, the Secretary must consider the following factors: (a) aquatic biota and wildlife that utilize or are present in the waters; (b) habitat that supports existing aquatic biota, wildlife, or plant life; (c) the use of the waters for recreation and fishing; (d) the use of the water for water supply, or commercial activity that depends directly on the preservation of an existing high level of water quality; and (e) evidence of the uses' ecological significance in the functioning of the ecosystem or evidence of the uses' rarity. (Procedure VIII(F)(2))

249. The Secretary considered all of the factors listed in Finding 248 above and, based on information supplied by the Applicant and Agency staff field investigations, identified the following existing uses at the Morrisville development: aquatic biota, wildlife and aquatic habitat; aesthetics; and recreation.

250. The existing dam and impoundment have changed the natural condition of the river at the Morrisville development. Currently, aquatic biota, wildlife and aquatic habitat, aesthetics and recreation are impacted in the bypasses of the Morrisville development by insufficient bypass flows. Current operations do not sustain existing uses due to insufficient flows it the bypass reach. However, the modifications to the project conditioned under this Certification will result in improvements to water quality and will protect and maintain conditions to support existing uses, by assuring adequate conservation flows are passed consistently. These modifications include increased bypass flows at the Morrisville development.

251. The Secretary considered all of the factors listed Finding 248 above and, based on information supplied by the Applicant and Agency staff field investigations, identified the following existing uses at the Cadys Falls development: aquatic biota, wildlife and aquatic habitat; aesthetics; and recreation.

252. The existing dam and impoundment have changed the natural condition of the river at project facilities. Currently, aquatic biota, wildlife and aquatic habitat, aesthetics and angling are impacted in Lake Lamoille by water level fluctuations and in the bypass of the Cadys Falls development by insufficient bypass flows. Current operations do not sustain existing uses due to insufficient flows in the bypass reach and water level fluctuations at Lake Lamoille. The current operations allow the bypass flows to be completely dry at times and allow for seasonal drawdown at Lake Lamoille. However, the modifications to the project conditioned under this Certification will result in improvements to water quality, which will protect and improve conditions for existing uses. Those modifications include stabilization of Lake Lamoille and improved bypass flows at the Cadys Falls development.

253. The Secretary considered all of the factors listed in Finding 248 above and, based on information supplied by the Applicant and Agency staff field investigations, identified the following existing uses at the Green River development: aquatic biota, wildlife and aquatic habitat; and recreation.

254. The existing dam and impoundment have changed the natural condition of the river at project facilities. Currently, aquatic biota, wildlife and aquatic habitat, and angling are impacted in the Green River Reservoir by water level fluctuations and downstream of the Green River by insufficient conservation flows and high generation flows. Current operations do not consistently sustain existing uses as a result of the low flows or high generation flows in the Green River. In addition, current operations do not consistently support existing uses in the Green River Reservoir because the magnitude water level fluctuations are too severe to support aquatic habitat and biota. However, the modifications to the project conditioned under this Certification will result in improvements to water quality, which will protect and improve conditions for existing uses at this development. Those modifications include reduced water level fluctuations at Green River Reservoir and a moderated peaking regime in the Green River.

255. The Secretary considered all of the factors listed in Finding 248 above and, based on information supplied by the Applicant and Agency staff field investigations, identified the following existing uses at the Lake Elmore development: aquatic biota, wildlife and aquatic habitat; and recreation.

256. The existing dam has changed the natural condition of the lake and brook at project facilities. Currently, aquatic biota, wildlife and aquatic habitat, and angling are impacted in Lake Elmore by water level fluctuations, and by insufficient flows, and downstream of the Lake Elmore development. However, the modifications to the project conditioned under this Certification will result in improvements to water quality, which will protect and improve conditions for existing and designated uses. Those modifications include stabilization of Lake Elmore and operations changing to crest controlled run-of-river.

257. The Secretary finds that development and operation of the project as conditioned by this Certification will comply with the Vermont Water Quality Standards. Accordingly, the Secretary finds that the project, as conditioned, meets the requirements of the Policy and Procedure relating to the protection and maintenance of high quality waters.

Decision and Certification

The Department has examined the project application and other pertinent information deemed relevant by the Department in order to issue a decision in this Certification pursuant to the Department's responsibilities under Section 401 of the federal Clean Water Act. After examination of these materials, the Department certifies that there is reasonable assurance that operation and maintenance of the Morrisville Hydroelectric 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, 33 U.S.C. § 1251 et seq., as amended, and other appropriate requirements of state law.

A. **Compliance with Conditions**. The Applicant shall operate and maintain this project consistent with the findings and conditions of this certification, where those findings and conditions relate to protection of water quality and support of designated and existing uses under Vermont Water Quality Standards and other appropriate requirements of state law. If the Department determines that the Applicant's operations are not in compliance with the findings and conditions of this certification, the Applicant shall discontinue diversion of flow through the powerhouse and all water spilled at the dam until the Department has made a positive finding that the Applicant is operating in compliance with conditions.

B. **Flow and Water Level Management.** Project facilities shall be operated in accordance with the conservation flow and water level management conditions and schedules included herein. Conservation flows shall be released on a continuous basis and not interrupted. Conservation flows are the values listed below, or instantaneous inflow, if less, unless otherwise noted. True run-of-river operation means no utilization of headpond storage and that outflow from the facility is equal to inflow to the pond on an instantaneous basis, as further described in Footnote 42 of the certification, incorporated by reference. When a facility is not operating, all flows shall be spilled at the dam.

Morrisville: The development shall be operated in a true run-of-river mode with outflows equal to inflows on an instantaneous basis. When generating, a conservation flow of 70 cfs in the primary bypass reach and 12 cfs in the secondary bypass reach, or inflows if less, shall be continuously passed at all times, with at least one inch of water to be spilled over primary spillway crest for aesthetics. When the development is not operating, all flow should be passed through the bypassed reaches. The impoundment target elevation shall be at least 631.86 feet msl.

Cadys Falls: The development shall be operated in true run-of-river mode with outflows equaling inflows on an instantaneous basis. When generating, a conservation flow of 100 cfs, or inflows if less, shall be continuously passed at the dam at all times, with at least one-inch of spills over the dam crest for aesthetics. When the development is not operating, all flows shall be spilled over the dam. The impoundment target elevation shall be at least 580.47 feet msl when flashboards are in place.

Lake Elmore: The development shall be operated in crest controlled run-of-river mode. All flows shall be passed via the dam crest spillway to Elmore Brook. The impoundment target elevation shall be 1139.00 feet msl.

Green River: When operating in run-of-river mode, the reservoir elevation shall be maintained at 1219.75 feet msl. During peaking operations, the reservoir shall be maintained between 1218.50 and 1220.00 feet msl. Project operations shall be subject to the seasonal operational constraints described in the tables below.

Table 1a. Green River development April (April 1 – April 30) operating conditions with existing equipment and equipment capable of matching inflow.

	Existing equipment	**Equipment capable of matching inflow**
Target Reservoir Water Surface Elevation (feet msl)	≥1218.5 feet at all times =1219.75 by May 1	≥1218.5 feet at all times =1219.75 by May 1
Downstream Flow Management	Modified Run-of-River. Some inflow will be stored for refill. Generation flows in excess of the conservation flow shall not exceed inflow unless the reservoir level exceeds 1219.75 feet. If reservoir level exceeds 1219.75 feet, generate at minimum capacity or inflow, whichever is greater, until the target reservoir elevation is restored.	Modified Run-of-River. Some inflow will be stored for refill. Generation flows in excess of the conservation flow shall not exceed inflow unless the reservoir level exceeds 1219.75 feet. If reservoir level exceeds 1219.75 feet, generate at minimum capacity or inflow, whichever is greater, until the target reservoir elevation is restored.
Conservation Flow	60 cfs guaranteed from storage	60 cfs guaranteed from storage

Table 1b. Green River development May (May 1 – May 31) operating conditions with existing equipment and equipment capable of matching inflow

	Existing equipment	**Equipment capable of matching inflow**
Target Reservoir Water Surface Elevation (feet msl)	=1219.75	=1219.75
Downstream Flow Management	Modified Run-of-River. Generation flows in excess of the conservation flow shall not exceed inflow unless the reservoir level exceeds 1219.75 feet. If reservoir level exceeds 1219.75, generate at minimum capacity or inflow, whichever is greater, until the target reservoir elevation is restored.	Modified Run-of-River. Generation flows in excess of the conservation flow shall not exceed inflow unless the reservoir level exceeds 1219.75 feet. If reservoir level exceeds 1219.75, generate at minimum capacity or inflow, whichever is greater until the target reservoir elevation is restored.
Conservation Flow	60 cfs guaranteed from storage	60 cfs guaranteed from storage

Table 1c. Green River development summer (June 1 – September 30) operating conditions with existing equipment and equipment capable of matching inflow.

	Existing equipment		**Equipment capable of matching inflow**	
Target Reservoir Water Surface Elevation (feet msl)	=1219.75 feet Unless reduced by conservation flow requirements described below		=1219.75 feet Unless reduced by conservation flow requirements described below	
Downstream Flow Management	Modified Run-of-River. When inflow exceeds minimum capacity, generate to match inflow. When inflow is less than minimum capacity, outflow shall equal conservation flow.		Modified Run-of-River. When inflow exceeds conservation flow, generate to match inflow. When inflow is less than the conservation flows specified below, downstream flows shall be prioritized as set forth below.	
Conservation Flow	**Elevation (feet msl):**	**Conservation Flow**	**Elevation (feet msl):**	**Conservation Flow**
	>1219.50	Not less than 7 cfs.	>1219.50	Not less than 7 cfs.
	1219.50 to 1219.25	Maintain 5.5 cfs until target reservoir level is restored.	1219.50 to 1219.25	Maintain 5.5 cfs until target reservoir level is restored.
	Less than 1219.25	Reduce outflow to maintain a stable reservoir level. When inflow increases to 5.5 cfs, maintain outflow of 5.5 cfs until target reservoir level is restored. When target reservoir is restored, increase outflow to 7 cfs.	Less than 1219.25	Reduce outflow to maintain a stable reservoir level. When inflow increases to 5.5 cfs, maintain outflow of 5.5 cfs until target reservoir level is restored. When target reservoir level is restored, increase outflow to 7 cfs.

Table 1d. Green River development fall (October 1 – December 15) operating conditions with existing equipment and equipment capable of matching inflow.

	Existing equipment		**Equipment capable of matching inflow**	
Target Reservoir Water Surface Elevation (feet msl)	=1219.75 feet Unless reduced by conservation flow requirements described below		=1219.75 feet Unless reduced by conservation flow requirements described below	
Downstream Flow Management	Modified Run-of-River. When inflow exceeds minimum capacity, generate to match inflow. When inflow is less than minimum capacity, outflow shall equal conservation flows.		Modified Run-of-River. When inflow exceeds conservation flow, generate to match inflow. When inflow is less than the conservation flows specified below, downstream flows shall be prioritized as set forth below.	
Conservation Flow	**Elevation (feet msl):**	**Conservation Flow**	**Elevation (feet msl):**	**Conservation Flow**
	>1219.50	Not less than 10 cfs	>1219.50	Not less than 10 cfs
	1219.50 to 1219.0	Maintain 7 cfs until target reservoir level is restored.	1219.50 to 1219.0	Maintain 7 cfs until target reservoir level is restored.
	<1219.0	Reduce outflow to maintain a stable reservoir level. When inflow increases to 7 cfs, maintain outflow of 7 cfs until target reservoir level is restored. When target reservoir level is restored, increase outflow to 10 cfs.	<1219.0	Reduce outflow to maintain a stable reservoir level. When inflow increases to 7 cfs, maintain outflow of 7 cfs until target reservoir level is restored. When target reservoir level is restored, increase outflow to 10 cfs.

Table 1e. Green River development winter (December 16 – March 31) operating conditions with existing equipment and proposed upgrades of automated bypass valve and installation of low flow turbine.

	Existing equipment		**Equipment capable of matching inflow**	
Target Reservoir Water Level Elevation (feet msl)	1218.50 feet to 1220.00 feet Unless reduced by conservation flow requirements described below		1218.50 feet to 1220.00 feet Unless reduced by conservation flow requirements described below	
Downstream Flow Management	Store and Release Maximum generation flow of 110 cfs or inflow, whichever is greater. Ramping shall be conducted.		Store and Release Maximum generation flow of 110 cfs or inflow, whichever is greater. Ramping shall be conducted.	
Conservation Flow	**Elevation (feet msl):**	**Conservation Flow**	**Elevation (feet msl):**	**Conservation Flow**
	≥1218.00	Not less than 8 cfs	≥1218.00	Not less than 8 cfs
	<1218.00	Reduce outflow to maintain a stable reservoir level. When inflow increases to 6 cfs, maintain outflow of 6 cfs until a reservoir elevation of 1219.50 feet is restored. When reservoir elevation of 1219.50 feet is restored, release 8 cfs.	<1218.00	Reduce outflow to maintain a stable reservoir level. When inflow increases to 6 cfs, maintain outflow of 6 cfs until a reservoir elevation of 1219.50 feet is restored. When a reservoir elevation of 1219.50 feet is restored, release 8 cfs.

C. **Flow Management during Impoundment Refill.** During refilling of a project impoundment following a drawdown associated with peaking operations at Green River Reservoir or for purposes of maintenance or replacement of flashboards, up to 10 percent of instantaneous inflow may be placed in storage.

D. **Flow Management Plan.** The Applicant shall develop a flow management plan within 180 days of the effective date of the FERC license. The plan shall provide details regarding how each development will be operated to comply with the conservation flow and reservoir management limitations described in Condition B.

The plan shall include a detailed description of how flow will be partitioned between the primary and secondary bypass reaches at the Morrisville development when inflow is less than 82 cfs.

The plan shall include a detailed description of how stable impoundment levels and consistent downstream flows as required by instantaneous run-of-river operations will be assured.

The plan shall include detailed description about operations at the Cadys Falls development will comply with bypass flow requirements both with and without the flashboards in place.

The plan shall include a detailed description of ramping procedures to be used for peaking operations from December 16 – March 31 at the Green River development.

The plan shall be subject to review and approval by the Department prior to being submitted to FERC. The Department reserves the right of review and approval of any material changes made to the plan.

E. **Monitoring Plan and Reporting Requirements.** The Applicant shall develop a continuous monitoring plan for reservoir water level and flow management within 180 days of the effective date of the FERC license. The plan shall provide for continuous monitoring and reporting of flow releases at all project developments (spillage, turbine discharges and bypass flows), impoundment levels, and inflow.

The plan shall include procedures for reporting deviations from prescribed operating conditions. In reporting deviations, the Applicant shall include an explanation of the cause; propose steps to be taken to prevent a recurrence; and revise the flow management plan if required to do so by the Department.

The plan shall be developed in consultation with the Department and the U.S. Fish and Wildlife Service. The plan shall be subject to Department review and approval. The Department reserves the right of review and approval of any material changes made to the plan and the right to require revisions to the plan as necessary to assure compliance.

The Applicant shall maintain continuous records of flows and impoundment levels and provide this data to the Department on a quarterly basis. The Applicant shall submit data to the Department fifteenth day after the close of each quarter. Compliance records shall be kept permanently and provided to the Department quarterly in a format specified by the Department.

F. **Fish Passage.** In the event that the status of the Lamoille River fish populations or fishery management objectives change, and upon a request of the Department of Fish and Wildlife, the Department may require the Applicant to provide upstream or downstream fish passage facilities.

G. **Tailrace Dissolved Oxygen.** The Applicant shall develop, within 180 days of the effective date of the FERC license, a plan for measures necessary to meet dissolved oxygen standards in the Green River development tailrace. The plan shall include a monitoring component to assess the effectiveness of the measures taken and an implementation schedule. The plan and schedule shall be subject to approval by the Department prior to implementation. If the Department determines that violations of dissolved oxygen standards persist, the Applicant shall revise the plan to include additional measures to meet dissolved oxygen standards. Any revised plan shall be subject to approval by the Department prior to implementation.

H. **Trashracks.** Prior to the next replacement of the trashracks at the Cadys Falls and Morrisville developments, the Applicant shall consult with the Department of Fish and Wildlife with respect to the trashrack design to determine the appropriate bar clear spacing and shall file the trashrack design information with the Department of Environmental Conservation for approval prior to commencement of work.

I. **Turbine Rating Curves.** The Applicant shall furnish 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 the license.

J. **Recreational Facilities.** The Applicant shall develop a recreation management plan within 180 days of the effective date of the FERC license. The plan shall be subject to approval by the Department prior to implementation. The plan shall include an implementation schedule and recreational facilities shall be constructed and maintained consistent with the plan. The issues addressed in the plan shall include provision of portages and sanitation at recreation sites for the four facilities. Where appropriate, the recreation plan shall include details on erosion control. The Applicant shall update the plan at intervals not exceeding ten years unless the Department approves a written statement that indicates the basis why there is no need to upgrade the facilities or otherwise modify the plan. Modifications to the recreation plan shall also be subject to Department approval over the term of the license. The Department approved recreation plan and all amendments thereto as approved by the Department shall be incorporated by reference as conditions of this Certification.

K. **Public Access.** The Applicant shall allow public access to the project lands for utilization of public resources, subject to reasonable safety and liability limitations. Such access should be prominently and permanently posted so that its availability is visible to the public. The Applicant shall not limit access to State waters without receiving written approval by the Department. In cases where an immediate threat to public safety exists, access may be restricted without prior approval. In such instances, the Applicant shall so notify the Department and shall file a request for approval, if the restriction is to be permanent or long term, within 14 days of the restriction of access.

L. **Debris Disposal Plan.** The Applicant shall develop a plan for proper disposal of debris associated with project operation, including trashrack debris. The plan shall be developed in consultation with the Department and a draft shall be submitted to the Department within 90 days of the effective date of the FERC license. The final plan shall be subject to Department approval. The Department reserves the right of review and approval of any material changes made to the plan at any time.

M. **Maintenance and Repair Work.** Any proposals for project maintenance or repair work, including drawdowns below the normal operating range to facilitate repair or maintenance work, shall be filed with the Department for prior review and approval if said work may have an adverse effect on water quality or cause less-than-full support of an existing use or a beneficial value or use of State waters.

N. **Compliance Inspection by Department.** The Applicant shall allow the Department to inspect the project area at any time to monitor compliance with certification conditions.

O. **Posting of Certification.** A copy of this certification shall be prominently posted within the powerhouses at the three generating developments.

P. **Approval of Project Changes.** 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 where appropriate and authorized by law and only as related to the change proposed.

Q. **Continuing Jurisdiction.** The Department reserves the right to add and alter the terms and conditions of this certification, when authorized by law and as appropriate to carry out its responsibilities with respect to water quality during the life of the project.

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

S. **Reopening of Certification.** The Department may reopen and alter or amend the conditions of this Certification over the life of the Project when such action is necessary to assure compliance with the Vermont Water Quality Standards and to respond to any changes in the classification or management objectives for the affected waters. Any amendment that results in a change of conditions for the Project shall be subject to Paragraph IX (Public Notice and Comment; Public Hearing; Issuance of Decision) of the Section 401 Water Quality Certification Practice, dated October 22, 2014.

Effective Date and Expiration of Certification

This certification shall become effective on the date of issuance, and the condition of any certification shall become conditions of the federal permit (33 U.S.C. § 1341(d)). If the federal authority denies a permit, the certification becomes null and void. Otherwise, the certification runs for the terms of the federal license or permit.

Enforcement

Upon receipt of information that water quality standards are being violated as a consequence of the project's construction or operation or that one or more certification conditions has not been complied with, the Secretary, after consultation with the Applicant and notification of the appropriate federal permitting agency, may, after notice and opportunity for a public hearing, modify the Certification and provide a copy of such modification to the Applicant and the federal permitting agency.

Certification conditions are subject to enforcement mechanisms available to the federal agency issuing the license and to the state of Vermont. Other mechanisms under Vermont state law may also be used to correct or prevent adverse water quality impacts from construction or operation of activities for which certification has been issued.

Appeals

Pursuant to 10 V.S.A. Chapter 220, any appeal of this decision must be filed with the clerk of the Environmental Division of the Superior Court within 30 days of the date of the decision. The Notice of Appeal must specify the parties taking the appeal and the statutory provision under which each party claims party status; must designate the act or decision appealed from; must name the Environmental Division; and must be signed by the appellant or their attorney. In addition, the appeal must give the address or location and description of the property, project, or facility with which the appeal is concerned and the name of the Applicant or any permit involved in the appeal. The appellant must also serve a copy of the Notice of Appeal in accordance with Rule 5(b)(4)(B) of the Vermont Rules for Environmental Court Proceedings. For further information, see the Vermont Rules for Environmental Court Proceedings, available on line at www.vermontjudiciary.org. The address for the Environmental Division is 32 Cherry Street, 2nd Floor, Suite 303; Burlington, VT 05401 (Tel. 802.828.1660).

Dated at Montpelier, Vermont this
XXth day of January, 2016

Alyssa Schuren, Commissioner
Department of Environmental Conservation

By _____
Peter LaFlamme, Director
Watershed Management Division
Department of Environmental Conservation