Upland data collection on foot.

Aquatic and riparian data collection from a rowboat.

Area (henceforth generically, "Area" or "Areas") based on its composition, density, and distribution. A Trimble Pro XH handheld GPS unit (equipped with a data dictionary aiding in feature attribution) was used to record the boundary of each Area. A Trimble GPS unit was used because it is capable of producing spatial data with submeter accuracy. The polygon feature fields included qualitative categorizations including Gross Area/Infested Area ID, dominant invasive plant species present, abundance, and notes on land use and cover type. Line and point features were also collected in the field to support data interpretation and mapping. Botanists assigned density classes (Table 3) to each invasive species and Area, and identified the associated native species. The submersed aquatic vegetation was dense and tangled in many areas, so to ensure a comprehensive species survey, large clumps of plants were frequently pulled up for examination.

On the north side of the river where the project boundary includes upland areas (i.e., upland forest and mowed areas west of the dam), infestations were mapped on foot, with a biologist walking the perimeter of each delineated Area. Where the project boundary follows the river and cove banks (i.e., along the south shore of the river and along the north shore west of the dam), infestations within ten feet of the project boundary were mapped either on foot or from a rowboat. The aquatic invasive plant infestations were accessed by rowboat, and most were mapped as Gross Areas.

Haines (2011) and Crow and Hellquist (2006) were the primary sources for species identification and nomenclature. Three morphologically similar invasive shrubs—Morrow's Honeysuckle, Tartarian Honeysuckle, and their hybrid, Bell's Honeysuckle—were all present but individual shrubs were not identified to species due to time constraints.

Table 3. Invasive plant density classes and their corresponding percent cover values.

Density Class	Estimated Cover (%)	Midpoint (%)	Qualitative Description
1	<1	0.5	Trace
2	1-10	5.5	Low
3	11-25	18.0	Low-medium
4	26-50	38.0	Medium
5	51-75	63.0	Medium-high
6	76-95	85.5	High
7	96-100	98.0	Monoculture

5.2.3 Data Processing and GIS Mapping

GPS data were differentially corrected by post-processing against base providers to improve accuracy. Data were then imported into ArcGIS 10 software for further analysis and mapping. Infestations were mapped at a scale of 1:1,200 feet for this report. Raw polygon data were spatially edited to portray aerial coverage of Gross and Infested Areas delineated in the field. Aquatic polygons were generally snapped to the shoreline and riparian and upland polygon features were generally snapped to the survey area boundary. Descriptive infestation data were entered into Excel spreadsheets.

5.3 Invasive Plant Results

5.3.1 Species

A total of 26 invasive plant species were documented within the survey area (Table 2). All but one of these species are on the MDA Prohibited Plant List. Of these, 19 are defined by MIPAG as "invasive" and six are defined as "likely invasive." Botanists also noted Ornamental Jewelweed along the riverbank; this species is neither on the MIPAG list nor the MDA Prohibited List, but has been

Table 4. Summary of invasive plant infestation areas in the Glendale Hydroelectric Project.

Category	Area (acres)	% of Survey Area
Total Infestations	23.2	50.1
Gross Areas (GA)	21.3	46.0
Infested Areas (IA)	1.9	4.1
Uninfested Areas	23.1	49.9
Upland/Riparian Total Area	12.4	26.8
Upland/Riparian Gross Areas (GA)	10.6	22.9
Upland/Riparian Infested Areas (IA)	1.8	3.9
Aquatic Total Area	10.8	23.3
Aquatic Gross Areas (GA)	10.7	23.1
Aquatic Infested Areas (IA)	0.1	0.2
Riparian Emergent*	2.3	5.0
Upland/Riparian Woody**	10.1	21.8

*invasive cover dominated by emergent wetland species
**invasive cover dominated by woody species

banned in Connecticut. It has also been identified by the Invasive Plant Atlas of New England (IPANE) committee as invasive. Most invasive species were observed in the upland forest, along the riverbank, and within mowed areas. One species was observed along a gravel roadside, three species were observed within emergent vegetation beds, and three species were observed within aquatic beds. Neither of the target MIPAG early detection priority species, Mile-a-minute Vine and Water Chestnut, was observed.

Seventeen of the 26 species had not been documented in 2006: sixteen species in the upland and riparian areas (Autumn Olive, Asiatic Bittersweet, Burning Bush, Coltsfoot, Common Buckthorn, Common Barberry, Creeping Jenny, Forget-me-not, Garlic Mustard, Glossy Buckthorn, Japanese Barberry, Morrow's Honeysuckle, Norway Maple, Ornamental Jewelweed, Spotted Knapweed, and Tartarian Honeysuckle), and one aquatic species (Brittle Water-nymph).

5.3.2 Mapped Infestation Overview

A total of 23.2 acres of infestations were mapped, which is 50.1% of the 46.3-acre survey area (Table 4, Appendix 2). Gross Areas make up 21.3 acres mapped, and Infested Areas make up 1.9 acres. Of all mapped infestations, 12.4 acres (26.8%) were within upland and riparian habitats (i.e., forests, thickets, and emergent beds, denoted in maps as "Riparian/Upland") and 10.8 acres (23.3%) were aquatic beds (denoted in maps as "Aquatic"). Uninfested areas (23.1 acres, 49.9%) include the fast-flowing and deep areas of the Housatonic River; short, shady stretches of riverbank made up of exposed bedrock; and the dam, powerhouse, and associated roads, lawns, and structures. Of all aquatic beds examined for invasives, just one at the eastern end of the impoundment appeared to lack invasive species.

Table 5. Gross Areas identified in the Glendale Hydroelectric Project: habitats, density class, spatial coverage, and map number.

GA ID*	Habitat	Density Class	Area (acres)	Map
1	Upland/riparian	3	2.008	2, 3
2	Upland/riparian	5	0.909	1, 2
3	Upland/riparian	5	0.061	1
4	Upland/riparian	5	0.052	1
5	Upland/riparian	5	0.107	1
6	Upland/riparian	5	0.056	1
7	Upland/riparian	6	0.127	1, 2
8	Upland/riparian	6	0.183	2
9	Upland/riparian	7	3.185	1, 2, 3
10	Upland/riparian	4	0.292	3
11	Upland/riparian	6	0.231	1, 2
12	Upland/riparian	6	0.357	2, 3, 4
13	Upland/riparian	5	0.204	1, 2
14	Upland/riparian	5	0.297	3, 4, 5
15	Upland/riparian	6	0.540	5, 6, 7, 8
16	Upland/riparian	6	0.353	8, 9
17	Upland/riparian	7	0.218	9
18	Upland/riparian	5	0.130	9
19	Upland/riparian	5	0.161	8, 9
20	Upland/riparian	4	0.671	6, 7, 8
21	Upland/riparian	7	0.111	5, 6
22	Aquatic	2	2.279	6, 7
23	Upland/riparian	5	0.045	5
24	Upland/riparian	7	0.344	3, 4
25	Aquatic	4	3.601	3, 4, 5
26	Aquatic	3	0.404	5, 6
27	Aquatic	3	0.258	6, 7
29	Aquatic	6	0.015	8
30	Aquatic	3	0.187	8, 9
31	Aquatic	2	0.032	9
32	Aquatic	2	0.252	3, 4
33	Aquatic	2	0.110	4, 5
34	Aquatic	2	0.800	5, 6, 7
35	Aquatic	4	0.759	7, 8
36	Aquatic	2	0.067	7, 8
37	Aquatic	4	0.183	8
38	Aquatic	2	0.195	8
39	Aquatic	2	0.583	9
40	Aquatic	2	0.107	9
41	Aquatic	4	0.062	9
42	Aquatic	2	0.147	9
50	Aquatic	4	0.617	5, 6

*Apparent non-sequential GA numbers in this table resulted from the merging of some GAs.

5.3.3 Gross Areas

Most of the infested upland and riparian portions of the survey area were mapped as Gross Areas (Appendix 2). They totaled 10.6 acres with a range of 0.05–3.2 acres (Table 5). Twenty-three species were documented in the upland and riparian Gross Areas (Appendix 3). Each Gross Area contained multiple invasive species (ranging 3–11) that did not have discrete, easily defined boundaries. Most were dominated by woody invasive species, but 0.8 acres was dominated by emergent wetland plants, including

Reed Canary Grass and Purple Loosestrife. Individual invasive species densities within Gross Areas spanned the classes (1–7), and Gross Area combined species density ranged from class 3 (26–50%) to class 7 (95–100%).

All but two aquatic beds were mapped as Gross Areas. Three invasive aquatic species were documented: Brittle Water-nymph, Curly-leaf Pondweed, and Eurasian Milfoil. Aquatic Gross Areas totaled 10.7 acres with a range of 0.01–3.6 acres. The number of invasive species present in each bed was 1–3, but most contained only Eurasian Milfoil. Eurasian Milfoil densities ranged from class 2 (1–10%) to class 6 (75–95%); both of the other aquatic species densities were consistently class 2. Aquatic Gross Area combined species density ranged from class 2 to class 6.

5.3.4 Infested Areas

Infested Areas were mapped for nine invasive species (Table 6); most of these are riparian wetland species, and Reed Canary Grass was the most common. Upland and riparian Infested Areas totaled 1.8 acres with a range of <10 ft^2–0.2 acres. Dominant invasive species densities within Infested Areas ranged from class 2 to class 7.

Three aquatic beds were mapped as Infested Areas. All three were isolated and discrete, and were dominated by Eurasian Milfoil. These total 0.1 acre with a range of 43 ft^2–2,753 ft^2 (0.06 acres). Eurasian Milfoil densities within Infested Areas ranged from class 2 to class 4 (26–50%).

5.4 Invasive Plant Discussion

This report provides a detailed understanding of the distribution, abundance, and density of invasive plant species at the Glendale Hydroelectric Project. These data will help inform future control and monitoring efforts. Invasive species are pervasive within survey area; 26 species were documented and infestations were observed within nearly every naturally vegetated area. In the upland forest, invasive shrubs range in density from occasional to very dense. Native understory species are becoming outcompeted by invasive species in some areas. Invasive species are dominant along the riverbank; Reed Canary Grass is pervasive throughout the lower bank, and invasive shrubs dominate the upper bank. Overall, emergent beds are heavily infested with Reed Canary Grass and Purple Loosestrife, but a few dense beds dominated by native Bur-reed and Cattail persist. Eurasian Milfoil was documented within all but one small aquatic plant bed.

Comparison of 2006 and 2012 Data: The goals and design of the 2012 invasive plant survey differed from the 2006 survey. The 2006 survey was a rapid, coarse-scale assessment of general vegetation cover types, wetland types, and invasive plant species upstream from the dam. Although our ability to make conclusive comparisons is limited, we note the following similarities and differences:

- Spatial data collected during both surveys show that emergent and submersed aquatic beds continue to be

Table 6. Infested Areas identified in the Glendale Hydroelectric Project: invasive species composition, density class, habitat types, spatial coverage, and map number.

IA ID	Common Name	Density Class	Habitat Type	Area (acres)	Map
2a*	Purple loosestrife	2	Upland/riparian	0.004	2, 3
2b*	Common reed	2	Upland/riparian	0.004	2,3
3	Multiflora rose	2	Upland/riparian	0.001	2, 3
4	Purple loosestrife	2	Upland/riparian	0.001	2
5	Common reed	2	Upland/riparian	0.001	2
6	Eurasian milfoil	1	Aquatic	0.001	2
7	Reed canary-grass	3	Upland/riparian	0.001	1, 2
8	Reed canary-grass	4	Upland/riparian	0.000	1, 2
9	Reed canary-grass	4	Upland/riparian	0.000	1, 2
10	Japanese knotweed	6	Upland/riparian	0.013	1
11	Japanese knotweed	5	Upland/riparian	0.031	1, 2
12	Garlic mustard	3	Upland/riparian	0.000	1
13	Garlic mustard	5	Upland/riparian	0.011	1, 2
14	Reed canary-grass	5	Upland/riparian	0.011	1, 2
15	Reed canary-grass	7	Upland/riparian	0.029	1, 2
16	Reed canary-grass	6	Upland/riparian	0.007	2
17	Reed canary-grass	5	Upland/riparian	0.060	2
18	Reed canary-grass	5	Upland/riparian	0.227	2
19	Reed canary-grass	5	Upland/riparian	0.175	2
20	Reed canary-grass	5	Upland/riparian	0.020	2
21	Reed canary-grass	5	Upland/riparian	0.016	2
22	Creeping jenny	4	Upland/riparian	0.005	3
23	Reed canary-grass	6	Upland/riparian	0.012	1
24	Reed canary-grass	7	Upland/riparian	0.019	1
25	Reed canary-grass	6	Upland/riparian	0.009	1
26	Reed canary-grass	7	Upland/riparian	0.002	1
27	Reed canary-grass	7	Upland/riparian	0.177	2, 3
28	Reed canary-grass	4	Upland/riparian	0.047	3
29	Eurasian milfoil	4	Aquatic	0.063	1
30	Reed canary-grass	4	Upland/riparian	0.030	4
31	Garlic mustard	4	Upland/riparian	0.004	5
32	Japanese knotweed	6	Upland/riparian	0.009	5
33	Japanese knotweed	7	Upland/riparian	0.026	5, 6
34	Reed canary-grass	6	Upland/riparian	0.116	7
35	Reed canary-grass	7	Upland/riparian	0.112	7, 8
36	Common reed	6	Upland/riparian	0.003	7, 8
37	Japanese barberry	7	Upland/riparian	0.008	8
38	Reed canary-grass	7	Upland/riparian	0.061	7
39	Reed canary-grass	7	Upland/riparian	0.180	6, 7
40	Common buckthorn	6	Upland/riparian	0.045	6, 7
41	Purple loosestrife	5	Upland/riparian	0.024	6
42	Common buckthorn	6	Upland/riparian	0.087	6
43	Common reed	5	Upland/riparian	0.010	5, 6
44	Reed canary-grass	6	Upland/riparian	0.184	5, 6
45	Common reed	7	Upland/riparian	0.010	5
46	Eurasian milfoil	3	Aquatic	0.001	2

*Both species occupy the same area within IA-2 and have equal density classes.

Japanese Knotweed on the riverbank, with native Bur-reed in the foreground.

widespread in the impoundment and are roughly in the same locations. The 2012 data show larger, more continuous submersed aquatic beds, but this could be an artifact of the finer-scale data collection in 2012.

- The wetland types and dominant native species within the riparian zones, emergent beds, and aquatic beds appeared similar in both years.
- In 2012, botanists documented 17 invasive species not observed in 2006. Though it is possible that a few of these species (i.e., those with small infestations such as Brittle Water-nymph, Creeping Jenny, and Ornamental Jewelweed) are new introductions, it is likely that most were missed in the 2006 survey due to its limited scope.
- Black Locust, Multiflora Rose, and shrubby honeysuckles were sparsely distributed along the woody riparian zone in 2006. In 2012, the former two species still occurred at low densities, but the shrubby honeysuckles seemed to be at a higher density (average density class value of 4, ranging from 2 to 7).
- Reed Canary Grass and Purple Loosestrife were widespread in the project area in 2006 and 2012. In 2006, these species were observed as "moderate" in abundance along the impoundment shoreline. Purple Loosestrife is still widespread and at low to moderate densities, with an average Gross Area density class of 2.5. Reed Canary Grass was observed to be quite dense in 2012, approaching a monoculture in areas. Its average density class value was 4 within Gross Areas and 5.5 within Infested Areas, with a median of 6.
- In 2012, botanists observed leaf damage on Purple Loosestrife plants that indicate the presence of a biocontrol beetle. The leaf damage was very minor, indicating that the beetles are probably present at a low density. This evidence was not noted in 2006. Though this light damage can be easily overlooked, it is possible that the beetle has colonized the area within the last six years.
- The species composition of the aquatic beds in 2012 was generally the same as observed in 2006, with the addition of one invasive species. Brittle Water-nymph was newly documented in 2012, and was observed at a very low density. Eurasian Milfoil, though present along the entire length of the impoundment, continued to exist at low to moderate density relative to the other aquatic species present. Curly-leaf Pondweed also remained at a low density.

Recommendations for Control: Control of all infestations at the Glendale Dam project area is not feasible be-

cause of the high number of invasive species and the high number of acres infested. As stated in the *Updated Invasive Species Monitoring and Control Plan* (August 2011), efforts to control invasive species that are widespread in the Housatonic River basin may be futile if they are not part of a regional effort. It may be feasible to control a prioritized subset of infestations.

The costs and benefits of invasive species control should be evaluated, and used to define priorities. Prioritization should include an analysis of the potential benefits (i.e., the purpose), the level of control required to gain those benefits (i.e., the goals), the likelihood of achieving and maintaining control, and the available resources (i.e., the feasibility) (Richburg 2008). The following criteria can be used as part of the infestation control prioritization process at the Glendale Dam project area:

- Infestations that threaten the integrity of the dam infrastructure or function.
- Infestations that threaten water quality.
- Infestations that threaten a native species of conservation priority.
- MIPAG early detection priority species.
- Early infestations of invasive species that dramatically change the vegetation structure and ecological function of a particular habitat type (e.g., form monocultures, and reduce native plant species diversity).
- Infestations in which a cost-effective control opportunity arises (e.g., directed grant funding, invasive research experiments, etc.).

There are currently no known threats to water quality, dam function, or rare species that are related to invasive plants within the Glendale Hydroelectric Project. No MIPAG early detection priority species were observed during the 2012 survey. However, a few relatively discrete infestations of Common Reed, Garlic Mustard, Japanese Knotweed, and Spotted Knapweed were found within the project area. Each of these species has the potential to outcompete native plants and form monocultures. Garlic Mustard, Japanese Knotweed, and Spotted Knapweed are known to be "allelopathic"—they exude chemicals into the soil that suppress the germination or growth of native species. We recommend that these sites be prioritized if control efforts are considered. See Appendix 5 for recommended control options.

Purple Loosestrife, which is widespread throughout the project area, appears to have low levels of foliage damage inflicted by a biocontrol beetle of the genus *Galerucella* (see photos in Appendix 4). This beetle is established elsewhere in Berkshire County and is suppressing Purple Loosestrife. We recommend investigating opportunities to increase the population of this beetle in the project area.

Future Survey Options: The 2011 *Updated Invasive Species Monitoring and Control Plan* specifies that surveys be updated every two years. A comprehensive evaluation of invasive plant species infestations was necessary to develop a long-term monitoring protocol that would meet resource agency goals. With these baseline data, several future monitoring options are possible. The 2012 survey could be repeated in 2014. This might detect significant changes in the areal extent of Infested Areas and Gross Areas, and may identify new invasive species. Alternatively, the 2012 data could be used to select priority infestations for the 2014 survey. Priority infestations could be re-mapped or surveyed in greater detail; for example, finer-scale data could be collected on density, size, and associated species. Priority areas could include ones for which control is being considered or has been attempted, or those that may harbor high priority species such as Mile-a-minute Vine and Water Chestnut.

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{ 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

2.2.3 Proposed Project Operation

Littleville Power proposes to continue run-of-river operation with minimal impoundment fluctuations and turbine unit ramping.

2.2.4 Proposed Environmental Measures

Aquatic Resources and Operations

To enhance aquatic habitat and protect fish, Littleville Power proposes to:

- continually release 90 cfs or inflow into the bypassed reach. The 90 cfs would be released through the new 165-kW minimum flow turbine generating unit at the dam into the bypassed reach
- install trash racks with 1-inch spacing at the minimum flow unit intake.

Recreation

To enhance recreation opportunities, Littleville Power proposes to:

- provide a canoe portage around the dam, including a new take-out and put-in and a portage trail using an existing access road; and
- provide formal parking, for the public at the bypassed reach, adjacent to the proposed put-in.

2.2.5 Modifications to Applicant's Proposal – Mandatory Conditions

The following mandatory conditions have been provided and are evaluated as part of the applicant's proposal.

Section 18 Prescription

Interior requests that a reservation of authority to prescribe fishways under section 18 be included in any license issued for the project.

2.3 STAFF ALTERNATIVE

Under the staff alternative, the project would include all of Littleville Power's proposed measures plus the following measures: (1) release (downstream of the project) 90 percent of inflow during impoundment refilling following any maintenance and emergency drawdowns; (2) an operation compliance monitoring plan; (3) an erosion and sedimentation control plan; (4) an invasive species control plan; (5) a recreation plan for

3.2.1 Geographic Scope

The geographic scope of the cumulative analysis defines the physical limits or boundaries of the proposed action's effect on the resources. We have identified the scope for water quality to include the Housatonic River from the Risingdale dam located about 4 miles downstream of the Glendale dam upstream to the outlet of Woods Pond, approximately 16 miles upstream from the Glendale dam. This 19.9-mile segment is classified by the Massachusetts DEP according to the Massachusetts Stream Classification Program and is considered impaired requiring a total maximum daily load for unknown toxicity, priority organics, thermal modifications, pathogens, and turbidity. We chose this geographic scope because the project in combination with other activities could affect water quality resources within this 19.9-mile reach.

3.2.2 Temporal Scope

The temporal scope of our cumulative effects analysis includes a discussion of past, present, and future actions and their effects on aquatic resources. Based on the potential subsequent license term, the temporal scope looks 30 to 50 years into the future, concentrating on the effects on the resources from reasonably foreseeable future actions. The historical discussion is limited, by necessity, to the amount of available information. We identified the present resource conditions based on the license application, agency comments, and comprehensive plans.

3.3 PROPOSED ACTION AND ACTION ALTERNATIVES

In this section, we discuss the effects of the project alternatives on environmental resources. For each resource, we first describe the affected environment, which is the existing condition and baseline against which we measure effects. We then discuss and analyze the site-specific environmental effects and any cumulative effects.

Only the resources that would be affected, or about which comments have been received, are addressed in detail in this EA. We present our recommendations in section 5.2, Comprehensive Development and Recommended Alternative section.

3.3.1 Aquatic Resources

Affected Environment

Hydrologic information

Monthly flow duration curves were developed for the project using USGS gage number 01197500 located about 5 miles downstream of the Glendale Project for the

Historical water quality

Massachusetts DEP conducts water quality assessments for the Housatonic River by river segments based on the Massachusetts Stream Classification Program hierarchy. The 19.9-mile segment of the Housatonic River including the project site is located in segment MA21-19, which is bounded by the outlet of Woods Pond downstream to the Risingdale dam in Great Barrington, Massachusetts. Massachusetts DEP measured a number of water quality parameters at sampling locations located about 10.5 miles upstream of the project (station 19C) and 0.7 miles downstream of the project (station 19E) during May, June, July, and September during 2002. Water quality conditions at station 19C were relatively poor with low dissolved oxygen (DO) levels and extremely high total phosphorus and ammonia-nitrogen concentrations. These conditions were attributed to the proximity of the sampling location to the Lee wastewater treatment plant. Water quality conditions at station 19E generally met state standards with the exception of high phosphorus levels.

Massachusetts DEP also conducted habitat assessments and sampled benthic macroinvertebrate communities as part of the 2002 water quality assessment. Station 19E received a total habitat score of 185 out of 200 and was chosen as a reference station for the mainstem Housatonic River, as it represented the least impacted conditions.

Based on the 2002 water quality assessment, Massachusetts DEP designated the entire MA21-19 segment as impaired for the aquatic life and fish consumption designated uses, due to contamination from polychlorinated biphenyls (PCBs) from the General Electric Company (GE) superfund site in Pittsfield, Massachusetts. Total concentrations of PCBs from fish tissue collected by the U.S. Environmental Protection Agency between 1998 and 2002 in the vicinity of the project exceeded the National Academy of Sciences/National Academy of Engineering guideline for the protection of fish-eating wildlife (500 µg/kg wet weight) by between 4 and 83 times.

Segment MA21-19 contains five permitted water withdrawals: (1) Schweitzer-Mauduit International, Inc.; (2) MeadWestvaco Corporation – Specialty Paper Division; (3) Cranwell Conference Center; (4) Lane Construction Company; and (5) Lee Water Department. All of these facilities are located upstream of the project. Seven National Pollutant Discharge Elimination System (NPDES) permitted facilities discharge into segment MA21-19 and all are located upstream of the project. Municipal water use within Stockbridge has consisted of both surface water and groundwater. Water use by the town is projected to reach 0.37 million gallons per day in 2010.

Water quality standards

Segment MA21-19 of the Housatonic River, along with the entire mainstem, is

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^{TM}, 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.

Interior and Massachusetts DFW state that the likelihood of DO depletion is low given the frequent amount of project spills and the proximity of the minimum flow unit's discharge location to a riffle which would facilitate reaeration.

Staff Analysis

We agree with the agencies' assessment. Water quality profile information from a single sampling day during August 2006 indicated that the impoundment was well oxygenated throughout the water column and not thermally stratified. Because this sample was taken during a typical summer month, if stratification was going to take place we would have expected it to be evident at this time. Therefore, it is likely that operation of the minimum flow unit would not result in the release of poorly oxygenated water during most years. In the event that low DO conditions do set up in deeper portions of the impoundment, spill flows and aeration due to the minimum flow release could ameliorate the low DO conditions in the bypassed reach. Spill flows would occur in the bypassed reach about 30 to 75 percent of the time on a monthly basis, and riffle habitat represents nearly 40 percent of the total habitat in the bypassed reach. Therefore, any potential for the minimum flow unit to release oxygen-depleted water from the deeper strata of the impoundment would likely be offset by increased turbulence and aeration caused by the higher minimum flows and frequent spill flows.

Flow continuation following impoundment drawdown

Hydro project impoundments may need to be drawn down periodically due to scheduled and unscheduled maintenance as well as emergencies beyond the control of the operator. The refill of an impoundment following a drawdown can disrupt flows downstream of a project and affect water quality and aquatic habitat. Littleville Power does not propose a refill protocol following impoundment drawdowns.

Interior and Massachusetts DFW recommend under section 10(j) that Littleville Power use 10 percent of the inflow to the project to refill the project impoundment after dam maintenance or emergency drawdowns and release 90 percent of inflow downstream of the project impoundment for the protection of aquatic resources.

Staff Analysis

Maintaining flow in the bypassed reach and below the project during project maintenance activities is important for the protection of aquatic biota. While most fish successfully move to deeper areas when flow decreases, many macroinvertebrates are not as mobile. Additionally, with lower flows, both fish and macroinvertebrates are more likely to be preyed on or stressed by increased water temperatures and decreased DO levels, especially in the summer. Releasing 90 percent of the project impoundment's

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)[2] study. Littleville Power formed a study team

[2] 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.

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

downstream of the project. Therefore, any contribution to cumulative water quality effects in the Housatonic River Basin due to operation of the Glendale Project or construction activities should be minimal and short term.

Unavoidable Adverse Effects

Unavoidable adverse impacts would include some entrainment mortality that would persist with the continued operation of the Glendale Project. However, there is no indication that any losses associated with entrainment have had a significant effect on fishery resources or fish populations within the project area. Trash racks with 1.0-inch clear spacing would continue to protect fish over 8 inches from entrainment at the main turbine intakes and provide a similar level of protection at the proposed minimum flow unit's intake. The project dam would continue to be an impediment to upstream movement of resident fish unless Interior prescribes fishways at the project in the future. As a result, any mussel species residing in the Housatonic River downstream of the project would not be able to recolonize areas upstream of the project because fishes serving as hosts to early life history stages of mussels would be prevented from moving upstream.[8] Also, there may be some minor short-term erosion and sedimentation effects resulting from the installation of the minimum flow turbine unit.

3.3.2 Terrestrial Resources

Affected Environment

The project boundary encloses about 43 acres of land within the Northeastern Highlands ecoregion of the commonwealth of Massachusetts. The limestone deposits and underlying carbonate rocks create alkaline soil conditions and mineral-rich wetlands. The project area is characterized by transitional hardwood forest dominated by white pine, oak, and hemlock.

The shoreline along the Housatonic River in the project vicinity varies from low wetland areas to relatively steep and sloped banks. Below the Glendale Dam, the river is confined by the railroad and Glendale Road. Above the dam to the Glendale Middle Road Bridge (approximately 1,400 feet upstream), the eastern side of the river is bordered by railroad and the western side of the river is bound by single-family residential development. The remainder of the river within the project area is bound by herbaceous wetlands and scrub and upland forests ranging from 100 to 750 feet in width.

[8] Massachusetts DFW states that resident host fishes for early life stages of these mussels include largemouth bass, fallfish, longnose dace, blacknose dace, common shiner, golden shiner, slimy sculpin, bluegill, rock bass, white sucker, and pumpkinseed sunfish.

The riparian zone below the Glendale Dam consists of a thin strip of shrubby vegetation and mixed-forest between the waters edge and Glendale Road to the west and the railroad to the east. Similar to the riparian zone along the tail race, the impoundment between the Glendale Dam and Glendale Middle Road Bridge is also bordered by the railroad on the eastern shore with a thin section of herbaceous and shrubby vegetation and Glendale Road on the western shore with a mixed-forest section. Upstream of the Glendale Middle Road Bridge, the riparian zone consists of wetlands and forested habitat along the eastern shore and residential development and mixed-forest on the western shore.

Several species of woody and herbaceous vegetation occupy the Housatonic shoreline along the riparian zone, including: jewelweed (*Impatiens capensis*), purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), white pine (*Pinus strobus*), Canadian hemlock (*Tsuga canadensis*), red maple (*Acer rubrum*), red oak (*Quercus rubra*), eastern hophornbeam (*Ostrya virginiana*), and black locust (*Robinia pseudoacacia*). The limited shrubby vegetation along the railroad on the eastern side of the project area is likely subject to periodic human disturbance during railroad maintenance activities. Likewise, the riparian zone bound by the residential development on the western shore is likely subject to periodic human disturbance.

Eight invasive species have been identified at the project. These are: purple loosestrife, reed canary grass, Japanese knotweed (*Polygonum cuspidatum*), an unidentified honeysuckle (*Lonicera* spp.), black locust, multiflora rose (*Rosa multiflora*), Eurasian watermilfoil, and curly leaf pondweed.

Wetlands and Aquatic Vegetation

There are two wetland areas documented in the project area upstream of the Glendale Middle Road Bridge on either side of the old bridge abutment. The wetland south of the abutment is a palustrine emergent (PEM) wetland dominated by broad leaf cattail (*Typha latifolia*). The wetland north of the abutment is composed of two wetland types, a PEM and palustrine scrub shrub (PSS) wetland. The PEM is dominated by jewelweed, purple loosestrife, reed canary grass, and broad leaf cattail. The PSS is dominated by boxelder (*Acer negundo*), honeysuckle, multiflora rose, and riverbank grape (*Vitis riparia*).

The littoral area in the impoundment is extensive, with multiple submergent aquatic vegetation (SAV) and emergent aquatic vegetation (EAV) beds present along margins of the impoundment and in the two coves of the wetlands along the eastern shore of the impoundment north and south of the old bridge abutments (figure 3). The dominant SAV species include wild celery (*Valisneria americana*), common waterweed (*Elodea canadensis*), coontail (*Ceratophyllum demersum*), and flatstem pondweed (*Potamogeton zosteriformis*). A sparse abundance of two invasive SAV species was found in the impoundment, Eurasian watermilfoil (*Myriophyllum spicatum*) and curly

leaf pondweed (*Potamogeton crispus*). The dominant EAV species are great bur reed (*Sparganium eurycarpum*), common arrowhead (*Sagittaria latifolia*), pickerelweed (*Pontederia cordata*), and purple loosestrife (*Lythrum salicaria*), an invasive species.

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Via eFiling

March 14, 2011

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

Re: Glendale Hydroelectric Project (FERC No. 2801-MA);
Updated Run-of-River and Minimum Flow Monitoring and Compliance Plan.

Dear Secretary Bose:

On August 19, 2009 the Federal Energy Regulatory Commission (FERC) issued a Subsequent License to Littleville Power Company, Inc. (LPC) for the Glendale Hydroelectric Project (FERC No. 2801).[1] In addition, on July 8, 2009 the Massachusetts Department of Environmental Protection (MDEP) issued a Water Quality Certification (WQC) for the project, which established the operating conditions deemed necessary to protect the water quality of the Housatonic River pursuant to Section 401(a) of the Clean Water Act. The FERC license incorporates the WQC Conditions at Ordering Paragraph (D).

LPC submitted its Run-of-River and Minimum Flow Monitoring Plan to the Commission on December 9, 2010, and simultaneously requested comments on the plan from the resource agencies. By this filing LPC submits the resource agency letters and email messages approving and commenting on the Plan, and has updated the Plan in response to agency requests for minor clarifications.

Project Description

The Glendale Project is located on the Housatonic River in Stockbridge, Berkshire County, Massachusetts. The major project features include: a 250-foot-long, 30-foot-high concrete gravity dam with a 182-foot-long spillway; a 23-acre reservoir; a gatehouse at the right (northern) dam abutment; a 1,500-foot-long intake canal; a penstock intake structure with trashracks; a 250-foot-long steel penstock; a powerhouse containing four identical turbine-generator units; a 300-foot-long tailrace; and an approximately 2,500-foot-long bypassed reach of the Housatonic River extending from the dam to the end of the tailrace. The existing turbine-generator units have a combined capacity of 1,140 kW and a total hydraulic capacity of approximately 400 cfs. The subsequent license authorizes LPC to install a new turbine-generator unit at the gatehouse adjacent to the dam, which will be used to meet the bypass reach minimum flow requirement of 90 cfs. The project is operated in a run-of-river mode using automatic pond level control.

[1] 128 FERC ¶ 62,123