UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Public Service Company of New Hampshire — Project No. 1893-042-New Hampshire

NOTICE OF AVAILABILITY OF ENVIRONMENTAL ASSESSMENT

(January 24 , 2006)

In accordance with the National Environmental Policy Act of 1969 and the Federal Energy Regulatory Commission's regulations, 18 CFR Part 380 (Order No. 486, 52 F.R. 47879), the Office of Energy Projects has reviewed the application for a new license for the Merrimack River Project, located on the Merrimack River, in Merrimack and Hillsborough counties, New Hampshire, and has prepared an Environmental Assessment (EA). In the EA, Commission staff analyze the potential environmental effects of relicensing the project and conclude that issuing a new license for the project, with appropriate environmental measures, would not constitute a major federal action significantly affecting the quality of the human environment.

A copy of the EA is on file with the Commission and is available for public inspection. The EA may also be viewed on the Commission's website at http://www.ferc.gov using the "eLibrary" link. Enter the docket number excluding the last three digits in the docket number field to access the document. For assistance, contact FERC Online Support at FERCOnlineSupport@ferc.gov or toll-free at 1-866-208-3676, or for TTY, (202) 502-8659.

Any comments should be filed within 30 days from the issuance date of this notice, and should be addressed to the Secretary, Federal Energy Regulatory Commission, 888 First Street, N.E., Room 1-A, Washington, D.C. 20426. Please affix "Merrimack River Project No. 1893" to all comments. Comments may be filed electronically via Internet in lieu of paper. The Commission strongly encourages electronic filings. See 18 CFR 385.2001(a)(1)(iii) and the instructions on the Commission's website under the "eFiling" link. For further information, contact Steve Kartalia at (202) 502-6131.

Magalie R. Salas
Secretary

ENVIRONMENTAL ASSESSMENT
FOR
NEW HYDROPOWER LICENSE

Merrimack River Project

FERC Project No. 1893-042

New Hampshire

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

January 2006

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SUMMARY

Public Service Company of New Hampshire (PSNH) filed an application for a new license on December 30, 2003, to continue to operate and maintain the 30-megawatt (MW) Merrimack River Project. The Merrimack River Project includes three developments (Amoskeag, Hooksett, and Garvins Falls) and is located on the Merrimack River within Merrimack and Hillsborough Counties, New Hampshire. The project does not occupy any federal land. This Environmental Assessment (EA) analyzes the effects of the proposed action, the proposed action with additional staff-recommended measures, and a no-action alternative. PSNH proposes to operate all three developments in a run-of-river (ROR) mode, finalize an operation plan for compliance with ROR mode and flow requirements, create a conservation easement along the river front adjacent to the Garvins Falls development, provide minimum flows to each of the bypassed reaches, develop a final upstream and downstream fish passage plan in consultation with the agencies, in accordance with PSNH's December 20, 2005 alternative fishway prescription, develop a shoreline management plan (SMP), develop a recreation plan, and develop an historic properties management plan.

Based on our analysis, we recommend licensing the project as proposed by PSNH with some staff modifications and additional measures. Our recommended modifications include or are based in part on recommendations made by the federal and state resource agencies. The additional measures we recommend include: develop and implement a more comprehensive operation compliance monitoring plan than what PSNH proposes in their draft ROR operations plan, and include shoreline buffer zones in the SMP.

In section VI of the EA, we estimate the annual net benefits of operating and maintaining the project under the three alternatives identified above. Our analysis shows that the annual net benefit would be $3,465,000 under the proposed action, $3,458,000 under the proposed action with additional staff-recommended measures, and $3,982,000 under the no-action alternative.

On the basis of our independent analysis, we conclude that issuing a new license for the project as proposed by PSNH, with the staff-recommended environmental measures would not be a major Federal action significantly affecting the quality of the human environment.

ENVIRONMENTAL ASSESSMENT

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Hydropower Licensing
Washington, D.C.

MERRIMACK RIVER PROJECT
FERC No. 1893-042, New Hampshire

I. APPLICATION

Public Service Company of New Hampshire (PSNH) filed an application for a new license on December 30, 2003, to continue to operate and maintain the 30-megawatt (MW) Merrimack River Project. The Merrimack River Project includes three developments (Amoskeag, Hooksett, and Garvins Falls) and is located on the Merrimack River within Merrimack and Hillsborough Counties, New Hampshire (Figure 1). The project does not occupy any federal land.

II. PURPOSE OF ACTION AND NEED FOR POWER

A. Purpose of Action

The Commission must decide whether to issue a license for the project, and what, if any, conditions should be placed in any license issued. Issuing a license would allow PSNH to continue generating electricity, making electric power from a renewable resource available to the area. In this environmental assessment (EA), we assess the effects of continued project operation, alternatives to the proposed project, and a no-action alternative, and recommend conditions to become a part of any new license issued. In deciding whether to issue a license for a hydroelectric project, the Commission must determine that the project will be best adapted to a comprehensive plan for improving or developing the waterway. In addition to the power and developmental purposes for which licenses are issued, the Commission must give equal consideration to the purposes of energy conservation; the protection of, mitigation of damage to, and enhancement of fish and wildlife (including related spawning grounds and habitat); the protection of recreational opportunities; and the preservation of other aspects of environmental quality.

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B. Need for Power

To assess the need for the project's power, we reviewed the licensee's present and anticipated future use of project power, together with that of the operating region in which the project is located. The Merrimack Project has generated an approximate average of 130,338 megawatt-hours (MWh), annually. If issued a new license for this project, PSNH would continue to supply their customers with project power.

The project is located in the New England Power Pool (NPCC) region of the North American Electric Reliability Council (NERC). According to the NERC, demand for electric energy in the region is expected to increase at an average rate of 1.25 percent per year through 2012 (NERC, 2003).

By producing hydroelectricity, this project displaces the need for other power plants, primarily fossil-fuel facilities, to operate, thereby avoiding some power plant emissions and creating an environmental benefit. The present and future use of the project's power, its displacement of nonrenewable fossil-fired generation, and contribution to a resource diversified generation mix, support a finding that the power from the project would help meet both the short- and long-term need for power in the NPCC region.

III. PROPOSED ACTION AND ALTERNATIVES

A. Proposed Action

1. Project Description

The project includes three developments.

The Amoskeag Development consists of the following existing facilities: (1) a 29-foot-high, 710-foot-long concrete gravity dam comprised of: (i) a low crest section with 5-foot-high flashboards; and (ii) a high crest section with 3-foot-high flashboards; (2) a 7-mile-long, 478-acre reservoir; (3) a powerhouse, integral with the dam, containing three generating units with a total installed capacity of 16,000 kW; (4) a pool and weir type fish ladder at the powerhouse with an eel trap; (5) a downstream fish passage system at the waste gate; and (6) a 415-foot-long, 34.5-kV transmission line.

The Hooksett Development consists of the following existing facilities: (1) a dam comprised of: (i) a 340-foot-long stone masonry section with 2-foot-high flashboards connected to; (ii) a 250-foot-long concrete section with 2-foot-high flashboards; (2) a 15-foot by 20-foot Taintor gate; (3) a 5.5-mile-long, 405-acre reservoir; and (4) a

powerhouse containing a single generating unit with an installed capacity of 1,600 kW; (5) 2.4-kV generator leads to a 2.3/11/34.5-kV transformer and (6) a downstream fish bypass system between the taintor gate and the powerhouse.

The Garvins Falls Development consists of the following existing facilities: (1) an 18-foot-high, 550-foot-long concrete and granite gravity dam comprised of: (i) a low crest section with 3-foot-high flashboards; and (ii) a high crest section with 1.2-foot-high flashboards; (2) an 8-mile-long, 640-acre reservoir; (3) a 500-foot-long power canal with a 10-foot-wide waste gate; (4) a louver-type fish guidance and downstream bypass system in the canal; (5) two powerhouses, each containing two generating units for a total installed capacity of 12,300 kW; and (6) a 340-foot-long, 34.5-kV transmission line.

PSNH estimates the project's total average annual generation is 130,338 MWh. See Figures 2, 3, and 4 for project facility schematics.

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2. Project Safety

The project has been operating for 25 years under the existing license and during this time, Commission staff have conducted operational inspections focusing on the continued safety of the structures, identification of unauthorized modifications, efficiency and safety of operations, compliance with the terms of the license, and proper maintenance. In addition, the project has been inspected and evaluated every 5 years by an independent consultant and a consultant's safety report has been submitted for Commission review. As part of the relicensing process, Commission staff would evaluate the continued adequacy of the proposed project facilities under a new license. Special articles would be included in any license issued, as appropriate. Commission staff would continue to inspect the project during the new license term to assure continued adherence to Commission-approved plans and specifications, special license articles relating to construction (if any), operation and maintenance, and accepted engineering practices and procedures.

3. Current Project Operation

The project's developments from upstream to downstream are Garvins Falls, Hooksett and Amoskeag. Garvin Falls does not generate at flows less than 248 cfs, operates in a ROR mode at low river flows (generally less than 719 cfs), operates in a daily peaking mode at flows from approximately 1000 cfs to 6,380 cfs (the plant's hydraulic capacity), and in ROR mode at flows over 6,380 cfs. During normal daily peaking operations, Garvins Falls is typically drawn down 0.5 to 1.0 feet. However, when high rainfall is anticipated, PSNH can lower the pond a maximum of 3 feet.

Hooksett does not generate when flows are below 500 cfs and operates in a ROR mode at all times.

Amoskeag currently does not generate at river flows below 209 cfs, operates in a ROR mode at low river flows (generally less than 833 cfs), operates in a daily peaking mode at flows from approximately 1,000 cfs to 5,640 (the plants hydraulic capacity), and in ROR mode at flows greater than 5,640 cfs. During normal daily peaking operations, the reservoir is typically drawn down 1 to 1.5 feet. However, when high rainfall is anticipated, PSNH can lower the pond a maximum of 3 feet if inflow allows.

4. Proposed Operation and Environmental Measures

PSNH proposes to:

- Operate all three developments in a ROR mode;
- Finalize an operation plan for compliance with the ROR mode and flow requirements;
- Create a conservation easement along the river front adjacent to the Garvins Falls development;
- Provide minimum flows to each of the bypassed reaches (same flows as those required by WQC (see Section IV E.1);
- Develop a final upstream and downstream fish passage plan in consultation with the agencies, in accordance with PSNH's December 20, 2005 alternative fishway prescription (see Section IV E.2 below);
- Develop a Shoreline Management Plan (SMP);
- Develop a Recreation Plan ; and
- Participate in a Programmatic Agreement (PA) and develop an Historic Properties Management Plan in consultation with FERC, the SHPO, and the Advisory Council on Historic Preservation (Advisory Council).

B. Proposed Action with Additional Staff-Recommended Measures

In addition to PSNH's proposed measures, we recommend the following environmental measures:

- Develop a more comprehensive operation compliance and monitoring plan than what PSNH's proposes in their draft ROR operations plan; and
- Include shoreline buffer zones in the SMP

Specific measures recommended under each plan are discussed under the appropriate resource sections and summarized in section VII of the EA.

C. No-Action Alternative

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented. We use this alternative to establish the baseline environmental condition for comparison with other alternatives.

D. Alternatives Considered but Eliminated from Detailed Study

As part of the National Environmental Policy Act (NEPA) scoping process, we considered, but have eliminated from detailed study several alternatives to the proposed project, because they are not reasonable under the circumstances of this case. These

alternatives include: (1) federal takeover; (2) issuing a non-power license; and (3) project retirement via partial or total project removal.

1. Federal Takeover

We don't consider federal takeover a reasonable alternative. Federal takeover and operation of the project would require congressional approval. While that fact alone would not preclude further consideration of this alternative, there is currently no evidence showing that a federal takeover should be recommended to Congress. No agency has suggested federal takeover would be appropriate, and no federal agency has expressed an interest in operating the project.

2. Non-power License

A non-power license is a temporary license that would be in effect until the licensee either surrenders the license or the Commission determines that another government agency will assume regulatory authority and supervision over the lands and facilities covered by the non-power license. No entity has recommended a non-power license, and there is no basis for concluding that the Merrimack River Project should no longer produce power. Therefore, issuing a non-power license is not a reasonable alternative to relicensing the Merrimack River Project.

3. *Project Retirement*

Project retirement could be accomplished with or without dam removal at one or more of the developments. Either alternative would require denial of the relicense application and surrender or termination of the existing license with appropriate conditions. The project provides a viable, safe, and clean renewable source of power to the region and contributes to the local economy by providing a source of revenue to PSNH.

IV. CONSULTATION AND COMPLIANCE

A. Agency Consultation and Interventions

The Commission's regulations require that applicants consult with appropriate state and federal agencies, tribes, and the public before filing a license application. This consultation is required to comply with the Fish and Wildlife Coordination Act, the Endangered Species Act, the National Historic Preservation Act, and other federal statutes. Pre-filing consultation must be complete and documented in accordance with Commission regulations.

B. Interventions

On August 26, 2004, the Commission issued a public notice accepting the application and soliciting motions to intervene. Sixteen entities filed motions to intervene in this proceeding, three of which were in opposition. Those in opposition are marked with an asterisk. Those interventions which were filed late are marked with a double asterisk.

Intervening Entity	Date of Intervention
New Hampshire Department of Environmental Services	October 22, 2004
New Hampshire Department of Fish and Game	October 22, 2004
Upper Merrimack Local Advisory Committee	October 15, 2004
Appalachian Mountain Club*	October 22, 2004
American Whitewater*	October 22, 2004
New England FLOW*	October 22, 2004
Town of Hooksett	September 24, 2004
City of Concord	September 27, 2004
Manchester Water Works	October 25, 2004
U.S. Department of the Interior	October 5, 2004
Boott Hydropower	October 22, 2004
Concerned Citizens of Bow	October 25, 2004
New Hampshire Public Utilities Commission	October 25, 2004
U.S. Environmental Protection Agency**	November 2, 2004
New Hampshire Rivers Council**	November 12, 2004
Greater Concord Chamber of Commerce**	January 24, 2005

C. Scoping

Before preparing this EA, we conducted scoping to determine the issues and alternatives that should be addressed. On June 3, 2004, we issued a Scoping Document and a notice soliciting written scoping comments on issues to be addressed in the EA. We distributed the Scoping Document to all entities on the project's mailing list and published the notice in local newspapers and the Federal Register. We also held public meetings and a site visit in Manchester, New Hampshire on June 23 and 24. The following entities filed scoping comments:

Commenting Entity	Date of Letter
U.S. Fish and Wildlife Service	July 26, 2004

D. Comments and Recommendations

On March 17, 2005, the Commission issued a public notice stating the application was ready for environmental analysis and requesting final comments, recommendations, prescriptions, and terms and conditions. The filing deadline was May 16, 2005. The following entities filed comments:

Commenting Entity	Date Filed
U.S. Department of the Interior	May 13, 2005
Concerned Citizens of Bow	May 16, 2005
Appalachian Mountain Club	May 16, 2005
American Whitewater	May 16, 2005
New England FLOW	May 16, 2005
U.S. Environmental Protection Agency, Region 1	May 24, 2005

PSNH filed responses to the comments, recommendations, prescriptions, and terms and conditions on June 30, 2005 and July 15, 2005.

E. Compliance

1. Water Quality Certification

Under section 401(a)(1) of the Clean Water Act (CWA), license applicants must obtain either state certification that any discharge from a project would comply with applicable provisions of the CWA, or a waiver of certification by the appropriate state agency.

PSNH requested a WQC from the New Hampshire Department of Environmental Services (NHDES) by letter dated December 16, 2003. NHDES received PSNH's request on December 17, 2003. NHDES issued a WQC for the project on December 16, 2004. PSHH appealed certain conditions of the WQC, and NHDES issued a modified WQC on May 10, 2005. The WQC contains eleven conditions attached herein as appendix A.

2. Section 18 Fishway Prescription

Section 18 of the FPA states that the Commission shall require the construction, operation, and maintenance, by a licensee of such fishways as may be prescribed by the Secretaries of Interior and Commerce. In a letter filed May 13, 2005, Interior requested

that the Commission reserve its authority to prescribe fishways in the future. In the same letter, Interior also provided a preliminary fishway prescription for all three developments. Interior states that it will submit its final prescription within 60 days of the close of the comment period on the Commission's draft NEPA document. The following summarizes Interior's preliminary fishway prescription:

Amoskeag:

- Operation of the existing upstream fish ladder according to the schedule below.
- Operation of the existing downstream fish bypass facility according to the schedule below.
- Evaluation of the effectiveness of the existing upstream fishway in passing American shad and river herring that reach the project.
- Reservation of Authority to prescribe a 4-foot-wide Denil fish ladder at the eastern end of the dam spillway, adjacent to the old canal house if effectiveness monitoring determines that the current upstream fishway is not effective in passing fish accessing the project spillway.
- Evaluation of the effectiveness of the existing downstream passage facility for passing American shad, river herring, and American eel.
- Reservation of Authority to prescribe new or modified downstream passage measures for shad and river herring if determined necessary after monitoring the effectiveness of the existing downstream bypass system.
- Evaluation of the effectiveness of the existing tailrace eelway and trap in passing American eel that reach the project, including an interim eelway and trapping facility at the project spillway.
- Reservation of Authority to prescribe permanent upstream fishway(s) for eel, or other additional measures to provide upstream passage for eel.
- Reservation of Authority to prescribe downstream passage for eel consisting of operational measures (shutdowns), combined with surface and/or bottom bypasses and/or screening, following a determination that existing fish bypass facilities are not effective in safely passing eels.

Hooksett:

- Operation of the existing downstream fish bypass facility according to the schedule below.
- Installation of a rock-ramp fishway on the west side of the dam at the western side spillway to be operational within three years after passage of

either 9,500 or more shad or 22,500 or more river herring at the Amoskeag developmemt in any given year.

- Installation of eelways for the second spring/summer migration period after license issuance, the design and siting to be developed in consultation with and approved by the Service.
- Evaluation of the effectiveness of the existing downstream passage facility for passing American shad, river herring and American eel.
- Reservation of Authority under Section 18 of the FPA to make new or modified prescriptions.

Garvins Falls:

- Operation of the existing downstream fish bypass facility according to the schedule below.
- Installation of an upstream fish lift adjacent to the discharge of the older, river-side powerhouse, and an exit flume to convey fish to the headpond to be operational within three years after passage of either 19,300 shad or 45,800 river herring at Amoskeag. If this trigger number is reached before an upstream fishway is installed at Hooksett, installation of the fish lift at Garvins Falls would be delayed until three years following installation at Hooksett.
- Installation of a 4-foot-wide Denil ladder that would collect fish from the spillway pool and convey them to an exit into the headpond at the western side of the spillway to be operational within three years after passage of 19,300 shad or 45,800 river herring at Amoskeag. If this trigger number is reached before an upstream fishway is installed at Hooksett, installation of the fish lift at Garvins Falls would be delayed until three years following installation at Hooksett.
- Evaluation of the effectiveness of the existing downstream passage facility for passing American shad, river herring and American eel.
- Reservation of Authority under Section 18 of the FPA to prescribe new or modified downstream passage measures for shad and river herring if determined necessary after monitoring the effectiveness of the existing fish bypass system for these species.
- Installation of eelway(s) to be operational for the second spring/summer migration period after eels are passed at Hooksett, the design and siting to be developed in consultation and approved by the Service.
- The Department may exercise its Reservation of Authority under Section 18 of the FPA to make new or modified prescriptions.

Timing of Seasonal Fishway Operations:

The fishways are to be maintained and operated, at the licensee's expense, to maximize fish passage effectiveness throughout the upstream and downstream migration periods for American shad, river herring, American eel and white sucker:

Upstream passage	April 1 to June 30	All species except American eel
	April 1 to Nov. 15	American eel
Downstream passage	April 1 to June 15	Atlantic salmon
	June 1 to July 15	Spent adults of all species
	Sept. 15 to Nov. 15	Adult eel; juvenile shad and herring

If monitoring indicates that these dates should be adjusted, the Department would use its reservation of authority to modify the operating schedule.

On December 19, 2005, PSNH filed with Interior a request for rehearing on Interior's preliminary Section 18 prescription, as well as an alternative prescription for Interior to consider. PSNH's alternative prescription would require:

- continued effectiveness testing of existing fishways for shad, river herring, and eels when the number of naturally occurring fish is adequate to conduct such studies;
- a permanent upstream eelway at Amoskeag bypass if determined to be necessary through monitoring;
- an upstream eelway at Hooksett within two years of license issuance;
- an upstream eelway at Garvins Falls within two years of passing eels at Hooksett;
- shortened seasons of fishway operations (upstream passage for eel would be April 1 to October 15 with a downstream passage schedule for eel, shad and river herring from August 15 to October 31); and
- reservation of the Commission's authority to require additional or modified fishways in the future as necessary.

3. Endangered Species Act

Section 7 of the Endangered Species Act (ESA) [1] requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification of the critical

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[1] 16 U.S.C. ' 1536(a)

habitat of such species. In an e-mail dated April 4, 2005, the FWS confirmed that the federally threatened bald eagle (*Haliaeetus leucocephalus)* makes extensive use of the project area during the winter.

Based on our analysis (see Section V.2) relicensing the project as proposed by PSNH and with the staff-recommeded measures, would not be likely to adversely affect the bald eagle. With the issuance of this EA we will be seeking concurrence with our effects determination.

4. Coastal Zone Management Act (CZMA)

The mouth of the Merrimack River is in the Commonwealth of Massachusetts. By letter dated January 4, 2005, the Massachusetts Office of Coastal Zone Management concurred with PSNH's finding that the Merrimack River Project has no reasonably foreseeable effects on the land and water resources of the Massachusetts coastal zone.

5. Section 10(j) Recommendations

Under section 10(j) of the FPA, each hydroelectric license issued by the Commission must include conditions based on recommendations provided by federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the project. The Commission is required to include these conditions unless it determines that they are inconsistent with the purposes and requirements of the FPA or other applicable law. Before rejecting or modifying an agency recommendation, the Commission is required to attempt to resolve any such inconsistency with the agency, giving due weight to the recommendations, expertise, and statutory responsibilities of such agency. By letter filed May 13, 2005, Interior filed 18 timely section 10(j) recommendations for the Merrimack River Project, as summarized below:

Recommendation 1 - Operate Amoskeag in an instantaneous ROR mode with headpond fluctuations $\pm$ 0.25 feet from top of flashboards or dam crest;

Recommendation 2 – When Amoskeag discharges are modified from ROR mode, ramp changes in discharge at a rate of 1,427 cfs change/hour when inflows are below 11,416 cfs, and at a rate of 2,854 cfs change/hour when outflows exceed 11,416 cfs;

Recommendation 3 – Year-round minimum bypass flows in the Amoskeag east-side channel of 410 cfs released from the east end of the spillway, and during non-fish passage season, flows to the west-side bypass channel of 149 cfs released through the fish bypass/trash sluice gate located on the west end of the spillway;

Recommendation 4 – During refilling operations at Amoskeag, minimum flows of 1,427 in the tailrace. If inflow is less than this, then 90% of inflow to be released;

Recommendation 5 – Up to 3 special weekend whitewater boating releases per year below Amoskeag, none during the upstream fish passage season except on case-by-case by mutual agreement between licensee, FWS, and NHFG. Ramping rates in recommendation 4 would apply. No whitewater flows until installation and operation of minimum flow release gate at east end of spillway;

Recommendation 6 – ROR operation and flow release monitoring plan for Amoskeag

Recommendation 7 – Instantaneous ROR mode at Hooksett with minimized impoundment fluctuations;

Recommendation 8 – When Hooksett discharges are modified from ROR mode, ramp changes in discharge at a rate of 1,403 cfs change/hour when inflows are below 11,220 cfs, and at a rate of 2,805 cfs change/hour when outflows exceed 11,220 cfs;

Recommendation 9 - A Hooksett bypass flow of 64 cfs released from west-side spillway;

Recommendation 10 – During Hooksett refilling operations, a minimum flow of 1,403 cfs released to tailrace or if inflow is less, then 90% of inflow;

Recommendation 11 – A ROR operation and flow release monitoring plan for Hooksett;

Recommendation 12 – Instantaneous ROR mode at Garvins Falls with fluctuations $\pm$ 0.25 feet from top of flashboards or dam crest;

Recommendation 13 – When Garvins Falls deviates from ROR, ramp at the rate of 1,214 cfs change/hour at outflows below 9,708 cfs and at 2,427 cfs change/hour at outflows above 9,708 cfs;

Recommendation 14 – Garvin Falls minimum bypass reach flows of: 55 cfs year-round from the spillway; maintaining existing seepage flows from canal to center of bypassed reach; and 23 cfs year-round from the fish bypass gate or ice sluice to the fish bypass/ice sluice channel;

Recommendation 15 – During Garvins Falls refilling operations, minimum flow of 1,214 cfs released to tailrace or if inflow is less, then 90% of inflow;

Recommendation 16 – ROR operation and flow release monitoring plan for Garvins Falls;

Recommendation 17 – Develop shoreline management plan for existing developed land adjacent to the project;

Recommendation 18 – Implement conservation restrictions at Garvins Falls tract within six months and develop a conservation restriction plan;

Recommendation 19 – Develop conservation restriction and protection plan for non-protected and non-licensee owned riparian buffer zones in the area upstream from Hooksett Dam.

Table 10, in Section VIII lists each of the recommendations subject to section 10(j) and whether the recommendations are recommended for adoption under the staff alternative. Recommendations that we consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA. All recommendations are addressed in the specific resource sections of this EA.

V. ENVIRONMENTAL ANALYSIS

In this section, the general environmental setting in the project area and the scope of our cumulative effects analysis are described. An analysis of the environmental effects of the proposed action and action alternatives is also included. Sections are organized by resource area (aquatic and recreation, etc.). Under each resource area, current conditions are first described. The existing condition is the baseline against which the environmental effects of the proposed action and alternatives are compared, including an assessment of the effects of proposed mitigation, protection and enhancement measures, and any potential cumulative effects of the proposed action and alternatives. Staff conclusions and recommended measures are discussed in section VII of the EA.

Unless noted otherwise, the sources of our information are the license application (PSNH 2003) and additional information filed by PSNH (PSNH, 2004, and 2005).

A. General Description of the Area

The Merrimack River is the second largest river in New England and has a drainage area of 5,014 square miles. The project consists of three developments, the most downstream of which is the Amoskeag development at river mile 73.2. Approximately half of the river basin area is above the Garvins Falls Dam, the most upstream of the three developments. All three developments are located in developed areas within the towns of Bow, Pembroke, Allenstown, and Hooksett and the cities of Concord and Manchester,

New Hampshire. Manchester has a population of 107,000 and Concord's population is 40,000 (2000 census). The project area experienced population growth of approximately 11% between 1990 and 2000. Upstream of Concord, approximately 80% of the land in the river basin is classified as forested, wetland, or farmland.

The project area is characterized by low, rolling hills that rise 100 to 200 feet above the valleys. The climate of the area exhibits wide variations in daily and seasonal temperatures, caused in part by proximity to the ocean and mountains. The area has four distinct seasons, with summers that are generally short and cool and winters that are long and cold. Mean temperatures in Concord are 20 degrees Fahrenheit in January and 70 degrees in July. The Concord area receives approximately 38 inches of precipitation annually, including more than 64 inches of snowfall.

B. Scope of Cumulative Effects Analysis

According to the Council on Environmental Quality's regulations for implementing NEPA (40 CFR, Section 1508.7), an action may cause cumulative impacts on the environment if its impacts overlap in time and/or space with the impacts of other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time, including hydropower and other land and water development activities.

Based on our review of PSNH's license application and agency and public comments, we identified water quality, anadromous fish, and American eel as having the potential to be cumulatively affected by the continued operation of the Merrimack River Project in combination with other activities such as other hydroelectric developments, farming, logging, construction (residential and commercial), and industrial development in the Merrimack River Basin. There are 2 mainstem dams located downstream of the Merrimack River Project in the basin as well as several dams upstream. There are 10 other FERC-licensed projects on tributaries of the Merrimack (Figure 1).

1. Geographic Scope

The geographic scope of our cumulative effects analysis defines the physical limits or boundaries of the proposed action's effects on aquatic resources. The scope of analysis for these resources encompasses the Merrimack River Basin. We chose this geographic scope because of the potential effect the project has on water quality and migratory fish in the Merrimack River Basin.

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 new 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 of past actions and effects is, by necessity, limited to the amount of available information for the resource. The quality and quantity of information diminishes as we analyze the resource further away in time from the present.

C. Proposed Action and Action Alternatives

Only the resources that would be affected, or about which comments have been received, are included in detail in this EA and discussed in this section. Based on this, we have determined that water quality and quantity, aquatic, terrestrial, threatened and endangered species, recreation, cultural, and aesthetic resources may be affected by the proposed action and action alternatives. Because no significant construction or other types of ground-disturbing activities are proposed, we have not identified any substantive issues related to geology and socioeconomics associated with the proposed action, and therefore, these resources are not assessed in the EA. Land use is discussed in the recreation and terrestrial resource sections.

1. Aquatic Resources

Affected Environment

Water Quantity

The Merrimack River drains 5,014 square miles, approximately half of which are above Garvins Falls, the project's most upstream development. The Merrimack River is regulated above the Merrimack River Project by two Corps storage reservoirs. Approximately 30 miles upstream of Garvins Falls is the Corps' Eastman Falls Project and a short distance above that is the Corps' Franklin Falls Project. Data on river flow at the project are taken from the United States Geological Survey (USGS) gaging station near Goff's Falls (No. 01092000; period of record 1937-2001), located approximately 3 miles downstream of the Amoskeag Development in Manchester, the most downstream of the three project developments. Flows at each of the developments are estimated by multiplying the Goff's Falls data by factors of 0.923 at Amoskeag, 0.907 at Hooksett, and 0.785 at Garvins Falls, to account for the smaller drainage area compared to the gage location. The 50th and 90th percentiles for flow exceedance at Amoskeag are 3,157 cfs and approximately 1,000 cfs, respectively. The highest recorded flow at Amoskeag has

been 87,503 cfs. Typically, April is the month with highest flows and August is the month with lowest flows.

Known consumptive water uses in the project area include the Pennichuck Water Works downstream of the project, which provides drinking water to the city of Nashua and is permitted at 12 to 30 million gallons per day (approximately 18 to 45 cfs), depending on river flow. There are also four entities that discharge water into the river, three of which are the wastewater treatment plants of Concord, Allenstown and Hooksett, with combined design flows of about 18.5 cfs. The Concord discharge is above Garvins Falls dam, Allenstown's discharge is in the Hooksett impoundment, and Hooksett's discharge is in the Amoskeag impoundment. Merrimack Station, a coal-fired electric plant, is permitted to discharge 397 cfs of cooling water into the river. There is also a sod farm, a nursery, and a country club that each use between 4 and 15 million gallons per year, mostly during the growing season.

At full pond, the Garvins Falls impoundment is approximately 8 miles long and 640 acres (2,700 acre-feet), the Hooksett impoundment is approximately 5 miles long and 350 acres (1,650 acre-feet), and the Amoskeag impoundment is approximately 8 miles long and 478 acres (4,320 acre-feet).

Currently there are no requirements for minimum flows in the bypassed reaches of any of the three developments. Minimum flows required by the current license in the tailwaters of each development are: 719 cfs or inflow at Garvins Falls, 819 cfs or inflow at Hooksett, and 833 cfs or inflow at Amoskeag.

Water Quality

The reach of the Merrimack River that encompasses the project area is classified as Class B by the State of New Hampshire. In general, Class B waters are to provide, where attainable, for the protection of fish, shellfish and wildlife, and for recreation in and on the surface waters. Numeric standards associated with Class B waters include, but are not limited to dissolved oxygen (DO) of at least 75 percent saturation, based on a daily average, and an instantaneous minimum DO of at least 5 milligrams per liter (mg/l), unless naturally occurring. The pH must be 6.5 to 8.0, unless due to natural causes. Class B does not have water temperature criteria. The only other criteria related to or possibly affected by the project is that existing instream water uses and the level of water quality necessary to protect the existing uses are to be maintained and protected.

PSNH continuously monitored DO and temperature during the summer of 2002, a period that was characterized by extremely low flows in the Merrimack River, and hotter than average air temperatures. Average monthly flows in July, August, and September

2002, were 1,471 cfs, 770 cfs, and 770 cfs respectively, compared to the long term historical averages of 2,459 cfs, 1,958 cfs, and 2,106 cfs. Flows during some periods of the sampling period were below the 7Q10[2] flow (650 cfs at Amoskeag). Under these conditions, the Merrimack River Project was unable to operate for much of the summer. Monitoring stations included one upstream of Garvins Falls and one in each of the development tailraces for four total stations.

During the sampling period, DO above Garvins Falls was below the 75 percent saturation standard 15 percent of the time. Consequently, there were also many days during the sampling period when DO was below state standards in the project area as well. Garvins Falls DO was below the saturation standard 44 percent of the time (instrument fouling suspected),[3] Hooksett DO was below the saturation standard 10 percent of the time, and Amoskeag DO was below the saturation standard 5 percent of the time. The study revealed that under extreme low-flow conditions (monitoring only occurred during the summer since that is the period of time agencies were concerned with), hydropower generation at the project has the potential to improve DO levels in the project tailraces. For example, when Garvins Falls generated, it tended to stabilize tailrace DO levels (compared to normal diurnal fluctuations). When generation resumed following a period of non-generation, an increase in DO was often observed. The same was true at Hooksett. DO was generally unaffected by generation in the Amoskeag tailrace. NHDES has determined that the Merrimack River, throughout the project boundary did not attain Class B standards for DO during PSNH's study period, and therefore NHDES included this reach in its 303(d) list[4] in 2004. The list does not specify the source of the impairment.

The Hooksett impoundment has the most noticeable effect on temperature, most likely because of the influence of Merrimack Station cooling water. Water temperatures were generally 2-4 degrees Celsius greater in the Hooksett impoundment than in the Garvins Falls impoundment. The effect of the Merrimack Station cooling water is

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[2] 7Q10 refers to the lowest consecutive 7-day streamflow that is likely to occur in a 10- year period. It is based on historical streamflow data for a given river or river segment.

[3] The sensor became fouled by algae and this is believed to have caused inaccurate data.

[4] The list each state is required to create every year, under the clean water act, to document water bodies which do not attain state standards for one reason or another.

noticeably reduced by the time the water travels below Amoskeag. Garvins Falls and Amoskeag appear to have little to no effect on river water temperature.

NHDES also determined, from PSNH's pH monitoring during 2002 and 2003, that the river downstream of the Hooksett Development did not attain Class B standards for pH. As with DO, the 313(d) listing did not specify the source of the impairment. Finally, the NHDES identified the three project bypassed reaches as impaired water bodies in its 2004 313(d) list, because of the lack of minimum year-round flows. The project is listed as the source of impairment.

Fisheries resources

The Merrimack River in the project area is known to support at least 33 species of fish representing 13 different families. Sport fish known to occur in the area include Atlantic salmon (rarely), brook, brown, and rainbow trout, largemouth and smallmouth bass, and chain pickerel. The fish population in the area is described as healthy and supports a good resident sport fishery primarily focused on largemouth and smallmouth bass (Normandeau 1997). In addition to Atlantic salmon, other anadromous fish include American shad, alewife, blueback herring, and rainbow smelt. American eel, a catadromous species, also occurs in the project area.

Atlantic salmon, once abundant in the Merrimack River, no longer occured in the upper Merrimack River as early as 1847, due to the construction of Essex dam in Lawrence, Massachusetts. Since 1976, an Atlantic salmon restoration program has captured sea-run adult salmon at Essex dam as brood stock for egg production. Approximately 1-2 million salmon fry are stocked annually into tributaries of the Merrimack, including the Pemigewassett and its East Branch, Souheagan, Piscatquog, Smith, Baker, and Mad Rivers. In addition to fry stockings, agencies annually stock approximately 50,000 1-year old smolts into the Merrimack River. The program has had only limited success. From 1982 until 2004, adult salmon returns at Essex have ranged from 21 to 332 fish per year, totaling 2,703 fish. In those same 22 years, approximately 10 total salmon have returned to Amoskeag which is 32 river miles upstream from Essex.

There have also been efforts to reestablish the once plentiful runs of American shad and river herring (term used to collectively describe alewife and blueback herring). Shad returns to Essex have ranged from 4,349 up to a high of 76,717 in 2001. River herring returns have ranged from 51 up to a high of 387,973 in 1989. Runs of river herring are highly variable. The last time the river herring run at Essex was over 100,000 fish was in 1992. Although designed for salmon, the fish ladder at Amoskeag passed as many as 6,000 river herring in 2004.

Very few American shad have made it to Amoskeag. Of the shad passed at Essex dam over the years, only 5 to 10 percent of them have passed upstream of Pawtucket dam in Lowell, Massachusetts, which is 11 miles upstream of Essex dam and 21 miles below Amoskeag. In studies conducted in 2002 and 2003, the Amoskeag ladder was not very effective at passing shad, although interpretation of study results is complicated by multiple attempts at adjusting flow through the ladder and the availability of shad in the tailrace to use the ladder. At this time, it is not clear whether the Amoskeag fish ladder could be effective for shad passage, with adjustments to operation, or if the design of the ladder is inherently inefficient for passing shad.

There are currently no upstream fishways at Hooksett or Garvins Falls. However, in cooperation with NHFG and FWS, PSNH notched several flashboards on the low section of Hooksett dam and river herring have been observed ascending via that route.

In addition to the Amoskeag fish ladder, other fish passage facilities at the project developments include downstream bypass systems at Amoskeag (waste gate), Hooksett (sluiceway between Taintor gate and powerhouse) and Garvins Falls (floating louvers and fish collector in the canal). These facilities are designed to provide passage for salmon smolts and juvenile clupeids. Effectiveness studies at Amoskeag and Garvins Falls have shown that these facilities are effective for smolts. Hooksett was tested with smolts in spring 2005 but the results are not yet in the record. Effectiveness studies of the downstream fishways for passing juvenile clupeids have been attempted at Amoskeag and Garvins Falls but the results have been inconclusive.

None of the downstream fishways has been tested for effectiveness at passing outmigrating eels. There is an eel trap in the lower portion of the Amoskeag fishway. In 2003 and 2004, this trap collected 641 and 2,144 juvenile eels, respectively. Currently, there are no eelways at Hooksett or Garvins Falls, however, the presence of eels upstream in the basin indicates that some passage must be occurring over the project dams.

Environmental Impacts and Recommendations

Water Quality

Other than converting project operation to ROR at all three developments and maintaining minimum flows in the bypassed reaches, PSNH does not propose any measures to specifically address water quality. Condition E-3 of the WQC requires that PSNH consult with NHDES, as well as participate and assist, to the extent necessary, in implementing a Total Maximum Daily Load (TMDL) study in the Merrimack River that would include segments at the project. AMC recommends that PSNH develop a plan to achieve compliance with temperature and DO standards, as well as a monitoring plan to

demonstrate compliance.

Staff Analysis

From the water quality monitoring conducted by PSNH in 2002, it is clear that Class B standards for DO and pH are not met in project waters, at least under extreme low flow summer conditions. It is also clear that the project is not the cause of these DO and temperature problems (except perhaps in the bypassed reaches) because measurements taken upstream of Garvins Falls showed that water quality was already impaired before it reached the project. Nevertheless, the project can influence diurnal fluctuations in DO, particularly in the tailraces, depending on how the project is being operated. The project's effects on aquatic habitat, as it relates to meeting Class B standards in the bypassed reaches, and the effects of ROR operation, are addressed below in the fisheries section.

Converting all three developments to ROR operation and providing year-round minimum flows in the bypassed reaches would minimize the project's effects on and perhaps enhance DO. This is because water would not be stored in the impoundments and flows would not be interrupted in the tailraces as under the current license when the Garvins Falls and Amoskeag developments alternate between peaking and non-generation periods. Flowing water tends to contain more DO than standing water, all other factors being equal (such as temperature, time of day, and biological oxygen demand). Within the bypassed reaches, year-round minimum flows may increase DO in the river. This is because the bypassed reaches contain riffles and shallow water with abundant gravel, cobble, and boulder substrates. Also, the minimum bypass flows would be provided by spilling water. The combination of spillage, and the depth and substrate type in the bypassed reaches would likely result in better aeration of the water than under current operation which does not provide minimum flows to the bypassed reaches.

Although PSNH may not be the cause of the DO and pH water quality impairments that NHDES includes in its 313(d) list (except perhaps in the bypassed reaches), their assistance in monitoring water quality, providing access to NHDES, and perhaps modifying project operations for relatively short periods, could be beneficial in helping NHDES conduct their TMDL study which may lead to a better understanding of the source of the impairment.

With regards to AMC's recommendation to develop a plan for achieving compliance with water quality standards, as well as monitoring to document ongoing compliance, it seems that some of these objectives would be achieved by the operational plan proposed by PSNH and discussed below. As discussed, ROR operations and year-round minimum bypass flows would likely improve DO conditions in the river. It is not

clear that PSNH could do anything at the project to alter river water temperatures and we are also not aware of any numeric water temperature standards specified by NHDES for Class B waters. Water temperature issues are most likely caused by the Merrimack Station coal-fired plant. It is possible that ROR operation and minimum bypass flows would bring DO into full compliance within project waters. We note also that the TMDL study to be conducted by NHDES could include monitoring of DO in the project boundary.

Fisheries

ROR mode of operation

Under current operation, when the Garvins Falls and Amoskeag developments peak, flows in the tailraces increase from the minimum flows required by the current license (719 and 833 cfs respectively) up to as much as 6,380 cfs at Garvins Falls and 5,640 cfs at Amoskeag, the developments' respective hydraulic capacities. Hooksett currently operates in a ROR mode. PSNH proposes to operate all three developments in a ROR mode, with a target headpond fluctuation of $\pm$ 0.25 feet. EPA and AMC concur with this proposed mode of operation, NHDES would require it under condition E-7 of the WQC, and Interior's recommendations 1, 7, and 12 recommend ROR at all three developments.

Staff Analysis

By operating all three developments in a ROR mode, flows below each development would closely match inflows. Compared to current operation, this mode of operation would better protect water quality and aquatic biota. Water would not be stored and therefore any increases in water temperature in the impoundments would be minimized. The absence of storage would also minimize the amount of time that water could be depleted of oxygen from being in contact with impoundment sediments as flowing water tends to be more highly oxygenated. Any improvements in water quality are likely to improve conditions for aquatic biota. Below the devlopments, aquatic biota would not be subject to the daily fluctuations that currently result from peaking. Populations of fish and aquatic invertebrates may experience better growth and reproduction. Within the impoundments, eliminating the fluctuations at Garvins Falls and Amoskeag may enhance riparian vegetation as well as increase spawning success for species such as bass and sunfish, which spawn primarily in the littoral zone. Any shoreline erosion, both in the impoundments and the tailraces would also be minimized by converting from peaking to ROR operations at Garvins Falls and Amoskeag.

ROR Operation Plan(s)

In response to staff's additional information request, PSNH filed a draft operation plan, on February 28, 2005, that specified and included the following:

- ROR operation at all 3 developments with impoundment fluctuation targets of ± 0.25 feet;
- minimum flows below the project developments (1,427 cfs at Amoskeag, 1,403 cfs at Hooksett, and 1,214 cfs at Garvins Falls) during refilling operations after maintenance or emergency drawdowns;
- installation of a gate to maintain bypass flows during maintenance or emergency drawdowns;
- three whitewater boating releases in the Amoskeag tailrace of 3,000 cfs, including the last weekend in June, one pre-planned weekend in September; and on pre-planned weekend day in October; and
- procedures for agency notification for emergency drawdowns.

NHDES and Interior concur generally with the operational measures proposed in the draft operations plan, but there are some differences or additional measures that the agencies want PSNH to implement. The WQC issued by NHDES requires, under Condition E-6, an evaluation of the ability of the developments to maintain constant water surface elevations (± 0.25 feet) and/or constant downstream flows during times of daily power generation. This plan was to be completed by September 30, 2005 and a report submitted to NHDES by October 31, 2005. To date, there is nothing in the record to indicate the status of this evaluation. The results of the evaluation are to be used to develop the operations plan required by Condition E-7 of the WQC. Until the project is operating in ROR mode according to an approved operations plan (as required by Condition E-7), PSNH must release minimum flows in the project tailwaters of 719 cfs at Garvins Falls, 819 cfs at Hooksett, and 833 cfs at Amoskeag (same as minimum flows under current license).

Condition E-7 requires, in addition to the ROR mode of operation, an operations plan that includes details on how impoundment levels would remain constant while preventing un-natural fluctuations of river flows downstream from the project dams in the tailwaters, how compliance would be monitored and provided to the agencies, detailed descriptions of how minimum bypass flows would be maintained during drawdowns, contingency procedures for flashboard failures and emergency shutdowns, descriptions of how water would be distributed to the east and west channels of the Amoskeag bypassed reach, and a description of how the tailrace and bypass channel flows would be impacted when inflows are less than the sum of the respective minimum flow requirements. This operations plan would be prepared in consultation with NHDES, FWS, NHFG, and EPA

and would allow for exceptions to ROR operation if granted by the agencies. The operations plan would be implemented, including the construction of the minimum river flow release structure, no later than 90 days after license issuance. Interior's 10(j) recommendations 6, 11, and 16 are for ROR operation monitoring plans for the three respective developments.

Staff Analysis

Having a detailed ROR operation plan in place helps verify compliance with license conditions. In this case, since there are three developments, each with a somewhat unique configuration, such a plan would address not only normal operating procedures, but also development-specific procedures for conditions beyond what is considered normal. For example, how flows would be maintained in instances of flashboard failure, maintenance or emergency drawdowns, during whitewater boating events, or extremely low river flows. PSNH's draft operations plan does not, as yet, address these situations in enough detail to monitor compliance. A more detailed operation plan would help avoid misunderstandings about how certain atypical conditions are to be handled. Final operation plans could be developed for each development or combined into a single operation plan for the entire project, as long as procedures for maintaining compliance at each development are sufficiently detailed.

Tailrace Minimum Flows

As mentioned above, PSNH proposes to maintain minimum flows in the tailraces of 1,427 cfs at Amoskeag, 1,403 cfs at Hooksett, and 1,214 cfs at Garvins Falls during refilling operations after maintenance or emergency drawdowns. Interior's 10(j) recommendations 4, 10, and 15 are for minimum flows below the respective developments during impoundment refilling operations. Interior's refilling minimum flows match those proposed by PSNH, including the provision that in the event inflows are less than the specified minimum flows, 90 percent of inflow would be released in the tailraces.

Staff Analysis

The minimum downstream flows proposed by PSNH and recommended by Interior during periods of impoundment refilling are based on the aquatic base flow method, determined by multiplying the drainage area by 0.5 cfs. This amount of flow is thought to simulate typical median August flow conditions in New England. Providing such flows below each of the project developments should protect aquatic resources during impoundment refilling because organisms are adapted to similar low flows during the dry summer months. In the event that inflows to the project are less than these aquatic base

flows, releasing 90 percent of inflow below the project should minimize any adverse impacts, while allowing the impoundment to refill so that ROR operation could resume.

Whitewater Boating Releases

As noted, PSNH proposes to provide three whitewater boating flows of 3,000 cfs below Amoskeag, one during the last weekend in June, one in a pre-planned weekend in September, and one in a pre-planned weekend day in October. Interior's 10(j) recommendation 5 would allow up to three weekend whitewater boating releases per year, by mutual agreement between NHFG and FWS, none of which would be during the upstream fish passage season, which is April 1 through June 30 (April 1 through November 15 for eel). Also, no whitewater releases would be allowed until the spillway bypass gate is installed to ensure no interruption of minimum bypass flows. AMC wants additional weekly flow releases on one weeknight per week between June and October.

Staff Analysis

Flows of the magnitude proposed or recommended for whitewater boating (3,000 cfs) could have minor, short-term effects on aquatic resources in the Amoskeag tailrace. They would, however, be well within the range of flows that routinely occur due to natural storm events. For example, a flow of 3,000 cfs is exceeded at the project about 85, 40, 13, 8, 7, and 20 percent of the time, respectively, during the months May through October. So, even from July through August, a flow of 3,000 cfs occurs, on average, 2-4 days per month. Fish and other organisms should respond to these boating releases in the same way they respond to fluctuations caused by storm events.

There is the potential that flow releases could generally disrupt aquatic habitat if the higher flows are released more frequently. For example, the AMC recommended weekly flow releases could have a disrupting effect on aquatic habitat that is intermediate between strict ROR and daily peaking. Thus, a portion of the aquatic habitat benefits of changing to ROR operation would be negated.

Additionally, during operation of the fish ladder at Amoskeag, such fluctuations in flows, whether due to natural or project-related causes, could affect fish passage effectiveness. This effect could be beneficial or adverse. We do not think that sufficient information exists at this time to determine what the effect would be. It could be that higher tailrace flows would interfere with attraction flows at the fish ladder, or it could be that the boating releases could draw more fish into the tailrace area. Those fish may in turn use the fish ladder in greater numbers once the flows were ramped back down to ROR. The only way to know for sure what effect the boating releases would have would be to monitor fish activity before, during, and after the release. The only way to

completely avoid any effect on fish passage (beneficial or adverse) would be to schedule boating releases during times when the fish ladder is not being operated, as Interior recommends.

If the whitewater boating releases occur during times when inflow to the impoundment is less than the boating release scheduled, then the Amoskeag impoundment would be drawn down to some degree. The amount of the drawdown, and therefore the potential effect on littoral zone aquatic habitat (such as dewatering of sunfish spawning habitat), would depend on the amount of inflow and the duration of the release. Consultation with the agencies on the timing and duration of whitewater boating releases would minimize the potential for habitat in the Amoskeag reservoir to be adversely affected.

Ramping Rates

PSNH, by letter dated July 15, 2005, proposed ramping rates for flows below the developments that would apply during times when the developments deviated from ROR mode, such as following drawdowns or whitewater flows (1,550 cfs change per hour (hr) at Amoskeag, 1,500 cfs/hr at Hooksett, and 1,377 cfs/hr at Garvins Falls). Their purpose is to ensure that the transition between non-ROR operational periods and ROR operation has a minimal effect on aquatic resources below the project.

Interior's recommendations 2, 8, and 13 include ramping rates for Amoskeag, Hooksett, and Garvins Falls of 1,427 cfs/hr at Amoskeag, a 1,403 cfs/hr. at Hooksett, and a 1,214 cfs/hr at Garvins Falls.

PSNH objects to Interior's recommended ramping rates and instead proposes the flows listed above as a component of their operations plan, which correspond to the respective developments' single unit hydraulic capacities. PSNH argues that Interior's ramping rates are very close to PSNH's proposal, but PSNH's proposal would simplify operations, reporting, and monitoring because operating a single unit at full hydraulic capacity would be easy to document compliance with, and the difference between the two ramping proposals is insignificant. PSNH also notes that Interior's ramping rates may require installing gaging equipment in the tailrace and, thus, would be more expensive.

Staff Analysis

PSNH's and Interior's ramping rates are similar. The difference in river stage between a flow of 1,500 cfs and 1,400 cfs below Amoskeag is probably on the order of 1 inch and is likely to be insignificant from a biological standpoint. By ramping flows down in a gradual manner, fish would be less likely to be stranded in any isolated pools of

water. However, we note that there does not appear to be any evidence in the record that fish stranding is a problem under current operation, which includes peaking and no ramping rates. PSNH's proposed ramping rates would probably be easier and less costly implement and monitor because no gaging equipment would be necessary. With PSNH's ramping rates, the operator and agencies would know the rate of flow change based on the number of units in operation.

Bypassed Reach Flows

Under current operation, there is only leakage flow in the three the project bypassed reaches, except during periods of high flow (above the developments' hydraulic capacity) when the bypassed reaches receive spillage, typically in the spring.

PSNH proposes to provide continuous year-round minimum flows in each of the three project bypassed reaches, in accordance with the flows required by condition E-5 of the WQC (see Appendix A). Interior and EPA concur with the bypassed flows proposed by PSNH for Garvins Falls and Hooksett, but recommend higher flows for the Amoskeag bypass.

At Amoskeag, PSNH is proposing a year-round minimum release of 280 cfs from the eastern spillway plus a flow of 149 cfs from the fish bypass gate from April 1 to June 30 and September 15 to October 31 (fish passage seasons). Interior and EPA recommend that the year-round flow from the eastern spillway be 410 cfs instead of 280 cfs. PSNH, NHDES, Interior, and EPA all base their proposals, recommendations, and conditions for bypassed reach flows on habitat-based flow studies conducted by PSNH, in consultation with the agencies, during 2003 and 2004. For Amoskeag, the studies included an analysis of weighted useable area (WUA) over a range of flows for a variety of species and life stages. For Hooksett and Garvins Falls, several flow demonstrations were observed and evaluated by agency personnel. For Hookett, PSNH proposes, and the agencies recommend, a year-round minimum flow of 64 cfs. For Garvins Falls, PSNH proposes, and the agencies recommend, a year-round minimum flow of 55 cfs in the main bypassed channel in addition to a flow of 23 cfs year-round through the downstream fish passage and canal waste gate channel.

Staff Analysis

Amoskeag. This bypassed reach is about 2,000 feet long, and contains about 18 acres of aquatic habitat. Transects were selected in consultation with the agencies to best represent the types and relative proportions of habitat in the bypassed reach (pools, riffles, and runs). Because of the nature of the bypassed reach, some transects included more than one habitat type. Habitat conditions were quantified in the field at 10 transects,

under flows of 50, 150, 280, and 410 cfs. Then, WUA for various life stages of smallmouth bass, longnose dace, common shiner, fallfish, and blueback herring were calculated for each set of flow conditions, using PHABSIM.[5] WUA for aquatic macroinvertebrates (mayflies, stoneflies, and caddisflies) was also calculated over the same range of flows.

For the majority of fish species and life stages, the most WUA occurs at a flow of 280 cfs, although some would have more habitat with lower flows and some show a small gain in habitat at the 410 cfs flow. Since water velocities increase with flow, generally the fish that would do best at flows less than 280 cfs are those that prefer slower water, such as adult smallmouth bass and common shiner, as well as the fry of many species. The species and life stages that would benefit from 410 cfs are adult and juvenile longnose dace (gain in WUA of approximately 24 percent from 280 cfs to 410 cfs for adults, less gain for juveniles). For aquatic macroinvertebrates (mayflies, stoneflies, and caddisflies), the amount of habitat approximately doubles from a flow of 50 cfs to 280 cfs, but then increases only slightly from 280 cfs to 410 cfs (gains in WUA of about 2-5 percent from 280 cfs to 410 cfs, depending on group of macroinvertebrates). Figure 5 summarizes the flow versus WUA relationship for all species and life stages studied.

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[5] A computer model that calculates habitat values between and beyond actual measured data by using river stage/flow relationships and known species and life stage habitat suitability data for depth, velocity, and substrate type.

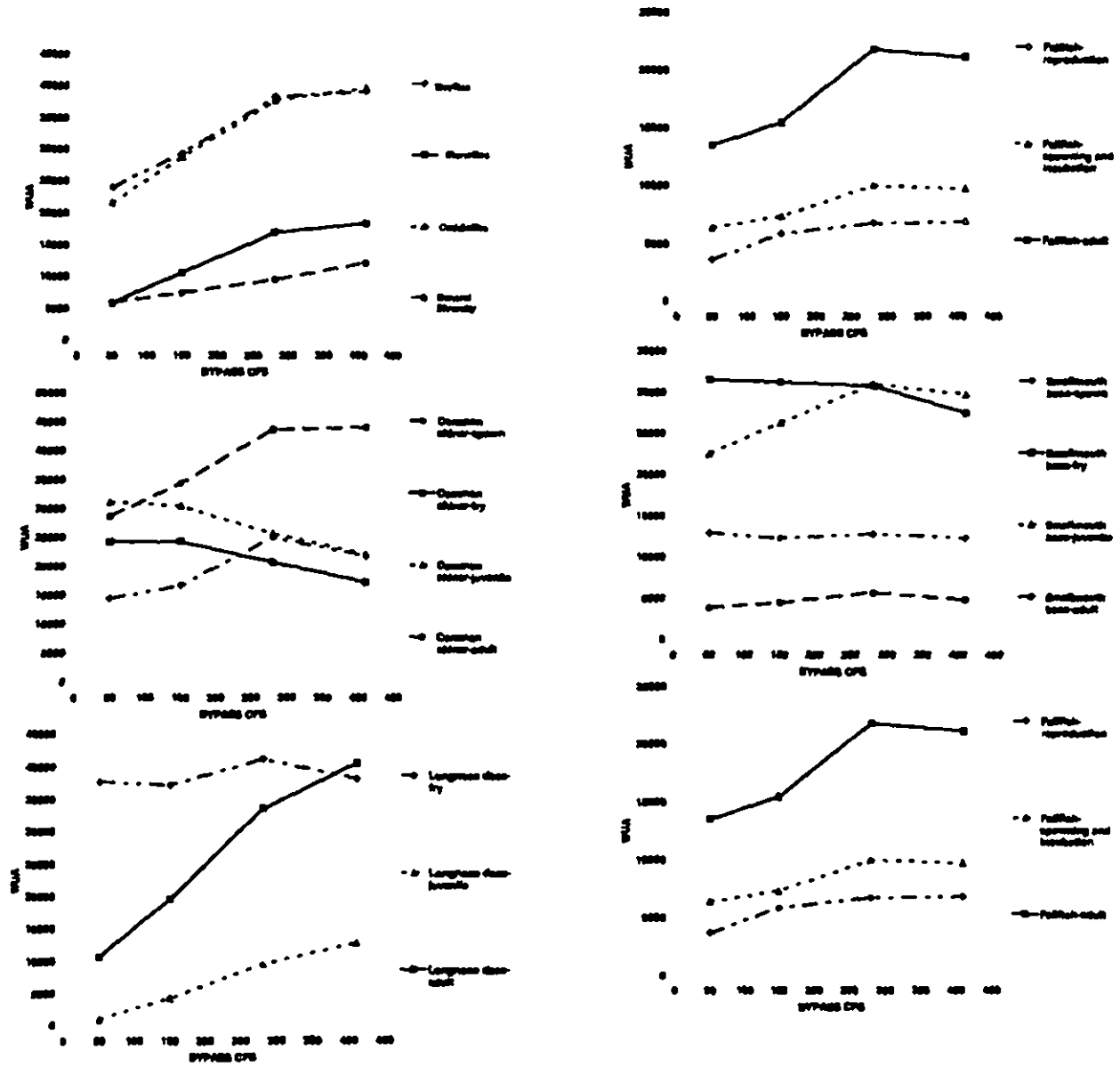

Figure 5. Flow versus WUA for aquatic insects and several fish species and life stages in Amoskeag bypassed reach (Source: PSNH as modified by staff).

One of the areas the agencies are primarily interested in is called riffle 16, which is the southern segment of the west channel. The flow versus WUA relationship for riffle 16 mimicked that for the entire bypassed reach. That is, for most species and life stages studied, a flow of 280 cfs provided higher WUA than 410 cfs.

Hooksett. This bypassed reach is only about 300 feet long and contains about 1.44 acres of aquatic habitat. During pre-filing consultation the agencies agreed that a

PHABSIM analysis was not necessary for this reach. Instead, PSNH conducted a flow demonstration study based on field observations and professional judgment of agency and PSNH personnel. The most valuable aquatic habitat in the reach is a wide riffle in the center and western portion. Flows of 7, 15, 26, and 64 cfs were observed. The agencies concluded that adequate depth across the riffle and overall habitat conditions in the bypassed reach were provided at a flow of 64 cfs. We reviewed video taken during the studies. It appears that a flow of 64 cfs, released from the west side of the spillway, would improve aquatic habitat in the Hooksett bypassed reach, although we have no quantitative data to assess how much the habitat would be improved. Wetted width does not appear to change substantially as flow increased from leakage to 64 cfs, but increases in the depth of the pools and water velocity throughout the bypassed reach appear to create more diverse habitat. Of the 4 flows observed, 64 cfs appears to provide the best quality habitat.

Garvins Falls. This bypassed reach overall is only about 650 feet long and includes a main bypass channel downstream from the spillway, and two additional smaller channels that provide flow from the power canal headrace and merge with the main bypassed channel. The main bypassed reach contains about 2.5 acres of aquatic habitat. During pre-filing consultation, the agencies agreed that a PHABSIM analysis was not necessary for this reach. Instead, PSNH conducted a flow demonstration study based on field observations and professional judgment of agency and PSNH personnel. By observing flows, agency personnel concluded that an acceptable distribution of flow through the main bypassed channel was provided by 55 cfs. An additional flow of 23 cfs in the downstream fish passage and canal waste gate channel was judged to provide full wetted width and adequate depths of 1 foot or greater. The 55 cfs was provided by removing a flashboard in the middle of the dam plus leakage from the canal. The 23 cfs can be provided by either the downstream fish passage system or via the canal waste gate. We reviewed video taken during the studies. It appears that bypass flows of 55 cfs and 23 cfs released from the locations discussed, would improve aquatic habitat in the Garvins Falls bypassed reach, although we have no quantitative data to assess how much the habitat would be improved. Wetted width does not appear to change substantially, but increases in the depth of the pools and water velocity throughout the bypassed reach appear to create more diverse habitat. Flows other than 55/23 cfs were not observed.

Fish Passage

PSNH proposes to finalize a fish passage plan, in consultation with the agencies, and according to their alternative fishway prescription filed with Interior on December 20, 2005 (see detailed measures proposed in Section IV E.2).

WQC condition E-8, would require that PSNH enhance upstream and downstream

passage at the project according to the prescriptions defined 1986 Comprehensive Plan for Provision of Anadromous Fish Passage Measures and Facilities at PSNH's Merrimack-Pemigewasset River Hydroelectric Dams (Volume 6 of PSNH 2004). Under this agreement, PSNH is to test the effectiveness of the Amoskeage fish ladder and the three downstream fishways and, in the event that passage targets at Amoskeag reach specified thresholds, construct and test new upstream fishways at Hooksett and Garvins Falls. All of the existing fishways have been tested for effectiveness, although not all study results are conclusive, as discussed below.

Interior has both reserved its authority to prescribe fishways and provided a preliminary fishway prescription for all three developments. Interior's preliminary prescription is detailed in section IV.E.2. In general, Interior's preliminary prescription would require a 4-foot Denil fishway at the Amoskeag spillway (if determined necessary by Interior), a rock ramp upstream fishway at Hooksett, and a fish lift at Garvins Falls, to be operational within 3 years of passage of defined trigger numbers of shad or river herring at the next downstream development. The trigger numbers are lower than in the 1986 Comprehensive Plan and the period between passage of the trigger numbers and fishway operation is reduced from 5 years to 3 years. The preliminary prescription also requires additional effectiveness studies on the existing downstream fishways for passing juvenile clupeids and eels, an upstream eelway at Hooksett (operational by the second spring following project license issuance), and installation of an eelway at Garvins Falls to be operational by the second spring following passage of eels at Hooksett. The preliminary prescription also contains reservations of authority to modify the conceptual designs contained in it, as well as to require additional downstream fishways if the existing ones are not effective for passing juvenile clupeids or eels.

In general, PSNH's position is that, considering the current status of the anadromous fish runs below the Merrimack River Project, and the uncertainty of future restoration progress and fishway technology and costs, their alternative prescription, combined with a reservation of authority to require future fishways as may be prescribed by Interior, is adequate at this time. Apparently, NHDES agrees with this approach, as the WQC requires adherence to the agreements made in the 1986 Comprehensive Plan. With the exception of measures for eels (which were not a species of concern in 1986), the 1986 plan is consistent with PSNH's alternative prescription. Interior's preliminary prescription, however, indicates that it believes the target numbers and timing of construction need to be revised. Although they provide conceptual design drawings for each development, they acknowledge that future technology may dictate that other designs are more appropriate for each site. One thing all parties seem to agree on is that the downstream fishways have been proven effective for salmon smolts but not for juvenile clupeids or eels (PSNH 2004, Interior's preliminary prescription).

PSNH, in its December 20, 2005 alternative fishway prescription, proposes to shorten the seasons of fishway operations compared to the seasons preliminarily prescribed by Interior. For upsteam eel passage, PSNH's proposal to curtail fishway operation on October 15 instead of Interior's prescribed date of November 15. PSNH states that during the past two years, upstream passage of eels has declined or ceased at the end of September. For downstream passage of eel, shad, and river herring, PSNH suggests ending the passage season on October 31 instead of November 15, based on the observations that river temperatures drop and fish out-migration tends to be over by the end of October.

Staff Analysis

American shad, river herring, and Atlantic salmon

Fish passage at the Merrimack Project has been an issue for over 20 years. The 1986 Comprehensive Plan generally required the construction of the Amoskeag fish ladder, target passage numbers that would trigger upstream passage facilities at Hooksett and Garvins Falls, investigation of downstream passage alternatives at all three developments, and effectiveness studies of all fishways some of which have been completed successfully and some of which have been inconclusive due to test fish mortality and low numbers of naturally migrating fish. At this point, the Amoskeage fish ladder is in operation, as are downstream fishways at all three developments. All the fishways have been determined to be effective for salmon smolts and the effectiveness of the fishways for shad and river herring are not known, primarily due to the lack of natural runs of fish during the times effectiveness studies were attempted.

For restoration of shad and river herring, the current obstacles seem to be a combination of 1) low numbers of fish entering the Merrimack River, and 2) ineffective passage at one or more of the dams downstream of the Merrimack Project. For salmon, restoration obstacles may not even be in the Merrimack River Basin, but may instead be in the ocean from a combination of factors such as commercial fishing, low ocean survival due to causes other than fishing, disease, genetics, or other factors including some that may not have yet been identified by researchers.

The existence of well-designed, efficient fishways does not guarantee fish restoration success. Only when the fish are there to use them do they serve any useful purpose. The fishway most likely to be necessary in the near future would be the fishway on the Amoskeag spillway. This is because once the bypassed reach has year-round minimum flows, it is likely that shad and river herring would be attracted to that area and require passage.

In regards to passage triggers and timing of future construction, we note the highly variable nature of anadromous runs historically. For example, the fish ladder at Amoskeag was put into operation in 1988, presumably in response to relatively encouraging runs of all three species (including salmon) in the mid-1980s. However, while those passage triggers caused the Amoskeag fish ladder to be built, the ladder has not been used by very many fish, especially considering the relatively large runs of river herring in the late '80s and early '90s, and the fairly steady and encouraging runs of shad since the mid-1990s. A longer time frame and the higher passage triggers contained in the 1986 Comprehensive Plan would seem to make more sense than Interior's preliminary prescription. Another approach would be for the trigger numbers to be averages over a certain time period, such as 3 years. That way, if a "boom" year was followed by a "bust" year, fishway construction could be put on-hold. This could potentially avoid building future unused fishways.

Optimizing the effectiveness of existing fishways makes sense. However, there are inherent problems in study plan design associated with using test fish (especially clupeids) that would not otherwise be in the project area. First among these is the high test fish mortality caused by handling stress. Fish that are stressed cannot reasonably be expected to behave the same way that wild, naturally present clupeids would. Over the last several years, several studies of passage effectiveness have been conducted at considerable effort and expense, yet none involving clupeids (adult or juvenile) have provided useful or conclusive information. These include the adult shad video monitoring studies at Amoskeag in 2002 and 2003, downstream passage effectiveness study for clupeids at Amoskeag in 2003, and a downstream passage effectiveness study for clupeids at Garvins Falls in 2003. There are additional clupeid downstream passage effectiveness studies planned at Hooksett in 2006. If and when there are enough naturally occurring clupeids in the river would be the best time to determine fishway effectiveness for clupeids.

Regarding the rock ramp upstream fishway preliminarily prescribed for Hooksett, we are not aware of other rock ramp applications at similar sites. However, if and when an upstream fishway at Hooksett is warranted, we would expect that Interior would rely on the most up-to-date information regarding rock ramp fishway success at other sites to determine if the rock ramp type of fishway is still appropriate. As we noted earlier, river herring have been observed passing over the low portion of Hooksett dam. This implies that there may be simpler, less expensive, but effective means of passing some species at Hooksett. Effective upstream passage at Hooksett could potentially benefit shad and river herring, if the adult fish are present and if lack of access to upstream spawning and nursery habitat is currently limiting populations. At this time, adult fish are not present in significant numbers and it is unknown whether upstream habitat is necessary for population growth. If adult salmon are ever present at Hooksett, then an upstream

fishway could benefit them as well, although with the jumping ability of adult salmon, the spillway sections at Hooksett are almost certainly passable now.

As with the rock ramp fishway at Hooksett, the fish lift preliminarily prescribed for Garvins Falls could potentially benefit shad and river herring populations, but we note same caveats. The adult fish would need to be present and the river upstream of Garvins Falls would need to have value as spawning and nursery habitat. Fish lifts, when properly located, designed, and operated, are known to be effective for passing shad and river herring, as well as numerous other species, including salmon.

In summary, it is unclear why Interior, given the current status of anadromous fish runs (shad, herring, and salmon), has chosen to do anything more at this time than request a reservation of authority. It seems clear that the reason for lack of successful fish passage at the Merrimack Project, is the lack of fish, not the lack of fishways or a fishway plan. Replacing the 1986 Comprehensive Plan with Interior's preliminary prescription would not fundamentally change the situation.

American eel

For American eel, the situation is different than for shad, herring, and salmon. For the latter species, the status of the populations are known and design criteria for effective fishways is relatively well-understood. For eel, the status of the population in general has agencies concerned[6] but the status of the eels in the Merrimack River is essentially unknown. All that is known is that they have been collected in the river, and in all three project reservoirs. Population numbers or trends are not known and since eel do not home like clupeids and salmon, improving passage in a river basin may not have an effect on eels in that particular basin. The 1986 Comprehensive Plan does not mention eel because they were not a species of concern when it was issued. If PSNH finalizes a fish passage plan, as it proposes, including the agency management goals, as well as completed and planned eel passage activities at the project and in the basin, that would help focus future efforts on filling in missing information on this species.

Upstream eelways are inexpensive and effective if placed in the proper location, where eels are naturally attracted. They may not be necessary because eels are already upstream of all the dams and, therefore, have demonstrated the ability to get over these dams. Nevertheless, if the upstream eelway at Hooksett is constructed, and a future

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[6] In 2000, the Atlantic States Marine Fisheries Commission published the "Interstate Fishery Management Plan for American Eel" citing declines in populations on the East Coast.

eelway at Garvins Falls is also built, they should make it easier for juvenile eels to move upstream. The presence of upstream eelways, however, may or may not increase eel populations in the project area.

The prescribed downstream passage effectiveness studies for eel at all three developments could be important and potentially helpful. That is because, presently, designs for downstream eel passage are considered experimental. All three downstream passage facilities at the project were designed for salmon smolts and clupeids, which are known to usually migrate near the surface. Out-migrating adult eels may migrate near the bottom, but this is not known for sure. Therefore, it is not known whether the existing downstream fishways are effective at passing eels. We note that there is nothing in the record to indicate that entrainment or impingement mortality of adult eels is a problem at this project. If adult eel mortality is currently affecting eel populations, and if the existing or future downstream fishways are effective at passing adult eels, then such fishways may benefit eel populations, either in the project area or in whatever river basin to which the juvenile eels migrate.

For all of the migratory species of concern in the basin (shad, river herring, salmon, and eels), Interior's reservation of authority to prescribe or modify fishways in the future would allow the flexibility to address project specific and basin-wide fisheries management issues during the term of the license.

Seasonal Timing of Fishway Operations

PSNH's proposed shortening of the fishway operational seasons would have no effect on fish passage success if, in fact, fish migrations are completed by the dates that PSNH suggests. However, dates of fish migration do vary from year to year and further monitoring and analysis would need to be completed to determine if shortening the seasons of operation is prudent. Existing data on run timing of fish at the Merrimack Project do not appear to be adequate to make this determination at this time. This question could be answered if fish run timing is a component of the final fish passage plan proposed by PSNH.

Cumulative Effects Analysis

Water Quality. Water quality in the Merrimack River has some documented problems, such as DO and pH. The Merrimack Project probably only has the ability to influence DO. As discussed above, ROR operation and year-round minimum flows in the bypassed reaches could increase DO in project waters. Because ambient water quality at any given location in a river is influenced by both local and basin-wide factors, higher DO in the project area could result in higher DO in the Merrimack River at locations further

downstream. Additionally, if the TMDL study conducted by NHDES results in any recommendations for DO-related measures, and if those measures are implemented in the future, an additional increment of DO improvement could occur. Therefore, the measures proposed by PSNH and recommended or required by the agencies, and addressed in this EA, have the potential to cumulatively and beneficially affect DO in the Merrimack River downstream of the project.

Anadromous Fisheries. Anadromous fish restoration programs, by their nature, are made necessary, at least in part, by the cumulative effects of dams within river basins. The Merrimack River anadromous fish restoration programs for Atlantic salmon, American shad, river herring, and the catadromous American eel are no exception. The success of such programs is also determined, at least in part, by the cumulative efforts of agencies and dam owners to provide effective fish passage. Increasing the passage capability and efficiency throughout the basin is one element in successful restoration of migratory fish populations. However, other factors such as numbers of fish entering the mouth of the river, abundance and quality of spawning and nursery habitat within the river and its tributaries, production capacity of those spawning and nursery habitats, stocking efforts, disease, commercial and recreational fishing, water quality, and other factors, all effect restoration success. If migratory fish numbers increase at the Merrimack River Project, and if the proposed and prescribed measures and facilities are implemented, and if the measures and facilities operate in an effective manner, then the measures and facilities addressed in this EA could have beneficial cumulative effects on migratory fish populations in the Merrimack River.

Unavoidable Adverse Impacts

None.

2. Land Use and Terrestrial Resources

Affected Environment

General Land Use

Land use within the Merrimack Project boundary includes utility facilities, open water, recreational development, and open space. The power generation and associated facilities are located around the three project dams on land owned in fee by PSNH. These facilities include the three dams and adjacent powerhouses and the Amoskeag Fishway and Interpretative Center. The remainder of the lands and waters within the project boundary are located directly along the approximately 25 miles of the Merrimack River from Manchester to Concord. PSNH has flowage rights over these river and shoreline

lands to the level of pondage created by use of the dam flashboards. These lands and waters are mostly undeveloped and are open space and impoundment.

Land use adjacent to the project boundary includes open space, residential, commercial, recreational, farmland, and industrial. Beginning at the most upstream portion of the Garvins Falls impoundment, the project is bordered by agriculture, conservation lands, and open space. At the City of Concord, the lands adjacent to the impoundment are commercial and industrial. The adjacent land use then returns to open space until reaching the Garvins Falls development. Immediately downstream of the Garvins Falls development, the land use adjacent to the Hooksett impoundment is a combination of open space, recreation, and residential. Land use adjacent to the Amoskeag impoundment is a mix of residential, recreation, and open space with a larger amount of residential development than either of the other two impoundments. As the impoundment flows into the city of Manchester, the adjacent land use is a mix of industrial, commercial, and residential.

There is some shoreline development throughout the project. Private boat docks along the downstream end of the Amoskeag impoundment are used by residents living along the Merrimack River adjacent to the project boundary. There is urban development along the Garvins Falls impoundment in Concord, and recreation sites interspersed along all three impoundments. Most of the remaining project shoreline does not have shoreline development, with the exception of a few small, public boat docks. The wetlands, floodplains, state and town lands, protected lands, recreation access sites, and railroad right-of ways along the shoreline limit future shoreline development.

Vegetation

New Hampshire is heavily forested with an abundance of elm, maple, beech, oak, pine, hemlock, and fir. Wetlands in the project vicinity were mapped in September 2002. The Merrimack River has carved into the surrounding bedrock and therefore has steep high banks with very few wetlands. A relatively small portion of the riverbed, generally those areas associated with the junction of tributaries, small drainages, and groundwater seeps that feed the river, contains wetlands. The most extensive of these occurs at the upstream end of the Garvins Falls impoundment, although there are small pockets throughout the project area. These primarily forest and shrub wetlands along the Merrimack River receive over-bank floodwater and are very important flood storage areas. These wetlands also serve as groundwater discharge locations and supply groundwater to the Merrimack River. This contributes to the flow and moderates water temperature, which is important to the river's biological health during hot, dry summers. The forest and shrub wetlands are typically dominated by silver and red maple and other common tree associates and the shrubs silky dogwood, arrow-wood, highbush blueberry,

and winterberry holly. The wetlands provide food, cover, and breeding habitat for a diversity of animal species.

There are a few small areas of invasive plant species throughout the project area with purple loosestrife and common reed. Small populations of the slightly invasive curly pondweed occur near and south of the Hooksett dam near the boat ramp.

Wildlife

Developed and open spaces at the project are inhabited by gray, raccoon, skunk, European starling, Canada goose, deer, fox, coyote, and woodchuck. New England cottontails, which have been petitioned for federal listing, are located in upland areas adjacent to the project.

Softwood stands provide preferred habitat for pine warbler and red squirrel. These stands are important for the winter survival of deer. In addition, deer like dense stands of hardwoods, which are also utilized by wild turkey, blue jay and chickadee.

Wetlands near the project provide a travel corridor for large mammals such as deer, moose, black bear, and coyote. Several water-dependent furbearers frequent the wetlands and river within the project area: beaver, river otter, muskrat, and mink. These mammals, along with fish and waterfowl, also depend on the emergent wetlands and aquatic vegetation found throughout the project. Below Amoskeag dam, the bypass channel pools (present when bypass is dewatered) are heavily used by waterfowl. Resident waterfowl species include black duck, wood duck, common merganser, and hooded merganser. Mallard and Canada goose are year-round residents at the project. Other waterfowl species are attracted to the impoundments during migration.

Threatened and Endangered Species

The federally threatened bald eagle makes extensive use of the project area. Foraging may occur in all sections of the river, but most important are the areas associated with thermal discharges, dams, and falls that remain free of ice throughout the winter. Roughly a third of the river within the project boundary is identified as known perching and foraging habitat, and several tracts of land adjacent to the river are identified as known or potential roosting areas. Undeveloped lands and various conservation lands adjacent to the project provide perching, night roosting, and potential nesting habitat. Habitat elements of primary importance to bald eagles include ice-free water for winter foraging and riparian forests buffered from human activity and weather, with large, open-crowned trees.

Environmental Impacts and Recommendations

Project Operation

PSNH proposes to convert all three developments to ROR operation and provide minimum flows in the bypassed reaches. Interior's 10(j) recommendations are consistent with these proposals.

Staff Analysis

Under current operation, the daily pool fluctuation is about 1 foot or less at Hooksett and Garvins Falls, and up to 1.5 feet at Amoskeag. Wildlife present in the project area are adapted to the large water elevation changes that are inherent to northeastern rivers, such as spring snowmelt and heavy precipitation events. Given this and the effects of ice scouring, it is likely that the plants and animals are adapted to a dynamic disturbance of their environment that makes the current water level fluctuations insignificant. In addition, rooted wetland plants being fed by groundwater discharge are not appreciably dried out by present operations.

The proposed conversion to ROR operation would decrease water level fluctuations in the project's impoundments, and the proposed minimum flows would prevent the dewatering of the bypassed reaches. Since current operation does not significantly impact wildlife, this would either have a neutral or slightly beneficial effect on wildlife by stabilizing riparian habitat at all three developments. Because of their propensity for denning near water, water-dependent furbearers such as beaver and river otter may benefit from the relative water level stability afforded by the project area impoundments. Emergent and fringe wetlands that depend partly or entirely on input from surface water could likewise benefit by a reduction in impoundment fluctuations and the provision of flows in the bypassed reaches.

Garvins Falls Conservation Easement

PSNH proposes to protect, with a conservation easement[7], a 200-foot buffer zone on its Garvins Falls property to protect 2.9 miles of undeveloped riverfront (figure 6).

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[7] PSNH has met with the Society for the Protection of New Hampshire Forests (Society) to discuss their potential interest in holding the conservation easement on this riverfront corridor. The Society has expressed an interest in holding a conservation easement deed with a purpose aimed at riparian protection. PSNH and the Society have agreed to pursue due diligence and hope to bring PSNH's proposal before the Society's Board of Trustees in 2005.

The easement would be outside the project boundary and would specifically exclude any land that is currently within the project boundary. PSNH is also willing to grant conservation easements[8] on the two islands just below its Amoskeag dam.

Interior agrees with the proposed Garvins Falls property conservation easement and includes the development of a conservation restriction plan for the Garvins Falls tract in its 10(j) recommendation 17. However, Interior disagrees with the 200-foot buffer zone limit since it considers this an important tract of land facing substantial development pressure. Interior feels that the easement should be more expansive than proposed and include a wedge of land owned by PSNH along the Soucook River that provides additional riparian zone protections at the mouth of that tributary, as well as wider buffers near areas populated by rare plants and communities.

The Appalachian Mountain Club, New England FLOW, American Whitewater, and New Hampshire Rivers Council (AMC et al.) recommend a perpetual conservation easement at Garvins Falls that extends beyond 200 feet to defined boundaries such as roads or railroad right-of-ways to make for easy and less expensive monitoring of the easement.

Concerned Citizens of Bow (CC Bow) also recommend expanding the proposed Garvins Falls conservation easement beyond 200 feet in order to protect habitat for bald eagle and other state and federal rare, threatened and endangered species.

In reply comments filed June 30, 2005, PSNH states that protection of their entire Garvins Falls parcel would be inappropriate because such restriction measures on approximately 400 acres of prime development land would constitute an unlawful taking of private property for public use. PSNH maintains that protection of the proposed approximately three-mile-long, 200-foot buffer zone by conservation easement is reasonable based on the needs of the resources and the impact of providing additional protection on project economics. PSNH also notes that their proposed easement includes land along the Soucook River that Interior identifies as significant habitat.

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[8] The potential holder of this easement has not yet been identified.

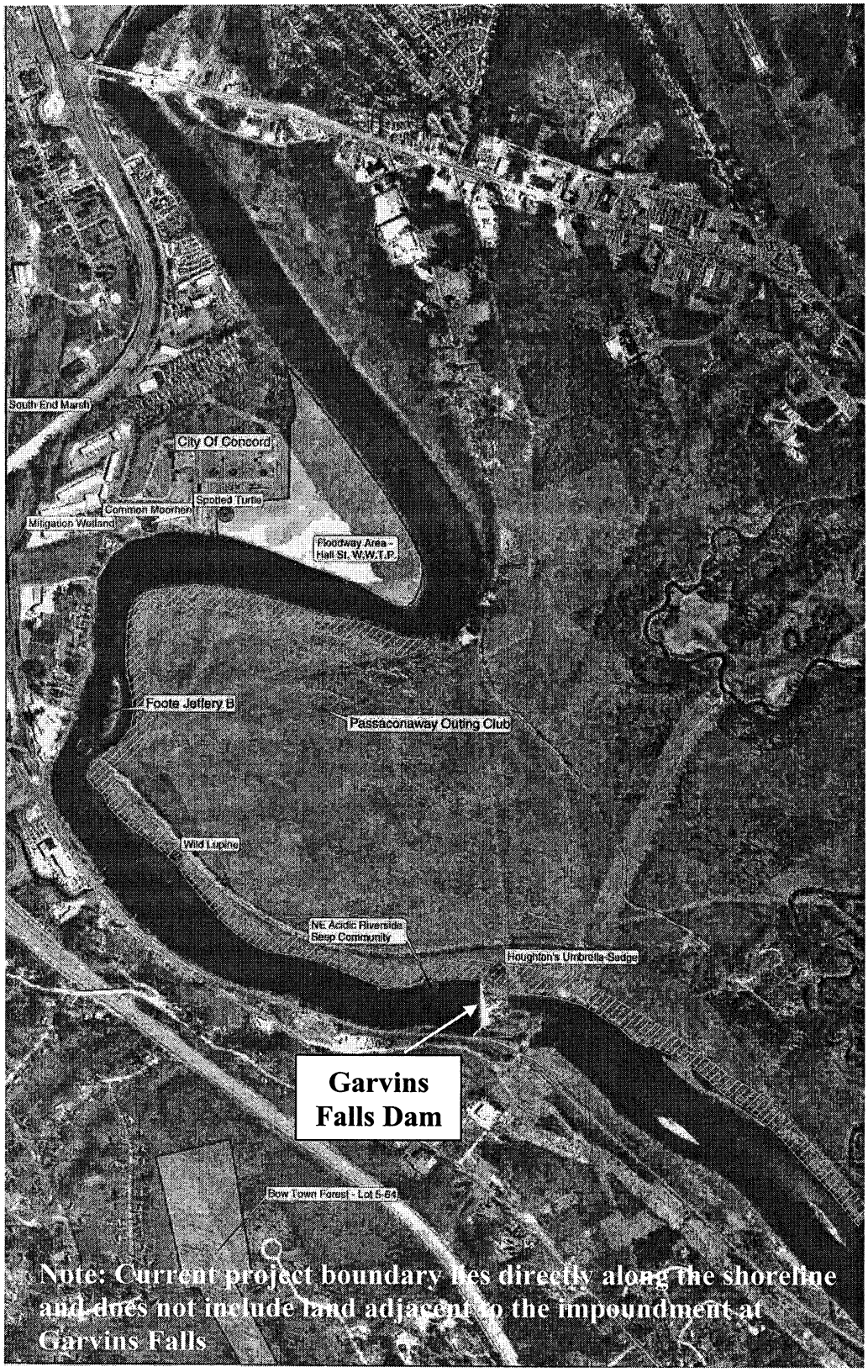

Figure 6. Proposed Garvins Falls conservation easement, shaded (source: application)

Staff Analysis

Under PSNH's proposal, the Garvins Falls easement would extend up to 200 feet along 2.9 miles of the shoreline, encompassing approximately 70 acres. PSNH does not propose to add this land to the project boundary. The proposed easement is a segment of a larger parcel of PSNH-owned land identified as an undeveloped area where eagle use could occur but has not been documented. The federally threatened bald eagle would benefit from this proposal through the preservation of any tall trees that exist close to the water; such trees provide night roosting, nesting, and day perching habitat. In addition, the proposed Garvin Falls easement would contain and therefore help protect the following from the New Hampshire Natural Heritage Inventory of Rare Species and Exemplary Natural Communities (Natural Heritage Inventory): wild lupine, Houghton's umbrella-sedge, and NE Acidic Riverside Seep Community. The latter occurs on open bedrock or cobble, sand, or silt substrate of flood-scoured shores of larger rivers where cold groundwater emerging from bedrock generates fen-like conditions. This community is rare in New England. The proposed easement area also includes land along the western bank of the Soucook River, which Interior has identified as a riparian zone of importance.

Regarding Interior, AMC et al., and CC Bow's recommendation that conservation restrictions on this property extend further than the proposed 200 feet to include the protection of New Hampshire and federal rare, threatened and endangered species, the proposed 200-foot easement width should meet the objectives of bald eagle habitat protection such that it would buffer the river from most human activities and ensure the protection of any potential perching, nesting, or roosting trees that exist adjacent to the river. In addition, the Natural Heritage Inventory communities that exist along the river appear to be included in the proposed conservation easement and thus should be adequately protected by the proposed easement boundary (see Figure 6).

Although PSNH does not intend for this conservation easement area to become part of the project boundary, the project boundary could be extended to enclose the proposed easement area. The area would then be brought under the Commission's jurisdiction with whatever habitat protection measures the license specifies.

Shoreline Management/Protection

As described above, PSNH proposes to protect, with a conservation easement, a 200-foot buffer zone on its Garvins Falls property that would protect 2.9 miles of undeveloped riverfront (figure 6). PSNH is also willing to grant conservation easements on the two islands just below its Amoskeag dam. When considering the feasibility of

providing a shoreline buffer throughout the entire project, PSNH analyzed the cost of purchasing in-fee a 200-foot buffer adjacent to and outside of the current project boundary, not including existing PSNH-owned lands, protected or state lands. PSNH estimated the cost of this to be prohibitive at over $22.3 million.

PSNH does, however, propose to develop a shoreline management plan (SMP) and is in the process of developing a shoreline permitting program that includes policies and procedures for shoreline development on project lands.

Interior agrees with PSNH's proposal to develop a SMP and includes the development of this plan in its 10(j) recommendation 16. Interior notes that the relatively undeveloped shorelines and riparian zone in the project area upstream of Hooksett Dam provide tremendous habitat value. Interior recommends that PSNH target specific areas containing the greatest resource value or target one general area of the project (i.e., upstream from Concord, or the Hooksett Pool). The basis for this recommendation is that these alternatives would be far less expensive than an estimated $22.3 million for a project-wide buffer and yet would provide substantial benefits to wildlife and natural communities and the river itself. To this end, Interior includes as a 10(j) recommendation not only the establishment of conservation restrictions on the Garvins Falls tract, but also recommends that PSNH develop a plan to protect riparian buffers and floodplain forest habitat by conservation restrictions or other protections on non-protected, non-PSNH-owned riparian buffer zones in the project area upstream from Hooksett Dam, currently adjacent to, but outside the project boundary.

AMC et al. note in their letter filed May 17, 2005, that the project is located in one of the fastest growing regions of the state and that New Hampshire is developing quickly; between 1990-2004 the state's population increased by 17.2%. AMC et al. recommend a SMP that preserves lands back from the high water mark to include identified habitat for New Hampshire and federal rare, threatened and endangered species. In addition to the proposed Garvins Falls easement, this would include the riparian-associated lands on the south shore of the Garvins Falls dam and lands on the Hooksett Reservoir associated with the Merrimack Coal Fired Power Plant, the riparian lands in the vicinity of the Hooksett Dam, and the islands downstream of the Amoskeag Dam. AMC et al. also state that protective management measures should be proposed for non-PSNH lands that abut project waters that contain rare, threatened, and endangered species and Natural Heritage Inventory occurrences. They note that since the majority of what they desire to be included in the shoreline management plan is already owned by PSNH, these terms and conditions are orders of magnitude below PSNH's estimated $22.3 million projected cost for a buffer around the entire project.

CC Bow states that PSNH failed to identify significant rare, threatened, and

endangered resources on the west side of the river in Bow. CC Bow recommends granting conservation easements on lands with known eagle roosting and nesting habitat along the river in the town of Bow, both within and outside of the current project boundary.

In reply comments, PSNH states that the most economic way to protect the shoreline is by encouraging appropriate shoreline management. PSNH maintains that protection via their proposed buffer zone at Garvins Falls is reasonable based on the needs of the resources.

PSNH also maintains, regarding Interior's recommendation to provide additional conservation restrictions upstream from Hooksett on non-PSNH-owned lands, that protection of additional waterfront areas not owned by PSNH would likely be very costly. They note that there are no plans for development on the significant amount of the PSNH property above Hooksett Dam that includes almost 300 acres associated with PSNH's Merrimack Generating Station and the Hooksett development. They note that other protected areas exist in this vicinity as well. In particular, PSNH notes that 22% of the lands within a quarter mile of the river of the Garvins Falls pool area are currently protected by conservation easements, public parks, and state and municipal ownership. Developing substantial amounts of property on the west side of the river is not likely to be feasible, according to PSNH, due to the combination of railroad right-of-way, topography, shoreline protection requirements, and local zoning.

Concerning CC Bow's comment that PSNH failed to identify significant rare, threatened, and endangered resources on the west side of the river in Bow, PSNH replied that on June 29, 2005, the New Hampshire Fish and Game Department was consulted by PSNH and acknowledged that through a recent effort to increase bald eagle documentation for New Hampshire's Comprehensive Wildlife Plan, three previously unknown roost sites were identified along the Merrimack in the Bow and Pembroke areas. PSNH adds that it will promptly obtain and provide the approximate locations for these recently discovered roosts.

Staff Analysis

SMPs typically provide guidelines for managing lands located within the project boundary. Such plans can include policies for the permitting of piers, docks, boat landings, bulkheads, and other shoreline facilities. SMPs can also designate certain land for special protection. Land within the Merrimack Project boundary and adjacent to the shoreline that is valuable for wildlife habitat, project aesthetics, public access, and the protection of water quality could be protected by a SMP.

Although 22% of lands within ¼ mile of the shore of the Garvins Falls pool area are currently protected by conservation easements, public parks, and state and municipal ownership, the Hooksett and Amoskeag developments have markedly less protected lands adjacent to them, 2% and 4%, respectively. Land use from the Amoskeag dam to Hooksett is largely an extension of suburban North Manchester; there are large areas of residential and commercial use including some sand and gravel operations and a golf course. As this region becomes more developed, the riparian zone couldcan be affected by habitat fragmentation and other impacts of human activity associated with development. The inclusion of shoreline lands in the project boundary for the purpose of a riparian buffer and shoreline management could play an important role in protecting riparian wildlife and aquatic resources, as well as recreation and public use of project water.

AMC et al.'s recommendations for protection measures or conservation restrictions on lands with threatened and endangered species habitat or Natural Heritage Inventory sites, including on non-project, non-PSNH owned lands would involve an unknown amount of acreage. However, because bald eagle perching, foraging, roosting, and potential nesting habitat was identified throughout approximately a third of the 25-mile reach of river where the project is located, this recommendation could require a buffer zone along approximately 9 miles of the river, most of which is non-PSNH land. In addition, AMC et al. recommends five locations for conservation easements, including the land north of Garvins Falls Dam. These sites are on PSNH-owned land and the size of these easements is not specified.

A buffer zone along 9 miles of the project and the recommended conservation easements on five separate parcels of land would protect fish and wildlife habitat, water quality, and public access along the project's shoreline. Specifically, a SMP that includes managing this buffer zone could protect bald eagle habitat and any Natural Heritage Inventory communities that occur in these riparian lands. This would offer a geographically broad scope of habitat protection by including lands from all three impoundments. Not only would it connect aquatic and terrestrial habitat within each parcel, but the parcels would collectively create a travel corridor for eagles and other wildlife migrating north and south along the river. However, the cost of obtaining the waterfront property that would include this habitat was not estimated by AMC et al, and is likely quite high.

CC Bow did not estimate the acreage involved for their recommended conservation easements on the Garvins Falls tract and on areas of eagle habitat in the town of Bow. It appears that there are two parcels of known perching and foraging habitat, one parcel of potential roosting habitat, and one parcel of potential roosting and nesting habitat along

the river in the town of Bow. As PSNH notes, information on additional habitat in this vicinity is pending. Much of this land is not owned by PSNH. Conservation easements on these lands and at Garvins Falls would allow for the protection of significant wildlife habitat in the Town of Bow and the City of Concord from the effects of shoreline development, as well from the effects of development outside the project and easement boundaries. CC Bow did not estimate the cost of acquiring the land necessary for their proposed conservation easements.

Interior's recommendation did not specify which lands in the project area upstream from the Hooksett dam should be acquired for inclusion in the project boundary as a riparian buffer. There are no identified Natural Heritage Inventory sites located directly adjacent to the shoreline in the Hooksett impoundment, but there are several parcels of undeveloped shoreline that are identified as eagle roosting or perching and foraging habitat. The acquisition of land in this vicinity would protect riparian habitat, such as eagle roosting, perching, and foraging habitat, at an impoundment that, unlike the Amoskeag impoundment, has undeveloped shoreline of significant habitat value, and, unlike the Garvins Falls impoundment, does not exist amongst large parcels of otherwise protected lands. Thus, wildlife dependent on these key areas of riparian vegetation could be protected from any shoreline development in this vicinity. Interior did not estimate the cost of acquiring non-PSNH lands adjacent to the river in the Hooksett impoundment.

Because the cost of acquiring waterfront land in the project area is unknown, but likely very high, a. n alternative approach to habitat protection would be targeting specific resources on PSNH-owned land. This should be significantly less costly than the recommendations from AMC et al., CC Bow, and Interior, which would require the acquisition of non-PSNH land. Because eight out of the 20 known Natural Heritage Inventory sites in the project area are already located on conservation lands or on PSNH's proposed conservation easement, and most of the remaining sites are in areas already developed, it appears to make more sense to focus on eagle habitat as a target resource for conservation. Areas of undeveloped eagle habitat currently exist adjacent to the project directly along the river, and protecting this habitat up to 200 feet from the shoreline would benefit eagles that frequent this stretch of the Merrimack River. Protecting the eagle habitat would also benefit the broad range of wildlife that exists within these riparian zones by decreasing the threat of habitat fragmentation and the negative effects associated with development.

The Endangered and Threatened Species Report (Normandeau & Associates, Inc., 2003) describes five categories of eagle habitat in the project area: known perching and foraging, known roosting, potential roosting, potential nesting, and undeveloped habitat blocks of potential importance. Several parcels (described below) of PSNH-owned land adjacent to the project and within 200 feet of the shoreline contain such habitat:

(1) approximately 2 acres of "known perching and foraging" eagle habitat on the east side of the river upstream of the Amoskeag dam;
(2) approximately 3 acres of "known perching and foraging" eagle habitat on the east side of the river upstream of the Hooksett dam;
(3) approximately 9 acres of "potential roosting" eagle habitat on the west side of the river about a mile and a half downstream from the Garvins Falls dam and just upstream of the coal fired Merrimack Power Plant in Bow, which is an undeveloped portion of a large tract of PSNH land;
(4) approximately 17 acres of "known perching and foraging" eagle habitat on the east side of the river immediately downstream from the Garvins Falls dam;
(5) approximately 7 acres of "known perching and foraging" eagle habitat on the west side of the river immediately downstream from the Garvins Falls dam; and
(6) approximately 70 acres of "undeveloped habitat block of potential importance" that includes the proposed Garvins Falls conservation easement.

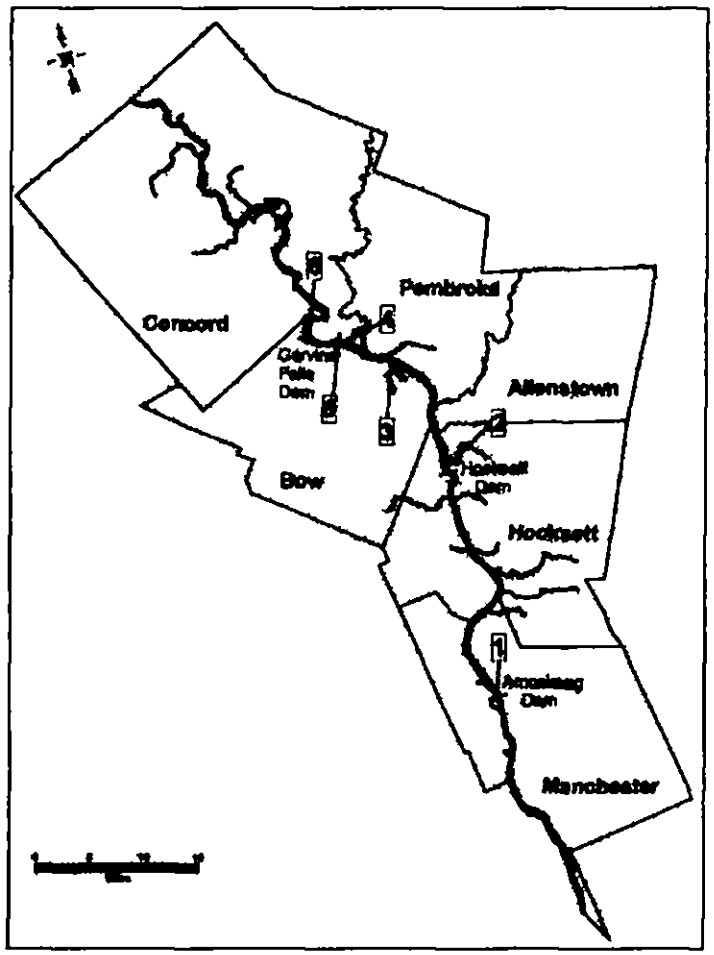

Figure 7. Approximate locations of eagle habitat on PSNH-owned land. (Source: staff)

The first two locations listed above appear to be a very narrow strips of PSNH land, which could provide an approximately 50-foot-wide buffer zone from the shore. The other sites are larger and would likely be able to provide a 200-foot-wide buffer. Inclusion of these buffer zones in the project boundary would protect, via a SMP, approximately 108 acres of wildlife habitat along the shoreline.

The above sites include approximately 12 acres of the valuable shoreline habitat in the Hooksett impoundment that Interior emphasizes in its recommendation. They also include approximately seven acres of eagle habitat along the west side of the river in the town of Bow, as recommended by CC Bow, and include land from the four locations that AMC et al. specifically targeted for conservation restriction measures. In addition, this boundary expansion would offer a geographically broad scope of habitat protection by including lands from all three impoundments. It would connect aquatic and terrestrial habitat within each parcel, and the parcels would collectively create a travel corridor for

eagles and other wildlife migrating north and south along the river. The six sites described above would provide approximately four miles of shoreline protection throughout the project, providing most of this protection in areas where little protection or management of wildlife currently exists.

The islands directly downstream from the Amoskeag dam, which PSNH tentatively proposed as conservation easements, were not identified as potential eagle habitat. However, one of the islands is currently within the project boundary and could be protected by the guidelines set by a SMP.

Threatened and Endangered Species

AMC et al. recommend a management plan to provide perpetual protection for New Hampshire and federally listed species. CC Bow also recommend that the license require a management or protection plan for each species and community type listed in the application, which includes New Hampshire and federal rare, threatened, and endangered species as well as Natural Heritage Inventory communities. Interior (10(j) recommendations 17 and 18) recommends conservation restrictions on the riparian buffer lands discussed above.

Staff Analysis

Any lands that are included in the project boundary could be managed via a SMP. The SMP could specify the inclusion of riparian lands within the project boundary and habitat protection measures and general guidelines for development within that boundary.

In addition to a SMP that would provide for protection of bald eagle habitat, the proposed and recommended conversion to ROR mode and minimum flows in the bypassed reaches could also benefit the bald eagle by improving foraging habitat. Therefore, the proposed project, with the described habitat protection measures, is not likely to adversely affect bald eagle at the project.

Unavoidable Adverse Impacts

None.

3. Recreation

Affected Environment

Recreation in the Region

Southern New Hampshire provides numerous opportunities for bank and boat fishing, motor boating, jet skiing, canoeing, kayaking, hiking, hunting, camping, and wildlife viewing. Winter recreation in the area includes ice fishing, snowmobiling, downhill and cross-country skiing, and snowshoeing. Within 50 miles of the project, there are over 300 known fishing areas, more than 320 miles of hiking trails, nearly 200 ponds and lakes, 386 miles of rivers and streams, and more than 120 boat launch sites.

Recreation at the Merrimack River Project

Results from a Merrimack Project 2003 recreation survey (Vol. IX, Application) identify motor boating, fishing, sightseeing, and picnicking as primary recreational uses at the project. The survey also concludes that current recreation facilities should be able to satisfy current and future demand. There are thirteen recreation sites with access to project waters. The table below summarizes these in order from south (downstream) to north (upstream). Of these thirteen, only Amoskeag Fishways and the portage and picnic area at the Amoskeag development are managed by PSNH. PSNH also provides portage and car top access at the Hooksett development.

Table1. Recreation Sites along the Merrimack River Project (Source: staff)

Location on Figure	Recreation Facility Management Entity Description	Boat Launch	Motor Boating	Canoeing/Kayaking	Fishing	Swimming	Hiking Trails	Picnic Area	Restroom Facilities	Parking Spaces
Amoskeag										
1	Arms Park (Manchester) *close to downtown Manchester, one acre of paved walkways and grass picnic areas, parking, launch for small boats, set of poles marking a slalom course in river, 5 benches*	x		x	x			x		5
2	Amoskeag Fishways (PSNH) *Environmental education center providing exhibits and instruction about the river and its fish ladder* Amoskeag Portage/Picnic (PSNH) *Portage sign on right bank, 1,200-foot portage trail through picnic and parking areas, through forested path to downstream of the facility*			x	x			x	x	25

3	A.J. Lambert Riverside Park (NHFG) *22-foot-wide boat launching ramp, parking, 100-foot-wide beach area for swimming and boating, portage from Hooksett*	x	x	x	x	x			x	29
Hooksett										
4	Hooksett Dam Site (Hooksett) *Canoe take-out, concrete overlook platform for fishing and sightseeing, parking*			x	x					20
5	Hooksett District Court Boat Launch (Hooksett) *12-foot wide boat launching ramp, parking, sandy beach area for swimming and boating*	x	x	x	x	x			x	60
6	Allenstown Circle Boat Launch (Allenstown) *parking, 35-foot-wide boat launching ramp, shoreline access for fishing, sandy beach area for swimming, picnic table*	x	x	x	x	x				60
7	Jack Martel Pointfield and Boat Launch (Pembroke) *adjacent to athletic facilities, picnic and parking area, 14-foot-wide boat launching ramp, shoreline access for fishing, 4 picnic tables, 8 concrete grills, posts and area for horseshoes*	x	x	x	x	x		x		100
8	Bow Boat Launch (Bow) *Parking, 14-foot-wide boat launching ramp, small grassy area*	x	x	x	x			x	x	15
Garvin Falls										
9	Terrill Park (Concord) *Riverside sightseeing area with parking, 1 picnic table*							x		100
10	Waterfront Park, Everett Arena Boat Ramp (Concord) *close to downtown, parking, grass picnic area with dirt riverside walkways, 12-foot-wide boat launching area for small boats, 7 picnic tables, 3 benches*	x		x	x			x		120
11	NH Technical Institute Boat Launch (Concord) *close to athletic facilities, parking, 12-foot-wide boat launching ramp*	x	x	x	x					80
12	Les Clark Nature Area (Society for the Protection of New Hampshire Forests, or the Society for Forests) *Circular 1.25 mile hiking trail and wildlife refuge, parking*						x			20
13	Concord to Lincoln Railroad Bridge Boat Launch (Concord) *parking, 10-foot-wide boat launching ramp*	x	x	x	x					25

Figure 8. Location of recreation sites along the Merrimack River Project (Source: staff)

Boating Access and Portage

PSNH currently provides portage trails and access at the Amoskeag and Hooksett dams. At Amoskeag, boaters exit the river on the right bank under the Amoskeag Bridge near a portage sign. The egress is up a shore bank of concrete slabs. A sign directs people to continue along the 1,200-foot portage trail through the Amoskeag picnic and parking areas along the outer fence of the facility. The final portion of the portage trail is along a forested path down to the river ingress. Currently there is no portage around the Garvins Falls dam.

Appalachian Mountain Club, American Whitewater, New England Flow, and the New Hampshire Rivers Council (AMC et al.) describe the upstream access under the Amoskeag Bridge as difficult and the granite riprap that boaters need to walk over slippery. In addition, the portage down to the put-in consists of both an official portage trail and a generally preferred informal trail, but states that both are difficult and unsafe. In addition, AMC et al. notes inadequate signage.

The Town of Bow, which contains the Garvins Falls Dam, is creating a Master Plan for the area, and the Bow Master Plan Community Survey indicated that "access to the Merrimack River" is an aspect of recreation that residents would like to see expanded.

Whitewater Boating

Immediately downstream of the Amoskeag development is a whitewater boating reach. The American Whitewater website[9] describes this reach as class I-III rapids and 5.3 miles long, with an average drop of four feet per mile. A put-in is located right at the dam. About a quarter of a mile downstream, outside of the project boundary, is the Arms Park recreation area that includes a set of poles marking a slalom course over a portion of the river. The American Whitewater website indicates that 900 cfs is the minimum flow required for whitewater boating, and American Whitewater, as part of AMC et al., recommends 2,500-3,000 cfs as a suitable whitewater flow. Mean daily flows below the Amoskeag development at Goffs Falls, demonstrate that flows generally provide whitewater boating opportunities throughout the year, though flows from mid July through late September may be below 2,500 cfs the majority of the time (see Table A). The recorded dam release phone line at (603) 634-3569 provides flow updates.

Table 2. USGS gage #01092000 Merrimack River at Goffs Falls, below Manchester, NH (Source: staff)

Day of month	**Mean of daily mean values for this day for 68 years of record[1], in ft³/s**											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	4714	4518	5271	13100	11650	6362	3388	2354	1676	2267	3526	5665
2	4694	4357	5233	13860	11380	6303	3335	2204	1746	2359	3629	5331
3	4589	4337	5312	14470	11230	6475	3064	2186	1728	2459	3857	5205
4	4493	4645	5329	14929	11150	6177	2733	2207	1671	2357	4468	5050

9 http://www.americanwhitewater.org/rivers/id/1175/

5	4470	4745	5338	15150	11080	5823	2713	2090	1661	2277	4517	4964
6	4378	4598	5394	15840	10390	5474	2796	2092	1617	2315	4350	5082
7	4427	4492	5548	15580	9816	5184	2839	2023	1593	2623	4209	5646
8	4397	4538	5704	14879	9388	5060	2768	1988	1578	2848	4420	6102
9	4370	4521	5808	14070	9197	4905	2609	2122	1647	2684	4529	5838
10	4458	4238	6129	13540	9073	4712	2376	2160	1649	2581	4753	5735
11	4571	4223	6289	13660	8934	4448	2374	2348	1716	2656	4840	5699
12	4387	4326	6422	13890	8808	4307	2343	2584	1955	2577	4779	5671
13	4286	4385	6626	13990	9018	4216	2295	2425	2053	2624	4846	5765
14	3998	4384	7029	14000	9075	4366	2351	2266	2048	2554	5111	5638
15	3898	4352	7328	14070	8945	4627	2501	2252	2056	2597	5056	5543
16	4000	4414	7504	14320	8821	4700	2516	2139	2129	2614	4828	5375
17	3997	4374	7728	14750	8595	4604	2434	2093	2086	2812	4707	5130
18	3947	4309	7925	14720	8359	4316	2235	2021	2255	2883	4555	5241
19	3862	4236	8017	14740	8266	4066	2166	2001	2269	2968	4313	5326
20	3943	4258	8615	14470	8092	3857	2116	1877	2274	2965	4257	5290
21	4106	4325	9060	14060	7896	3749	2169	1825	2594	3362	4604	5178
22	4232	4692	9428	13860	7697	3640	2123	1777	3273	3904	4845	5382
23	4319	5264	9848	13650	7216	3599	2090	1770	3407	3831	4899	5285
24	4496	5285	9838	13330	6865	3474	2198	1690	2838	3701	4713	5064
25	4713	5447	9939	13239	6875	3613	1991	1633	2530	3937	4652	4959
26	5097	5558	10230	13039	6939	3570	1963	1640	2404	3998	4849	5103
27	5368	5521	10760	12880	6798	3530	1868	1634	2351	3796	5314	5051
28	5550	5416	11410	12600	6561	3545	2015	1501	2386	3852	5543	5046
29	5460	5425	12070	12440	6395	3478	2131	1499	2325	4031	5766	5033
30	5132		12400	12140	6279	3411	2272	1650	2333	3941	5871	4831
31	4798		12659		6326		2411	1686		3649		4738

1 -- Available period of record may be less than value shown for certain days of the year.

http://nwis.waterdata.usgs.gov/nh/nwis/dvstat/?site_no=01092000&agency_cd=USGS

Environmental Impacts and Recommendations

PSNH proposes to continue to provide environmental education exhibits and instruction about the Merrimack River and its fish ladder facilities at its Amoskeag Fishways facility. PSNH also proposes to continue to provide a flow phone, which provides flow information for members of the public interested in boating flows associated with the project.

In addition, PSNH proposes to develop a Recreation Plan. The plan would include existing recreation facilities, which include the Amoskeag Fishways facility and portage facilities at the Hooksett and Amoskeag developments. In addition, the plan would include an evaluation of the need for the facilities or improvements recommended by the stakeholders in their comments, an evaluation of the existing portage routes and the feasibility of providing portage at Garvins Falls, an evaluation of the feasibility of providing access to the project area tailwaters and bypassed reaches given any topographic or safety considerations, and the possibility of providing special whitewater releases.

AMC et al. recommend the provision of adequate, safe, well-defined, and reasonable access around each of the three project dams for portage of canoes and kayaks as well as adequate access, egress, and signage for use of the whitewater reach immediately below the Amoskeag dam. AMC et al. note that part of the Amoskeag portage consists of concrete slabs under the Amoskeag Bridge that are slippery and difficult to traverse and that the portage trail ends in a steep hill that is difficult for boaters carrying a canoe or kayak. They recommend several measures to make this portage less challenging for boaters carrying kayaks and canoes, including the placement of rails on the slope down to the put-in, the rearranging of the granite riprap to form steps, and the providing of better signage.

The Concerned Citizens of Bow (CC Bow) recommend that the license require adequate, safe and reasonable access above and below the Garvins Falls dam for purposes of portage of canoes and kayaks.

Whitewater Boating Releases

In response to an additional information request, PSNH originally proposed to provide three scheduled whitewater boating flows of 3,000 cfs below Amoskeag, one during the last weekend in June, one during a weekend in September, and one on a weekend day in October. PSNH did not describe how its flows would be provided. However, since the whitewater reach of concern is downstream of the powerhouse, the boating flows could be provided by generation, releases into the bypassed reach, or a

combination of the two.

AMC et al. recommend the following whitewater releases below the Amoskeag project: a) flows for historic race events including but not limited to the scheduled races during the 2nd weekend in June, the weekend following Labor Day in September, and the National Canoe Poling contest, and b) a once a week, scheduled weekday evening release starting on or about 5 PM of approximately 2500-3000 cfs for whichever number of hours does not have a strong negative impact on reservoir or downstream resources from the first week in June until the week after Labor Day.

Interior (10(j) recommendation 5) recommends allowing for up to three special weekend releases per year at the Amoskeag development, but none during the upstream fish passage season unless by mutual agreement between PSNH, FWS, and NHFGD. In addition, they note that ramping rates should be applied to all releases and no special releases should be scheduled until after the installation and operation of a minimum bypass flow gate at the east end of the project spillway.

In their reply comments, PSNH states that if the new license requires whitewater boating releases at selected times, PSNH will make the river flow forecasts and real time information electronically available. In addition, PSNH does not object to Interior's recommendation to limit whitewater releases until the Amoskeag bypass flow gate is installed.

Staff Analysis

The primary recreational activities at the project are motor boating, fishing, sightseeing, and picnicking. The proposed and recommended conservation restrictions on riparian lands and a SMP, as discussed in section 2, would enhance sightseeing and picnicking opportunities at the project by maintaining a natural setting around the project's shoreline. The proposed and recommended minimum bypass flows and conversion to ROR operation at Garvins Falls and Amoskeag would enhance fish habitat, as described in section 1, which would likely result in an overall increase in the quality and quantity of fishing opportunities at project waters.

Recreational Access

Although the towns adjacent to the project, as well as NHFGD and the Society for Forests, provide recreational access to the Merrimack Project, recreational access at the Garvins Falls dam could be improved. This section of the river is particularly scenic and serene, providing an ideal environment for canoeing and flatwater kayaking. There is currently no portage around the Garvins Falls dam, and both CC Bow and AMC et al.

recommend the development of a portage. Portage facilities around the dam on the east bank of the Merrimack River would avoid the railroad tracks on the west bank and further enhance boating access in this important recreation area.

The portage that currently exists around the Amoskeag dam is used by some boaters, as demonstrated by the presence of an unofficial portage trail down to the put-in, which has been selected by users over the official trail as an easier route. As AMC et al. note, the steepness of the put-in and the granite riprap at the take-out may prevent some boaters from choosing to use this portage. AMC et al.'s recommendations to form steps out of the granite rip rap and to make the portage trail less challenging by installing a railing or making other improvements would increase the usability of this facility. More boaters would be physically able to navigate the take-out and portage trail, which could result in an increase in overall boater usage.

Whitewater Flows

The reach downstream of Amoskeag reportedly requires a minimal flow of at least 900 cfs for boating; boating releases of 2500-3000 cfs are requested by AMC et al. ROR flows would generally be below this range from mid-July through early October. According to monthly flow duration curves, calculated based on average daily flows downstream of Amoskeag, flows for the months of July, August, September, and October meet or exceed the requested boating flows (2500-3000 cfs) 25%, 16%, 15%, and 33% of the time, respectively. Currently, the project operates some of the time in a daily peaking mode when inflow is between 1000-5640 cfs and is operated in ROR mode at flows above and below this range. Representative weekly hydrographs depicting the daily operational cycles at Amoskeag show that under peaking operation, there may be periods (generally during daylight hours) when flows released downstream of the project are greater than flows entering the project impoundment. At other times, which may or may not occur during daylight hours, flows released are less than those entering the project impoundment, as the project is storing water. Thus, the current operation with daily peaking may provide daytime whitewater boating flows during the months of July-October when flows would otherwise be sub-optimal. Likewise, due to periods of water storing, there may be times throughout the summer and fall when flows released at the dam are sub-optimal when they would otherwise be optimal; however, these periods are more likely to occur at night. Based on our analysis, conversion to ROR mode would likely decrease the number of optimal whitewater boating opportunities downstream of the Amoskeag development during the months of July-October.

Representative weekly hydrographs depicting the daily operational cycles at Amoskeag show that under peaking operation, there may be periods (generally during daylight hours) when flows released downstream of the project are greater than flows

entering the project impoundment. At other times, which may or may not occur during daylight hours, flows released are less than those entering the project impoundment, as the project is storing water. Thus, current operation with daily peaking may provide daytime whitewater boating flows during the months of July-October when flows would otherwise be sub-optimal. Likewise, due to periods of water storing, there may be times throughout the summer and fall when flows released at the dam are sub-optimal when they would otherwise be optimal; however, these periods are more likely to occur at night. Based on our analysis, conversion to ROR mode would likely decrease the number of optimal whitewater boating opportunities downstream of the Amoskeag development during the months of July-October.

Weekday, evening flow releases, as requested by AMC et al., would likely be used by boaters who live in the vicinity of the project. Without these weekday flows, however, local boaters would still likely have boating opportunities throughout the boating season, since they live nearby and would be able to respond quickly to naturally occurring whitewater flows. The proposed and recommended weekend flow releases, however, would provide predictable opportunities for those outside the immediate vicinity who would not otherwise be able to take advantage of flows resulting from random storm events.

The continued provision of a flow phone, as proposed, would allow the public access to information on current flows, allowing boaters to plan for short-term trips.

Unavoidable Adverse Effects

Conversion of project operation from a daily peaking mode to ROR may result in a decrease in optimal whitewater boating flows during the months of July-October.

4. Cultural Resources

Affected Environment

Historical background

Settlement of large sites in the Merrimack River Valley began during the Middle Woodland period (1-1000 AD). These settlements are characterized by an increased dependence on agriculture and include such sites as Garvins Falls. During the Contact period (1600-1750 AD) Native Americans moved to more isolated locations and the villages along the Merrimack River were replaced by European settlements that looked to take advantage of the river's natural resources. In the early eighteenth century, large numbers of settlers moved into the heavily wooded valley in order to harvest the timber.

In the late eighteenth and early nineteenth centuries small grist and sawmills were erected along both sides of the Merrimack River in the vicinity of Garvins Falls, primarily to serve individuals (Louis Berger 2003).

The first mills were constructed in the Hooksett Falls area between 1770 and 1803. The exact locations of the mills are unknown. Brick making was a particularly important industry, with brickyards situated on the east side of the Merrimack River beginning around 1820 (Louis Berger 2003).

In ca.1760 Captain John Stark established a sawmill north of the Amoskeag Bridge. After the revolutionary war, Stark built a new mill near the 1760 mill. It was with the construction of the first mill at Amoskeag Falls, Benjamin Pitchard's 1804 cotton mill, that Manchester began to realize its industrial potential. That mill, along with two others constructed by Bell Mill and Island Mill on the west side of the river, became the foundation of the Amoskeag Manufacturing Company, incorporated in 1831 (Louis Berger 2003).

Establishment of the Merrimack River Hydroelectric Project

The Garvins Falls Development is the oldest component of the Merrimack River Project and was constructed in 1903 by the Manchester Tractor, Light, and Power Company. The Manchester Tractor, Light, and Power Company was established in 1901 through consolidation of several small providers of electricity in the city of Manchester and along the Merrimack River. One of the Company's primary consumers was the electric streetcar industry in Manchester. In 1925 Manchester Tractor, Light, and Power Company was bought by Middle West Utilities, whose holdings in the Northeast has been previously consolidated as New England Public Service Company. PSNH was established in 1926 as a subsidiary of New England Public Service.

The Hooksett Falls Development was established in 1926 by Manchester Tractor, Light, and Power Company, as a unit of PSNH. An existing powerhouse at the falls, likely constructed by the Hooksett Manufacturing Company, and a wood crib dam were replaced, while two stone dams were left in place.

In 1923, Amoskeag Manufacturing Company constructed a hydroelectric plant and dam at Amoskeag Falls. PSNH purchased the Amoskeag Falls plant in 1936.

PSNH conducted an archaeological and historical resource reconnaissance and evaluation for the Merrimack River Project in 2003. Several previous investigations recorded 38 archaeological sites within a one mile radius of the Merrimack River Project, seven are, or were, located within the area of potential effect (APE); five are

prehistoric sites, one is a historic archaeological district, and one (destroyed in 1985 by construction) contained prehistoric and historic period archaeological material.[10]

The archaeological reconnaissance classified the shorelines of the reservoirs based on environmental variables, including erosion, soil type, land use, and vegetation. This data was used to assign an archaeological sensitivity (low, medium, or high) to determine the potential of areas to contain archaeological resources. In general, the land around the project's three reservoirs, especially Amoskeag and Hooksett, has been modified by development, such as; railroads, roads, and residential and industrial uses. The disturbance caused by the development has affected the likelihood of finding intact undiscovered archaeological resources.

The reconnaissance located 11 historic archaeological sites, seven at Hooksett and four at Garvins Falls. Of the 30 shoreline localities surveyed at Amoskeag, only three were classified as sensitive for prehistoric archaeological resources and none appear to be sensitive for historic archaeological sites.

Of 47 shoreline localities surveyed at Hooksett, 11 were estimated to be sensitive for intact prehistoric archaeological resources. There are 14 localities that have more than low potential for intact historic archaeological resources.

Of 66 shoreline localities surveyed at the Garvins Falls development, 26 were estimated to be sensitive for intact prehistoric resources and one locality as having at least moderate sensitively for intact historic archaeological resources.

Properties Eligible for Inclusion in the National Register

No archaeological or historic properties within the project area are currently listed in the National Register, but several properties are likely eligible.

Garvins Falls Site (27MR78)

The Garvins Falls Site (27MR78), which is partially located within the project boundary, in the vicinity of the Garvins Falls Dam is likely eligible for the NHRP as a site of statewide significance. In recent years there have been incidents of looting at the site,

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[10] The APE of the project encompasses all lands within the project boundary as well as locations outside the project boundary where project operation or project related activities, such as recreational enhancements, could affect properties listed in or eligible for inclusion in the National Register of Historic Places.

and both PSNH and the New Hampshire Division for Historic Preservation (NHDHP) have made efforts to monitor this activity and prevent its recurrence.

Amoskeag Hydroelectric Development

In April 2000, the NHDHR determined that the facilities of the Amoskeag development are eligible for listing in the National Register as part of a large number of properties collectively designated the Amoskeag Millyard, a very large complex of mill buildings, canals, and other features developed by the Amoskeag Manufacturing Company from the 1830s to the company's collapse in 1936. The millyard reflects the growth and decline of what was at one time the largest textile manufacture in the world. In addition to textiles, fire engines, locomotives, rifles, and many other machines were produced at the milliard. At its peak, the company employed appropriately 15,000 workers. The layout of almost continuous rows of mills along two power canals with distinct yards is a unique example of a planned industrial space.

Elements of the Amoskeag development that are within the project boundary that are contributing elements to the National Register-eligible historic district are the powerhouse; dam, remains of an 1871 arch/wing dam under the present-day Bridge Street overpass; remnants of a possibly ca. 1840 dam; remains of the 1807 Blodget's canal; upper canal basin; headgate/floodgate house; and ice weir.

Hooksett Hydroelectric Development

The Hooksett development is eligible for the National Register because of its local significance (Louis Berger 2003). The development is representative of a common New England type. The powerhouse is the only remaining site harnessing water power for the manufacturing (in this case, the "manufacture" of electricity). Such developments typically incorporate elements from several periods of water power developments at a site, as is most clearly represented at the Hooksett development in the dam and powerhouse. The Hooksett development has one contributing building (the powerhouse), and three contributing structures (the stone dam, concrete spillway, and tainter gate structure). All are located within the project boundary.

Garvins Falls Hydroelectric Development

The Garvins Falls development is eligible for the National Register for its contribution in the area of industry through its direct and important association with the emergence of the Manchester Tractor, Light and Power Company at the turn of the twentieth century as a major supplier of electric power for lighting and electric railways in Manchester and southern New Hampshire. Additionally, the Garvins Falls development

is a locally significant representative of construction for hydroelectric power generation with features representing the first three decades of the twentieth century.

Contributing elements of the Garvins Falls development are the dam, canal headgate structure and gatehouse (all from 1904); the canal, including the two overflow sections and waste gate (all from 1904); the 1925 powerhouse; and the 1915 substation building. All are located within the project boundary.

Environmental Impacts and Recommendations

The reconnaissance survey identified four areas (H-14, -22, -31, and -34) of moderate to high archaeological sensitivity along the shorelines of the three project reservoirs that are currently experiencing high rates of erosion and recommended a Phase 1B survey to locate and identify undiscovered significant archaeological resources. In addition, the survey recommended that a Phase 1B archaeological survey be completed for seven historic archaeological features (TS3160-01, -02, -03, -09, -10, -11, and -12) to determine whether these sites, all of which are eroding out of the riverbank, represent primary deposits or redeposited cultural materials. All of the above sites are located within the project boundary.

By letter dated September 30, 2003, to PSNH, the New Hampshire State Historic Officer (SHPO) concurred with the reconnaissance survey findings concerning the potential for archaeological resources at the project and with the recommendations for Phase 1B investigations. The SHPO also recommended additional Phase 1B investigations at:

1. the undisturbed terrain in the vicinity of Black Brook, Millstone Brook, and Martins Brook as having a high sensitively for prehistoric archaeological sites (two sites at Locality A-12 and one at A-20), unless it can be demonstrated that the locations have been altered such that no archaeological resources could be preserved;
2. the shoreline of the Sod Farm at the upper end of the Garvins Falls reservoir (Localities GF-7, -8, and -9);
3. two islands in the river approximately 2,000 feet upstream of the Hooksett development (locality H-41) and one near the upstream end of the Garvins Falls development (Locality GF-12); and
4. the eastern shoreline of the Hooksett reservoir from site TS3160-03 (temporary designation) to the Soucook River Mouth North Site (27MR102) a distance of approximately 6,200 feet.

PSNH proposes to develop a historic properties management plan (HPMP) in

consultation with the SHPO consistent with a Programmatic Agreement (PA) to be executed between the Commission and SHPO prior to issuance of a new license. The HPMP would be designed to: (1) protect known National Register eligible prehistoric and historic archaeological sites and structures at the project; and (2) prevent disturbance of undiscovered sites that may be eligible for listing in the National Register during any ground-disturbing activities that may be undertaken during the term of the new license.

Staff Analysis

We agree with the SHPO's determination that the facilities of the Amoskeag development and the Garvins Falls Site (27MR78) are eligible for listing in the National Register. In addition, we believe, based on the reconnaissance survey, that the facilities of the Hooksett and Garvins Falls developments are eligible for listing in the National Register.

PSNH is not proposing any modifications to the project facilities. Thus, continuing to operate the project would not affect the project facilities' eligibility for the National Register. PSNH is proposing to study the feasibility of developing a canoe portage at Garvins Falls Dam. The location of the canoe portage is not known. However, if the canoe portage is located near the Garvins Falls Site (27MR78) it could affect the site.

PSNH proposals to operate all three developments in a run-of-river mode and create a conservation easement along the river front of the Garvins Falls property would have a beneficial effect on cultural resources.[11] Operating run-of-river, compared to peaking operations, tends to minimize erosion. If project operation is causing erosion which could affect cultural resources located on the shoreline, operating in a run-of-river mode would minimize the effects. Placing land along the river front of the Garvins Falls property in a conservation easement would protect cultural resources that may be located there by limiting development and its potential effects.

Developing and implementing a HPMP that provides guidelines for protection for prehistoric and historic archaeological sites and structures would ensure that continued project operation would not adversely affect these properties.

Unavoidable Adverse Effects

None.

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[11] Amoskeag currently operates in a run-of-river mode at low flows and but in a daily peaking mode during normal flow conditions.

5. Aesthetic Resources

Affected Environment

The dam and powerhouse at the Amoskeag development are visible from a variety of roads and bridges that parallel and cross the project boundary. The project facilities blend well with the industrial character of the City of Manchester in this area. The dam and powerhouse of the Hooksett facility are visible from the A.J. Lambert Riverside Park, which is directly downstream from the dam and powerhouse. The powerhouse is a small building along the east bank of the river, and neither the dam nor the powerhouse limits upstream or downstream views of the river. The dam and powerhouse of the Garvins Falls development are not easily visible from any roads along the impoundment. The project facilities are neutral colors, and although they do not completely blend with the surrounding environment, they fit with the character of the surrounding area. The vegetated nature of the shoreline, as well as all existing wetlands, floodplains, extensive public lands, recreation areas, and railroad right-of-ways protect the scenic values of the Merrimack Project

Currently below each dam, the river channel is dewatered (bypassed) for a distance of approximately 400 to 450 feet at Hooksett and Garvins Falls and 1800 feet at Amoskeag except during spring rainfall and other periods of water release when water flows, sometimes with considerable force. Steep slope and bedrock, a high water energy environment, characterize the natural setting of the riverbed in these locations. Groundwater seep and leakage from the dams maintain small pools and moisture throughout the year.

Environmental Impacts and Recommendations

PSNH proposes to provide minimum bypassed reach flows at all three developments and to convert the entire project to ROR operation. PSNH also proposes to provide a conservation easement on the approximately 2.9 miles of shoreline immediately upstream of Garvins Falls dam on the east side of the river.

As described in section 2, Interior, AMC et al., CC Bow, recommend providing additional conservation restrictions throughout the project in the interest of providing buffer zone protection in areas providing valuable habitat.

Staff Analysis

The proposed provision of minimum flows in the bypass reach would benefit

aesthetics by maintaining a riverine setting in these river channels, which are typically dewatered under current project operation. The additional spillage over the dams to provide this minimum flow would also benefit project aesthetics.

The proposed conservation easement at Garvins Falls would benefit project aesthetics by maintaining a natural setting along those 2.9 miles. A shoreline management plan with a project boundary expansion would further enhance project aesthetics by providing a more extensive riparian buffer than what currently exists.

Unavoidable Adverse Effects

None.

D. No-Action Alternative

Under the no-action alternative, the project would continue to operate under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented.

VI. DEVELOPMENTAL ANALYSIS

In this section, we analyze the project's use of the Merrimack River's available water resources to generate hydropower; estimate the economic benefits of the proposed project and alternatives; estimate the cost of various environmental measures; and estimate the effects of these measures on project operations.

A. Power and Economic Benefits of the Project

Under the Commission's approach to evaluating the economics of hydropower projects, as articulated in *Mead Corporation, Publishing Paper Division*,[12] the Commission employs an analysis that uses current costs to compare the costs of the project and likely alternative power with no forecasts concerning potential future inflation, escalation, or deflation beyond the license issuance date. The basic purpose of the Commission's economic analysis is to provide a general estimate of the potential power benefits and the costs of a project, and reasonable alternatives to project power. The estimate helps to support an informed decision concerning what is in the public interest with respect to a proposed license.

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[12] 72 FERC ¶ 61,027 (1995).

Our estimate of the energy and capacity value was developed from the most reasonable alternative generation available. We base our estimate of the comparable cost of energy generation on the fixed cost to construct and operate a combined-cycle combustion turbine plant fueled by natural gas in the New England region of the United States, and a regional energy cost of 43.15 mills per kWh. We estimate the energy cost based on information in Energy Information Administration, Annual Energy Outlook 2005.[13] We assume a capacity value of $96 per kilowatt (kW)-year. The licensee states that the dependable capacity of the operating project would be 31.5 MW. Under these conditions, the total energy and capacity cost is 66.35 mills/kWh.

For our economic analysis of the alternatives, we use the parameters, values (2004$), and sources shown in table 3.

Table 3. Staff parameters for economic analysis of the Merrimack Project (Source: the staff).

Parameters	Values (2005$)	Sources
Period of analysis	30 years	Staff
Term of financing	20 years	Staff
Interest/cost of capital	8.0 percent	Staff
Escalation rate	0 percent	Staff
Federal tax rate	34 percent	Staff
Local tax rate	3.05 percent	Staff
Insurance rate	$0.25 percent of cost of construction	Staff
Net investment[1]	$11,554,420	PSNH
Operation and maintenance cost	$1,362,908	PSNH
Future estimated average annual generation[2]	115,310 MWh	PSNH
Energy and capacity value	66.35 mills/kWh	Staff

[13] See http://www.eia.doe.gov/oiaf/aeo/index.html.

[1] The net investment provided in the application $12,409,704 (2003 value) has been depreciated to $10,583,704 (2005 value), and also includes the cost of relicensing $907,716.00, provided in additional information filed by PSNH on January 3, 2005.
[2] ROR operation and bypass flows would decrease project generation by a total of 15,028 MWH from the reported average generation of 130,338 MWh, provided in additional information provided September 12, 2005.

1. Proposed Action

In this section, we present the annual cost of the proposed action that includes operating the Merrimack Project with PSNH's proposed environmental measures.

Based on the parameters in table 3 and the cost of measures shown in table 4, we estimate that the annual cost of PSNH's Merrimack Project, would be about $4,534,000 (39.32 mills/kWh). The annual power value would be $8,000,000 (69.37 mills/kWh) for the estimated annual generation of 115,310 MWh. The resulting annual net benefit would be $3,465,000 (30.05 mills/kWh).

2. Staff-Recommended Alternative

In this section, we present the annual cost of the proposed action that includes operating the Merrimack Project with PSNH's proposed environmental measures with staff-recommended measures.

Based on the parameters in table 3 and the cost of measures shown in table 4, we estimate that the annual cost of PSNH's proposed Merrimack Project with environmental measures under the staff-recommended alternative would be about $4,542,000 (39 mills/kWh). The annual power value would be $8,000,000 (69.37 mills/kWh) for the estimated annual generation of 115,310 MWh. The resulting annual net benefit would be $3,458,000 (29.99mills/kWh).

Table 4. Summary of annual costs (2005$) of the proposed and recommended measures for the Merrimack Project (Source: Applicant and the staff).

Measures	Recommending Entity	Capital Cost($)	Operation and Maintenance Cost($)	Annual Cost($)
Operate run-of-river	Staff, DES, Interior, AMC, EPA, Applicant	0	200,000	200,000

Measures	Recommending Entity	Capital Cost($)	Operation and Maintenance Cost($)	Annual Cost($)
Operation Compliance Monitoring Plan	DES, Staff, Applicant	0	5,000	5,000
Bypass minimum flow at Amoskeag (280cfs)	DES, Applicant, Staff	0	253,000	253,000
Bypass minimum flow at Amoskeag (410cfs)	Interior and EPA	0	453,000	453,000
Bypass minimum flow at Hooksett (64cfs)	DES, Applicant, Interior, Staff	0	21,000	21,000
Bypass minimum flow at Garvin Falls (78cfs)	DES, Applicant, Interior, Staff	0	52,000	52,000
Final fishway plan	Applicant, Staff	5,000	0	400
Shoreline management plan	Applicant, Staff	0	4,000	4,000
Conservation easements at Garvin Falls	Applicant	50,000	0	3,900
Recreation Plan (including canoe portage at Garvin Falls)	Applicant, Staff	5,000	0	400
Whitewater boating flows	Applicant, AMC, Staff	0	0	0
Recreation measures	AMC et al., CC Bow, Staff	15,000	2,000	3,170
More expansive conservation easement	Interior, AMC et al., CC Bow	Unknown	Unknown	Unknown
Bypass flow gage at Amoskeag	Applicant, DES, Interior, Staff	90,000	0	7,030

Measures	Recommending Entity	Capital Cost($)	Operation and Maintenance Cost($)	Annual Cost($)
Bypass flow opening at Hooksett	Applicant, DES, Interior, Staff	15,000	0	1,170
Historic properties management plan	Applicant, Staff	15,000	1,000	2,170
New fishways at all three developments	Interior	3,000,000	50,000	267,261

3. No-Action Alternative

Under the no-action alternative, the licensee would continue to operate the Merrimack Project under the terms and conditions of the existing license, and no new environmental protection, mitigation, or enhancement measures would be implemented.

The estimated annual cost of the existing Merrimack Project is about $ 4,666,000 (35.80 mills/kWh). The estimated annual power value of the project is about $ 8,648,000 (66.35 mills/kWh) for the annual generation of 17,897 MWh. The resulting annual net benefit would be about $ 3,982,000 (30.55 mills/kWh).

4. Cost of Environmental Measures and Economic Comparison of Alternatives

Table 5 presents a summary of the current annual net power benefits for PSNH's proposed action; the staff–recommended alternative; and the no-action alternative.

Table 5. Summary of annual net benefits of the alternatives for the Merrimack Project (Source: the staff).

Parameter	No-Action Alternative	Proposed Action	Proposed Action with additional staff-recommended measures
Annual generation (MWh)	130,338	115,310	115,310
Installed capacity (MW)	29.5	29.5	29.5
Annual power value ($)	8,648,000	8,000,000	8,000,000
Annual cost ($)	4,666,000	4,534,000	4,542,000

Parameter	No-Action Alternative	Proposed Action	Proposed Action with additional staff-recommended measures
Annual net benefit ($)	3,982,000	3,465,000	3,458,000

5. Pollution Abatement

The Merrimack Project would produce about 115,310 MWh of electricity annually. This amount of hydropower generation, when contrasted with the generation of an equal amount of energy by a fossil-fueled facility, avoids the emission of atmospheric pollutants. Assuming that the hydropower generation would be replaced by an equal amount of natural gas-fired generation, generating electrical power equivalent to what would be produced at the Merrimack Project would require combustion of about 1,189 million cubic feet of natural gas annually. Removal of pollutants (N0x and S0x) from the emissions produced by burning fossil fuels to those levels presently achievable by state-of-the-art technology would cost about $56,680 annually.

VII. COMPREHENSIVE DEVELOPMENT AND RECOMMENDED ALTERNATIVE

Sections 4(e) and 10(a) of the FPA require the Commission to give equal consideration to all uses of the waterway on which a project is located. When we review a hydropower project, we consider water quality, fish and wildlife, recreation, cultural, and other non-developmental values of the involved waterway equally with its electric energy and other developmental values. In deciding whether, and under what conditions a hydropower project should be licensed, the Commission must weigh the various economic and environmental tradeoffs involved in that decision. This section contains the basis for, and a summary of, our recommendations for relicensing the Merrimack Project. We weigh the costs and benefits of our recommended alternative against other proposed measures.

A. Recommended Alternative

Based on our independent review and evaluation of the environmental and economic effects of the proposed action, the proposed action with additional staff-recommended measures, and no action, we recommend the proposed action with additional staff-recommended measures, as the preferred alternative.

We recommend this alternative because: (1) issuing a new license would allow PSNH to continue operating the project as a beneficial and dependable source of electric

energy; (2) the project, with a total installed capacity of 30 MW, would continue to eliminate the need for an equivalent amount of fossil-fuel-produced energy and capacity, which helps conserve these nonrenewable resources and limits atmospheric pollution; and (3) the recommended environmental measures would protect water quality, enhance fish and wildlife resources, and recreational opportunities.

Licensee-proposed measures

PSNH proposes to operate all three developments in a ROR mode, finalize an operation plan to document compliance with the ROR mode and flow requirements (including bypassed reach flows, whitewater flows, minimum tailrace flows, and flow ramping rates), create a conservation easement along the river front adjacent to the Garvins Falls development, provide minimum flows to each of the bypassed reaches, develop a final upstream and downstream fish passage plan in consultation with the agencies, develop a shoreline management plan, develop a recreation plan, and develop an historic properties management plan. In addition, we recommend that certain of PSNH's proposals be expanded or modified. We discuss the basis for these measures below.

ROR Operation. Currently, Hooksett operates in ROR mode and Amoskeag and Garvins Falls either peak or operate in ROR mode, depending on inflow. PSNH proposes to operate all three developments in ROR mode. The agencies concur with this proposal and ROR is a condition of the WQC and a 10(j) recommendation from Interior. The ROR mode of operation is typically a better mode of operation for protecting and enhancing habitat for aquatic biota and water quality than peaking. In this case, converting to ROR at all three developments would avoid habitat-disturbing flow fluctuations below Amoskeag and Garvins Falls, minimize potential fish stranding in those tailraces, and minimize shoreline erosion in the Amoskeag and Garvins Falls impoundments. Therefore, we recommend that ROR mode of operation be required as a condition of the new license. This measure has an estimated cost of $200,000 per year for all three developments.

Minimum Flows in Bypassed Reaches. Currently there are only leakage flows provided to the bypassed reaches, except during times when the developments' hydraulic capacities are exceeded and the bypassed reaches receive spill flows. PSNH proposes to provide minimum year-round flows to all three bypassed reaches to be released through spill at each of the project dams. Based on a flow demonstration study, at the 300-foot-long Hooksett and 650-foot-long Garvins Falls bypassed reaches, agency and PSNH personnel evaluated habitat changes in response to several different flow releases. Interior concurs (via 10(j) recommendations), and the WQC requires, PSNH's respective minimum flow proposals for Garvins Falls and Hooksett (78 cfs and 64 cfs). While the analysis is not quantitative, our review of video taken during the flow demonstration

studies leads us to conclude that the proposed flows do not appear to change wetted width substantially, but that under these flows increases in the depth of the pools and water velocity throughout the bypassed reaches would appear to create more diverse habitat compared to the current leakage condition.

At Amoskeag, PSNH proposes, and the WQC requires a minimum flow of 280 cfs from the east spillway, while Interior and EPA recommend a flow of 410 cfs from this location. The IFIM analysis conducted indicates that for most species and life stages, a flow of 280 cfs would provide the most WUA, and with additional flow, WUA stays the same or declines. The species and life stages that would benefit the most from a flow of 410 cfs are adult and juvenile longnose dace and the increases are relatively minor compared to the gains in WUA up to 280 cfs. A flow of 410 cfs would cost $200,000 more per year than a flow of 280 cfs. Because longnose dace is a very common and abundant species in the river basin, and the Northeast in general, and because most species and life stages would gain just as much habitat with a flow of 280 cfs, we recommend a minimum year-round flow from the east spillway of 280 cfs, as required by the WQC and proposed by PSNH. The estimated cost of providing the proposed minimum flows at all three developments is $326,000 total ($253,000 at Amoskeag; $21,000 at Hooksett, and $52,000 at Garvins Falls).

Ramping Rates. Although PSNH proposes to operate all three developments in a ROR mode, there would still be times when the projects must deviate from this mode of operation, such as before and following whitewater boating flows or maintenance drawdowns. In such instances, PSNH proposes to ramp discharges at rates of 1,550, 1,500, and 1,377 cfs/hr. for Amoskeag, Hooksett, and Garvins Falls, respectively. PSNH's ramping rates are based on the single unit hydraulic capacities at the three developments. Interior recommends ramping rates for the three respective developments of 1,427, 1,403, and 1,214 cfs/hr.

There is no documented problem with fish or aquatic biota being stranded in the development tailraces, which is the typical reason for recommending ramping flows. PSNH's and Interior's ramping rates are very similar and would result in a less than 0.1 foot/hr. in river stage difference. This difference should be insignificant for aquatic habitat. Additionally, we agree with PSNH that its ramping rates would be easier to implement and document compliance with. Interior's ramping rates may require some gate control structures to be modified, which would have some unspecified cost. Considering that the difference between PSNH's rates and Interior's rates would be biologically insignificant, we do not think any additional cost is warranted. Therefore, we recommend the ramping rates proposed by PSNH. We estimate the cost of this measure would be minimal or perhaps zero because no additional instrumentation or operational equipment would be required.

Minimum Tailrace Flows. PSNH proposes to maintain minimum flows in the tailraces of 1,427 cfs at Amoskeag, 1,403 cfs at Hooksett, and 1,214 cfs at Garvins Falls during refilling operations after maintenance or emergency drawdowns. Interior's 10(j) recommendations 4, 10, and 15 are for minimum tailrace flows that match those proposed by PSNH. In the event that inflows are less than the specified minimum tailrace flows, 90 percent of the inflow would be released to the tailraces.

Providing such flows below each of the project developments should protect aquatic resources during impoundment refilling because organisms are adapted to similar low flows during the dry summer months. In the event that inflows to the project are less than these aquatic base flows, releasing 90 percent of inflow below the project should minimize any adverse impacts, while allowing the impoundment to refill so that ROR operation could resume. We estimate the cost of this measure would be minimal and insignificant because it would only need to be implemented in low-flow periods when generation at the project would be low or discontinued anyway.

Comprehensive Operation Compliance Monitoring Plan. PSNH proposes to finalize their draft ROR operation plan, which in addition to ROR compliance, includes tailrace minimum flows, whitewater flow releases, drawdown refilling guidelines and agency notification procedures. The WQC requires a plan that would go beyond PSNH's plan to include procedures for minimum bypassed reach flows, fishway operations, and contingencies for emergency shutdowns or other events necessitating deviation from ROR operation, such as whitewater boating flows. Interior's 10(j) recommendations include ROR operation, a ROR operation and flow release monitoring plan, bypassed reach flows, tailrace minimum flows, ramping rates, and limitations on whitewater flow releases

We recommend a comprehensive operational compliance monitoring plan that includes all operational situations discussed in this section. Well-defined procedures for maintaining and prioritizing flow releases during emergency shutdowns, especially those which occur during times of extremely low project inflow, would ensure that agency resource management goals are reflected in PSNH's response to such situations and prevent misunderstanding among PSNH, the Commission, agencies, and other stakeholders. Since there are three developments in this project, each with a unique configuration and set of operational capabilities, the plan should include development-specific operational details. Monitoring the required measures would ensure the project is being operated in compliance with the license and WQC. Including all the listed operational details and procedures in a single plan would prevent redundancy between many individual plans. This measure would have an estimated one-time cost of $5,000.

Fishway Plan. Currently, the project has an upstream fish ladder at Amoskeag and downstream fishways at all three developments. The existing fishways at the project are adequate given the low numbers of anadromous fish (American shad, river herring, and Atlantic salmon) returning to the Merrimack River Project. PSNH proposes finalizing a fish passage plan, in consultation with the agencies and in accordance with its alternative fishway prescription filed with Interior on December 20, 2005. The WQC would require compliance with a 1986 Comprehensive Plan which requires continued effectiveness testing of existing fishways and would also require the construction of upstream fishways at Hooksett and Garvins Falls when certain trigger numbers of fish are passed at Amoskeag. The 1986 Comprehensive Plan is consistent with PSNH's proposal, with the exception of eels (discussed below). Interior has filed a detailed preliminary prescription for all three developments that would require upstream fishways at Hooksett and Garvins Falls (for shad and herring) to be constructed in response to lower trigger numbers than those in the 1986 Comprehensive Plan and also sooner after the trigger numbers are reached. Interior's preliminary prescription would also require an upstream eelway at Hooksett and potentially another upstream eelway at Garvins Falls, in addition to more effectiveness testing of all fishways, current and future.

The 1986 Comprehensive Plan does not address current agency management goals for American eel. Therefore, the plan should be updated to include existing efforts and planned activities for eel management at the project. However, in all other aspects, the 1986 plan is still a reasonable means of protecting and enhancing migratory fish populations at the project. Interior's preliminary prescription could cost significantly more than the 1986 Comprehensive Plan or Interior's preliminary prescription by requiring effectiveness studies that may well be inconclusive and by requiring expensive fishway designs and capacities that may not be necessary. Strictly implementing Interior's preliminary prescription could cost over $267,000 per year more than continuing with the 1986 Comprehensive Plan or PSNH's alternative prescription, if it causes expensive fishways to be built prematurely for fish runs that may not occur. The current issue with shad, herring and salmon restoration above the Merrimack River Project is a lack of fish reaching the project, not the lack of fishways at the project.

The status of the eel population in the project area is unknown so it seems unreasonable to assume that lack of fishways is currently a problem for this species. Additionally, juvenile eels are known to be ascending the dams currently and there is no evidence that adult eels are being entrained during their out-migration. Nevertheless, if upstream eelways are constructed, they would probably make it easier for juvenile eels to get past the project dams.

Therefore, we recommend that PSNH update the 1986 Comprehensive Plan to include eel management measures and status updates of all species (shad, river herring,

salmon, and eel), to the extent that they are known without additional research on PSNH's part. Although we understand the mandatory nature of Interior's prescriptions, we recommend that Interior revise its prescriptions so that the final prescription only requires compliance with the 1986 Comprehensive Plan and a reservation of authority. This would be consistent with PSNH's alternative prescription and would prevent costly fishways being constructed prior to fish being present to use them or costly effectiveness studies being conducted potentially without conclusive results. The plan should include measures to monitor run timing to determine if, as PSNH suggests in its alternative prescription, the seasons of fishway operations could be shortened without adverse effects to migrating fish. We recommend that a final fishway plan be developed for the Merrimack River Project in consultation with NHDES, Interior, and NHFG. We estimate the one-time cost of this measure as $5,000, not including the construction, testing, and operation of any additional facilities that might be required by the 1986 plan, PSNH's alternative prescription, or Interior's preliminary prescription.

Shoreline Management Plan. The current project boundary encloses the three project dams and their adjacent powerhouses and the Amoskeag Fishway and Interpretive Center as well as several small, undeveloped islands. For those project lands that it does not have fee title to, PSNH has flowage rights over the approximately 25 miles of Merrimack River and shoreline lands to the level of pondage created by use of the dams' flashboards.

Parts of the project's shoreline are potentially subject to developmental pressure. Private boat docks along the downstream end of the Amoskeag impoundment are used by residents living along the Merrimack River adjacent to the project boundary. There is also urban development along the Garvins Falls impoundment in Concord, and recreation sites are interspersed along all three impoundments. However, most of the remaining project shoreline is currently undeveloped, with the exception of a few small, public boat docks.

PSNH proposes to develop a shoreline management plan (SMP) for the project and to grant a 2.9-mile-long, 200-foot-wide conservation easement to the Society for the Protection of New Hampshire Forests or another land managing organization on PSNH-owned riverfront property just upstream of the Garvins Falls dam adjacent to the project. PSNH does not propose to expand the project boundary; the proposed easement would be entirely outside of the project boundary.

Interior recommends placing conservation restrictions on both the Garvins Falls tract of land and, in addition, developing a plan to likewise protect non-PSNH riparian land in the project area upstream from Hooksett Dam adjacent to the impoundment. The purpose of these protective measures would be to create a riparian buffer zone that would

protect water quality and aesthetic resources and improve habitat corridors. In order to manage project lands for these purposes, Interior also recommends the development of a SMP.

AMC et al. recommend a SMP that preserves lands abutting project waters that contain New Hampshire and federal rare, threatened, and endangered species and Natural Heritage Inventory sites on PSNH-owned land, as well as the provision of protective management measures for non-PSNH lands that contain such species. CC Bow recommends granting conservation easements on lands with known eagle roosting and nesting habitat along the river in the town of Bow outside of the current project boundary, on both PSNH and non-PSNH lands.

Interior, AMC et al., and CC Bow recommend expanding the proposed Garvins Falls easement, or conservation restrictions on this land, beyond 200 feet.

The recommendations from Interior, AMC et al, and CC Bow would require conservation restrictions or easements on non-PSNH-owned land. Interior and CC Bow do not quantify the acreage involved in their recommendations. AMC et al. likewise do not quantify the amount of land necessary for their recommendation, but protective measures for the threatened and endangered species could require up to 9 miles of riverfront to be included in the project boundary, due to the wide range of bald eagle use at the project.

We do not recommend the acquisition of non-PSNH-owned land for the purposes of conservation restrictions or easements because the acquisition of waterfront property in this relatively urban location would likely be very costly. However, several areas of undeveloped riparian land of high habitat value do occur on PSNH-owned land adjacent to the project. Therefore, we recommend that PSNH expand the project boundary to include these lands for the purpose of a riparian buffer. Specifically, we recommend including, at a minimum, any bald eagle habitat located on PSNH-owned land adjacent to the current project boundary that occurs within 200 feet of the shore. The following tracts meet these criteria:

(1) the approximately 2 acres of "known perching and foraging" eagle habitat on the east side of the river upstream of the Amoskeag dam on the impoundment;
(2) the approximately 3 acres of "known perching and foraging" eagle habitat on the east side of the river upstream of the Hooksett dam on the impoundment;
(3) the approximately 9 acres of "potential roosting" eagle habitat on the west side of the river about a mile and a half downstream from the Garvins Falls

dam on the Hooksett impoundment and just upstream of the coal fired Merrimack Power Plant in Bow, which is an undeveloped portion of a large tract of PSNH land;

(4) the approximately 17 acres of "known perching and foraging" eagle habitat on the east side of the river immediately downstream from the Garvins Falls dam;

(5) the approximately 7 acres of "known perching and foraging" eagle habitat on the west side of the river immediately downstream from the Garvins Falls dam; and

(6) the approximately 70 acres of "undeveloped habitat block of potential importance" on the east side of the river upstream from the Garvins Falls dam.

This list includes the 70 acres at Garvins Falls that PSNH proposes as a conservation easement.

We do not recommend Interior, AMC et al., and CC Bow's recommendations for more expansive conservation restrictions at this project because our alternative measure should meet the objectives of bald eagle habitat protection such that it would buffer the river from most human activities and ensure the protection of any potential perching, nesting, or roosting trees that exist adjacent to the river.

We recommend that PSNH include the above parcels in the project boundary and, and include these areas in the shoreline management plan PSNH proposes.

The plan, at a minimum, should include: (1) allowable uses for the buffer zone lands; (2) conditions to be specified for such allowable uses; and (3) any proposed permit system. In addition to these guidelines for development, the plan should include measures for protection of bald eagle and other valuable wildlife habitat at the project, including: (a) measures to protect bald eagle and other species of concern and their habitat at the project; (b) provisions for monitoring and documenting bald eagle nesting activity; and (c) consultation with the Commission, Interior, and New Hampshire Fish and Game Department prior to conducting significant land-disturbing activities on project lands with eagle habitat.

Collectively, the six sites described above are approximately 108 acres, all on PSNH-owned land and within 200 feet of the shoreline, and contain habitat that is valuable to bald eagles and other wildlife that are dependent on the shoreline environment. Including this in the project boundary under the SMP would protect approximately four miles of the project shoreline from the effects of shoreline development and thus benefit fish and wildlife habitat, water quality, and public access.

The cost of the project boundary expansion and SMP is unknown but should be minimal due to PSNH ownership of the included lands. We estimate the annual cost of this plan to be $4,000.

Regarding the 2.9-mile long, 200-foot wide parcel of land upstream from the Garvins Falls dam that we recommend be included in the project and in the SMP, because PSNH would be responsible for managing the property under the new project license, any easement they might grant would need to ensure that PSNH can comply with the license.

Recreation Plan

Facilities

PSNH proposes to develop a Recreation Plan that would include continuing to provide environmental education exhibits and instruction about the Merrimack River at its fish ladder facilities at Amoskeag Fishways, as well as maintaining existing portage trails and access around the Amoskeag and Hooksett dams. The proposed plan would also include an evaluation of the need and feasibility of access improvements, the feasibility of providing portage at Garvins Falls, and the provision of special whitewater boating releases.

AMC et al. recommend improving the portage at Amoskeag dam, and both AMC et al. and CC Bow recommend a portage at Garvins Falls.

The Garvins Falls impoundment has high scenic value and is popular for canoeing and flatwater kayaking. Providing a portage at Garvins Falls would improve access at this development and recreational navigation. Therefore, in addition to the measures proposed by PSNH, we recommend that a recreation plan for the project include a portage facility around Garvins Falls Dam. Because the existing portage at Amoskeag is difficult to traverse due to the granite riprap at the take-out and the steepness of the slope at the put-in, we also recommend that PSNH improve the portage there as part of the recreation plan.

The recreation plan should be developed in consultation with Interior, New Hampshire Fish and Game Department, New Hampshire Department of Environmental Services, Appalachian Mountain Club, American Whitewater, New England Flow, and the New Hampshire Rivers Council.

The plan should include, at a minimum: (1) design plan(s) for the provision of portage facilities at the Garvins Falls development; (2) measures to provide improvements

of the portage facilities at the Amoskeag development; (3) an implementation schedule for the provision of recreation improvements; (4) measures to continue to provide the Amoskeag Fishways facility and portage at the Hooksett development; (5) an annual whitewater boating release schedule that takes into consideration the maintenance of minimum flows, maximum allowable impoundment fluctuations, and the avoidance of impacts on fish ladder operation; (6) a description of the volume, timing, and duration of the whitewater boating releases, including provisions for ramping; and (7) a description of measures to manage the flow notification system through the flow phone.

Whitewater Boating Releases

There is a 5.3-mile-long whitewater boating reach with class I-III rapids located immediately downstream of the Amoskeag development. In response to an additional information request, PSNH originally proposed to provide three scheduled whitewater boating flows of 3,000 cfs below Amoskeag, one during the last weekend in June, one during a weekend in September, and one on a weekend day in October.

PSNH did not describe how its flows would be provided. However, since the whitewater reach of concern is downstream of the powerhouse, the boating flows could be provided by generation, releases into the bypassed reach, or a combination of the two.

Appalachian Mountain Club, American Whitewater, New England Flow, and the New Hampshire Rivers Council (AMC et al.) recommend whitewater boating releases below the Amoskeag development as follows: (a) flows for race events including but not limited to the scheduled races during the second weekend in June, the weekend following Labor Day in September, and the National Canoe Poling contest, and (b) a once a week, scheduled weekday evening release of approximately 2500-3000 cfs for as long as possible without having negative impacts on the reservoir or downstream resources from the first week in June until the week after Labor Day.

Interior is concerned that variances from ROR operation, such as these boating releases, could adversely affect the riverine aquatic community. However, with the stipulation that PSNH follow Interior's recommended ramping rates and delay releases until after the installation and operation of a minimum bypass flow gate, Interior is willing to agree to up to three special weekend whitewater boating releases per year. Interior also recommends that no whitewater releases be scheduled during the upstream fish passage season (April 1 through June 30) except on a case-by-case basis by mutual agreement between PSNH and the fisheries agencies.

After reviewing the recommendations filed by AMC et al. and Interior, PSNH has agreed to conduct any whitewater boating releases required by the license and to make

these modified river flow forecasts and real time information available electronically.

Flows of the magnitude proposed or recommended for whitewater boating (2,500-3,000 cfs) could have minor, short-term effects on aquatic resources in the Amoskeag tailrace. The flows would, however, be well within the range that routinely occurs due to natural storm events. Fish and other organisms should respond to these boating releases in the same way they respond to fluctuations caused by storm events. However, if the higher flows were released more frequently than would normally occur, such as in the case of the AMC et al.-recommended weekly releases during the months of July-September, there is the potential that flow releases could generally disrupt aquatic habitat. In this scenario, the disrupting effects would likely be intermediate between those of strict ROR operation and those of daily peaking; thus, a portion of the aquatic habitat benefits of changing to ROR operation could be negated.

During operation of the fish ladder at Amoskeag (April 1st through June 30th), such fluctuations in flows, whether due to natural or project-related causes, could affect fish passage effectiveness. This effect could be beneficial or adverse. Sufficient information does not exist at this time to determine what the effect would be. The only way to completely avoid any effect on fish passage (beneficial or adverse) would be to schedule boating releases during times when the fish ladder is not being operated, as Interior recommends.

Our review of flow duration curves for a 64-year period of record show that flows below Amoskeag under ROR operation would generally meet or exceed AMC et al.'s recommended 2,500 cfs in January (70% of the time), February (75%), March (85%), April (97%), May (88%), June (60%), November (65%), and December (75%). The months of July, August, September, and October generally would not provide adequate flows for whitewater boating under ROR operation, meeting or exceeding 2,500 cfs only 25%, 16%, 15%, and 33% of the time. However, the reach is reportedly boatable at 900 cfs, and flows at Amoskeag would generally meet or exceed 900 cfs in July (87% of the time), August (80%), September (77%), and October (93%) under ROR operation.

Because ROR flows would be adequate for whitewater boating for a majority of the year, and because AMC et al.'s recommendation for summer-season weekly releases could conflict with the beneficial effects of conversion to ROR operation, we do not recommend regularly scheduled weekly boating releases during the summer season. However, we would not be opposed to a few planned releases primarily to accommodate special events, as long as these releases do not result in drawing down the impoundment or adversely affecting the fishway operation.

An option would be an annual release schedule, to be prepared in consultation

with Interior, New Hampshire Fish and Game Department, New Hampshire Department of Environmental Services, Appalachian Mountain Club, American Whitewater, New England Flow, and the New Hampshire Rivers Council, that includes a schedule and description of a limited number of weekend whitewater boating releases for the following summer season. When planning the schedule, consideration would need to be given to the necessary environmental conditions such as maintaining minimum flows, potential ramping rates if needed, maximum allowable impoundment fluctuations, and avoiding impacts on fish ladder operation. Each release could occur on one or both days of the specified weekend, and for as many daylight hours as possible while working within the determined environmental and operational parameters.

The cost associated with providing scheduled flows would depend on how much of the flow(s) is provided when the project is generating. Under ROR operation, flows of at least 2,500 cfs would generally be available 25%, 16%, and 15% of the time in July, August, and September, respectively. We do not expect the cost to supplement these ROR flows during daylight hours for a few planned whitewater releases to be significant.

Historic Properties Management Plan. To protect historic and archaeological resources in the project area, we recommend that an historic properties management plan (HPMP), as part of a programmatic agreement be developed. The HPMP should be developed in consultation with the New Hampshire SHPO and include, at a minimum: (a) a description of each historic property identified at the project indicating whether it is listed in or eligible to be listed in the NRHP; (b) a Phase 1B survey consistent with the recommendations of the reconnaissance survey conducted for the project; (c) a description of potential effects on each discovered property; (d) proposed measures for avoiding or mitigating effects; (e) documentation of the nature and extent of consultation; (f) a schedule for mitigating effects and conducting additional studies; (g) measures, if necessary, to protect the Garvins Falls Site (27MR78) from the effects of constructing the canoe portage; and (h) measures, developed in cooperation with the SHPO, to protect site (27MR78) from looting. We estimate the annual cost of this plan to be $2,170.

B. Measures not Recommended

As noted above, we are not recommending: Interior and EPA's minimum bypassed flow at Amoskeag; Interior's ramping rates and fishway prescription; the more expansive shoreline buffers recommending by AMC et al; and regularly scheduled summer whitewater boating releases. .

C. Conclusion

Based on our review of the agency and public comments filed on the project and our independent analysis pursuant to sections 4(e), 10(a)(1), and 10(a)(2) of the FPA, we conclude that licensing the Merrimack River Project, as proposed by PSNH with the additional staff-recommended measures would be best adapted to a plan for improving or developing the Merrimack River waterway.

VIII. RECOMMENDATIONS OF FISH AND WILDLIFE AGENCIES

Under the provisions of section 10(j) of the FPA, each hydroelectric license issued by the Commission shall include conditions based on recommendations provided by the federal and state fish and wildlife agencies for the protection, mitigation, and enhancement of fish and wildlife resources affected by the project.

Section 10(j) of the FPA states that whenever the Commission finds that any fish and wildlife agency recommendation is inconsistent with the purposes and the requirements of the FPA or other applicable law, the Commission and the agency shall attempt to resolve such inconsistency, giving due weight to the recommendations, expertise, and statutory responsibilities of the agency.

In a letter filed May 13, 2005, Interior filed 19 recommendations pursuant to section 10(j) of the FPA, respectively. Table 6 lists Interior's recommendations submitted subject to 10(j), and whether the recommendations are adopted under the staff alternative.

Recommendations that are within the scope of section10(j) but we do not recommend adopting are discussed below. Recommendations that we consider outside the scope of section 10(j) have been considered under section 10(a) of the FPA and are addressed in the specific resource sections and comprehensive development section of this document.

Table 6. Analysis of fish and wildlife agency recommendations for the Merrimack River Project (Source: the staff).

Recommendation	Agency	Within scope of section 10(j)?	Annual cost	Recommend adopting?
1, 7, &12. ROR at all three developments	Interior	Yes	$200,000 for all 3 developments	Yes

Recommendation	Agency	Within scope of section 10(j)?	Annual cost	Recommend adopting?
2, 8, & 13. Ramping rates below each development when not operated in ROR mode	Interior	Yes	Unspecified cost of potential gate modification or gauging equipment,	No, we recommend PSNH's proposed ramping rates
3. Amoskeag minimum bypass flows of 410 cfs in east side channel and 149 cfs in west side channel	Interior	Yes	$200,000	No, we recommend 280 cfs and 149 cfs as in WQC
4.Minimum flow below Amoskeag of 1,427 cfs or 90% of inflow when refilling	Interior	Yes	Minimal, unknown	Yes
5. Restrictions (timing and number)on up to 3 special weekend whitewater boating releases at Amoskeag	Interior	Yes	Minimal, unknown	Yes
6, 11, &16. ROR operation monitoring plans at all three developments	Interior	Yes	$5,000 for all three developments	Yes, as part of comprehensive operations and monitoring plan
9. Hooksett minimum bypass flows of 64 cfs from west-side spillway	Interior	Yes	$21,000	Yes
10. Minimum flow below Hooksett of 1,403 cfs or 90% of inflow when refilling	Interior	Yes	Minimal, unknown	Yes
14. Garvins Falls minimum bypass flows of 55 cfs year-round from spillway; maintaining seepage to center of bypass; and 23 cfs through fish bypass gate or ice sluice	Interior	Yes	$52,000	Yes

Recommendation	Agency	Within scope of section 10(j)?	Annual cost	Recommend adopting?
15. Minimum flow below Garvins Falls of 1,214 cfs or 90% of inflow when refilling	Interior	Yes	Minimal, unknown	Yes
17. Shoreline management plan	Interior	No, not a specific fish and wildlife recommendation	$4,000	Yes
18. Conservation restriction and plan for Garvins Falls tract	Interior	No, not a specific fish and wildlife recommendation	Included in shoreline management plan	Yes, as part of shoreline management plan
19. Conservation restriction and protection plan for non-PSNH riparian land upstream of Hooksett	Interior	No, not a specific fish and wildlife recommendation	Included in shoreline management plan	No

Ramping rates

We are making a preliminary determination that Interior's section 10(j) recommendations for ramping rates of 1,427 cfs/hr at Amoskeag, 1,403 cfs/hr at Hooksett, and 1,214 cfs/hr at Garvins Falls are inconsistent with the comprehensive development and public interest standards of sections 10(a) and 4(e) of the FPA.

PSNH proposes ramping rates of 1,550 cfs/hr at Amoskeag, 1,500 cfs/hr at Hooksett, and 1,377 cfs/hr at Garvins Falls, each of which corresponds to the single unit hydraulic capacities at the three respective developments. PSNH suggests that implementing Interior's ramping rates would be more operationally complicated and may require the modification of gate structures or the addition of gauging equipment in order to comply.

The ramping rates are meant to prevent stranding of aquatic biota in the tailraces, during times when project operation is modified from ROR mode, such as following whitewater boating releases. There is nothing in the record to suggest that stranding of aquatic biota is a problem at the project. More importantly, the difference in the two sets of ramping rates would be biologically insignificant, resulting in about 0.1 foot/hr difference in river stage below the developments. Therefore, even though the cost of implementing Interior's ramping rates is not precisely known, no additional cost would be justified in this case as PSNH's ramping rates would adequately protect aquatic biota in

the project's three tailraces.

Minimum flow in Amoskeag bypassed reach

We are making a preliminary determination that Interior's section 10(j) recommendation for a minimum flow of 410 cfs in the east side channel of the Amoskeag bypassed reach is inconsistent with the comprehensive development and public interest standards of sections 10(a) and 4(e) of the FPA.

PSNH proposes, and the WQC requires, a minimum flow of 280 cfs in the east side channel of the Amoskeag bypassed reach. As we discussed in Section V C.1, almost all of the benefits of the 410-cfs flow are realized at 280 cfs. Only juvenile and adult longnose dace and macroinvertebrates show any habitat gains between 280 cfs and 410 cfs. Gains for macroinvertebrates are minor and gains for longnose dace are not at the same rate as gains achieved by going from 150 cfs to 280 cfs. Additionally, longnose dace are an extremely common non-game species found throughout the Eastern United States. Because the 410 cfs flow would cost $200,000 more per year than 280 cfs, we conclude that the costs do not justify the relatively minor habitat gains. The flows proposed by PSNH and required by the WQC would provide significant habitat improvements for fish and aquatic macroinvertebrates at a more reasonable cost.

IX. CONSISTENCY WITH COMPREHENSIVE PLANS

Section 10(a)(2) of the FPA requires the Commission to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, or conserving waterways affected by the project. Under section 10(a)(2), federal and state agencies filed a total of 12 comprehensive plans that address various resources in New Hampshire. Of these, we identified and reviewed 7 comprehensive plans that address resources relevant to the Merrimack River Project.[14] No conflicts were found.

[14] Strategic plan for the restoration of Atlantic salmon to the Merrimack River, 1990-2004; Wild, scenic, & recreational rivers for New Hampshire, 1977; New Hampshire wetlands priority conservation plan, 1989; New Hampshire outdoors, 2003-2007: State Comprehensive Outdoor Recreation Plan (SCORP); Public access plan for New Hampshire's lakes, ponds, and rivers, 1991; Upper Merrimack River corridor plan – volume 2: management plan, 1991; New Hampshire rivers management and protection program, 1991.

X. FINDING OF NO SIGNIFICANT IMPACT

If the Merrimack River Project is licensed as proposed with the additional staff-recommended measures, the project would continue to operate while providing enhancements to fish and wildlife resources, improvements to recreation facilities, and protection of cultural resources in the project area.

Based on our independent analysis, issuance of a license for the Merrimack River Project, as proposed with the additional staff-recommended measures, would not constitute a major federal action significantly affecting the quality of the human environment.

XI. LITERATURE CITED

Normandeau Associates, Inc. 1997. Merrimack Station (Bow) Fisheries Study. Prepared for Public Service of New Hampshire.

North American Electric Reliability Council, Reliability Assessment 2003-2012. The Reliability of Bulk Electric Systems in North America, December 2003.

PSNH. 2003. Merrimack River Project (FERC License No. 289-013), Application for New License for Major Project Existing Dam. December 2003.

PSNH. 2004-2005. Merrimack River Project (FERC License No. 1893), Response to Information Requests. December 2004 through March 2005 (several filings)

XII. LIST OF PREPARERS

John Costello – Cultural Resources (Landscape Architect; BLA, Landscape Architecture and Environmental Planning)

Kristen Murphy – Terrestrial Resources, Threatened and Endangered Species, Recreation Resources, Aesthetic Resources (Environmental Biologist, B.S. Biology)

Steve Kartalia - Project Coordinator, Aquatic Resources (Fisheries Biologist; M.S., Fisheries Biology)

Michael Spencer – Need for Power, Developmental Analysis

Appendix A

WATER QUALITY CERTIFICATION CONDITIONS

E-1. A copy of this modlfled 401 Certification shall be posted within each of the Project powerhouses within seven days of issuance of the new Commission license.

E-2. The Applicant shall allow the Department to inspect the Project at any time to monitor compliance with the conditions of this modified 401 Certification.

E-3. The Applicant acknowledges a Total Maximum Dally Load (THDL) study will occur in the Merrimack River that will include segments of the Merrimack River within the Project boundary. The issuance of this modified 401 Certification shall not affect or change the obligation of the Applicant to participate in any TMDL study and to comply with any TMDL requirement. Participation may include, but is not limited to, assistance with monitoring or dam operation to facilitate development of the TMDL. The Applicant may be asked to consult with the Department during the development of the TMDL and to comply with all applicable provisions of any final TMDL.

E-4. The Applicant shall provide minimum flow releases in Project tailwaters, as follows, for the protection of aquatic life until such time that the Project is operated in run-of-fiver mode in accordance with the approved operations plan described in section E-7 of this certification.

a. Garvlns Falls: 719 cfs or inflow, whichever is lower;
b. Hooksett: 819 c'fs or inflow, whichever is lower; and
c. Amoskeag: 833 cfs or inflow, whlchever is lower.

E-5. Unless otherwise permitted in the approved operations plan, and upon implementation of the approved operations plan as described In section E-7 of this modified 401 Certification, the Applicant shall, at all times, provide minimum flow releases In Project bypass reaches for the protection of aquatic life, as follows:

a. Garvlns Falls: 55 cfs in the mainstem bypass and 23 cfs in the downstream fish bypass channel;
b. Hooksett: 64 cfs; and
c. Amoskeag: In accordance with Table 1.

Table 1. Minimum river flow releases in the Amoskeag bypass for the Merrimack River Hydroelectric Project, FERC No. 1893.

	Description	East Channel	West Channels: Riffle 15	West Channels: Riffle 16	West Channels: Total	Bypass Total
Apr. 1 – June 30 and Sept. 15 – Oct. 31	280 cfs from eastern spillway	249	5	26	31	
	149 cfs from 2.0 ft. opening in the fish bypass gate (crest-gate)		125	24	149	429
	Total	249	130	50	180	
July 1 – Sept. 14 and Nov. 1 – Mar. 31	280 cfs from eastern spillway	249	5	26	31	280

E-6. The Applicant shall evaluate the ability of the developments to maintain constant water surface elevations and/or constant downstream flows during times of daily power generation. The evaluation shall include, but not be limited to, a run-of-river scenario where water levels fluctuations in Project impoundments do not exceed 0.25 feet. Unless otherwise approved by the Department, the Applicant shall complete the evaluation by September 30, 2005 and submit a report containing the results of the evaluation to the Department by October 31, 2005. The results of the evaluation shall be used to develop the run-of-river operations plan described In E-7 of this modified 401 Certification.

E-7. The Applicant shall operate the Project In run-of-river mode, as follows:

a. The Applicant shall develop an operations plan that shall

i. Define, in detail, run-of-river operations, including, but not limited to, provisions for the maintenance of constant water levels in the impoundments and/or constant river flows downstream from Project dams;

ii. Provide compliance monitoring, including reservoir levels, outflow, and if necessary, inflow, at the Garvlns Falls, Hooksett, and Amoskeag developments unless otherwise approved by the Department;

iii. Describe the spillway and downstream fish bypass configurations, including design drawings, used to maintain the minimum flows in the bypass reaches described in Condition E-5 of this modified 401Certification;

iv. Describe contingency procedures to maintain minimum flows in the bypass reaches or tailraces during periods of failures of the spillway flashboards or fish bypass configurations (e.g., obstructions) or emergency shutdowns;

v. Identify spillway and downstream fish passage facility configurations at the Amoskeag dam for distributing water to the east and west channels of the Amoskeag bypass reach;

vi. Describe how the tailrace and bypass channel flows will be Impacted when inflows are less than the sum of the permitted minimum tailrace and bypass channel flows described in section E-4 and E-5 of this modified 401 Certification; and

vii. Provide a design and implementation schedule for all activities included in the operations plan.

b. The Applicant shall develop the operations plan in consultation with the Department, New Hampshire Fish and Game Department (NH F&G), U.S. Fish and Wildlife Service (USFWS), and U.S. Environmental Protection Agency (USEPA). The operations plan shall be submitted to the Department for review and approval by December 31, 2005, unless otherwise approved by the Department.

c. The Applicant shall implement the operations plan, excluding the construction of a new minimum river flow release structure, as soon as possible, but not later than 90 days after issuance of the new Commission license for the Project, unless otherwise approved by the Department. The construction and operation of a new minimum river flow release structure shall be completed no later than December 31, 2006. Any proposed modifications to the approved operations plan shall be submitted to the Department for review and approval. Proposed modifications shall not be implemented until after approval by the Department.

d. The Applicant shall notify the Department not more than 24 hours after any

substantial deviation from the approved operations plan and shall maintain a log of deviations, which shall be submitted annually to the Department not later than December 31 of each year.

e. Exceptions to run-of-river operations may be granted by the Department, as necessary, in consultation with the Applicant, USFWS, NH F&G, and USEPA for reasons including, but not limited to, flashboard failure and reinstallation and the installation of new minimum flow release structures.

E-8. The Applicant shall enhance upstream and downstream fish passage at the Amoskeag, Hooksett, and Garvlns Falls developments according to the prescriptions defined in *A Comprehensive Plan for the Provision of Anadromous Fish Passage Measures and Facilities at PSNH's Merrlmack-Pemlgewasset RiverHydroelectric Dams, FERC Project Nos. 1893, 2456, and 2457* (Comprehensive Plan) published in 1986. The Applicant shall maintain the agreements established under the Comprehensive Plan, including, but not limited to, the construction of upstream fish passage at the Hooksett development after the fifth year following the annual passage of 15,000 American shad at the Amoskeag development, and the construction of upstream passage facilities at the Garvins Falls development after the fifth year following the annual passage of 15,000 American shad at the Hooksett development. The Applicant shall also conduct studies, as necessary, to determine the effectiveness of the downstream passage facilities at the Garvins Falls, Hooksett, and Amoskeag developments relative to Atlantic salmon smolts, American shad, and alewife. After the fourth year following the annual passage of 15,000 American shad at either the Amoskeag or Hooksett development, the Applicant shall submit annual status reports to the Department by December 31 regarding the design, construction, and anticipated completion date of fish passage facilities.

E-9. The Applicant shall operate and maintain the Project consistent with the conditions of this modified 401 Certification.

a. The manner in which the Project is operated shall not contribute to violations of NH surface water quality standards. If It is determined that the manner of project operation contributes to violations of surface water quality standards, additional conditions may be imposed or conditions amended by the Department, when authorized by law and after notice and opportunity for hearing.

b. The Applicant shall consult with the Department regarding any proposed modifications to the Project or its operation that may not be in accordance with this modified 401 Certification to determine whether this modified 401Certification requires amendment or if a new 401 Certification is required for the Project. Any amendment of this modified 401 Certification or the issuance of a new 401

Certification, determined appropriate by the Department, shall be required prior to the implementation of any modifications to the Project.

E-10. The conditions of this modified 401 Water Quality Certification may be amended and additional terms and conditions added as necessary to ensure compliance with NH surface water quality standards, when authorized by law, and after notice and opportunity for hearing.

E-11.The Department may, at any time, request from the Commission the reopening of the license to consider modifications to the license as necessary to ensure compliance with NH surface water quality standards.