

GLENDALE HYDROELECTRIC PROJECT

LIHI APPLICATION

ATTACHMENT C

FISH PASSAGE AND PROTECTION

144 FERC ¶ 62,017
UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Littleville Power Company, Inc.

Project No. 2801-033

ORDER APPROVING REVISED TRASH RACK DESIGN

(July 9, 2013)

1. On June 17, 2013, Littleville Power Company, Inc., licensee for the Glendale Hydroelectric Project, filed revised plans for the minimum flow unit trash rack design, pursuant to license article 403 of the Commission's Order Issuing Subsequent License¹ and condition 21 of the Water Quality Certificate (WQC), issued by the Massachusetts Department of Environmental Protection (DEP).² The licensee's original trash rack design was approved by the Commission on May 12, 2011.³ The Glendale Hydroelectric Project is located on the Housatonic River in the Town of Stockbridge, Berkshire County, Massachusetts.

BACKGROUND

2. Article 403 of the license requires the licensee to file, at least 90 days before the start of any land-clearing or land-disturbing activities at the project site associated with installation of the minimum flow turbine-generator, for Federal Energy Regulatory Commission (Commission) approval, detailed design drawings of the trash racks to be installed at the intake for the minimum flow turbine unit and a schedule to construct and install the trash racks. The filing shall include, but not be limited to: (1) specifications of the size of the openings between the trash rack bars not to exceed 1 inch; (2) the maximum intake approach velocity not to exceed 2 feet per second (fps); and (3) a description of the methods and a schedule for installing the trash racks.

¹ 128 FERC ¶ 62,123 (August 19, 2009).

² The WQC was issued on July 8, 2009, and made part of the license by ordering paragraph D.

³ 135 FERC ¶ 62,137.

3. The licensee is required to prepare the aforementioned drawings and schedule after consultation with the DEP, Massachusetts Department of Fisheries and Wildlife (DFW), and the U.S. Fish and Wildlife Service (FWS). The licensee is also required to include with the drawings and schedule documentation of consultation, copies of comments and recommendations on the drawings and schedule after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the licensee's facilities.

LICENSEE'S PLAN

4. The revised trash rack structure proposed by the licensee would be installed in a newly constructed intake opening in the existing concrete power canal wall. The trash rack would consist of a single 8 feet 2 ³/₄ inches wide, by 14 feet 6 inches high panel positioned in the newly constructed canal wall intake opening. The trash rack frame would extend from the top of the power canal concrete wall to the bottom of the canal intake opening at a 12:1 slope. The sides of the trash rack structure would be contained within concrete side walls of the new intake to prevent fish from passing behind the trash racks. The licensee states that, based on the gross area of the racks, the approach velocity one foot in front of the trash racks is calculated to be 1.2 fps, which is less than the 2.0 fps requirement and the velocity through the trash rack bars is calculated to be 1.6 fps.

5. The licensee states that the design details for installing the new minimum flow unit are presently being finalized. The licensee proposes to de-water the power canal and construct the new canal intake. There would be no change to the licensee's plans to construct the powerhouse in the dry (behind a cofferdam). In addition no impoundment drawdown would be necessary. The licensee expects that construction will commence in summer 2013, with unit commissioning scheduled for December 2013. The licensee proposes to fabricate the trash rack panel off site and installed it when the intake opening is completed.

AGENCY CONSULTATION

6. The licensee provided the draft plan to the agencies on June 7, 2013. The DEP and DFW provided approval of the plan in letters dated June 10, 2013. The FWS approved the plan in an email dated June 12, 2013.

DISCUSSION

7. In accordance with the article 403 requirements, the licensee's plan states that the trash racks will not have opening in excess of one inch, and the calculated approach velocity will not exceed 2 fps. The licensee's submitted, pursuant to article 302 of the license, copies of its plans, specifications, and supporting design documents to the Commission's New York Regional Engineer and the Commission, on July 19 2011. The licensee's plans were approved by letter dated October 21, 2011. On June 27, 2013, the

licensee filed its revised plans, specifications, and supporting design documents to the Commission's New York Regional Engineer and the Commission. The licensee's plan addresses the requirements of license article 403 and WQC condition 21 for trash racks at the minimum flow unit and should be approved.

The Director orders:

(A) The revised trash rack plan for the minimum flow unit filed on June 17, 2013, by Littleville Power Company, Inc., licensee for the Glendale Hydroelectric Project, is approved.

(B) This order constitutes final agency action. Any party may file a request for rehearing of this order within 30 days from the date of its issuance, as provided in section 313(a) of the Federal Power Act, 16 U.S.C. § 8251 (2006), and the Commission's regulations at 18 C.F.R. § 385.713 (2013). The filing of a request for rehearing does not operate as a stay of the effective date of this order, or of any other date specified in this order. The licensee's failure to file a request for rehearing shall constitute acceptance of this order.

Steve Hocking
Chief, Environmental Resources Branch
Division of Hydropower Administration
and Compliance



LITTLEVILLE POWER COMPANY, INC.
A SUBSIDIARY OF ENEL GREEN POWER NORTH AMERICA, INC.

Green Power

Enel Green Power North America, Inc.

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T 978 681 1900 F 978 681 7727

Via eFiling

June 17, 2013

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, D.C. 20426

Re: Glendale Hydroelectric Project (FERC No. 2801-033);
License Article 403 – Revised Intake and Trashrack Design.
Expedited Review Requested

Dear Secretary Bose:

On May 12, 2011 the Commission approved the trashrack design proposed by Littleville Power Company, Inc. (LPC) for the new minimum flow unit at the Glendale Hydroelectric Project (FERC No. 2801), pursuant to Article 403 of the project's Subsequent License.¹ As approved, the minimum flow unit would draw water from the project impoundment through two abandoned waste gates located between the dam and the main intake canal. LPC selected this design because it would maximize the operational flexibility of the project by allowing the minimum flow unit to operate independently of the project's main units, when the power canal to the main units is dewatered. However, the waste gates are heavily silted in by PCB-contaminated river sediments, such that reactivating these gates for the minimum flow unit would require dredging and disposal of over 1,000 cubic yards of contaminated sediments at substantial cost. Because the construction bids for this project far exceeded LPC's budget, LPC temporarily shelved construction of the minimum flow unit to explore options for reducing the construction costs.

To avoid the expense of dredging and disposal and to eliminate the need for a cofferdam in the impoundment, LPC has developed an alternative intake configuration in which the minimum flow unit would draw water from the main power canal, instead of through the waste gates. While this configuration would reduce the operational flexibility of the project, the savings in construction costs and time would be more in line with the project's overall financial goals. All other aspects of the powerhouse design as presently approved by the Regional Engineer would remain unchanged.

¹ 135 FERC ¶ 62,137

Pursuant to the terms of license article 403, LPC is submitting its revised minimum flow unit trashracks for the canal intake. LPC respectfully requests expedited review of this submittal due to construction timing concerns. Article 403 requires that the submittal include: (1) specifications of the size of the openings between the trash rack bars not to exceed 1 inch; (2) the maximum intake approach velocity not to exceed 2 feet per second; and (3) a description of the methods and a schedule for installing the trash racks. As required, the attached trashrack plans were prepared in consultation with the resource agencies.

Trashrack Design and Bar Spacing

The attached three drawings show the overall layout of the modified intake design and the construction details of the proposed trashrack. Water will be drawn from the canal into the minimum flow unit's forebay via a 8'-4" wide by 8'-9" deep (at normal pond elevation of 810.9 ft NGVD) opening in the concrete canal wall, controlled by a 7 ft by 7 ft slide gate (Drawing No. 3). A new trashrack structure will be mounted within the opening, consisting of a single 8'-2³/₄" wide by 14'-6" tall panel with 76 bars 3" by 5/16" each with 1-inch clear spacing (Drawing No. 12). The trash rack panel will extend from the top of the concrete canal wall to the bottom of the canal opening at a 12:1 slope (Drawing No. 11), and will have an effective submerged depth of 8'-9". The sides of the rack structure will be contained within the concrete sidewalls of the canal opening, thereby preventing fish from passing behind the trash racks.

Approach Velocity

Trashrack approach and through-flow velocity calculations are provided in Note 6 at the right side of Drawing 12. Based on the gross area of the submerged portion of the racks, the approach velocity 1 ft in front of the trash racks is calculated to be 1.2 ft/s, well within the 2.0 ft/s maximum approach velocity requirement. Furthermore, the calculated velocity through the net open area of the submerged racks is 1.6 ft/s, also within the 2.0 ft/s requirement.

Construction Schedule and Method

LPC is presently finalizing the engineering details for new intake design. On October 21, 2011 FERC's Regional Engineer granted construction approval for the original powerhouse and intake design. LPC also previously obtained all other necessary local, state and federal permit approvals for the construction activities at the dam. LPC expects to submit the engineering details of the new intake design to the Regional Engineer for a revised construction approval shortly. As LPC reported by letter dated October 25, 2011, the new turbine-generator unit has been purchased and received. Pending the Regional Engineer's revised approval, on-site construction is anticipated to commence in July, 2013 with unit commissioning scheduled to occur by December 31, 2013.²

Construction of the canal intake and installation of the trashracks will be accomplished "in the dry" with the canal dewatered. An impoundment drawdown will not be necessary to facilitate any construction activities. The trashrack panel will likely be

² LPC understands that construction must be completed by November 1, 2013 under Article 301. LPC will separately request an extension of time to complete construction from the Commission.

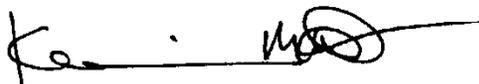
fabricated off-site and installed when the concrete work for the canal opening is complete. There will be no change to the construction of the new powerhouse downstream of the gatehouse structure, which will be conducted "in the dry" behind a cofferdam.

Agency Consultation

Pursuant to the consultation requirements under Article 403, LPC submitted a draft of this plan to the MDEP, the MDFW and the USFWS for their review and comment. All three agencies approved the proposed changes to the trashrack design and location. Copies of all comments received are attached.

Thank you for your review of this revised trash rack design. Please do not hesitate to contact me at (978) 681-1900, extension 809 if you have any questions concerning this submittal.

Sincerely,
Littleville Power Company, Inc.



Kevin M. Webb
Environmental Affairs Coordinator

cc: R. Bartlett, LPC

Attachments:

- 3 drawings (CEII)
- Agency approval letters

Attachment A

Trashrack Design Drawings

The trashrack design drawings contain Critical Energy Infrastructure Information and have been removed from the publicly-available portion of this submittal, in accordance with the Commission's CEII guidelines.

Attachment B

Agency Approvals



MassWildlife

Commonwealth of Massachusetts

Division of Fisheries & Wildlife

Wayne F. MacCallum, *Director*

June 10, 2013

Kevin M. Webb
Hydro Licensing Manager
Enel Green Power North America, Inc.
One Tech Drive, Suite 220
Andover, Massachusetts USA 01810

RE: Glendale Hydroelectric Project (FERC No. 2801)
Minimum Flow Unit Installation – Revised Intake and Trashrack Design.

Dear Kevin,

The Massachusetts Division of Fisheries and Wildlife (Division) is the agency responsible for the protection and management of the fish and wildlife resources of the Commonwealth. As such we monitor operations at hydroelectric projects within the Commonwealth. The Division has the following comments on the "Revised Intake and Trashrack Design" for the Glendale Hydroelectric project (FERC No. 2801) issued on June 7, 2013.

Proposal

The project owner has proposed to change the location of the intake for the new minimum flow unit at the Glendale dam from old waste gates that would draw water from the project impoundment to a new gate that would draw water from the project's power canal. All other aspects of the minimum flow unit design would remain unchanged. The proposed gate will be protected by a trash rack with 1" clear space with an approach velocity calculated at less than 2 feet per second.

Comments

The Division finds the proposed new gate and trashrack acceptable.

Thank you for this opportunity to comment,

A handwritten signature in black ink, appearing to read "Caleb Slater".

Caleb Slater, Ph.D.

www.mass.gov/masswildlife



Department of Environmental Protection

Central Regional Office • 627 Main Street, Worcester MA 01608 • 508-792-7650

DEVAL L. PATRICK
Governor

RICHARD K. SULLIVAN JR.
Secretary

KENNETH L. KIMMELL
Commissioner

Kevin M. Webb
Littleville Power Company, Inc.
One Tech Drive, Suite 220
Andover, Massachusetts USA 01810

June 10, 2013

Re: Glendale Hydroelectric Project (FERC No. 2801-MA)
Minimum Flow Unit Installation – Revised Intake and Trashrack Design

Dear Mr. Webb,

The MA Department of Environmental Protection (the Department) is the agency that issues 401 Water Quality Certificates on behalf of the Commonwealth for hydroelectric projects. To accomplish this, the Department relies on the recommendations provided by the MA Division of Fish & Wildlife regarding aquatic life habitat and fisheries issues. Accordingly, the Department concurs with the recommendations to be developed by the MA Division of Fish & Wildlife for the revised intake and trashrack design.

If I can be of any further assistance, please contact me at 508-767-2854.

Sincerely,

Robert Kubit, P.E.

From: [Grader, Melissa](#)
To: [Webb, Kevin \(EGP North America\)](#)
Cc: [Caleb Slater \(Caleb.Slater@state.ma.us\)](#); [Kubit, Robert \(DEP\)](#); [Bartlett, Randald \(EGP North America\)](#)
Subject: Re: Glendale Project - revised trashrack design
Date: Wednesday, June 12, 2013 1:04:05 PM

Hi Kevin,

The FWS has reviewed Enel's request to change the location of the minimum flow turbine at the Glendale Project. Based on the information you provided, the Service has no objection to moving the location of the minimum flow intake from the spillway to the upper end of the power canal. The trashracks at the intake to the new unit will have 1 inch clear spacing and an approach velocity less than 2 fps, in conformance with Service design criteria to minimize impingement and entrainment of fishes. The location of the new powerhouse (and therefore, of the minimum flow release discharge point) would remain unchanged.

Thank you for this opportunity to comment.

Regards,
Melissa

Melissa Grader
Fish and Wildlife Biologist
U.S. Fish and Wildlife Service - New England Field Office
103 East Plumtree Road
Sunderland, MA 01375
413-548-8002 x124
melissa_grader@fws.gov

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"But now's the time to look and look again at what you see,  
Is that the way it ought to stay?" That's the Way by Led Zeppelin

On Fri, Jun 7, 2013 at 3:15 PM, Webb, Kevin (EGP North America)  
<[Kevin.Webb@enel.com](mailto:Kevin.Webb@enel.com)> wrote:

Following up on my recent phone conversations with each of you, please find attached a letter formally asking for review of our revised trashrack design for the Glendale minimum flow unit. As we will also need to submit this to FERC for approval, I would great appreciate it if you could give this a review as soon as possible.

Thanks again and please don't hesitate to contact me if you have any questions.

**Kevin M. Webb**

Hydro Licensing Manager

# { EXCERPTS FROM ORDER ISSUING LICENSE }

128 FERC ¶ 62,123  
UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Littleville Power Company, Inc.

Project No. 2801-027

## ORDER ISSUING SUBSEQUENT LICENSE

(August 19, 2009)

### INTRODUCTION

1. Pursuant to Part I of the Federal Power Act (FPA),<sup>1</sup> Littleville Power Company, Inc. (Littleville Power) filed an application on October 31, 2007, for a subsequent license to continue to operate the existing 1,140-kilowatt (kW) Glendale Hydroelectric Project No. 2801. Littleville Power's application includes a proposal to install a new 165-kW minimum flow turbine-generator unit, increasing the project's installed capacity to 1.305 kW. The Glendale Project is located on the Housatonic River in Berkshire County, Massachusetts. The project does not occupy any federal land.<sup>2</sup> As discussed below, I am issuing a subsequent license for the project.

### BACKGROUND

2. The Commission issued a 30-year minor license for the project on November 23, 1979, and the license will expire on October 31, 2009.<sup>3</sup>

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<sup>1</sup> 16 U.S.C. §§ 791(a) – 825(r) (2006).

<sup>2</sup> Because the Housatonic River is a navigable waterway of the United States, the project is required to be licensed by section 23(b)(1) of the FPA, 16 U.S.C. 816(1) (2006). See *The Connecticut Light & Power Co.*, 55 F.P.C. 2397 (1975), *reh'g denied*, 55 F.P.C. 473 (1976), *aff'd*, *Connecticut Light & Power Co. v. FPC*, 557 F.2d 349 (2d Cir. 1977).

<sup>3</sup> *Mary C. Heather*, 9 FERC ¶ 62,110 (1979). The Commission approved the transfer of the license from Mary C. Heather to Joseph A. Guerrieri in 1989, 49 FERC ¶ 62,156 (1989), and, subsequently, from Joseph A. Guerrieri to Littleville Power Co. in 1995, 73 FERC ¶ 62,126 (1995).

consistency with the state's CZMA program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days of its receipt of the applicant's certification.

16. By letter filed July 8, 2008, the Connecticut Department of Environmental Protection (Connecticut DEP) confirmed that the project is located beyond the limit of tidal influence on the Housatonic River and would otherwise have no reasonably foreseeable effect on coastal resources or uses in Connecticut, thus the project is not subject to Connecticut coastal zone program review. Therefore, no consistency certification is required.

### **SECTION 18 FISHWAY PRESCRIPTIONS**

17. Section 18 of the FPA<sup>13</sup> provides that the Commission shall require the construction, maintenance, and operation by a licensee of such fishways as may be prescribed by the Secretary of Commerce or the Secretary of the Interior, as appropriate. In a letter filed December 30, 2008, Interior requested that the Commission reserve its authority to require fishways that it may prescribe in the future. Consistent with the Commission's policy, Article 402 of this license reserves the Commission's authority to require fishways that may be prescribed by Interior for the project.

### **THREATENED AND ENDANGERED SPECIES**

18. Section 7(a)(2) of the Endangered Species Act of 1973,<sup>14</sup> requires federal agencies to ensure their actions are not likely to jeopardize the continued existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of their designated critical habitat.

19. The EA noted that U.S. Fish and Wildlife Service (FWS) staff informed Littleville Power in an April 27, 2007 letter that there are no known federally listed endangered or threatened species and there is no critical habitat for these species within the project area. In addition, no listed species were identified during a 2006 mussel survey. Because the presence of listed species has not been documented at the project, the EA concluded that issuing a license would not affect federally listed threatened and endangered species.

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<sup>13</sup> 16 U.S.C. § 811 (2006).

<sup>14</sup> 16 U.S.C. § 1536(a) (2006).

activities; and 50-year terms for projects with extensive measures.<sup>34</sup> This license requires a moderate amount of new construction including constructing a new turbine generating unit in the waste gate slot located at the gatehouse adjacent to the project dam, and constructing new trash racks with 1-inch clear spacing. Consequently, a 40-year license for the Glendale Project is appropriate. Because the term of the current license does not expire until October 31, 2009, this license is not effective until November 1, 2009.<sup>35</sup>

The Director orders:

(A) This license is issued to Littleville Power Company, Inc. (licensee), for a period of 40 years, effective November 1, 2009, to construct, operate, and maintain the Glendale Project. This license is subject to the terms and conditions of the FPA, which is incorporated by reference as part of this license, and subject to the regulations the Commission issues under the provisions of the FPA.

(B) The project consists of:

(1) All lands, to the extent of the licensee's interests in those lands, enclosed by the project boundary shown by Exhibit G drawings filed June 9, 2008:

| Exhibit G Drawings | FERC No. 2801- | Description                   |
|--------------------|----------------|-------------------------------|
| Sheet 1 of 2       | 1001           | General Project Location Map  |
| Sheet 2 of 2       | 1002           | Detailed Project Location Map |

(2) The Glendale Project consists of: (a) a 250-foot-long, 30-foot-high concrete gravity dam with a 182-foot-long spillway and a gatehouse containing two manually-operated 10- by 10-foot-square canal intake gates and a waste gate slot equipped with two 8- by 8-foot-square waste gates; (b) a new 165-kW turbine generating unit in the waste gate slot equipped with new trash racks with 1-inch clear spacing; (c) a 23-acre reservoir with a normal water surface elevation of 810.9 feet National Geodetic Vertical Datum (NGVD); (d) a 1,500-foot-long, 40-foot-wide intake canal; (e) a forebay structure containing two manually-operated headgates (with trash racks with 1-inch clear bar

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<sup>34</sup> See *Consumers Power Company*, 68 FERC ¶ 61,077 at 61,383-84 (1994).

<sup>35</sup> For this reason, the various deadlines in the license articles are measured from November 1, 2009, the effective date, rather than from the order issuance date.

emergency, as soon as possible, but no later than 10 days after each such incident. The Massachusetts DEP, Massachusetts Department of Fisheries and Wildlife, and the U.S. Fish and Wildlife Service shall also be notified prior to implementing any modifications to run-of-river operation or minimum flows required by certification conditions 14 and 15, respectively.

| Massachusetts DEP Condition No. | License Requirement    |
|---------------------------------|------------------------|
| 14                              | Run-of-river operation |
| 15                              | Minimum flows          |

(c) Requirement to File Amendment Applications.

The Massachusetts DEP’s certification conditions noted below contemplate unspecified long-term changes to project operations or facilities for the purpose of mitigating environmental impacts. These changes may not be implemented without prior Commission authorization granted after the filing of an application to amend the license. These conditions are listed below.

| Massachusetts DEP Condition No. | Project Modification      |
|---------------------------------|---------------------------|
| 11                              | Unspecified modifications |
| 12                              | Unspecified modifications |

Article 402. Reservation of Authority to Prescribe Fishways. Authority is reserved to the Commission to require the licensee to construct, operate, and maintain, or provide for the construction, operation, and maintenance of such fishways as may be prescribed by the Secretary of the Interior pursuant to section 18 of the Federal Power Act.

Article 403. Trash racks. The licensee, at least 90 days before the start of any land-clearing or land-disturbing activities at the project site associated with installation of the minimum flow turbine-generator, shall file, for Commission approval, detailed design drawings of the trash racks to be installed at the intake for the minimum flow turbine unit as required by condition 21 of the water quality certification in Appendix A to reduce impingement and entrainment of fish together with a schedule to construct and install the trash racks.

The filing shall include, but not be limited to: (1) specifications of the size of the openings between the trash rack bars not to exceed 1 inch; (2) the maximum intake

approach velocity not to exceed 2 feet per second; and (3) a description of the methods and a schedule for installing the trash racks.

The licensee shall prepare the aforementioned drawings and schedule after consultation with the Massachusetts Department of Environmental Protection, Massachusetts Department of Fisheries and Wildlife, and the U.S. Fish and Wildlife Service. The licensee shall include with the drawings and schedule documentation of consultation, copies of comments and recommendations on the drawings and schedule after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the licensee's facilities. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the drawings and schedule with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific information.

The Commission reserves the right to require changes to the proposed facilities and schedule. Construction of the facilities shall not begin until the licensee is notified by the Commission that the filing is approved. Upon Commission approval, the licensee shall implement the proposal, including any changes required by the Commission

Article 404. Upstream eel passage. The licensee, at least 90 days before the start of any land-clearing or land-disturbing activities at the project site that involve eel passage, shall file, for Commission approval, detailed design drawings of the upstream eel passage facilities required by condition 22 of the water quality certification together with a construction and installation schedule.

The licensee shall prepare the aforementioned drawings and schedule after consultation with the Massachusetts Department of Environmental Protection, Massachusetts Department of Fisheries and Wildlife, and the U.S. Fish and Wildlife Service. The licensee shall include with the drawings and schedule documentation of consultation, copies of comments and recommendations on the drawings and schedule after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the licensee's facilities. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the drawings and schedule with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific information.

The Commission reserves the right to require changes to the proposed facilities and schedule. Construction of the facilities shall not begin until the licensee is notified

by the Commission that the filing is approved. Upon Commission approval, the licensee shall implement the proposal, including any changes required by the Commission.

Article 405. Upstream and downstream anadromous fish passage. The licensee, at least 90 days before the start of any land-clearing or land-disturbing activities at the project site that involve anadromous fish passage, shall file, for Commission approval, detailed design drawings of the upstream and downstream anadromous fish passage facilities required by condition 24 of the water quality certification together with a construction and installation schedule.

The licensee shall prepare the aforementioned drawings and schedule after consultation with the Massachusetts Department of Environmental Protection, Massachusetts Department of Fisheries and Wildlife, and the U.S. Fish and Wildlife Service. The licensee shall include with the drawings and schedule documentation of consultation, copies of comments and recommendations on the drawings and schedule after they have been prepared and provided to the agencies, and specific descriptions of how the agencies' comments are accommodated by the licensee's facilities. The licensee shall allow a minimum of 30 days for the agencies to comment and to make recommendations before filing the drawings and schedule with the Commission. If the licensee does not adopt a recommendation, the filing shall include the licensee's reasons, based on site-specific information.

The Commission reserves the right to require changes to the proposed facilities and schedule. Construction of the facilities shall not begin until the licensee is notified by the Commission that the filing is approved. Upon Commission approval, the licensee shall implement the proposal, including any changes required by the Commission.

The plan shall be consistent with, and if preferred, combined with the soil erosion and sediment control plan required by condition 9 of the water quality certification and Article 303.

Article 406. Recreation Plan. Within 6 months of the effective date of the license, the licensee shall file a recreation plan for the Glendale Project for Commission approval, which shall include:

(a) The recreation facilities proposed in the license application at pages 89 and 91 which include construction of: a canoe portage around the dam consisting of a new take-out located upstream of the dam on the right bank near the gatehouse; a portage trail that uses an existing access road and crosses the power canal at an existing bridge; a new stairway/ramp at the bypassed reach that will serve as a canoe put-in location; formal vehicular and pedestrian access to the Glendale Dam area and bypassed reach via a

**APPENDIX A**

**COMMONWEALTH OF MASSACHUSETTS DEPARTMENT OF  
ENVIRONMENTAL PROTECTION  
WATER QUALITY CERTIFICATION CONDITIONS  
ISSUED JULY 8, 2009**

1. Massachusetts DEP (MassDEP) APPROVES the application of Littleville Power Company, Inc. and CERTIFIES that there is reasonable assurance that Glendale Hydroelectric Project, as described above and subject to the conditions below, can be operated in compliance with the applicable provisions of § 303 of the Federal Act, 33 U.S.C. § 1313.
2. This Water Quality Certification shall become a condition on the FERC License issued to the Project Owner.
3. This Certification shall become effective on the date that the license issued for the Project by FERC becomes effective.
4. The state and federal resource agencies referred to in this Certification include the MassDEP, the Massachusetts Department of Fisheries and Wildlife (MADFW), and the U.S. Department of the Interior, Fish and Wildlife Service (USFWS).
5. The Project shall be operated by the Project Owner in accordance with the conditions contained in this Certification and the information included in the FERC application dated October 2007. Any modifications made to the FERC application during the initial licensing process that would have a significant or material effect on the conclusions or conditions contained in this Certification, as determined by MassDFP, must be submitted to MassDEP for prior review and approval.
6. The Project shall be operated to maintain the existing and designated uses of the Housatonic River as outlined in the Standards at 314 CMR 4.00, and to maintain an integrated and diverse biological community within the Housatonic River.
7. The Project Owner shall obtain and comply with all applicable federal, state and local licenses, permits, authorizations, conditions, agreements and orders required for the operation of the project in accordance with the terms of this Certification.
8. All activities shall be conducted in compliance with the Massachusetts Wetlands Protection Act, including the Rivers Protection Act, G.L. Chapter 131, Section 40, and

monitoring invasive species within the project area, including without limitation zebra mussel and water chestnut. The plan shall also identify methods used to control selected species. The Project Owner shall consult with the state and federal resource agencies and in developing the ISCP, shall respond to all agency comments, and shall include agency comment letters when submitting the plan to MassDEP for approval. The Project Owner shall provide the resource agencies with at least thirty days to respond to a draft plan before submission to MassDEP for approval. The Project Owner shall implement the plan as approved by MassDEP.

21. Within one year of the effective date of this Certification, or upon such other schedule established by FERC, the Project Owner shall install flu-depth, one inch clear trash racks with velocities less than or equal to two feet per second ( $<2$  fps) at the intakes to the main and minimum flow units to reduce impingement and entrainment of fish at the Project.

22. The Project Owner shall, in a manner approved by MassDEP after consultation with the state and federal resource agencies, design, construct, operate, and maintain upstream eel passage facilities within one year of the installation of upstream eel passage facilities at the Risingdale Dam downstream of the Project. Six months prior to initiating operation of these facilities, the Project Owner shall, after consultation with the state and federal resource agencies, submit to MassDEP for approval an American eel passage effectiveness monitoring plan. The Project Owner shall implement the plan as approved by MassDEP. The schedule and other requirements of this condition may be amended with the mutual written agreement of the Project Owner and MassDEP.

23. Within one year of the installation of upstream eel passage facilities, the Project Owner shall submit to MassDEP for approval, a plan for providing safe downstream passage for American eels. The Project Owner shall implement the plan as approved by MassDEP.

24. The Project Owner shall, in a manner approved by MassDEP after consultation with the state and federal resource agencies, design, construct, operate, and maintain upstream and downstream anadromous fish passage facilities within one year of the installation of upstream and downstream anadromous fish passage facilities at the Risingdale Dam. Six months prior to initiating operation of these facilities, the Project Owner shall, after consultation with the state and federal resource agencies, submit to MassDEP for approval an upstream and downstream anadromous fish passage effectiveness monitoring plan. The Project Owner shall implement the plan as approved by MassDEP. The schedule and other requirements of this condition may be amended with the mutual written agreement of the Project Owner and MassDEP.

*{ EXCERPTS FROM }*

ENVIRONMENTAL ASSESSMENT  
FOR  
SUBSEQUENT HYDROPOWER LICENSE

Glendale Project

FERC Project No. 2801-027

Massachusetts

Federal Energy Regulatory Commission  
Office of Energy Projects  
Division of Hydropower Licensing  
888 First Street, NE  
Washington, D.C. 20426

March 2009

designated as a Class B surface water body and a warmwater fishery. Massachusetts state water quality standards define a warmwater fishery as “Waters in which the maximum mean monthly temperature generally exceeds 68 degrees Fahrenheit during the summer months and are not capable of sustaining a year-round population of stenothermal (i.e., capable of surviving within a narrow range of temperature) aquatic life” (2006).

Massachusetts standards in Class B waters for DO are greater than or equal to 5.0 milligrams per liter (mg/l) and greater than or equal to 60 percent saturation unless background conditions are lower; temperature is not to exceed 28.3 degrees Celsius (°C) with a temperature change in rivers of not more than 2.8°C; and the pH standard unit range is 6.5-8.3. Designated uses for Class B waters include habitat for fish, other aquatic life, and wildlife, and for primary and secondary contact recreation. Class B waters shall also have consistently good aesthetic value. The lower 10.7-mile reach of segment MA21-19, which contains the project, was listed as supporting the primary contact, secondary contact, and aesthetic designated uses.

#### *Water quality studies*

In support of its license application, Littleville Power collected water quality profile information from three locations within the project impoundment and from one location at the inflow to the project impoundment on August 30, 2006. The vertical profile data showed that the impoundment was well oxygenated throughout the water column and not thermally stratified. DO levels ranged from 7.58 to 7.72 mg/l (80.6 to 82.1 percent saturation) and water temperatures ranged from 18.3 to 18.5°C within the impoundment locations. Upstream of the impoundment, water temperature was 18.3°C and DO was 7.77 mg/l. Temperatures and DO concentrations during the August sampling event met the state standards for Class B waters with the warmwater fishery restrictions.

#### *Fisheries*

The fish community within segment MA21-19 is generally represented by warmwater species but brook trout and brown trout are stocked in several reaches. Massachusetts DFW stocks over 35,000 trout (brook, brown, and rainbow) within the basin. A total of about 2,000 brown trout is stocked within two catch and release areas along the mainstem, one of which extends downstream from the Glendale dam for approximately 1 mile. No diadromous species are known to migrate into the Massachusetts portion of the Housatonic River. Migrations of anadromous fish and American eel are blocked by several downstream dams.

The most recent fish surveys were conducted by Massachusetts DFW between 2002 and 2004 at 18 sites within segment MA21-19, including one site within the

Glendale impoundment and one 0.7 mile downstream of the project tailrace. A total of 3,623 fish representing 24 species were collected. Overall, rock bass was the most abundant species collected. At the impoundment site, 207 fish were collected with bluegill, common shiner, largemouth bass, and rock bass being the most abundant. At the tailrace site, 135 fish were collected with longnose dace, smallmouth bass, rock bass, and common carp being the most abundant. Two brown trout were also collected in the tailrace location.

The Massachusetts Natural Heritage and Endangered Species Program (Massachusetts NHESP) lists four aquatic species—longnose sucker, bridle shiner, creeper mussel, and triangle floater mussel—as species of special concern that have been observed within the project area during the last 25 years. Massachusetts NHESP maps indicate the 3-mile-long reach downstream of the Glendale dam as longnose sucker habitat; however, Massachusetts DFW did not collect any longnose sucker during its most recent fish sampling.

Littleville Power conducted a survey for freshwater mussels within the bypassed reach of the Glendale Project on October 12, 2006. Habitats within the bypassed reach were checked for mussel presence using view buckets and an Aqua-Scope II™, however, no live mussels were found. One relic shell of a creeper mussel was found during the survey.

### *Habitat*

Aquatic habitat mapping of the bypassed reach was completed on July 12, 2006, as part of an Instream Flow Incremental Methodology Study. The bypassed reach was characterized by a relatively moderate gradient dominated by riffle and run habitat representing about 39 and 38 percent of the total habitat length, respectively. Side-channel habitat, which was mostly riffle, represented 11 percent of the total habitat, and pool habitat represented 12 percent of the total. The predominant substrate type in the bypassed reach was large and small boulder, with lesser amounts of cobble and gravel. Substrate embeddedness was low (0 to 25 percent) which means that the space between larger rocks was not filled with fine substrate. Low embeddedness is consistent with quality habitat for macroinvertebrates and fish. Overhead cover was limited (0 to 25 percent) but instream cover in the form of boulders and large woody debris was common.

## **Environmental Effects**

### Mode of operation

In its license application, Littleville Power proposes to continue operating the project in a run-of-river mode under which impoundment levels would continue to be stable and project outflows would equal project inflows and to provide a 90-cfs minimum

flow in the bypassed reach with a new turbine generator unit (discussed below). To address downstream flow fluctuations, Littleville Power states that it would continue to operate the main turbine units, when possible, such that a unit's output is reduced to its minimum hydraulic capacity before being taken offline ensuring that the magnitude of downstream fluctuations is minimized.

Interior and Massachusetts DFW recommend under section 10(j) that the project be operated in a run-of-river mode such that inflow to the project equals outflow from the project on an instantaneous basis, and fluctuations of the impoundment water level are minimized.

### *Staff Analysis*

Fish species that inhabit and spawn in near-shore areas of project impoundments can be susceptible to stranding as well as egg desiccation from project-related fluctuating water levels.

Operating in a run-of-river mode and limiting impoundment fluctuations as proposed by Littleville Power would continue to reduce the chances of fish stranding and disruption of spawning. Maintaining relatively stable impoundment levels within the control of the Glendale Project (up to flows of about 490 cfs) would continue to benefit aquatic vegetation beds near the shoreline, as well as fish and other aquatic organisms that rely on near-shore habitat for feeding, spawning, and cover. Erosion of shoreline areas and resultant turbidity as well as sediment mobilization (including any contaminated sediments) would also continue to be minimized when the impoundment is held relatively stable. In addition, by not storing water, impoundment water would be less likely to increase in temperature or decrease in DO content.

Fluctuating water levels downstream of hydro projects can cause fish stranding, egg desiccation, and effects to invertebrate populations. We discuss below Littleville Power's proposal to provide a minimum flow to the bypassed reach to protect and enhance water quality and aquatic habitats. Downstream of the confluence of the bypassed reach and the project tailrace channel, run-of-river operation along with Littleville Power's ramping of turbine units prior to taking a unit offline would ensure that any fluctuations occurring in the Housatonic River due to project operation are kept to a minimum.

### Water quality effects due to operation of minimum flow turbine

Littleville Power proposes to install a 165-kW turbine generator unit within an existing waste gate slot adjacent to the dam. Because the proposed unit would draw water from the deeper portions of the impoundment, water released from the unit could be low in DO and affect water quality conditions in the bypassed reach.

inflow during refill would ensure that downstream flows are kept at near natural flow levels. Releasing the majority of the project's inflow would help maintain water quality conditions by maximizing water turbulence and aeration and preventing desiccation of most aquatic habitats.

#### Minimum flows in the bypassed reach

Under current conditions, the project's 2,500-foot-long bypassed reach receives a minimum flow of 10 cfs, or inflow, whichever is less. The project impoundment is typically held at elevation 811.0 feet above mean sea level. At this elevation, about 1 inch of flow passes over the dam which is enough to provide the required minimum flow of 10 cfs. When about 2.5 inches of spill occurs over the dam, the pond level control (PLC) unit is programmed to start up one unit beginning at 55 percent gate and then gradually increasing the setting to 80 percent gate. If the level of spill exceeds 2.5 inches with one unit operating, the PLC is programmed to start additional units sequentially as flows become available while maintaining the 10-cfs minimum flow. When the project is not generating, as might occur during scheduled maintenance or unscheduled shutdown, or when inflows to the impoundment are less than 200 cfs, as discussed previously, all inflow to the project is spilled through the bypassed reach.

Littleville Power proposes to increase the minimum flow in the bypassed reach to 90 cfs to enhance water quality and aquatic habitat in the bypassed reach and to minimize the effects of fluctuating water levels downstream of the confluence of the bypassed reach and tailrace due to unit operation. Littleville Power intends to provide the minimum flow through a new 165-kW turbine generator unit to be installed at the project dam.

Interior and Massachusetts DFW recommend under section 10(j) that Littleville Power release a continuous minimum flow of 90 cfs, or inflow, whichever is less in the project bypassed reach for the protection of fish and aquatic habitat.

#### *Staff Analysis*

Littleville Power based its minimum flow proposal on an Instream Flow Incremental Methodology (IFIM)<sup>2</sup> study. Littleville Power formed a study team

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<sup>2</sup> The IFIM is a tool developed by the U.S. Fish and Wildlife Service (FWS) to evaluate the relationship between flow and habitat. Habitat suitable for a particular species life stage is often expressed in terms of weighted usable area (WUA). WUA is the wetted area of a stream weighted by its suitability for use by aquatic organisms or recreational activity. WUA is usually expressed in units of square feet or square meters of habitat per a specified length of stream.

composed of representatives of the FWS, Massachusetts DFW, Massachusetts DEP, Massachusetts Riverways, Housatonic Valley Association, and Trout Unlimited. Habitat mapping within the 2,500-foot-long bypassed reach was used to delineate the different mesohabitat types. Six transects were established representing the different habitat types. Two transects each were placed in riffle and run habitats while one transect was established in a pool and another in side channel habitat. A list of species potentially occurring in the bypassed reach was identified and grouped into five habitat guilds based on similar habitat preferences. Four evaluation species – brown trout, fallfish, white sucker, and longnose dace – were chosen from each of the four fish guilds to represent the habitat requirements of the guild. A fifth guild represented the habitat requirements of macroinvertebrates (mayflies, stoneflies, and caddisflies). Field data were collected at four flows: 70, 92, 174, and 299 cfs—which allowed extrapolation of habitat calculations over a range of flows from 28 cfs to 748 cfs.<sup>3</sup> Because the hydraulic model could not be extrapolated to flows less than 28 cfs, habitat results from the flow study could not be compared to the existing 10-cfs minimum flow condition. The flow corresponding to the maximum WUA for each species life stage; the percent of maximum WUA at several selected flows; and the percent of total habitat available at the maximum WUA<sup>4</sup> for each species are presented in table 3.

Table 3. Flows (cfs) corresponding to the maximum WUA for each species life stage evaluated, the percent of maximum WUA at several selected flows (proposed 90-cfs flow shaded), and the percent of total habitat available at the maximum WUA.

| Species/life stage  | Maximum WUA flow (cfs) | Percent of maximum WUA at 60 cfs | Percent of maximum WUA at 90 cfs | Percent of maximum WUA at 200 cfs | Percent of total habitat available at the maximum WUA |
|---------------------|------------------------|----------------------------------|----------------------------------|-----------------------------------|-------------------------------------------------------|
| <b>Brown trout</b>  |                        |                                  |                                  |                                   |                                                       |
| Juvenile            | 150                    | 83                               | 91                               | 96                                | 48                                                    |
| Adult               | 180                    | 73                               | 86                               | 100                               | 36                                                    |
| <b>Fallfish</b>     |                        |                                  |                                  |                                   |                                                       |
| Spawning/Incubation | 160                    | 53                               | 67                               | 96                                | 1                                                     |
| Fry                 | 90                     | 77                               | 100                              | 84                                | 5                                                     |
| Juvenile            | 160                    | 61                               | 67                               | 95                                | 15                                                    |

<sup>3</sup> The IFG4 hydraulic model used in the analysis permits calculations of habitat conditions over a range of flows from 40 percent of the lowest calibration flow (70 cfs) to about 250 percent of the highest calibration flow (299 cfs).

<sup>4</sup> Percent of total habitat available at the maximum WUA is calculated by dividing the habitat area at the maximum WUA flow by the total wetted area at the maximum WUA flow multiplied by 100.

|                           |     |     |     |     |    |
|---------------------------|-----|-----|-----|-----|----|
| Adult                     | 200 | 79  | 89  | 100 | 26 |
| <b>White sucker</b>       |     |     |     |     |    |
| Spawning/Incubation       | 110 | 82  | 97  | 87  | 2  |
| Fry                       | 50  | 99  | 90  | 72  | 39 |
| Juvenile/Adult            | 60  | 100 | 96  | 95  | 17 |
| <b>Longnose dace</b>      |     |     |     |     |    |
| Spawning/Incubation       | 130 | 64  | 86  | 96  | 12 |
| Fry                       | 120 | 56  | 84  | 77  | 5  |
| Juvenile                  | 110 | 84  | 98  | 73  | 11 |
| Adult                     | 130 | 79  | 93  | 93  | 27 |
| <b>Macroinvertebrates</b> |     |     |     |     |    |
| Ephemeroptera             | 100 | 92  | 100 | 90  | 42 |
| Plecoptera                | 160 | 83  | 91  | 96  | 18 |
| Trichoptera               | 140 | 87  | 95  | 95  | 48 |

A flow of 90 cfs would provide more than 80 percent of the maximum WUA for all but two of the sixteen species life stages evaluated and over 90 percent of the maximum WUA for 9 of the species life stages evaluated. For fallfish spawning/incubation and fallfish juveniles, the two species life stages with less than 80 percent maximum WUA at 90 cfs, 67 percent of the maximum WUA would be provided. However, even at 160 cfs, which provides the maximum WUA for those two species life stages, only 1 percent and 15 percent of the total wetted habitat in the bypassed reach would be available for those species life stages, respectively. These results indicate that the bypassed reach has very little habitat available for those species life stages regardless of the flow. In general, the bypassed reach has limited spawning and incubation habitat for most species, which is likely due to an absence of suitable substrate.

On the other hand, at flows producing the maximum WUA for five of the species life stages evaluated—brown trout juveniles (150 cfs) and adults (180 cfs), white sucker fry (50 cfs), and two families of macroinvertebrates (100 to 140 cfs)—36 to 48 percent of the total habitat present in the bypassed reach would be available for those species life stages. Therefore, with more suitable habitat potentially available in the bypassed reach, a minimum flow would be most beneficial for those species life stages. While a flow of 90 cfs would not provide the maximum habitat for any of these species life stages, it does provide 90 percent or more of the maximum WUA for all but brown trout adults (86 percent).

In addition to the IFIM study results, we considered how frequently spill flows would occur in the bypassed reach and what benefit, if any, these flows may have on the fish and macroinvertebrate life stages evaluated in the IFIM study. Based on the annual and monthly flow duration curves, flows in the Housatonic River would exceed the project's hydraulic capacity and proposed minimum flow about 45 percent of the time on an annual basis and between 50 and 75 percent of the time during the spring spawning

months of April and May. Therefore, spill flows would provide additional habitat for those species life stages whose maximum WUA occurred at flows higher than the proposed 90-cfs release.

#### Operation compliance monitoring plan

Littleville Power did not propose a means of ensuring compliance with its proposed operating mode.

Interior and Massachusetts DFW recommend under section 10(j) that Littleville Power prepare a plan for monitoring run-of-river operation and flow releases from the project. Interior and Massachusetts DFW recommend that the plan include a description and design of the mechanisms and structures to be used along with any periodic maintenance and calibration that would be necessary. Both agencies request that the monitoring data be made available for inspection.

#### *Staff Analysis*

A plan to monitor run-of-river operation and minimum flow releases developed in consultation with the relevant resource agencies that describes contingencies for emergencies (such as providing downstream flows during project shutdown), scheduled maintenance drawdowns, droughts, as well as reporting criteria, would minimize misunderstandings about operational compliance and help ensure that aquatic resources at the project are protected. Such a plan could include monitoring water surface elevations in the project's impoundment and tailwater, maintaining a log of impoundment and tailwater water surface elevations and project generation data, establishing a staff gage in the bypassed reach, and a means for providing the data to the resource agencies upon request.<sup>5</sup>

#### Short-term construction effects

Littleville Power states that the turbine generator unit installation would not require a drawdown and would be accomplished by enclosing the work area within a cofferdam installed upstream of the gatehouse. As such, the work area could be completely dewatered without affecting impoundment levels. In addition, Littleville Power proposes to undertake all necessary and reasonable measures to minimize the effects of short-term construction effects including, but not limited to, erosion, siltation,

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<sup>5</sup> Littleville Power requests that the filing deadline for any operations compliance and monitoring plan be 6 months from license issuance, as opposed to 3 months, as recommended by Interior and Massachusetts; the due date for any required plans will be discussed in the license order.

and dust control measures.

In a letter filed January 3, 2008, Massachusetts DFW states that if a drawdown of the impoundment is needed to complete the turbine installation, the lowered water levels may affect wildlife, including state-listed mussels.

#### *Staff Analysis*

The installation of the new turbine generator unit could cause some short-term effects on habitat within the impoundment and downstream in the bypassed reach resulting from erosion and sedimentation. However, because the installation activities would not require an impoundment drawdown, we would not expect much of an effect on aquatic habitats within the impoundment or downstream in the bypassed reach. Nevertheless, implementing specific measures to control erosion and sedimentation during construction activities would help ensure that aquatic habitats are protected. These measures would also protect habitat during construction of the proposed recreation facilities, discussed in section 3.3.4.

#### Fish entrainment and impingement

Currently, there are no upstream fish passage facilities at the project and any downstream passage occurs via spillage or turbine passage. The existing trash racks with 1-inch clear spacing and approach velocities of 2 feet per second or less provide some level of protection to fishes susceptible to entrainment and turbine-induced mortality through the project's main turbine intakes. Littleville Power proposes to use similar trashracks with 1-inch clear bar spacing to protect fishes from entrainment and turbine-induced mortality at the proposed minimum flow turbine unit. The trashracks at the minimum flow unit would also be of sufficient dimensions to ensure approach velocities of 2 feet per second or less.

Interior and Massachusetts DFW recommend under section 10(j) that full depth, 1-inch clear trash racks with velocities less than or equal to 2 feet per second be installed at the project's main and minimum flow units.

#### *Staff Analysis*

Fish that reside in the project impoundment could be susceptible to impingement on the trash rack or entrainment through the project's turbine units when the project is operating. For any fish entrained through the turbines, a certain number may be killed due to turbine-induced mortality.

The existing trash rack at the intake to the main turbine units already meets Interior's and Massachusetts DFW's recommendation for 1-inch clear bar spacing and

approach velocities of 2 feet per second or less. Littleville Power's proposal to install trash racks with similar requirements at the proposed minimum flow turbine unit intake would provide a similar level of protection.

Trash racks with 1-inch clear bar spacing would prevent all but the smaller fish from passing through the intake structures. Based on the results of studies conducted by Lawler et al. (1991), 1-inch clear spacing would generally not allow passage of smallmouth bass or brown trout greater than 9 inches in total length,<sup>6</sup> thus preventing most adult resident bass and stocked trout from entering the project turbines. Littleville Power presented similar results for data obtained from Smith (1985) for a variety of fish species found in the project vicinity. Littleville Power's analysis showed that for seven of the nine species analyzed (including smallmouth bass and brown trout), fish with total lengths greater than 8 inches would be excluded by the trash racks. In addition, the turbulence generated by the trash racks may create a behavioral deterrent to reduce entrainment of the smaller individuals that would otherwise be able to fit through the racks.

Littleville Power provided the results of a literature review of mortality rates for various groups of fishes obtained from studies conducted at other projects with Kaplan or propeller-type turbines.<sup>7</sup> While no projects were identified that had the exact turbine configuration as the Glendale Project, turbine survival at the three most similar projects was 81 percent or greater (range 81 to 98 percent) for the fish species and sizes tested and survival estimates for fish smaller than 8 inches were 86 percent or greater (range 86 to 98 percent). Kleinschmidt (2003) reported an average mortality rate of 13.7 percent based on the results of 14 turbine mortality studies conducted on Kaplan/propeller-type turbines which corroborate the results of Littleville Power's analysis.

In addition to entrainment effects, fish can become impinged on the bars of a trash rack if they are not able to overcome the approach velocity. As stated above, the average approach velocity in front of the existing project intake is 2 feet per second or less and a similar maximum approach velocity is predicted for the proposed minimum flow turbine intake. To escape the influence of a trash rack, fish are capable of swimming at a burst speed, which is defined as a short, intense swimming effort generally sustainable for about 1 second or less (Bell, 1991). Beamish (1978) reports that most fish can burst at a speed equal to about 10 times their body length in centimeters per second.

To analyze whether or not impingement of gamefish on the trash racks would

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<sup>6</sup> Total length is defined as the distance from the furthest forward protruding portion of a fish's head to the tip of the furthest protruding tail fin ray.

<sup>7</sup> Four identical vertical Kaplan turbine units are used to generate power at the Glendale Project.

occur at the project, we used the results of Beamish (1978) and coupled them with our calculation of the smallest gamefish that would be excluded by the 1-inch clear-spaced trash rack. The burst speed for a 9-inch bass or trout is about 7.5 feet per second. Therefore, a 9-inch smallmouth bass or brown trout would be expected to easily escape the 2-foot-per-second intake velocities at the project and avoid becoming impinged on the trash rack. Bell (1991) also reported sustained swimming speeds of nearly 4 feet per second for white sucker, which is another commonly occurring species in the Housatonic River and likely to occur in the impoundment. Therefore, white sucker should also be able to avoid impingement on the project trash rack.

In summary, the existing 1-inch-spaced trashracks at the project's main turbine intake would protect most of the adult gamefish residing within the impoundment from being entrained into the turbines and being subjected to potential turbine-induced mortality. Based on the swimming speeds of fishes residing in the project impoundment and the existing approach velocities in front of the intakes, most fishes would be able to avoid impingement. Installing trashracks with similar 1-inch clear spacing and approach velocities at the intakes for the proposed minimum flow turbine unit would provide an equal level of protection. Although smaller fishes would still be susceptible to entrainment and some level of turbine mortality, by acting as a behavioral barrier, the trashracks may guide many of them away from the intakes and prevent them from entering the turbine units. Last, nothing in the record for this project suggests that entrainment and turbine mortality are having an adverse effect on fish populations in the project area.

### **Cumulative Effects**

During the scoping process, water quality was identified as a resource that may be cumulatively affected by the proposed operation of the Glendale Project in combination with the Willow Mill Hydroelectric Project located upstream and municipal, industrial and urban land use and other non-point sources of pollution in the basin.

As discussed above, run-of-river operation would minimize the effect of the project on DO concentrations and water temperatures under most conditions. Erosion of shoreline areas and resultant turbidity as well as sediment mobilization (including any contaminated sediments) would also continue to be minimized when the impoundment is held relatively stable. The use of cofferdams and implementing soil erosion control measures during the installation of the proposed minimum flow unit would minimize any effects on water quality within the impoundment and the Housatonic River downstream of the dam due to erosion and sedimentation. The potential for the minimum flow unit to release oxygen-depleted water from the deeper strata of the impoundment would be offset by increased turbulence and aeration within the bypassed reach caused by the higher minimum flows. Also, increased flow would minimize pockets of standing water and thus reduce the likelihood of any temperature increases in the bypassed reach and