

**Full Application Review for
Low Impact Hydropower Certification of
Ladd's Mill Hydroelectric Facility (FERC #8242)**



Prepared by:

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May 24, 2017



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I. INTRODUCTION

This report reviews the application received by the Low Impact Hydropower Institute (LIHI) for Low Impact Hydropower Certification of the Ladd's Mill Hydroelectric Facility ("Ladd's Mill" or "Facility.") The Facility is located on the North Branch of the Winooski River in the Town of Worcester, Washington County, Vermont. The Facility consists of one small concrete gravity dam, an adjacent powerhouse with a single turbine-generator rated at 187 KW, and appurtenant facilities. A more detailed description of Project Works and Watershed is provided in sections below. The Facility is owned and operated by Worcester Hydro Company, Inc., an independent power producer in the State of Vermont¹.

Operations at the Facility are regulated by the terms and conditions contained in an Exemption from FERC Licensing, issued June 11, 1985 and an amended Water Quality Certificate, issued January 6, 1986. The current Owner has demonstrated a record of working with the Vermont Department of Environmental Conservation to bring the project into compliance with the terms of the Water Quality Certificate, and making considerable investments to provide environmental enhancements at the site. These specific measures are outlined in the relevant LIHI Criteria in this report. The Agency provided comments commending the Owner for these efforts and supporting certification.

Worcester Hydro Company, Inc., submitted a complete Intake Application to LIHI on January 19, 2017. I completed the Intake Review on March 2, 2017, noting several deficiencies and potential issues to address in a Full Application. The Owner submitted a Final Certification Application to LIHI on March 17, 2017. I have conducted a review of this Application and all supporting materials, the project record on FERC e-library, and agency comments, and conclude that the Ladd's Mill Hydroelectric Facility meets LIHI Criteria contained in the 2nd edition handbook.

II. PROJECT LOCATION AND SITE CHARACTERISTICS

The Facility is located on the North Branch of the Winooski River near the Town of Worcester, Vermont, approximately 10 miles above the confluence with the main stem Winooski River in Montpelier. The Winooski River basin covers a total drainage area of 1,080 square miles, and nearly 75% of this area is located in natural forest and wetlands. The network of rivers, streams, lakes and ponds in the region surrounding Ladd's Mill offer exceptional fish and wildlife habitat and support a variety of aesthetic and recreational uses. Fish in the immediate project vicinity include brook, rainbow and brown trout, and deer, weasel, otter, mergansers, minks and many other species have all been observed. The Facility is the furthest hydropower plant upstream on the North Branch, approximately five miles upstream from the Wrightsville Reservoir Dam, owned and operated by the Army Corps of Engineers for flood protection purposes. The region above the Facility consists of rural wilderness and the headwaters of the North Branch, formed near the top of the Worcester Range Mountains.

The Facility is located on a 1.1 acre site (excluding river) and features a mixed hardwood forest that is currently returning from previously developed land. The watershed area at the dam is approximately 42.2 square miles, and average annual flows at the dam are 82 cfs, with peak April flow of 277 cfs and low flow in August of 26 cfs. The powerhouse uses head of approximately 18 feet entering a 18 foot-long by 9 foot-wide forebay with an average depth of 15 feet. Shallow rapids and several feeder streams enter the

¹ Ownership rights have been transferred multiple times

North Branch immediately downstream of the Facility, and this stretch is lined with alternating walls of ledge and cobble-sized rocks.

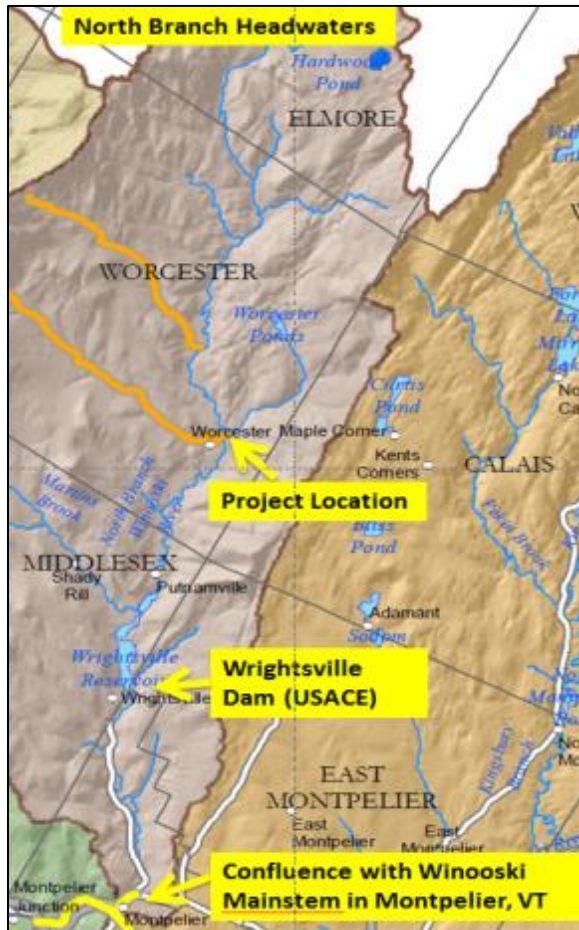


Figure 2 – Location within Watershed



Figure 1 – North Branch Headwaters



Figure 3 – Location within Vermont

III. PROJECT WORKS

The Dam is a concrete gravity structure, with a height of 21 feet (topped with an additional 1-foot flashboard) and a width of 80 feet. The concrete powerhouse is built into the eastern end of the dam, and features an intake structure that is approximately 18.5 foot-long and 9 foot-wide with an average depth of 14.6 feet. The Intake is overlaid with a stainless steel trash rack which was replaced in 2013 with approval from VTDEC for preventing fish from entering the intake. The Powerhouse is a concrete structure approximately 19 foot-long by 30 foot-wide and incorporated directly into the dam face at the remains of the original saw mill site. After passing through the Intake Structure, water enters a transitional piece (similar to a penstock) which delivers water to a 172 KW Ossberger 800 mm Crossflow Turbine. Water exits the powerhouse into the 40 foot-long by 25-foot-wide tailrace immediately below the dam. A 2 foot-wide by 1.5 foot-deep weir was cut into the dam in fall 2015 to provide a more effective means of downstream fish passage at the facility. The Owner continues to make improvements to the structural integrity and aesthetics of the dam. This includes a series of ongoing projects since 2014 to remove and replace concrete in the forebay interior, retaining walls, and top of dam. Much of this work is already completed, although several ongoing projects will continue through 2019.



Figure 4 - Forebay and Powerhouse (looking downstream)



Figure 5 - Tailrace and Powerhouse (looking upstream)

IV. ZONES OF EFFECT

The Applicant appropriately applied two Zones of Effect. Zone 1 is defined as the riverine stretch from the downstream face of the Ladd’s Mill Dam approximately 0.25 mile downstream to the entrance of a third feeder stream to the North Branch of the Winooski River. (During conversations with the applicant, we discussed bounding this zone with the point where the cumulative flows of the downstream feeder streams approximate the annual flows at the project site.) Zone 2 consists of the Ladd’s mill impoundment, extending approximately 0.35 miles upstream of the project and covering a surface area of 4.57 acres, (although there is practically no usable storage at the project.) There is no bypassed reach, as the powerhouse is located adjacent to the dam and discharges immediately into the tailrace.



Figure 6 - Zone 1 (Downstream stretch)



Figure 7 - Zone 2 (Impoundment)

V. HISTORY & REGULATORY STATUS

The site was originally developed in 1905, when a crib dam was constructed to supply power for a sawmill owned by the Ladd family landowners. In 1928, this dam was washed out and a concrete gravity dam was rebuilt in its place with hydroelectric power for the sawmill. In 1957, the dam failed again due to heavy flooding and the site was abandoned for nearly 30 years. In 1985, the passage of PURPA motivated the landowners Wendell and Madeline Ladd to reconstruct the facility. The Facility applied to and was issued an Exemption from FERC Licensing (P-8242) on June 11, 1985. This was preceded by a Water Quality Certificate (WQC) issued in January 25, 1985, later amended on January 8, 1986 due to as-built changes in the project. The WQC and Exemption include several Terms and Conditions to protect and preserve aquatic life, habitat and aesthetics in the vicinity impacted by the Facility, as described later in each relevant LIHI Criteria.

Since the original Exemption, the project’s ownership rights have changed hands several times. The most recent owner, Worcestor Hydro Company reached out to Vermont Department of Environmental

Conservation (VDEC) to determine compliance with the terms and conditions of the WQC, in order to support their application to LIHI. In May 2012, VDEC conducted a site visit and noted several areas of noncompliance with the WQC. The Owner conducted follow-up meetings with VDEC to determine an appropriate plan of action to bring the project back into compliance, including several which required considerable capital outlays for a project of this small size. Since that time, the Owner has demonstrated a successful working relationship and record of working with the agency to bring the Facility into compliance with terms in the WQC and make environmental enhancements the Facility. The VTDEC completed a site visit on May 24, 2012, and noted several compliance issues and ways for the Facility to enhance its ability to ensure minimum flows and provide fish passage. These included sensors to monitor impoundment level to ensure minimum flow is met, a more protective trashrack than previously used, refacing the back face of the dam to prevent physical injury to passing fish, and relocating a new downstream fish passage weir. The VTDEC returned to the site on October 15, 2015, and noted the successful resolution of all issues and consistency with LIHI criteria:

“Due to these improvements, the project now has the infrastructure in place to operate in full compliance going forward. Further, Worcester Hydro Company has made the modifications recommended by the Department to provide safe passage for fish attempting to pass downstream. In addition to operating in compliance with its water quality certification, these modifications will also enable operations consistent with applicable LIHI criteria.”

VI. COMPLIANCE WITH LIHI STANDARDS

Criterion A: Ecological Flow

Standard Applied: A2 – Agency Recommendation (Zones 1 & 2)

The most recent resource agency recommendation² is contained in the Water Quality Certificate (“WQC”), amended in 1986 and updated and confirmed during a site visit in 2012. Condition B of the WQC requires an instantaneous flow of 10 cfs or inflow, whichever is less, be discharged from the dam at all times, and that specific records from pond level sensors be submitted to the Vermont Department of Environmental Conservation (VDEC) for approval. These recommendations were made in consultation with the state fishery agencies and designed to maintain water quality in the river, and included an analysis of the forebay design, turbine flow, and approach velocity. Before final approval of the minimum flow, the Owner was required to furnish the Department with plans and calculations for the device used to maintain that flow. This diligence work constitutes the scientific basis of the recommendation and is consistent with the agency management goals and objectives to protect and preserve aquatic life.

In March 2012, the Owner requested VDEC review the site’s compliance with WQC conditions to support their original LIHI application. On May 24, 2012, VDEC visited the site and observed that the project was not meeting this requirement, among other areas of noncompliance. On August 1, 2013, VDEC met with the Owner and developed a plan and commitment to bring the project back into compliance. The Owner fulfilled this commitment, by cutting a new 2 ft-wide by 1.5 ft-deep weir at the intake, resurfacing the dam face to avoid physical injury to fish using the weir, and providing the required

² LIHI 2nd edition Handbook provides the following criteria for valid *resource agency recommendation* as: (1) science-based, (2) issued pursuant to a proceeding, (3) most recent, (4) most environmentally stringent, and (5) consistent with and supportive of agency management goals and objectives

pond level data collected with a MEAS KPSI 700 pressure transducer. The Department visited the site on October 15, 2015, and confirmed that all project measures were undertaken and that “the project was operating in full compliance with its water quality certification.” Please see Appendix A for a description of the actions taken approval to bring this Facility into compliance with Agency Recommendations.



Figure 8 - Reconfigured Weir for Minimum Flow Passage

Criterion B: Water Quality

Standard Applied: B2 – Agency Recommendation (Zones 1 & 2)

The *Winooski River Basin Water Quality Management Plan* shows that the Ladd’s Mill Facility does not contribute to any impairment on the North Branch of the Winooski River. The report lists all hydropower facilities within Basin 8, and notes: “The operation of the facilities results in some degree of alteration of flows; however, only the facilities noted on the 2010 List Of Priority Surface Waters Outside The Scope Of Clean Water Act § 303(D) Part F (see Table 9) are responsible for an impairment to the river segment used by the facility.” Ladd’s Mill is listed as a hydropower facility with Basin 8, but is clearly listed as not contributing to an impairment. The original WQC noted that the water quality in this stretch is Excellent, and that the project would not degrade water quality if the proposed minimum flows were maintained.

The Water Quality Certificate contains the most recent and stringent Agency Recommendations impacting this Criterion. However, these Conditions – to provide minimum flow and support water quality in a plunge pool at the base of the dam – are more appropriately applied to Criterion A (Flows) and Criterion D (Downstream Passage,) and are covered in detail under those criteria in this report.

Criterion C: Upstream Fish Passage

Standard Applied: C2 – Agency Recommendation (Zone 1)

The Applicant selected Agency Recommendation due to the Exemption Condition that reserves authority to install passage facilities if required to by the agencies. Upstream fish passage has never been required at this site, and the downstream Wrightsville Reservoir Dam does not include upstream passage. In my opinion, Standard C1 would be better applied here. Reservation of authority to prescribe passage is not a

science-based recommendation, but rather a standard term contained in nearly all licenses and exemptions for hydroelectric plants. There are no migratory fish species in the North Branch of the Winooski River, and efforts to stock Atlantic Salmon via trap and haul (discussed in an original USFWS letter in the Exemption process,) have not materialized. Until any specific recommendations are issued pursuant to a regulatory proceeding, this Facility passes with Criterion 1 – Not applicable/De Minimis, in my opinion.

Standard Applied: C1 – Not Applicable/De Minimis (Zone 2)

The Applicant appropriately selected Standard C1, because this is an impoundment Zone and this Criterion does not apply for this Zone.

Criterion D: Downstream Fish Passage:

Standard Applied: D1 – Not Applicable/De Minimis (Zone 1)

The Applicant appropriately selected Standard D1, because this is a free-flowing downstream reach and this Criterion therefore does not apply for this Zone.

Standard Applied: D2 – Agency Recommendation (Zone 2)

The most recent resource agency recommendation is contained in the Water Quality Certificate, amended in 1986 and updated and confirmed during a site visit in 2012. Condition J required a protective trashrack be placed over the headworks to prevent fish from entering intake to crossflow turbine. During the site visit, the trashrack was observed to be at the end of its serviceable life. The Owner developed and submitted design documents for a replacement trashrack to VDFW on April 22, 2013, and the as-built design was approved to meet the WQC specifications.

During the original WQC process, it was recommended that the Owner pass bypass flow through a structure that would not result in physical injuries to fish using the structure to pass downstream. During the May 24, 2012 site inspection, the downstream face of the dam was found to be eroded concrete in addition to the inadequate flow passage (as described above in Criterion A: Flows.) The Department was concerned that fish passing through the bypass structure would strike the dam on the ledge below, instead of landing in the plunge pool as desired. On August 1, 2013, they recommended the Owner relocate a new, 2 ft-wide by 1.5 ft-deep weir near the powerhouse, and resurface the downstream face of the dam to smooth the portion below the weir to avoid physical injury to fish. The Owner completed this work in the fall of 2015. The Department re-visited the site on October 15, 2015, and noted the weir was built to recommended specifications.

The new weir and dam re-facing design and construction recommendations do not qualify as valid Resource Agency Recommendations according to LIHI standards, as they were not issued pursuant to a regulatory proceeding. However, these measures ensure the Owner meets the 10 cfs requirement, and it is the Owner's prerogative to comply with recommendations issued by agencies outside of regulatory proceedings and/or LIHI standards.

Criterion E: Shoreline & Watershed Protection:

Standard Applied: E1 – Not Applicable/De Minimis (Zones 1 & 2)

The land surrounding and downstream of Ladd’s Mill consists of a mixed hardwood forest and cleared land. The land surrounding the impoundment consists primarily of grass/reed-covered shoreline with one segment of high ledge. Both Zones of Effect are bounded primarily by private property, which the Owner has no control over or regulatory requirement to maintain. There is no Shoreline Management Plan for the Facility. The Owner proposed an erosion control plan during the original WQC process in 1986, and this was approved with one exception³.

Criterion F: Threatened and Endangered Species:

Standard Applied: F1 – Not Applicable/De Minimis (Zones 1 & 2)

The Owner provided a screenshot of the Vermont ANR Biofinder GIS mapping tool for this site to show that no threatened or endangered species exist in the Facility’s vicinity. The map does not identify any state-listed species within the project area. (Any rare animal or plant habitat would be shaded red or green.)

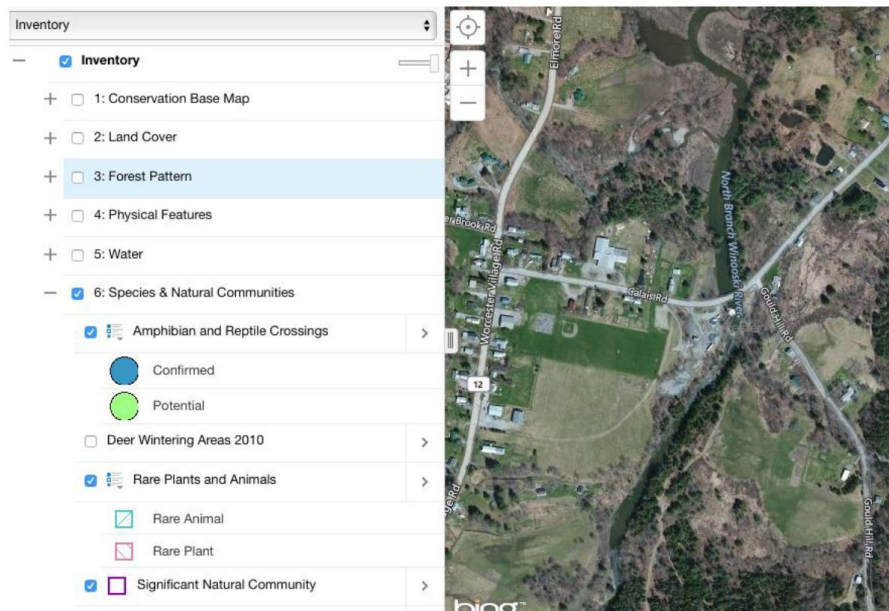


Figure 9 - VT Biofinder Screenshot for Ladd's Mill Site

Criterion G: Cultural and Historic Resources:

Standard Applied: G1 – Not Applicable/De Minimis (Zones 1 & 2)

The Owner provided a historic survey of Worcester, Vermont to show that no historical sites exist in the immediate vicinity of the Facility. The survey finds the two properties nearest to the facility are still well outside the area impacted by the site.

³ This consisted of identifying the best location to dispose of rock debris during construction.

Criterion H: Recreation:

Standard Applied: H2 – Agency Recommendation (Zones 1 & 2)

As an Exempted Project, the Owner is required to allow public access to the project area public uses, subject to reasonable limitations for safety and liability. The Owner allows fishermen and canoeists to park at the site and access the river. Following Hurricane Irene, a stone stairway was constructed to mitigate the danger of accessing the river downstream of the Facility.



Figure 10 - Stone stairway to downstream access

VII. PUBLIC COMMENTS RECEIVED

No public comments were received during the 60-day comment period.

VIII. CONCLUSIONS AND RECOMMENDATION

Based on a thorough review of the application and supporting documentation, public records, and comments provided by resource agencies for the application, in my opinion the Ladd's Mill Falls Hydroelectric Project meets the requirements for LIHI certification for one, five-year term. The project has taken significant measures to promote environmental compatibility of the project, as noted by the Vermont Department of Environmental Conservation. No conditions are required.

APPENDIX A AGENCY COMMUNICATIONS

Date: January 11, 2016

Contact: Eric Davis, River Ecologist

Agency: Vermont Department of Environmental Conservation

The following letter from Eric Davis covers 3 LIHI Criteria – Flows, Water Quality and Fish Passage. Given the comprehensive nature of the letter, and the fact that the Applicant clearly provided evidence to support passing all additional LIHI Criteria, no additional agency outreach was deemed necessary as part of this review.

[Letter on Next Page]

Vermont Department of Environmental Conservation*Agency of Natural Resources*

Watershed Management Division

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January 11, 2016

Hobart Guion and Charles Wanzer
Worcester Hydro Company
345 Kelton Road
East Montpelier, Vermont 05651

RE: Ladds Mill Hydroelectric Project (FERC No. 5182)

Comments on Application for LIHI Certification

Dear Mr. Guion and Mr. Wanzer,

The Department of Environmental Conservation (the Department) has reviewed recent improvements made at the project and writes to summarize the progress that has been made to bring the project into compliance with the water quality certification issued for the project and with criteria established by the Low-Impact Hydropower Institute (LIHI).

The Ladds Mill Hydroelectric project (FERC Project No. 5182) was certified by the Department in 1985, and the certification was amended in 1986. In March 2012, Worcester Hydro Company (WHC) requested a review of the project's compliance with its water quality certification for its application to LIHI to be certified as low impact. The Department's file review and May 24, 2012 site visit identified several compliance issues. At the time of inspection, the project was not spilling the required 10 cfs. Additionally, the Department did not have a record of the level sensor utilized at the project, nor a record of Department approval of the trashrack. On August 1, 2013 the Department met with representatives of the Worcester Hydro Company at the project to discuss these compliance issues. The project owners committed to working with the Department to bring the project into compliance. This letter serves to summarize the progress made since that date.

Condition B of the Water Quality Certification, requires that an instantaneous flow of 10 cfs or inflow flow, if less, be released at the dam at all times. It also states that specific information on level sensors used to maintain the impoundment level need to be submitted to the Department before approval can be issued on the minimum flow passage technique. The Department requested that Worcester Hydro Company submit specific information on the level sensors used to measure the elevation of the impoundment. Worcester Hydro has since supplied this information to the Department. The level sensor maintaining the pond level upstream of the powerhouse is a MEAS KPSI 700 pressure transducer.

Condition J of the Water Quality Certification, requires that the project place a protective trashrack over the headworks because of the high fish mortality associated with crossflow turbine. The design of the trashrack was subject to written approval from the Vermont Department of Fish and Wildlife. The Department recommended that Worcester Hydro Company submit measurements of the as constructed trashrack including spacing between vertical members. Given that the original trashrack was nearing the end of its serviceable life, Worcester Hydro Company submitted the design of a replacement trashrack to the Department for approval on April 22, 2013. The Department of Fish and Wildlife approved the design and the as built trashrack has been confirmed to meet the specifications required by the water quality certification.

In regards to adequate bypass spillage and safe downstream fish passage, the Agency of Natural Resources at the time of the amended certification asked the project owner to pass the bypass flow through a structure that would not result in physical injuries to fish that might approach it and/or attempt to pass downstream. At the time of the May 24, 2012 inspection, the dam spillage appeared to be significantly less than 10 cfs. The back face of the dam was also found to be very rough, eroded concrete. At the observed flow, these conditions would likely result in physical injury to any fish moving downstream via the weir release. On a site visit on August 1, 2013, the Department discussed how best to provide safe downstream fish passage at the project given the 10 cfs bypass flow requirement. The weir needs to be located so that fish will land in the plunge pool at the base of the dam and not strike the dam footer on ledge below. The Department indicated the preferred location of the weir would be on the end of the dam crest by the powerhouse. A weir 2 feet wide and 1.5 feet deep would provide the depth needed for fish passage while passing the required 10 cfs. The Department also indicated that a smooth concrete surface would be needed to provide safe downstream passage. During the summer of 2014, Worcester Hydro Company undertook the dam resurfacing work, smoothing the portion of the dam below the existing weir to avoid physical injury to fish moving downstream via the weir release. In the fall of 2015, Worcester Hydro Company cut a new 2 feet wide and 1.5 feet deep weir by the intake. The new weir and concrete work will allow for the most effective means of passage while passing the required 10 cfs bypass flow. The Department visited the site on October 15, 2015 and confirmed the weir was built to the specifications recommended by the Department.

At the time of the Department's October 15, 2015 site visit, the project was operating in full compliance with its water quality certification. The improvements needed to bring the project into compliance were capital intensive and required modifications to the existing infrastructure. Due to these improvements, the project now has the infrastructure in place to operate in full compliance going forward. Further, Worcester Hydro Company has made the modifications recommended by the Department to provide safe passage for fish attempting to pass downstream. In addition to operating in compliance with its water quality certification, these modifications will also enable operations consistent with applicable LIHI criteria.

Very truly yours,



Eric Davis
River Ecologist

c: Jeff Crocker, Vermont Department of
Environmental Conservation Rich Kirn, Vermont
Department of Fish and Wildlife