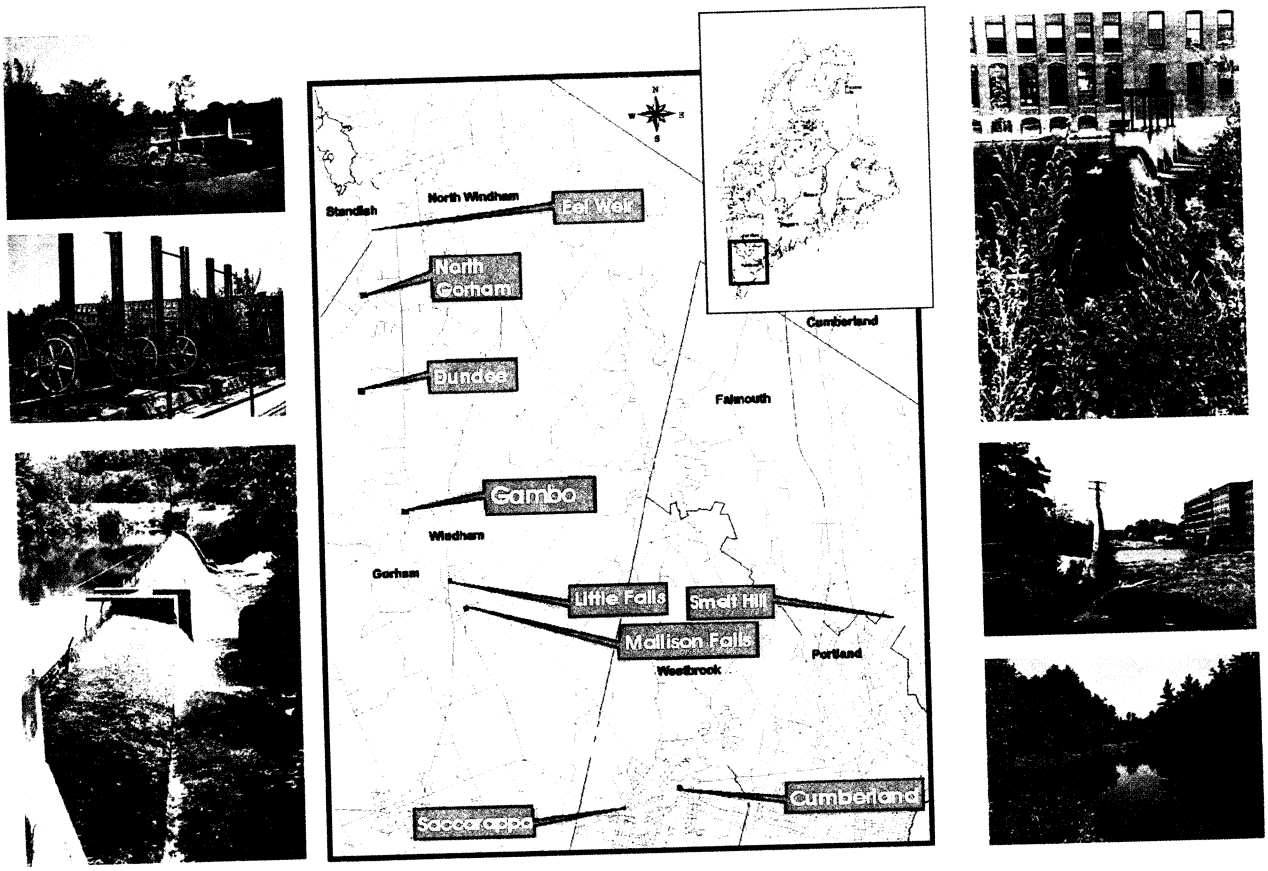
Federal Energy Regulatory Commission
Office of Energy Projects
June 2002

PART 1072

Final Environmental Impact Statement (FERC/FEIS-0139F)



Presumpscot River Projects
Maine

Dundee Project (FERC Project No. 2942)
Gambo Project (FERC Project No. 2931)
Little Falls Project (FERC Project No. 2941)
Mallison Falls Project (FERC Project No. 2932)
Saccarappa Project (FERC Project No. 2897)

888 First Street, N.E., Washington, DC 20426

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

S.D. Warren Company

Project Nos. 2942-005, 2931-002,
2941-002, 2932-003,
and 2897-003

NOTICE OF AVAILABILITY OF
FINAL ENVIRONMENTAL IMPACT STATEMENT

(**DATE**)

In accordance with the National Environmental Policy Act of 1969 and the Federal Energy Regulatory Commission's (FERC or Commission) regulations, 18 CFR Part 380 (Order No. 486, 52 F.R. 47897), the Office of Energy Projects staff has reviewed the applications for new licenses for the Dundee, Gambo, Little Falls, Mallison Falls, and the Saccarappa hydroelectric projects, and has prepared a Final Environmental Impact Statement (FEIS) for the projects. In the FEIS, the Commission's staff has analyzed the potential environmental impacts of the existing projects and has recommended that approval of the projects, with appropriate environmental protection measures, would be in the public interest.

Copies of the FEIS are available for review in the Public Reference Branch, Room 2-A, of the Commission's offices at 888 First Street, N.E., Washington, D.C. 20426.

Magalie R. Salas
Secretary

TO THE PARTY ADDRESSED

Attached is the Final Environmental Impact Statement (FEIS) for the Dundee Project (No. 2942-005), Gambo Project (No. 2931-002), Little Falls Project (No. 2941-002), Mallison Falls Project (No. 2932-003), and Saccarappa Project (No. 2897-003), located on the Presumpscot River in Cumberland County, Maine.

The FEIS documents the views of the Commission's staff regarding the five proposed hydroelectric projects. Before the Commission makes a decision on the proposals, it will take into account all concerns relevant to the public interest. The FEIS will be part of the record from which the Commission will make its decision.

Copies of the FEIS are available for review in the Commission's Public Reference Branch, Room 2-A, located at 888 First Street, N.E., Washington, D.C. 20426. The DEIS may also be viewed on the Internet at http://www.ferc.fed.us/online/rims.htm. Please call (202) 208-2222 for assistance.

Attachment: Final Environmental Impact Statement

FINAL ENVIRONMENTAL IMPACT STATEMENT FOR HYDROPOWER LICENSES

PRESUMPSCOT RIVER PROJECTS

Dundee Project
FERC Project No. 2942-005

Gambo Project
FERC Project No. 2931-002

Little Falls Project
FERC Project No. 2941-002

Mallison Falls Project
FERC Project No. 2932-003

Saccarappa Project
FERC Project No. 2897-003

Federal Energy Regulatory Commission
Office of Energy Projects
Division of Environmental and Engineering Review
888 First Street, NE
Washington, D.C. 20246

June 2002

COVER SHEET

a. Title: Relicensing the Dundee, Gambo, Little Falls, Mallison Falls, and Saccarappa projects in the Presumpscot River Basin, Federal Energy Regulatory Commission (FERC or Commission) Project Nos. 2942-005, 2931-002, 2941-002, 2932-003, and 2897-003

b. Subject: Final Environmental Impact Statement

c. Lead Agency: Federal Energy Regulatory Commission

d. Abstract: S.D. Warren Company (S.D. Warren) filed applications for new licenses for the existing Dundee, Gambo, Little Falls, Mallison Falls, and Saccarappa hydroelectric projects located on the Presumpscot River in southeastern Maine.

The primary issue in these relicensing proceedings is the effects of project operations on fisheries resources including resident trout, American shad, river herring, Atlantic salmon, and American eel. A secondary issue is public access for recreation at the projects. S.D. Warren proposes to provide minimum flows to the bypassed reaches at the Dundee, Gambo, and Mallison Falls projects to enhance resident fisheries and to provide upstream eel passage at the Dundee Project. S.D. Warren would also improve canoe portage, car-top boat access, and walk-in angler access at the projects.

During the scoping process for these proceedings, numerous entities called for the removal of the Little Falls, Mallison Falls, and Saccarappa dams, based on changing circumstances in the Presumpscot River Basin, including the potential removal of Smelt Hill dam near the mouth of the river at Casco Bay. Dam removal advocates recognize that Cumberland Mills dam (a non-jurisdictional dam also owned by S.D. Warren), located between the Saccarappa dam and the Smelt Hill dam, blocks upstream anadromous fish migration and condition their dam removal recommendation on installation of fish passage facilities at the Cumberland Mills dam. We analyzed the effects of dam removal on fisheries resources, assuming that these two lower dams would be removed or laddered, and conclude that only marginal benefits to fisheries would be realized.

The staff's recommendation is to relicense the proposed projects with additional staff-recommended measures, including the provision of higher seasonally adjusted minimum flows to the bypassed reaches, the design and installation of fish passage facilities on a schedule dictated by the provision of passage at downstream dams and the presence of the target species downstream of each project dam as defined in a fish passage implementation plan, the installation of upstream eel passage facilities and implementation of downstream eel passage measures at all five dams, the implementation of a recreation use monitoring study, and the preparation of a final recreation plan including the resolution of the location of and access to proposed recreational enhancements.

e. Contact:

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Office of Energy Projects
Division of Environmental and Engineering Review
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f. Transmittal:

This Final Environmental Impact Statement prepared by the Commission's staff on the hydroelectric license applications filed by S.D. Warren for the existing Dundee Project (FERC No. 2942); Gambo Project (FERC No. 2931); Little Falls Project (FERC No. 2941); Mallison Falls Project (FERC No. 2932); and Saccarappa Project (FERC No. 2897) is being made available to the public on or about June 10, 2002, as required by the National Environmental Policy Act of 1969[1] and the Commission's Regulations Implementing the National Environmental Policy Act (18 CFR Part 380).

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[1] National Environmental Policy Act of 1969, as amended (Pub. L. 91-190. 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, §4(b), September 13, 1982).

FOREWORD

The Federal Energy Regulatory Commission (Commission), pursuant to the Federal Power Act (FPA),[2] and the U.S. Department of Energy Organization Act,[3] is authorized to issue licenses for up to 50 years for the construction and operation of non-federal hydroelectric developments subject to its jurisdiction, on the necessary conditions:

> That the project adopted ... shall be such as in the judgement of the Commission will be best adapted to a comprehensive plan for improving or developing a waterway or waterways for the use or benefit of interstate or foreign commerce, for the improvement and utilization of water-power development, for the adequate protection, mitigation, and enhancement of fish and wildlife (including related spawning grounds and habitat), and for other beneficial public uses, including irrigation, flood control, water supply, and recreational and other purposes referred to in Section 4(e)...[4]

The Commission may require such other conditions not inconsistent with the FPA as may be found necessary to provide for the various public interests to be served by the project.[5] Compliance with such conditions during the licensing period is required. The Commission's Rules of Practice and Procedure allow any person objecting to a licensee's compliance or noncompliance with such conditions to file a complaint noting the basis for such objection for the Commission's consideration.[6]

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[2] 16 U.S.C. §§791(a)-825r, as amended by the Electric Consumers Protection Act of 1986, Public Law 99-495 (1986), and the Energy Policy Act of 1992, Public Law 102-486 (1992).

[3] Public Law 95-91, 91 Stat. 556 (1977).

[4] 16 U.S.C. §803(a).

[5] 16 U.S.C. §803(g).

[6] 18 C.F.R. §385.206 (1987).

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ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
APE	Area of Potential Effect
BIA	Bureau of Indian Affairs
BOD	biological oxygen demand
cfs	cubic feet per second
CBEP	Casco Bay Estuary Project
CPUE	catch per unit effort
HPMP	Historic Properties Management Plan
Commission	Federal Energy Regulatory Commission
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DO	dissolved oxygen
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
fps	feet per second
FOPR	Friends of the Presumpscot River
FWS	U.S. Fish and Wildlife Service
Interior	U.S. Department of the Interior
kV	kilovolt
kW	kilowatt
kWh	kilowatt-hour
LLMP	Lake Level Management Plan
MASC	Maine Atlantic Salmon Commission
MCASF	Maine Council of the Atlantic Salmon Federation
MDOC	Maine Department of Conservation
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MDMR	Maine Department of Marine Resources
MDOT	Maine Department of Transportation
mg/L	milligrams per liter
MHPC	Maine Historic Preservation Commission
ml	milliliter
MSPO	Maine State Planning Office

msl	mean sea level
National Register	National Register of Historic Places
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Council
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NPCC	Northeast Power Coordinating Council
NRPA	Natural Resources Protection Act
NWI	National Wetlands Inventory
PA	programmatic agreement
ppm	parts per million
PRW	Presumpscot River Watch
REA	ready for environmental analysis
RM	river mile
ROR	run-of-river
SD1	scoping document 1
SD2	scoping document 2
SHPO	State Historic Preservation Office
SMP	Shoreline Management Plan
USACOE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
WQC	Water Quality Certification

EXECUTIVE SUMMARY

On January 22, 1999, the S.D. Warren Company (S.D. Warren) filed applications for new licenses for five projects (herein referred to as the Presumpscot River projects) with the Federal Energy Regulatory Commission (FERC or Commission). The five projects are known as the Dundee Project (FERC No. 2942-005), Gambo Project (FERC No. 2931-002), Little Falls Project (FERC No. 2941-002), Mallison Falls Project (FERC No. 2932-003), and Saccarappa Project (FERC No. 2897-003). The five projects have installed capacities of 2,400 kilowatts (kW), 1,900 kW, 1,000 kW, 800 kW, and 1,350 kW, respectively. S.D. Warren does not propose any new capacity at any of the five projects. The project licenses expired on January 26, 2001. The existing projects are located on the Presumpscot River in Cumberland County, Maine.

In this multiple project Final Environmental Impact Statement (FEIS), we analyze and evaluate the effects associated with the issuance of new licenses for the existing hydropower projects, and recommend conditions for inclusion in any licenses issued. For any license issued, the Commission must determine that the project adopted will be best adapted to a comprehensive plan for improving or developing the waterway. In addition to the power and development purposes for which licenses are issued, the Commission must give equal consideration to energy conservation, the protection and enhancement of fish and wildlife, aesthetics, cultural resources, and the protection of recreational opportunities. This FEIS for the Presumpscot River projects reflects the staff's consideration of these factors.

Based on our consideration of all developmental and nondevelopmental resource interests related to the projects, we conclude that the following measures to protect and enhance environmental resource values should be included in any licenses issued for the Presumpscot River projects (measures apply to all five projects unless noted otherwise): (1) operate in a ROR mode; (2) continue daily headpond monitoring to facilitate better headpond control; (3) avoid impoundment drawdowns during the months of May and June and notify state fisheries personnel prior to any planned drawdowns; (4) after drawdowns, implement impoundment refill procedures as allowed by the lake level management plan (LLMP) for Sebago Lake; (5) provide seasonally adjusted minimum flows to the bypassed reaches at Dundee, Gambo, and Mallison Falls; (6) prepare and implement a headpond elevation and minimum flow monitoring plan; (7) design and install upstream eel passage facilities; (8) implement measures (shutdowns) to protect downstream-migrant adult eels during the autumn season; (9) conduct a 3-year downstream migrating eel study to assess timing of peak eel movement, to determine the optimum time for shutdowns; (10) design and install upstream and downstream fish passage facilities for shad and river herring at each dam in a phased approach; (11)

develop a fish passage implementation plan; (12) reserve the U.S. Department of the Interior (Interior's) authority to prescribe additional fishways; (13) maintain a buffer zone on any licensee-owned lands within the project boundary of up to 200 feet of the normal high-water level at the Dundee and Gambo project; (14) monitor and remove trees that pose hazards to boating downstream of the Gambo Project; (15) improve portage around dams; (16) improve angler and vehicular access to the bypassed reaches; (17) conduct a recreational use monitoring study in conjunction with the first Form 80 filing after construction of the proposed recreational facilities, and report monitoring results every 12 years thereafter; (18) develop and implement a revised final recreational facilities enhancement plan including resolution of the location of proposed portage and car-top boating access points, final designs for new facilities and improvements to existing facilities, and an implementation schedule; and (19) develop and implement an historic properties management plan including provisions to consult with the SHPO on non-routine maintenance, to mitigate adverse effects on historic properties, and to protect the Cumberland and Oxford Canal.

We recommend these environmental measures to protect and enhance water quality, fisheries, terrestrial, land use, aesthetics, recreational, and cultural resources. In addition, the electricity generated from the projects would be beneficial because it would continue to reduce the use of fossil-fuel, electric generating plants; conserve nonrenewable energy resources; and continue to reduce atmospheric pollution.

Section 10(j) of the Federal Power Act (FPA) requires the Commission to include license conditions based on recommendations provided by the federal and state fish and wildlife agencies. We have addressed the concerns of the federal fish and wildlife agency and made recommendations, some of which are inconsistent with those of the agency. In the DEIS, we made a preliminary determination that some of the recommendations of the U.S. Fish and Wildlife Service conflict with the public interest standard of Section 4(e) and the comprehensive planning standard of Section 10(a) of the FPA. Pursuant to Section 10(j) of the FPA, we were able to partially resolve issues of shoreline management plans and minimum flows (see section 6.3 and table 63 of this document).

Under Section 18 of the FPA, Interior filed preliminary fishway prescriptions on February 2, 2001, and filed final fishway prescriptions on February 5, 2002. Interior also requested that the Commission reserve authority for Interior to prescribe such fishways as may be necessary during the term of any license issued. The reservation includes authority to prescribe fishways for Atlantic salmon, American shad, alewife, blueback herring, and/or American eels in the event that additional prescriptions beyond those already provided are necessary in the future.

Based on our independent analysis of the projects, including our consideration of all relevant economic and environmental concerns, we conclude that the Dundee, Gambo, Little Falls, Mallison Falls, and Saccarappa projects, as proposed by S.D. Warren and with our additional staff-recommended enhancement measures, would be best adapted to a comprehensive plan for the proper use, conservation, and development of the Presumpscot River.

1.0 PURPOSE AND NEED FOR ACTION

1.1 Purpose of Actions

On January 22, 1999, the S.D. Warren Company (S.D. Warren) filed with the Federal Energy Regulatory Commission (FERC or the Commission) applications for new licenses for five projects (herein referred to as the Presumpscot River projects) located on the Presumpscot River in Cumberland County, Maine (figure 1). The five projects are known as the Dundee Project (FERC No. 2942-005), Gambo Project (FERC No. 2931-002), Little Falls Project (FERC No. 2941-002), Mallison Falls Project (FERC No. 2932-003), and Saccarappa Project (FERC No. 2897-003). The projects have installed capacities of 2,400 kilowatts (kW), 1,900 kW, 1,000 kW, 800 kW, and 1,350 kW, respectively. No new installed capacity is planned at any of these projects.

The individual licenses for the five projects all expired on January 26, 2001. The Dundee and Gambo projects continue to operate under annual licenses issued by the Commission on February 28, 2001. The Little Falls, Mallison Falls, and Saccarappa projects will continue to operate under the terms and conditions of their existing licenses until the Commission acts on the applications for relicense.[1] S.D. Warren has elected to pursue concurrent relicensing of these five projects because of their proximity, similar issues of concern, and cost efficiency.

The Commission must decide whether to issue new licenses for the continued operation of the five projects. The purpose of the proposed actions is to ensure the provision of electric power service to the public in compliance with requirements of the Federal Power Act (FPA). Part I of the FPA provides for regulation of non-federal hydropower development. A project may be licensed as long as it meets public interest standards, and other regulatory requirements of the FPA, taking into account its developmental and non-developmental merits.

In deciding whether to issue any licenses, the Commission must determine that the projects will be best adapted to a comprehensive plan for improving or developing a waterway. In addition to the power and development purposes for which licenses are

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[1] The three minor project licenses waive applicability of Section 15 and S.D. Warren has filed for subsequent licenses. Therefore, under 18 CFR 16.21(a), S.D. Warren may continue to operate its projects in accordance with the terms and conditions of the licenses after the minor licenses expire, until the Commission acts on its applications.

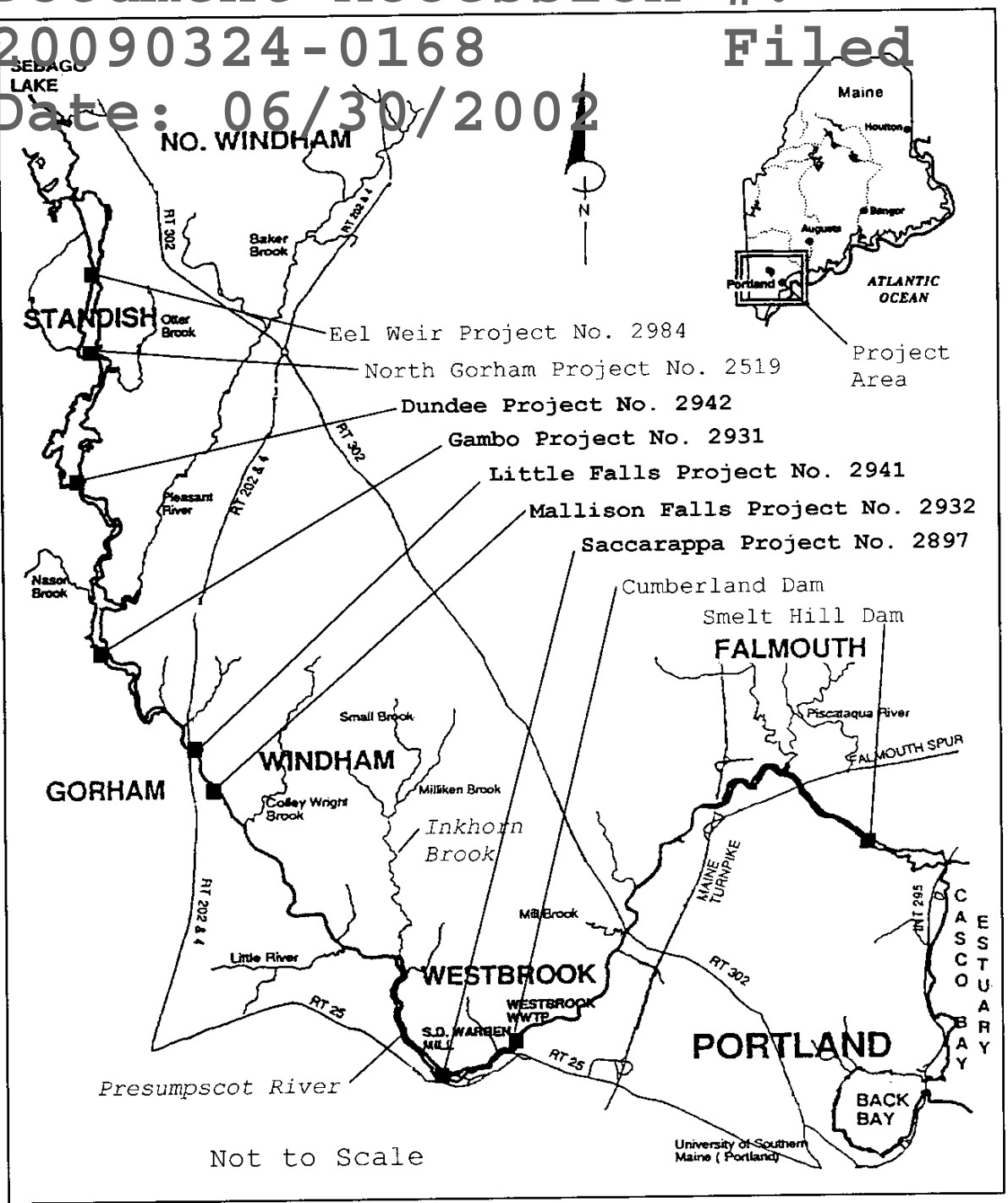

Figure 1. Presumpscot River Projects - location map (Source: License Application, 1999, as modified by staff).

issued, the Commission gives 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.

This Final Environmental Impact Statement (FEIS) analyzes and evaluates the effects associated with the continued operation of the five projects owned and operated by S.D. Warren and recommends conditions for inclusion in any licenses issued.

1.2 Need for Power

We assessed the need for power by reviewing the needs in the operating region in which the projects are located. S.D. Warren owns and operates six hydroelectric facilities (including the five projects that are the subject of this FEIS plus the 1,800-kW Eel Weir Project, located upstream of the Dundee Project at the outlet of Sebago Lake) and one co-generation facility that produces power by burning waste products from S.D. Warren's paper mill in Westbrook. The co-generation facility also produces steam used in the mill for processing paper. The energy produced by these facilities is used to meet the load (kW) and electricity (kWh) demands of the mill. Capacity and energy in excess of that used by the mill is sold on the open market to increase revenues from paper manufacturing.

S.D. Warren's six hydroelectric facilities, with a combined peak capacity of 9,250 kW, provide an annual average energy output of about 49,200,000 kWh. The co-generation facility produces about 50,000 kW with an average annual generation of 400,000,000 kWh. The mill load demand is about 21,000 kW and the annual electricity demand is about 180,000,000 kWh. Because the hydroelectric facilities produce electricity less expensively than the co-generation facility, the demands of the mill are met first by the hydroelectric facilities, in order to keep the operating costs of the mill as low as possible. The hydroelectric facilities provide about 22.5 percent of the energy demand and from 24 to 43 percent of the load. The remainder is provided by the co-generation facility.

The five projects that are the subject of this FEIS produce approximately 40,500,000 kWh of electricity per year, with a combined installed capacity of 7,450 kW. Dundee produces 16,000,000 kWh of electricity per year with an installed capacity of 2,400 kW. Gambo produces 8,500,000 kWh annually with an installed capacity of 1,900 kW. Little Falls, with an installed capacity of 1,000 kW, produces 4,200,000 kWh per year. Mallison Falls has an installed capacity of 800 kW and produces 4,200,000 kWh annually. Saccarappa produces 7,600,000 kWh per year with an installed capacity of

1,510 kW. Operation of these facilities allows S.D. Warren to generate inexpensive and reliable power using renewable resources. All of the power from these projects is used by S.D. Warren.

The projects are located in southern Maine, within the Northeast Power Coordinating Council (NPCC) region of North American Electric Reliability Council (NERC). NERC annually forecasts electrical supply and demand in the nation and the region for a 10-year period. NERC's most recent report on annual supply and demand projections indicates that, for the period 2000-2009, the demand for electric energy in the NPCC region will grow at an average rate of 1.2 percent annually.[2]

The projects displace existing and planned non-renewable fossil-fueled generation, which contributes to the production of nitrogen oxides, sulfur dioxides, and carbon dioxide. These gases create air pollution and may exacerbate global warming. In addition, hydroelectric generation contributes to the diversification of the generation mix in southern Maine.

Hydroelectric facilities are operated to maximize net energy, value of energy produced, recreational potential, and voltage support, while also being used to eliminate or minimize adverse environmental effects, enhance environmental benefits, increase system reliability, and minimize required maintenance. Hydroelectric units are also critical to system restoration following large-scale outages because they can be brought on line very quickly. In the burgeoning deregulated power market, hydroelectric facilities are important because the cost of producing electricity at these facilities is typically low and low-cost energy is purchased first on the market. The power generated by hydroelectric facilities is defined under Maine law as "green" or "renewable" power, and retail power suppliers are required to provide at least 30 percent of their power mix from renewable energy sources. While these facilities are not very large, every kW and kWh produced using low-cost, renewable resources is important to our national energy supply as well as our efforts to control or reduce air pollution caused by burning fossil-fuels.

Without these facilities, S.D. Warren's operating costs for their mill facilities would increase because it would need to use more expensive capacity and energy from the co-generation facility. The fuel source for that energy is coal and biomass, which are

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[2] Reliability Assessment 2000-2009: The Reliability of Bulk Electric Systems in North America, NERC, October 2000.

not as environmentally friendly as water power. S.D. Warren purchases standby capacity and energy when its co-generation facilities are not operating. In addition to the monthly standby capacity charge there are transmission and distribution (T&D) charges, along with other fees, and when this capacity is used, there are also energy charges.

The hydroelectric facilities reduce the amount of standby capacity needed (which also decreases the charges and fees) and the amount of energy that needs to be purchased. Without the hydroelectric facilities, the cost of providing standby power to the mill facilities would increase.

We conclude that present and future use of the power from these projects, their displacement of non-renewable fossil-fired generation, and their contribution to a diversified generation mix support a finding that the power from the projects would help meet a need for inexpensive and reliable power from renewable fuel sources in southern Maine in the short and long term.

2.0 PROPOSED ACTIONS AND ALTERNATIVES

The proposed actions and alternatives include: (1) continued operation of the projects as proposed by the applicant; (2) the continued operation of the projects as proposed with additional or modified measures recommended by federal and state resource agencies, NGO's, and other entities; (3) continued operation of the major projects at Dundee and Gambo with the removal of one or more of the three minor dams at Little Falls, Mallison Falls, and Saccarappa; (4) the continued operation of the projects with additional staff-recommended measures (the staff alternative); and (5) no action.

2.1 S.D. Warren's Proposed Action

2.1.1 Project Facilities and Operations

The Dundee Project consists of the following existing facilities (figure 2): (1) a 1,492-foot-long dam, consisting of a 175-foot-long, 50-foot-high earthen east embankment; a 1,050-foot-long, 50-foot-high earthen west embankment; a 90-foot-long concrete non-overflow section; a 150-foot-long, 42-foot-high concrete spillway; and a 27-foot-long, gated concrete canal intake structure; (2) a 1.7-mile-long impoundment extending from the Dundee dam upstream to the tailwaters of the North Gorham Project (FERC Project No. 2519), with a surface area of approximately 197 acres at normal headpond elevation of 187.22 feet U.S. Geological Survey (USGS) datum; (3) a 44-foot-wide by 74-foot-long reinforced concrete powerhouse which is integral to the spillway section of the dam; (4) three horizontal Francis turbines direct-connected to the

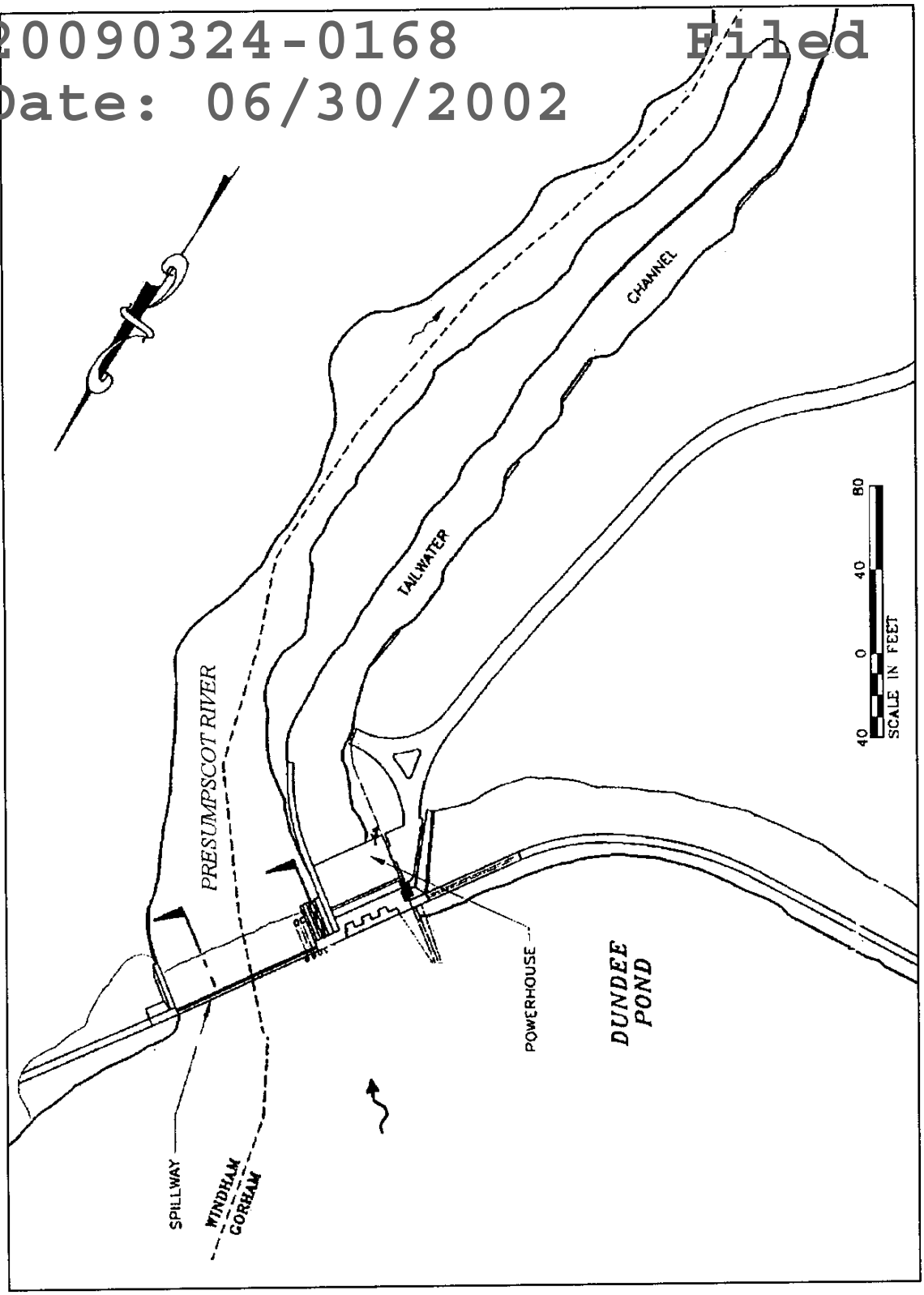

Figure 2. Dundee Project facilities (Source: License Application, 1999, as modified by staff).

generators, each with an installed capacity of 800 kW for a total project installed capacity of 2,400 kW; (5) a 1,075-foot-long bypassed reach; (6) a 1,075-foot-long, 50-foot-wide, and 11-foot-deep tailrace; (7) two 10-mile-long, 11-kilovolt (kV) transmission lines; and (8) other appurtenances.

The Gambo Project consists of the following existing facilities (figure 3): (1) a 250-foot-long, 24-foot-high concrete overflow section, a concrete sluice gate structure, and 50-foot-long canal intake structure; (2) a 3.3-mile-long impoundment extending from the Gambo dam upstream to the tailwaters of the Dundee Project, with a surface area of approximately 151 acres at normal headpond elevation of 135.13 feet USGS; (3) a 737-foot-long and 15-foot-deep concrete-lined intake canal; (4) a 47-foot-wide by 78-foot-long reinforced concrete and brick powerhouse; (5) two vertical Francis turbines direct-connected to generators, each with an installed capacity of 950 kW for a total project installed capacity of 1,900 kW; (6) a 300-foot-long bypassed reach; (7) an 8-mile-long, 11-kV transmission line; and (8) other appurtenances.

The Little Falls Project consists of the following existing facilities (figure 4): (1) a 331-foot-long and 14-foot-high reinforced concrete and masonry dam incorporating a 160-foot-long spillway section, 101.5 foot-long spillway and sluice gate section, and a 70.5-foot-long intake structure; (2) a 1.7-mile-long impoundment extending from the Little Falls dam upstream to the Gambo dam, with a surface area of approximately 29 acres at normal headpond elevation of 108.7 feet USGS; (3) a 25-foot-wide by 95-foot-long masonry powerhouse which is integral to the dam; (4) four vertical Francis turbines direct-connected to generators, each with an installed capacity of 250 kW for a total project installed capacity of 1,000 kW; (5) a 300-foot-long bypassed reach; (6) an 11-kV transmission line tied into the Gambo Project transmission line; and (7) other appurtenances.

The Mallison Falls Project consists of the following existing facilities (figure 5): (1) a 358-foot-long, 14-foot-high reinforced concrete, masonry, and cut granite diversion dam consisting of a 113.5-foot-long cut granite spillway section, a 174.5-foot-long reinforced concrete spillway section, and a 70-foot-long canal headgate structure; (2) a 0.5-mile-long impoundment extending from the Mallison Falls dam upstream to the tailwaters of the Little Falls Project, with a surface area of approximately 8 acres at normal headpond elevation of 90.6 feet USGS; (3) a 675-foot-long, 41-foot-wide, and 6-foot-deep bedrock-lined intake canal; (4) a 33-foot-wide by 51-foot-long reinforced concrete and masonry powerhouse; (5) two vertical Francis turbines direct-connected to generators, each with an installed capacity of 400 kW for a total project installed capacity of 800 kW; (6) a 675-foot bypassed reach; (7) an 11-kV transmission line tied into the Gambo Project transmission line; and (8) other appurtenances.

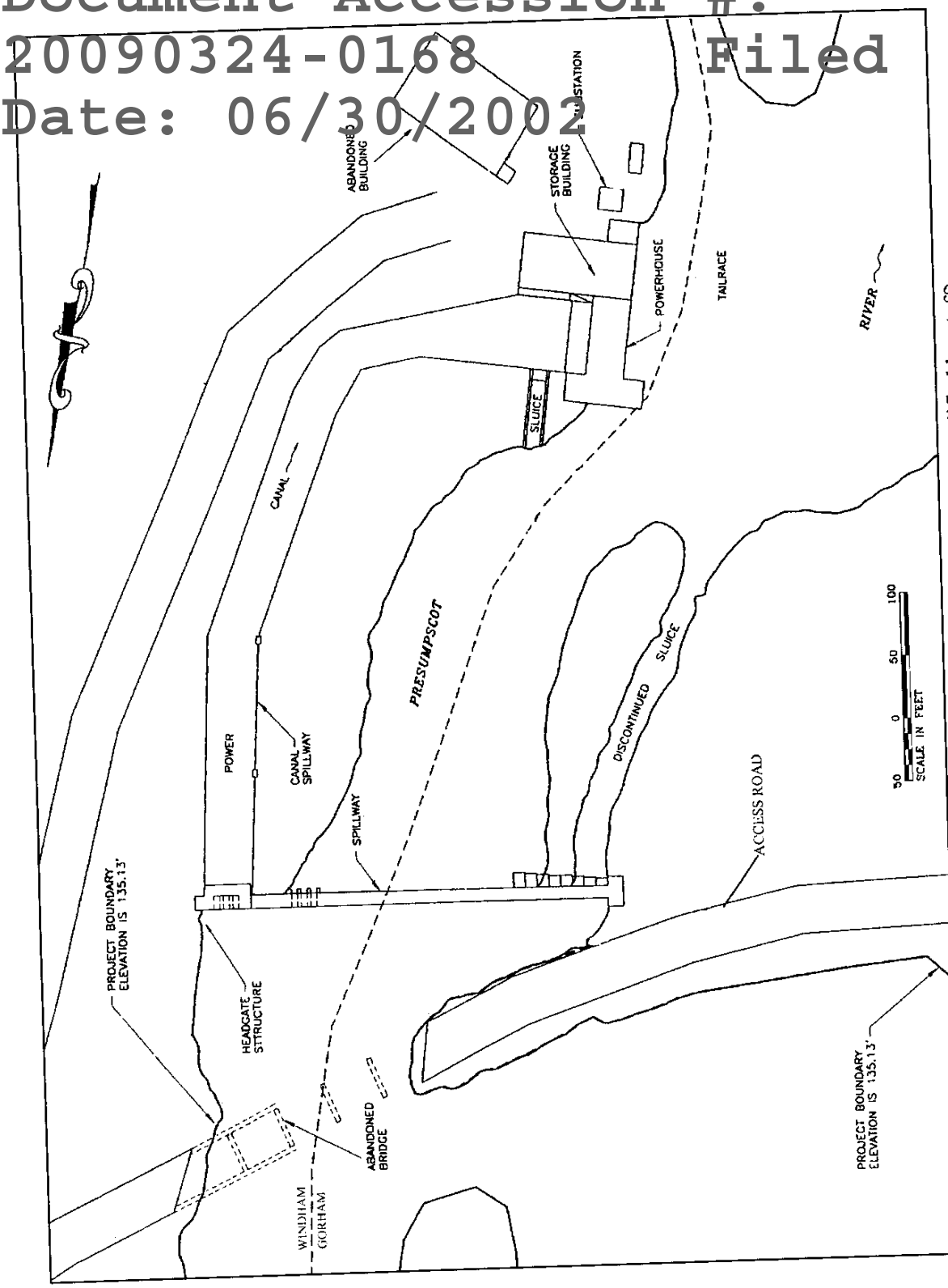

Figure 3. Gambo Project facilities (Source: License Application, 1999, as modified by staff).

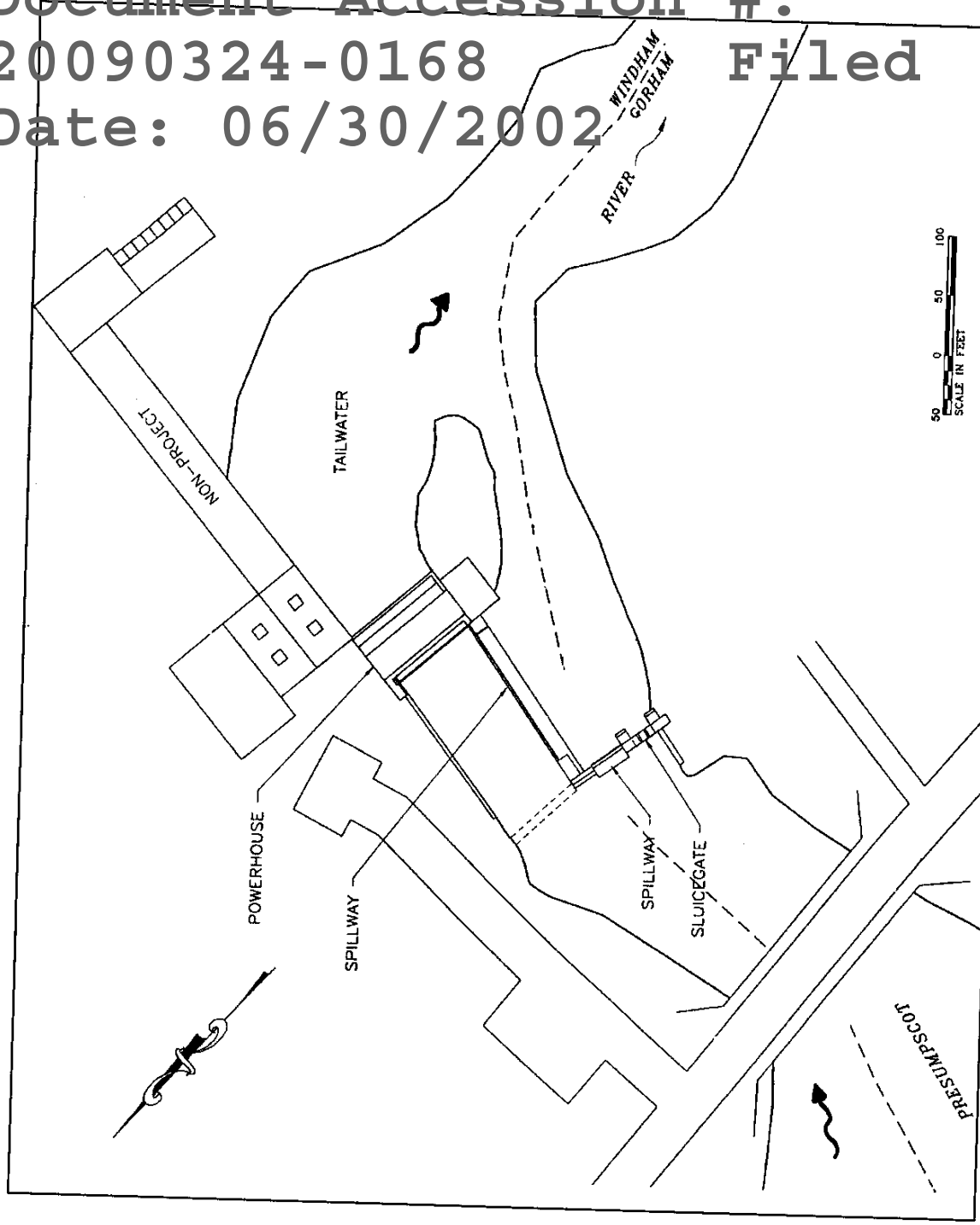

Figure 4. Little Falls Project facilities (Source: License Application, 1999, as modified by staff).

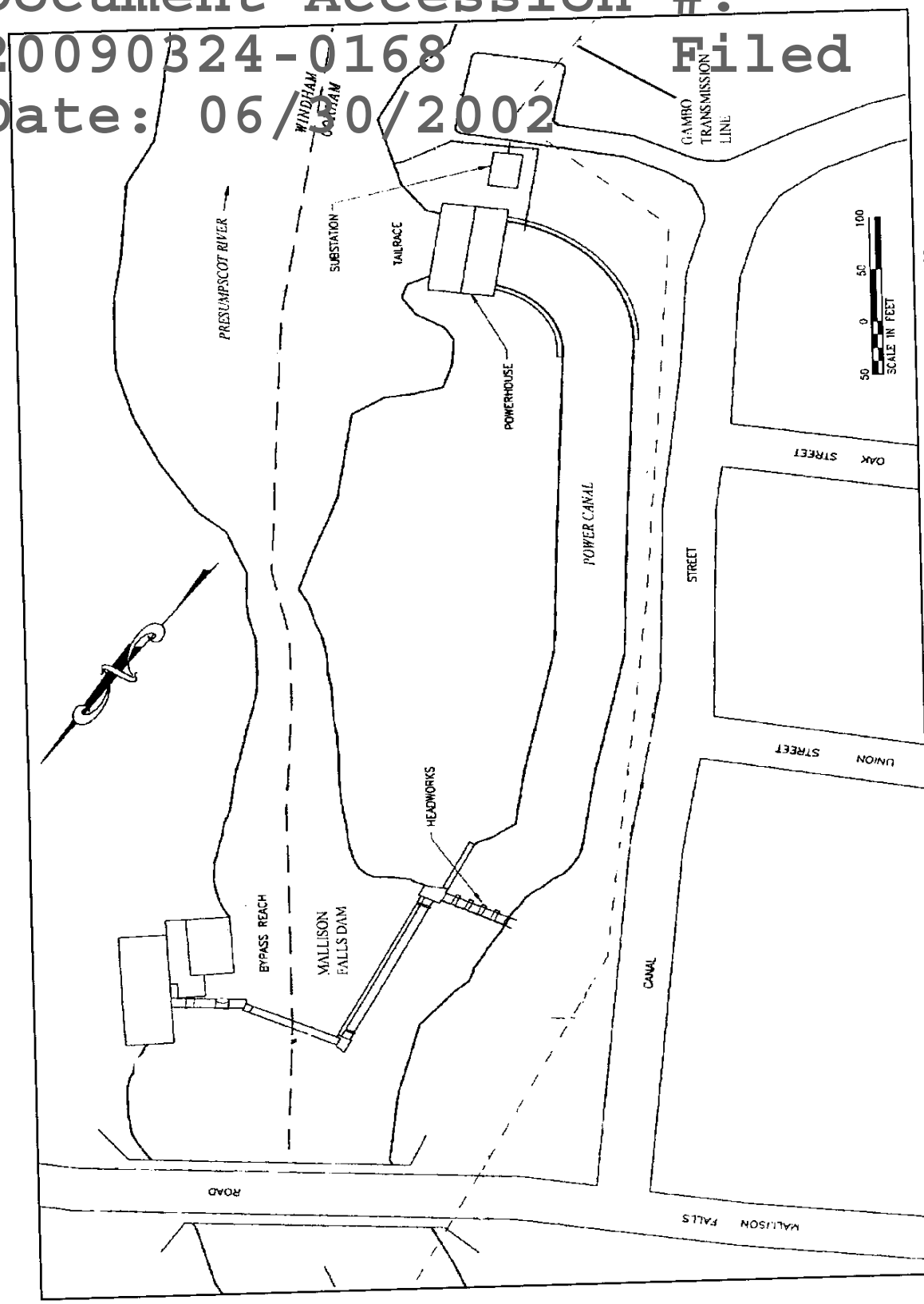

Figure 5. Mallison Falls Project facilities (Source: License Application, 1999, as modified by staff).

The Saccarappa Project consists of the following existing facilities (figure 6): (1) a 322-foot-long diversion dam consisting of a 220-foot-long, 10-foot-high concrete overflow section and a 102-foot-long, 12-foot-high concrete overflow section; (2) a 5.0-mile-long impoundment extending from the Saccarappa dam upstream to the tailwaters of the Mallison Falls Project, with a surface area of approximately 87 acres at normal headpond elevation of 69.95 feet USGS; (3) two bypassed reaches measuring 475 and 390 feet long; (4) a 380-foot-long and 36-foot-wide intake canal cut into bedrock; (5) a 49-foot-wide by 71-foot-long masonry powerhouse; (6) three horizontal Francis turbines direct-connected to generators, each with an installed capacity of 450 kW for a total project installed capacity of 1,350 KW; (7) a 345-foot-long tailrace formed by a 33-foot-high guard wall; (8) a 1-mile-long, 2.3-kV transmission line/generator lead; and (9) other appurtenances.

The Presumpscot River projects operate continuously to generate electricity that is used at S.D. Warren's paper mill at Westbrook. Under typical daily operations, S.D. Warren maximizes output by manually controlling the projects in response to flow inputs from S.D. Warren's upstream Eel Weir Project (FERC No. 2984), located at the outlet of Sebago Lake, and various minor tributaries to the Presumpscot River downstream of the Eel Weir Project. The licensee operates the projects in a run-of-river (ROR) mode so that the headponds are maintained at near constant levels year round. Because the powerhouses are manually operated, daily headpond levels typically fluctuate by 0.4 foot.

2.1.2 S.D. Warren's Proposed Environmental Measures

S.D. Warren proposes the following environmental measures at all five projects unless otherwise noted (table 1 provides details of site-specific enhancements):

- continue to operate projects in a ROR mode;
- continue daily headpond monitoring to facilitate better headpond control;
- notify personnel at the Region A Fisheries Headquarters, Maine Department of Inland Fisheries and Wildlife (MDIFW), in Gray, Maine, prior to any planned drawdowns and avoid impoundment drawdowns in the months of May and June;

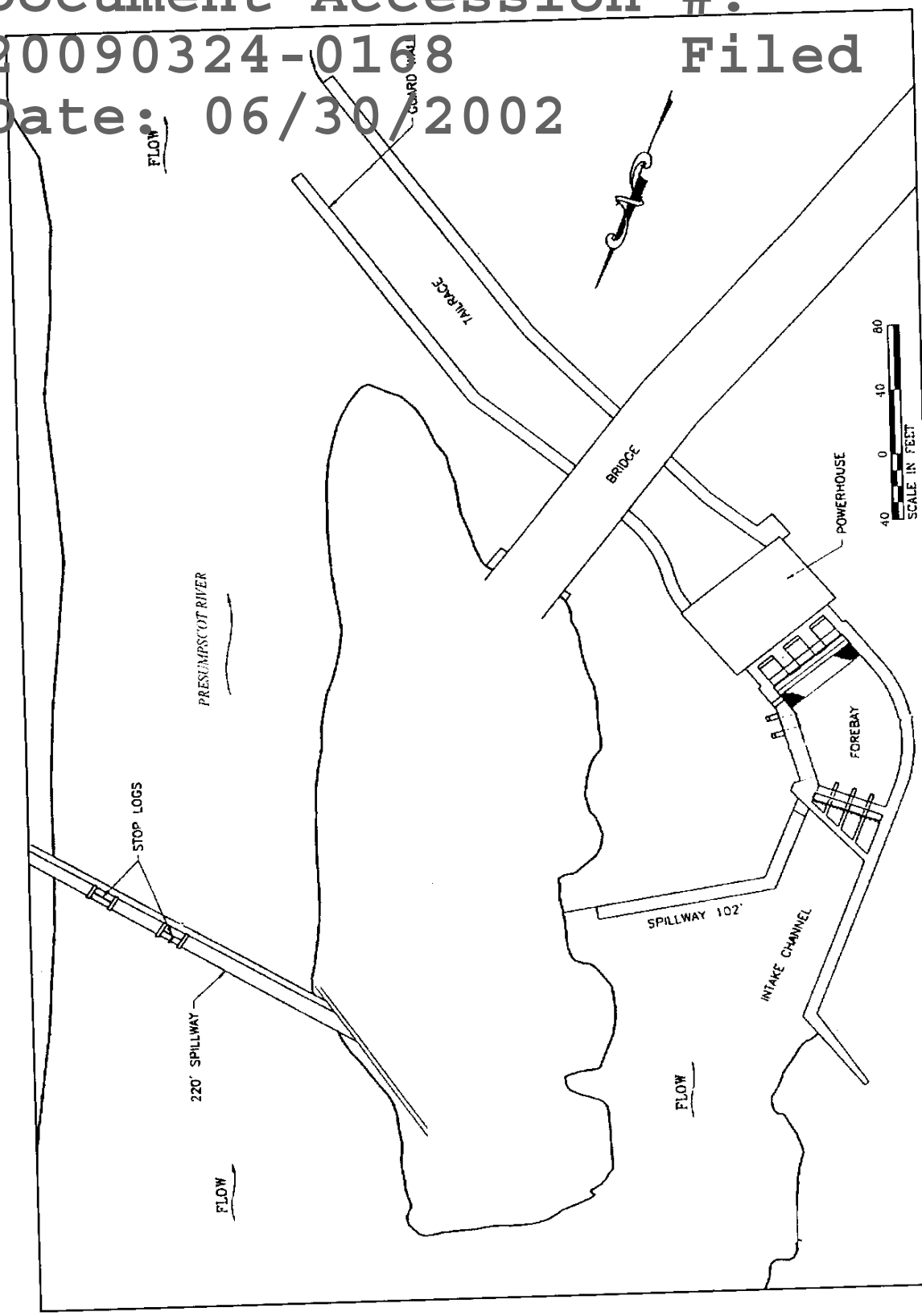

Figure 6. Saccarappa Project facilities (Source: License Application, 1999, as modified by staff).

- after drawdown periods, and if allowed by the lake level management plan (LLMP) for Sebago Lake, temporarily increase Sebago Lake outflows to refill the impoundments while maintaining tailrace flows greater than or equal to those required by the flow/temperature curves; or, if the LLMP does not allow for increased outflow from Sebago Lake, then a maximum of 25 percent of Sebago Lake outflow would be used for refill, while at least 75 percent of the Sebago Lake outflow would be released below the Dundee Project;

- provide seasonally adjusted minimum flows to the Dundee, Gambo, and Mallison Falls bypassed reaches as follows:[4]

	Jan - Mar	April	May - Sept	October	Nov - Dec
Dundee	20	30	57	30	20
Gambo	30	40	40	40	30
Mallison Falls	20	40	60	40	20

- monitor compliance with the minimum flows at the Dundee, Gambo, and Mallison Falls projects;

- install upstream eel passage facilities at the Dundee Project, to be operated annually from May to October;

- conduct an upstream eel monitoring program to study the need for upstream eel passage improvements at the Gambo, Little Falls, Mallison Falls, and Saccarappa projects (completed and filed with the Commission on November 15, 2000);[5]

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[3] April 21, 1997, FERC Order Approving Settlement and Amending License for the Eel Weir Project (79 FERC ¶61,064 (1997) as amended by the August 28, 2000, FERC Order Amending LLMP (92 FERC ¶62,180 (2000), rehearing 94 FERC ¶61,034 (2001).

[4] In its reply dated January 4, 2002, to agency comments on the DEIS, S.D. Warren adopted the seasonally adjusted minimum flows into the Dundee, Gambo, and Mallison Falls bypassed reaches recommended by staff in the DEIS.

[5] S.D. Warren assessed the need for upstream eel passage at the remaining four projects and concluded that additional measures to facilitate upstream eel passage were not warranted (KA, 2000).

- protect down-migrant adult eels by ceasing generation for 4 hours per night, in four, 7-day periods during the autumn out-migrating season. Timing of shutdowns would be based on a post-licensing 3-year downstream migrating eel study conducted by S.D. Warren to assess timing of peak eel movement;

- improve portage around dams;

- improve car-top boating facilities at the Gambo, Little Falls, Mallison Falls, and Saccarappa projects;

- improve angler and vehicle access to the Dundee, Gambo, and Mallison Falls bypassed reaches;

- provide protection and mitigation of adverse effects on any archaeological sites identified by ongoing studies;

- consult with the Maine Historic Preservation Commission (MHPC) before conducting non-routine maintenance on buildings or structures eligible for listing or listed in the National Register of Historic Places (National Register) at the Dundee and Saccarappa projects;

- if completing work that causes an adverse effect, develop (in consultation with the MHPC) a plan for recording of the affected resource(s);

- develop a plan to protect the historic canal and towpath from future construction activity related to project maintenance and monitor impacts;

- consult with the MHPC regarding recreation enhancements that may affect historic resources;

- remove nearshore tree snags as necessary to provide for portage access and egress at the Gambo Project;

- donate 0.8 acre of island across from the Hawkes Property to the Gorham Land Trust; and

- develop a plan for monitoring flow impacts on the Gambo Pony Truss Bridge.

Table 1. S.D. Warren's proposed enhancement measures by project (Source: S.D. Warren, 1999a).

Enhancement measure	Dundee Project	Gambo Project	Little Falls Project	Mallison Falls Project	Saccarappa Project
Continue ROR operations	yes	yes	yes	yes	yes
Continue daily headpond monitoring	yes	yes	yes	yes	yes
Avoid impoundment drawdowns during May and June	yes	yes	yes	yes	yes
Implement impoundment refill procedures after drawdown	yes	yes	yes	yes	yes
Provide minimum flows into bypassed reach[a]	57 cfs from May 1 through September 30, 30 cfs in October and April and 20 cfs from November 1 through March 31	40 cfs from April 1 through October 31, and 30 cfs from November 1 through March 31	No minimum flow proposed	60 cfs from May 1 through September 30, 40 cfs in October and April and 20 cfs from November 1 through March 31	No minimum flow proposed
Minimum flow monitoring plan	yes	yes	not applicable	yes	not applicable

Table 1. S.D. Warren's proposed enhancement measures by project (Source: S.D. Warren, 1999a).

Enhancement measure	Dundee Project	Gambo Project	Little Falls Project	Mallison Falls Project	Saccarappa Project
Upstream eel passage facilities	Install upstream eel passage facilities and operate from May to October	Study need for project modifications to enhance upstream eel passage (completed November 2000)	Study need for project modifications to enhance upstream eel passage (completed November 2000)	Study need for project modifications to enhance upstream eel passage (completed November 2000)	Study need for project modifications to enhance upstream eel passage (completed November 2000)
Downstream eel passage measures	yes	yes	yes	yes	yes
3-year study to determining peak seasonal and daily timing of downstream eel migration	yes	yes	yes	yes	yes
Improvements to and maintenance of portage trails	Reroute portage trail around lower portion of dam, complete bank stabilization at portage put-in	Delineate portage trail with signs, consult with interested parties to develop a formal portage trail and cooper-ative maintenance agreement	Delineate portage trail with signs, consult with interested parties to develop a formal portage trail and cooper-ative maintenance agreement	Delineate portage trail (to be located on the Gorham shore) with signs	Establish formal take-out site and allow car-top boat access to the impoundment, post signage appropriate to these uses, estab-lish parking spaces

Table 1. S.D. Warren's proposed enhancement measures by project (Source: S.D. Warren, 1999a).

Enhancement measure	Dundee Project	Gambo Project	Little Falls Project	Mallison Falls Project	Saccarappa Project
Improve car-top boat facilities	not applicable	Develop car-top boat access and parking area with signs at portage take-out site	Assist Gorham Land Trust in developing a car-top boat access and parking area with signs at the Gorham Land Trust Property off Tow Path Road	Provide car-top boat access above dam at portage take-out and signage and parking on S.D. Warren property at corner of Mallison Falls Rd/Canal St; install signage designating access point below the dam at the powerhouse; study feasibility of car-top boat unloading point next to bridge abutment with the Town of Gorham and the Maine Department of Transportation (MDOT)	Establish a formal take-out site with parking that will also serve as a car-top boat access to the impoundment,

Table 1. S.D. Warren's proposed enhancement measures by project (Source: S.D. Warren, 1999a).

Enhancement measure	Dundee Project	Gambo Project	Little Falls Project	Mallison Falls Project	Saccarappa Project
Improve angler access	Seek an easement for the use of property along the bypassed reach for angler access	Develop walk-in angler access to the bypassed reach by creating a portage route spur and facilitating safe descent to the river	not applicable	Seek an easement for the use of property along the bypassed reach for angler access	not applicable
Enhance recreational use of historic sites and protection of open space	not applicable	With the MHPC, develop signage about history of Oriental Powder Mill Complex; improve area around Gambo Pony Falls Bridge (with town of Gorham); with town assistance, conduct road grading, repair, and construction, install road gate for safety and aesthetics on 1,700 feet of Gambo Road in the town of Gorham	Donate 0.8 acre of island across from Hawkes property from S.D. Warren to Gorham Land Trust	not applicable	not applicable

Table 1. S.D. Warren's proposed enhancement measures by project (Source: S.D. Warren, 1999a).

Enhancement measure	Dundee Project	Gambo Project	Little Falls Project	Mallison Falls Project	Saccarappa Project
Remove vegetation for recreational enhancements by mechanical cutting only	yes	yes	yes	yes	not applicable
Plan any changes to current land uses to be consistent with aesthetic character of project area	yes	yes	yes	yes	yes
Protect and mitigate adverse effects on identified archaeological sites	yes	yes	yes	yes	yes
Implement MHPC recommendations for protection of National Register-eligible sites	yes	not applicable	not applicable	not applicable	yes
Plan for monitoring impacts on sections of the canal and protection of canal and tow path from project impacts	yes (includes monitoring of Dundee Section 2 of the canal during major flood events)	yes (includes monitoring of Gambo Section 14 of the canal during major flood events)	yes	yes	yes (includes construction plans for shoring Sections 9 and 15 of the canal)

Table 1. S.D. Warren's proposed enhancement measures by project (Source: S.D. Warren, 1999a).

Enhancement measure	Dundee Project	Gambo Project	Little Falls Project	Mallison Falls Project	Saccarappa Project
Maintenance of portions of canal on S.D. Warren property	yes	not applicable	not applicable	not applicable	yes
Plan for monitoring flow impacts on Gambo Falls Pony Bridge	not applicable	yes	not applicable	not applicable	not applicable
Plan to address impacts, if any, on the Oriental Powder Mill Complex feature D	not applicable	yes	not applicable	not applicable	not applicable
Consult with the MHPC on recreational enhancements that may affect historic properties	yes	yes	yes	yes	yes

[a] In its reply dated January 4, 2002, to agency comments on the DEIS, S.D. Warren adopted the seasonally adjusted minimum flows into the Dundee, Gambo, and Mallison Falls bypassed reaches recommended by staff in the DEIS.

2.2 Modifications to the Applicant's Proposed Action

2.2.1 Agency and Interested Party Recommendations

Commission regulations require applicants to consult with the appropriate resource agencies before filing a hydropower license or relicense application. This consultation is required to comply with the Fish and Wildlife Coordination Act, the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), and other federal statutes. Prefiling consultation must be completed and documented in accordance with the Commission's regulations.

The following is a summary of the comments received during the scoping process of the Presumpscot River projects and any specific concerns or recommendations provided by intervenors and other commenting parties.

Several NGO's, including the Friends of the Presumpscot River (FOPR), Friends of Sebago Lake, and the Maine Council of the Atlantic Salmon Federation (MCASF), as well as numerous individuals are advocating that the Commission order the removal of the Little Falls, Mallison Falls, and Saccarappa dams.

Other entities, including the U.S. Department of the Interior (Interior), the FWS, the U.S. Environmental Protection Agency (EPA), the Natural Resources Council of Maine, American Rivers, the Sebago Chapter of Trout Unlimited (TU), and the Maine Department of Marine Resources (MDMR) request that the Commission staff evaluate a dam removal alternative in this National Environmental Policy Act (NEPA) document.

The NGO's and agencies cited four factors that have changed since the relicensing process began several years ago:

(1) S.D. Warren has closed the Westbrook pulp processing mill, which has improved water quality downstream of Cumberland Mills dam (see figure 1);

(2) the MDEP worked with the U.S. Army Corps of Engineers (USACOE) to evaluate the environmental and engineering issues related to removing the Smelt Hill dam (FERC Project No. 7118)(see figure 1) as a habitat restoration project under Section 206 of the Clean Water Act (CWA) (report was completed in January 2001; USACOE, 2001);

(3) angling activity stimulated by the rewatering of the bypassed reach below S.D. Warren's Eel Weir Project (see figure 1) has exceeded expectations; and

(4) a new gas-fired turbine plant currently under construction in Westbrook may offer an alternative energy source to S.D. Warren to replace the energy that would be lost by decommissioning the three minor projects.

All of the NGO's and most of the private citizens who provided comments requested that the Commission prepare an EIS for this proceeding. Because the alternatives considered in this proceeding, including relicensing and dam removal, could constitute a major federal action significantly affecting the quality of the human environment, we decided to prepare a multiple-project EIS.

The MCASF requested that the Commission redefine the geographic scope of the analysis to include the portions of tributaries of the Presumpscot River that are backwatered by the project impoundments. We include these tributaries in our analysis of suitable habitat to support resident fish and the restoration of anadromous fish to the river because these tributaries could provide spawning and rearing habitat.

The MCASF also suggests extending the geographic scope to Casco Bay. We consider the lower river to Casco Bay in our analysis of the cumulative effects of the proposed actions and action alternatives, including dam removal, on fisheries resources because both the Cumberland Mills and Smelt Hill dams are existing barriers to upstream fish migration and must be considered in any analysis of anadromous fish potential.

American Rivers requested a detailed analysis of water use in the Presumpscot River Basin, including the impact of past and current water management plans on the shoreline and water quality of Sebago Lake. We recently issued an FEIS and license amendment for the Sebago Lake LLMP. We did not reconsider the LLMP during this proceeding. However, in this FEIS we address the constraints this plan places on the operations of the five projects subject to this proceeding.

TU and the FOPR state that the EIS should consider potential project impacts on the riverine habitat for trout, Atlantic salmon, blueback herring, smelt, shad, brown trout, and other species managed for recreational fisheries by the MDIFW. The FWS includes striped bass, in addition to those cited by TU, among the species that should be considered in the EIS. American Rivers includes shortnose sturgeon and Atlantic tomcod in addition to those mentioned by TU and the FWS.

We evaluate the effect of project operations on the aforementioned species to the extent that information is available, although we focus our analysis on the primary anadromous species with the potential for restoration to the Presumpscot River. We also evaluate the effects of potential fisheries restoration on angling opportunities in terms of recreational enhancement benefits.

The following is a summary of comments, recommendations, and terms and conditions received in response to the Commission's ready for environmental analysis (REA) notice.

The MDMR is the lead state agency in the restoration and management of diadromous (anadromous and catadromous) species of fish other than sea-run Atlantic salmon. The MDMR recommends installation of upstream and downstream fish passage facilities for American shad and blueback herring at the lower four projects, including screens on the trashracks and separate upstream and downstream measures (shut downs) for eels at each of the five projects.

The Maine Atlantic Salmon Commission (MASC) is responsible for the restoration of Atlantic salmon throughout its historical range in the state of Maine. During pre-filing consultation, restoration of Atlantic salmon to the Presumpscot River was a low priority for the agency. However, the recent events that prompted the request for dam removal (see section 2.2.2) also have caused the MASC to re-evaluate its priorities for restoration of Atlantic salmon in the Presumpscot River. The MASC recommends a reopener clause to address the need for upstream and downstream passage facilities for diadromous fish once the Cumberland Mills dam has fish passage facilities; consultation with S.D. Warren every 3 years to develop a schedule for installation of fish passage facilities; and a study to determine appropriate flows to support Atlantic salmon, after MASC has completed its assessment of the river habitat.

The MDIFW is responsible for management of inland fish and wildlife in Maine. The MDIFW is primarily concerned about maintenance of water levels, limitations on drawdowns, provision of adequate seasonal minimum flows in the bypassed reaches to support trout fisheries including coldwater releases in the Dundee bypassed reach, appropriate measures to facilitate upstream and downstream eel passage, angler access to the Dundee, Gambo, and Mallison Falls bypassed reaches, protection of anglers from new minimum flows in the bypassed reaches (wadability), access for agency trucks to stock the bypassed reach and tailwaters at Dundee, and development of a car-top boat access plan to resolve public access at the impoundments.

The FWS shares many of the same concerns as the state agencies for the protection of fisheries resources and the provision of recreational access to project lands and waters. The FWS recommends ROR operation, year-round minimum flows, a headpond elevation and flow monitoring plan, the development of a detailed Shoreline Management Plan (SMP) for licensee-owned lands that are needed for project-related purposes within 500 feet of the high water elevation, and recreational use monitoring every 6 years. The recommendations of the FWS are discussed in detail in the resource sections in section 4 and are summarized in section 6.3, *Fish and Wildlife Agency Recommendations.*

Interior also recommends installing upstream and downstream fish passage facilities for American shad and blueback herring, and separate measures for eel passage. We describe Interior's fishway prescriptions in detail in section 3.6, *Fishway Prescriptions,* and section 4.3.1.2, *Aquatic Resources.*

The National Park Service (NPS) expressed concern about the safety of the recreational enhancements proposed by S.D. Warren and the opportunity for whitewater boating below the Saccarappa Project if the dam is removed. The NPS recommends additional signage and provision of stairs at four impoundments, and a formal angler access site at Mallison Falls.

Because the aforementioned agencies vary in their primary interests, specific minimum flow recommendations, and recreation recommendations, we have not identified a specific agency alternative. Instead, we discuss each additional agency-recommended measure as a modification to S.D. Warren's proposed action.

The NGO's generally advocate the removal of the three minor projects dams. American Rivers and FOPR advocate the removal of the three minor project dams primarily citing their negative effects on fisheries resources. They advocate the immediate removal of the Little Falls and Mallison Falls dams to restore riffle and pool spawning habitat for a trout fishery. These NGO's also want the Commission to order the removal of the Saccarappa dam, contingent upon the removal of the Smelt Hill dam, and the installation of fish passage at the Cumberland Mills dam. They recommend that the Commission issue an annual license for the Saccarappa Project until these events occur. Finally, they support relicensing of the Dundee and Gambo projects with appropriate upstream and downstream fish passage facilities once anadromous species have become re-established, and the provision of eel passage measures at Dundee, Gambo, and at Saccarappa until it is removed. Should the Commission issue licenses for the three minor project dams, then these NGO's recommend effective upstream and downstream fish passage facilities and eel passage measures.

The MCASE and Friends of Sebago Lake cite their objective as securing sufficient habitat and safe access to that habitat to allow for swift and successful restoration of naturally reproducing populations of all migratory fish native to the Presumpscot River above the Cumberland Mills dam, including sea-run Atlantic salmon, American shad, alewife, blueback herring, anadromous brook trout, American eel, and sea lamprey. Without dam removal, they recommend a similar phased approach to the design and installation of fish passage facilities as proposed by American Rivers.

TU is primarily concerned with the protection and restoration of coldwater fisheries and their watersheds. TU argues that trout and salmon fisheries are extremely rare and supports removal of the three minor project dams to benefit and enhance coldwater fisheries upstream. Like the MDIFW, TU recommends minimum flows to the bypassed reaches and coldwater releases into the Dundee bypassed reach to support coldwater fisheries. TU also requests water temperature monitoring.

Finally, the city of Westbrook recommends that the Commission condition any license issued for the Saccarappa Project on the continued operation of the paper mill at the Cumberland Mill site. Should the mill close, the city would want to reopen the dam removal discussion.

2.2.2 Dam Removal Alternatives

Our analysis considers three discrete dam removal alternatives: (1) removal of the Little Falls, Mallison Falls, and Saccarappa project dams; (2) removal of the Saccarappa Project dam only; and (3) removal of the Little Falls and Mallison Falls project dams. We describe the effects of these alternatives on environmental resources in section 4.3.

2.3 Staff's Alternative

After evaluating S.D. Warren's proposal and recommendations from resource agencies and other interested parties, we considered what, if any, additional protection or enhancement measures would be necessary or appropriate with continued operation of the projects. The staff's alternative consists of the proposed action (section 2.1) with these additional or modified environmental measures (measures apply to all five projects unless otherwise noted):

- provide minimum flows to the bypassed reaches at Dundee, Gambo, and Mallison Falls as follows (modified measure):

Project	Jan - Mar	April	May - Sept	October	Nov - Dec
Dundee	20	30	50	30	20
Gambo	40	40	40	40	40
Mallison Falls	40	40	60	40	40

- prepare and implement a headpond elevation and minimum flow monitoring plan in consultation with the resource agencies;

- design and install upstream and downstream fish passage facilities for American shad and river herring using a phased approach such that facilities at each dam would be constructed only after migratory fish populations have become established immediately downstream of each dam;

- develop a fish passage implementation plan;

- design and install upstream eel passage measures;

- reserve Interior's authority to prescribe fishways in the event that additional prescriptions may be necessary in the future;

- develop a plan to maintain a shoreline buffer zone on licensee-owned lands within the project boundary up to 200 feet of the normal high-water level at the Dundee and Gambo projects;

- monitor and remove trees that pose hazards to boating downstream of the Gambo Project;

- conduct a recreational use monitoring study in conjunction with the first Form 80 filing for the Dundee and Gambo projects after construction of the proposed recreational facilities, and file an update of the study every 12 years thereafter;

- develop and implement a revised final recreational facilities enhancement plan including resolution of public walk-in angler and car-top boating access and the final locations of proposed portage and car-top boating access points, final designs for new facilities and improvements to existing facilities, and an implementation schedule; and

- develop and implement an historic properties management plan (HPMP) in accordance with a programmatic agreement (PA) to be executed by the Advisory Council on Historic Preservation (Advisory Council), Maine State Historic Preservation Officer (SHPO), and the Commission.

2.4 No Action

The no-action alternative would result in no change to the current environmental setting in the project areas. Under the no-action alternative, the projects would continue to operate as required by the original project licenses. No alterations or enhancements to existing environmental conditions would occur. We use this alternative to establish baseline environmental conditions for comparison with other alternatives.

2.5 Alternatives Considered But Eliminated from Detailed Study

We considered several other alternatives to S.D. Warren's relicensing proposals, but eliminated them from detailed study because they are not reasonable in the circumstances of these proceedings. They are: (1) federal takeover and operation of the Dundee and/or Gambo projects; (2) issuing a nonpower license for any of the projects; and (3) retirement of the Dundee and/or Gambo projects.

We do not consider federal takeover of the Dundee and Gambo projects to be a reasonable alternative. Federal takeover of the projects 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 party has suggested that federal takeover would be appropriate, and no federal agency has expressed interest in operating the projects. The minor project licenses for the Little Falls, Mallison Falls, and Saccarappa projects waive Section 14 of the FPA; therefore, these projects are not subject to federal takeover.

A nonpower license is a temporary license that the Commission would terminate whenever it determines that another governmental agency would assume regulatory authority and supervision over the lands and facilities covered by the nonpower license. At this point, no agency has suggested a willingness or ability to do so. No party has suggested a nonpower license for any of the five projects; thus we do not consider a nonpower license a realistic alternative to relicensing in this circumstance.

Project retirement would be accomplished with or without dam removal, but either alternative would involve denial of the license applications or surrender and termination of the existing licenses with appropriate conditions.

No party has suggested that dam removal at the Dundee and Gambo projects would be a reasonable alternative to project relicensing. Therefore, in the FEIS, we do not evaluate dam removal at these two projects. We evaluate the effects of relicensing the Dundee and Gambo projects on environmental and developmental resources including salmon restoration efforts, recreational opportunities, and power generation.

3.0 CONSULTATION AND COMPLIANCE

3.1 Interventions

On April 23, 1999, the Commission issued a public notice that S.D. Warren had filed license applications to relicense the Presumpscot River projects. The notice set June 22, 1999, as the deadline for filing protests and motions to intervene. In response to the public notice, the following entities intervened in the relicensing proceedings:

Intervenor	Date of Letter
U.S. Department of the Interior	June 14, 1999
Friends of the Presumpscot River	June 18, 1999
Friends of Sebago Lake	June 20, 1999
Maine Council of the Atlantic Salmon Federation	June 21, 1999
State of Maine, State Planning Office	June 22, 1999
Trout Unlimited	June 22, 1999
U.S. Environmental Protection Agency	July 2, 1999
P.R. Hennick (Dundee)	September 9, 1999
Sebago Lake Anglers Association (Dundee)	September 20, 1999
Allan Desjardin	September 20, 1999
American Rivers	September 21, 1999
The Honorable Janice E. Labrecque[6]	November 5, 2001

The FOPR filed an intervention in opposition to the relicensing of the Little Falls, Mallison Falls, and Saccarappa projects.

[6] The Commission granted this late-filed intervention on April 26, 2002.

3.2 Scoping Process

The Commission issued a Scoping Document 1 (SD1) on July 23, 1999, pursuant to 18 CFR Section 385.602(d) for the Presumpscot River projects to invite appropriate resource agencies, Native American tribes, and other interested parties to participate in the scoping process. The Commission also conducted two scoping meetings associated with the Presumpscot River projects on August 25 and 26, 1999, in Windham, Maine, and held a site visit to the Presumpscot River projects on August 25, 1999.

After careful consideration of all scoping input, the Commission revised SD1 and issued Scoping Document 2 (SD2) in March 2000. SD2 identifies issues to be addressed in the EIS, including potential effects on: (1) water use and quality; (2) aquatic resources; (3) terrestrial resources; (4) land use and aesthetic resources; (5) recreational resources; and (6) cultural resources. The scoping process did not reveal substantive issues related to geology and soils, except for potential sedimentation associated with the dam removal alternatives. We address potential sedimentation issues under water quality. We also determined that there are no significant socioeconomic issues associated with the proposed actions and do not include socioeconomics in our detailed analysis.

3.3 Agency Consultation

On December 4, 2000, the Commission issued a REA notice for the Presumpscot River projects soliciting comments, recommendations, terms and conditions, and prescriptions. In response to this notice, the following entities filed comments:

Commenting Entity	Date of Letter
State of Maine, State Planning Office[7]	January 31, 2001
U.S. Department of the Interior[8]	February 2, 2001
American Rivers and Friends of the Presumpscot River	February 2, 2001
City of Westbrook	February 2, 2001
Trout Unlimited	February 5, 2001
Friends of Sebago Lake	February 6, 2001

[7] The State of Maine included comments from the MDMR, the MASC, and the MDIFW.

[8] Interior included comments from the FWS and the NPS.

S.D. Warren filed reply comments on April 18, 2001.[9]

3.4 Comments on the Draft Environmental Impact Statement

The Commission sent its DEIS for the relicensing of the Dundee, Gambo, Little Falls, Mallison Falls, and Saccarappa projects to the U.S. Environmental Protection Agency (EPA) on September 25, 2001, and EPA issued the DEIS on October 5, 2001. The Commission requested that comments be filed within 60 days from the issuance date (by December 4, 2001). Fifteen letters, representing 12 entities and 3 individuals, commenting on the DEIS were filed with the Commission. We modified the text of the DEIS in response to these comments. Appendix A summarizes the comments that were filed and our responses to the comments.

3.5 Water Quality Certification

Under Section 401(a)(1) of the 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. On January 14, 1999, S.D. Warren applied to the MDEP for water quality certification (WQC) for the Presumpscot River projects. S.D. Warren withdrew and refiled its applications for WQC on January 12, 2000, January 11, 2001, and again on January 9, 2002. Action on the applications is pending.

3.6 Fishway Prescription

Section 18 of the FPA states that the Commission must require a licensee to construct, operate, and maintain such fishways as may be prescribed by the Secretary of the Interior or the Secretary of Commerce, as appropriate. By letter dated February 2, 2001, Interior filed, for comment, preliminary Section 18 prescriptions for fishways at the Presumpscot River projects. On February 5, 2002, Interior filed its final fishway prescriptions for the projects, and we describe these prescriptions in the following section. We provide the major provisions of the final fishway prescription below and the specific details in section V.C.4.3.2, *Aquatic Resources*.

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[9] Reply comments are due within 105 days of the date of the REA notice. S.D. Warren requested a 60 day extension of time, from March 14, 2001, to May 18, 2001, to file reply comments. The Commission granted a 30-day extension of time to April 18, 2001.

Fishway Design

A. This prescription for fishways is based on the assumption that fish passage or dam removal will be achieved at the Smelt Hill dam and Cumberland Mills dam, and that the Commission will not order the removal of the Saccarappa, Mallison Falls, and/or Little Falls projects, as described in the DEIS (p. 28). Several interested parties, including Interior, have urged the removal of one or more of these projects (DEIS, p. 95). If, in its public interest consideration and licensing decision, the Commission orders the removal of one or more of these projects, Interior will modify its prescription for fishways accordingly.

B. Fishways shall be constructed, operated, and maintained to provide safe, timely, and effective passage for Atlantic salmon, American shad, blueback herring, and American eels at the licensee's expense.

To ensure the immediate and timely contribution of the fishways to the ongoing and planned anadromous and catadromous fish restoration and enhancement program in the Presumpscot River, the following are included and shall be incorporated by the licensee to ensure the effectiveness of the fishways pursuant to Section 1701(b) of the 1992 National Energy Policy Act (P.L. 102-486, Title XVII, 106 Stat. 3008).

C. Design Populations

The total number of returning fish reaching the lowermost of the five projects covered in this relicensing would depend on a number of factors, including whether fishways are installed or dam removals are used to achieve passage. Overall fishway efficiency and cumulative losses of fish attempting to use upstream and downstream fish passage facilities also would affect the total potential restored run of shad, river herring, salmon, and eels. Table 2 provides a summary of fishway design populations.

1. Shad and river herring:

Based on current estimates, restored runs of shad and river herring in the Presumpscot River could approach 75,000 shad, 200,000 alewives, and 450,000 blueback herring. The numbers of fish expected to pass each of the dams on the river are contained in Interior's Administrative Record and are summarized in table 2.

2. Atlantic salmon:

Projections for restored runs of Atlantic salmon have been calculated along with minimum levels of escapement at each dam needed to ensure that restoration and management goals are met. Those numbers of fish are summarized in table 2. It is unlikely, however, that the runs of salmon will be large enough to affect the design of fishways at any of the five project dams. The more numerous species (shad and river herring) typically determine the kind of fish passage that should be built at a hydroelectric project.

3. American eel:

American eels already are present in the area occupied by the five projects. While Interior does not have a precise estimate of the numbers of eels that would be expected to use fish passage at the projects, such passage would enhance the eel stocks and help achieve overall management goals. In addition, upstream passage needs for eels differ from those of salmon, shad, and river herring. Separate upstream eel fishways typically are installed at barriers in addition to those that are provided for anadromous fish.

4. Other species:

Fish passage provided at one or more of the five projects would be expected to pass trout, landlocked salmon, and other riverine species. The numbers of riverine fish using the fishways are likely to be small, relative to anadromous and catadromous species.

D. Upstream fishways shall be operational during the designated migration period at river flows up to 3,000 cfs (see table 3), as measured at the USGS gage at Westbrook (No. 01064118). Downstream fishways shall be operated during the designated migration period whenever units are operated at the Presumpscot River projects.

E. Scheduling

The timing of installation of fish passage at all five projects will be based upon the growth of migratory and riverine fish populations in the Presumpscot River (see table 4). American eels already are present in the river, and would benefit from the immediate implementation of safe, timely, and effective upstream and downstream fishways. The Commission's DEIS also recommended permanent upstream eel fishways at all five projects (p. 225).

Table 2. Summary of fishway design populations [a] (Source: FWS final fishway prescription dated February 5, 2002)

Project	Species	Phase 1[b]	Phase 2[b]
Saccarappa	American shad	18,000	58,000
	Blueback herring	109,000	353,000
	Atlantic salmon	273	426
	American eel	undetermined	undetermined
Mallison Falls	American shad	4,200	44,000
	Blueback herring	26,000	270,000
	Atlantic salmon	32	185
	American eel	undetermined	undetermined
Little Falls	American shad	3,100	43,000
	Blueback herring	19,000	263,000
	Atlantic salmon	15	168
	American eel	undetermined	undetermined
Gambo	American shad	–	40,000
	Blueback herring	–	244,000
	Atlantic salmon	–	153
	American eel	undetermined	undetermined
Dundee	American shad	–	22,000
	Blueback herring	–	122,000
	Atlantic salmon	–	64
	American eel	undetermined	undetermined

[a] This is the maximum number of fish expected to use the fishways under each phase of the restoration program, and FWS uses this number in sizing the fish passage facilities. FWS has estimated that a standard full-size Denil fish ladder, as proposed under Phase 1 at Saccarappa, Mallison Falls, and Little Falls, has an annual capacity of 20,000 shad and 200,000 river herring (or equivalent biomass for both species). Thus, the Phase 1 Denil ladders would not be upgraded to lifts until the actual passage exceeds that capacity.

[b] Note: Data provided by state agencies rounded to nearest (1,000) above 10,000.

Table 3. Upstream and downstream migration periods for species covered in FWS prescription for fishways[a] (Source: FWS final fishway prescription dated February 5, 2002)

Species	Upstream migration period	Downstream migration period
Atlantic salmon	April 15 - November 15	April 1 - June 30 (smolts & kelts[b]) October 15 - December 31 (kelts)
American shad	May 1 - July 15	August 1 - November 15 (juv.) May 15 - August 1 (adult)
Alewife and blueback herring	May 1 - July 15	July 15 - November 15 (juv.) May 15 - August 1 (adult)
American eel	April 1 - June 30[c]	July 15 - November 15[d]

[a] Any of these migration periods may be changed during the term of the license by the FWS, based on new information, in consultation with the other fishery agencies and the licensee.

[b] Post-spawning adults that are migrating downstream.

[c] The eel upstream migration period will need to be refined as more information is made available. The FWS is calling for the licensee to study the duration and timing of upstream eel migration through the projects so that the effectiveness of this period can be evaluated.

[d] July 15 - November 15 is the period set by the State of Maine for harvesting silver eels. The FWS is initially using a reduced period, September 1 - October 31, as the downstream migration period for eels. The FWS is calling for the licensee to study the magnitude and timing of downstream eel migration through the projects so that the effectiveness of the reduced period can be evaluated.

Table 4. Schedule for implementation of fish passage at Presumpscot River projects (Source: FWS final fishway prescription dated February 5, 2002)

Project	Phase 1	Phase 2
Saccarappa	**Anadromous Fish:** **Upstream passage** completed 2 years after passage is available at Cumberland Mills dam. **Downstream passage** will be completed concurrent with the completion of upstream passage. However, in the event that the FWS notifies the licensee that sustained annual stocking of anadromous fish above the project has begun or will begin within 2 years, the downstream passage facility shall be constructed within 2 years of this notice. **American Eel:** **Upstream passage** within 2 years of licensing. **Downstream passage** (shutdowns) within 30 days of licensing.[a]	**Anadromous Fish:** **Upstream passage** upgrade of capacity in accordance with design populations for Phase 2.
Mallison Falls and Little Falls	**Anadromous Fish:** **Upstream passage** will be completed 2 yeas after 2,960 American shad or 18,020 blueback herring are passed in any single season at Saccarappa dam.[a, b, c]	**Anadromous Fish:** **Upstream passage** upgrade of capacity in accordance with design populations for Phase 2.

Table 4. Schedule for implementation of fish passage at Presumpscot River projects (Source: FWS final fishway prescription dated February 5, 2002)

Project	Phase 1	Phase 2
Gambo	**American Eel:** **Upstream passage** within 2 years of licensing. **Downstream passage** (shutdowns) within 30 days of licensing.[a]	**Anadromous Fish:** **Upstream passage**, pending agency review of Phase 1 for the downstream projects, will be completed 2 years after 620 American shad or 3,800 blueback herring are passed in any single season at Little Falls dam. **Downstream passage** will be completed concurrent with the completion of upstream passage. However, in the event that the FWS notifies the licensee that sustained annual stocking of anadromous fish above the project has begun or will begin within 2 years, the downstream passage shall be constructed within 2 years of this notice.

Table 4. Schedule for implementation of fish passage at Presumpscot River projects (Source: FWS final fishway prescription dated February 5, 2002)

Project	Phase 1	Phase 2
Dundee	**American Eel:** **Upstream passage** within 2 years of licensing. **Downstream passage** (shutdowns) within 30 days of licensing.[a]	**Anadromous Fish:** **Upstream passage,** pending agency review of Phase 1 for the downstream projects, will be completed 2 years after 4,020 American shad or 24,460 blueback herring are passed in any single season at Gambo dam. **Downstream passage** will be completed concurrent with the completion of upstream passage. However, in the event that the FWS notifies the licensee that sustained annual stocking of anadromous fish above the project has begun or will begin within 2 years, the downstream passage shall be constructed within 2 years of this notice.

[a] Initially, downstream passage will be via spill resulting from project shutdown for 8 hours per day beginning at sunset from September 1 through October 31. The timing and magnitude of eel migration through the projects is to be evaluated and reported by the licensee and changed as deemed necessary and appropriate by the FWS. There will be consultation at each step.

[b] The trigger numbers represent 20 percent of the estimated production of these species for each reach.

[c] Design of upstream fishways will be based on potential size of the runs of shad and blueback herring. In the event that the shad and blueback herring trigger numbers are not reached, the FWS, in consultation with the MASC, will assess the options for passing any runs of Atlantic salmon that may be present.

A fishway must be installed at Saccarappa dam as soon as passage is achieved at Smelt Hill and Cumberland Mills. The Commission will need to include appropriate license articles requiring preparation of detailed design plans, installation schedules, and

studies to evaluate effectiveness of all upstream and downstream measures to be developed in consultation with the FWS and other resource agencies. In order to allow for proper consultation with resource agencies and approval by the Commission of all design plans, permanent fish passage must be operational at Saccarappa dam within 2 years of the completion of fishway installation at Cumberland Mills dam (or within 2 years of its removal or breaching). If Saccarappa dam is not relicensed, and is subsequently removed, the Commission must place similar requirements for implementing fish passage at the license for the next upstream project (Mallison Falls). Numbers of fish counted at each barrier that would be sufficient to trigger installation of fishways at upstream dams are provided in table 4.

Upstream fish passage for American eels shall be fully operational no later than 2 years after the date of issuance of a new license. Downstream passage (shutdowns) shall be implemented as soon as the licenses are effective (30 days after date of license issuance). This will ensure that the existing eel resource in the Presumpscot River benefits from passage improvements as soon as practicable.

F. The timely installation of the prescribed fishway structures, facilities, or devices is a measure directly related to those structures, facilities, or devices and is necessary to ensure the effectiveness of such structures, facilities, or devices. Therefore, Interior's Prescription includes the express requirement that the licensee (1) notify, and (2) obtain approval from the FWS for any extensions of time to comply with the provisions included in Interior's Prescriptions for fishways.

G. Regarding the timing of seasonal fishway operations, fishways shall be maintained and operated, at the licensee's expense, to maximize fish passage effectiveness throughout the upstream and downstream migration periods for Atlantic salmon, American shad, blueback herring, and American eel.

H. The licensee shall keep the fishways in proper order and shall keep fishway areas clear of trash, logs, and material that would hinder passage. Anticipated maintenance shall be performed sufficiently before a migratory period such that fishways can be tested and inspected, and will operate effectively prior to and during the migratory periods. In consultation with the FWS and other fishery agencies, the licensee shall develop a fishway maintenance plan describing the anticipated maintenance, a maintenance schedule, and contingencies. The plan shall be submitted to the FWS for final review and approval, and the plan shall contain the consultation comments of the fishery agencies. If any agency recommendation is not incorporated, the licensee's explanation shall be in the plan that is filed with the Commission. Upon approval by the FWS, the licensee shall submit the plan to the Commission for approval.

I. The licensee shall develop plans for and conduct fishway effectiveness evaluations in consultation with the FWS and other fishery agencies on all prescribed fish passage. The plans and results of effectiveness studies shall be submitted to the FWS for final review and approval, and the plan shall contain the consultation comments of the fishery agencies. If any agency recommendation is not incorporated, the licensee's explanation shall be in the plan that is filed with the Commission. Upon approval by the FWS, the licensee shall submit the plan to the Commission for approval.

J. The licensee shall provide personnel of the FWS, and other FWS-designated representatives, access to the project site and to pertinent project records for the purpose of inspecting the fishways to determine compliance with the fishway Prescriptions.

K. The licensee shall develop in consultation with and submit for approval by the FWS, all functional and final design plans, construction schedules, and any hydraulic model studies for the fishways or modifications to existing fishways described herein.

Finally, Interior requests that the Commission reserve its authority to require such fishways as Interior may prescribe in the future, including authority to prescribe fishways for Atlantic salmon, American shad, alewives, blueback herring, and/or American eels in the event that additional prescriptions beyond that already provided are necessary in the future.

3.7 Endangered Species Act

Section 7 of the ESA requires that federal agencies consult with the FWS when a proposed action may adversely affect federally listed threatened or endangered species. By letter dated May 3, 2001, the FWS indicated that the federally threatened small whorled pogonia occurs in the vicinity of the Dundee Project in North Gorham. Based on our evaluation in sections 4.3.2 and 4.3.3, we conclude that relicensing the Presumpscot River projects would not affect the small whorled pogonia.

3.8 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act requires federal agencies, such as the Commission, to consult with the Secretary of Commerce, through the National Marine Fisheries Service (NMFS), regarding any action or proposed action authorized, funded, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH) identified under the Act. The Presumpscot River has been designated by the New England Fishery Management Council as EFH for Atlantic salmon. In section 4.3.2, we assess the potential effect of relicensing the Presumpscot

River projects on Atlantic salmon habitat. We conclude that relicensing the projects, as proposed by S.D. Warren with our additional staff- and agency-recommended measures for fish passage, would increase the available habitat for Atlantic salmon, although suitable salmon habitat may be limited within the basin. This assumes that the Smelt Hill dam is removed, as recommended by the USACOE, and that Atlantic salmon can pass the Cumberland Mills dam.

3.9 Coastal Zone Management Act

The Presumpscot River projects are subject to Maine's jurisdiction under Section 307 of the Coastal Zone Management Act (CZMA). Although the projects are located outside of the geographic boundary of the Maine Coastal Program, the projects may affect diadromous fishery resources of the coastal zone, including the American eel. If and when the Presumpscot River projects receive state WQCs, pursuant to Section 401 of the CWA, the state will deem the projects, subject to the terms and conditions of the WQCs, consistent with the enforceable policies of the Maine Coastal Program (letter to Maureen Winters, Kleinschmidt Associates, Pittsfield, ME, from Todd Burrows, Federal Consistency Coordinator, Maine State Planning Office [MSPO], Augusta, ME, dated May 3, 1999).

4.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

4.1 General Description of the Presumpscot River Basin

The Presumpscot River originates at the outlet of Sebago Lake and extends approximately 25 miles to the Atlantic Ocean at Casco Bay. The five projects that are the subject of this environmental review span a river reach of about 12 miles from Windham (about 3 miles downstream of Sebago Lake) to Westbrook, about 10 miles upstream from Casco Bay. Seven tributaries feed the Presumpscot River between Sebago Lake and the Saccarappa Project. These include the Otter, Nason, Black, Colley Wright, and Inkhorn brooks, and the Pleasant and Little rivers.

The topography of the area is gently rolling and hummocky with a few isolated hills. Elevations range from lows of about 80 feet mean sea level (msl) on the river in the vicinity of the Saccarappa Project to 188 feet msl north of the project between Sebago and Little Sebago lakes. The general geology of the area is typical of southern and central Maine. Igneous rocks and highly deformed metamorphic rocks underlie Wisconsin glacial sediments of variable composition and thickness, some of which are good sources of groundwater.

The climate in this region is highly influenced by the proximity of the North Atlantic Ocean. Precipitation averages approximately 43 inches per year, while average temperatures range from 22 degrees Fahrenheit (F) in the winter to 69 degrees F in the summer.

Vegetation in the vicinity of the projects is predominantly forest and brushland typical of the Northern Hardwoods Ecoregion of northern New England. The forest communities found along the river include mixed hardwood forest, coniferous forest, shrub/successional old field, and agriculture/maintained field.

The land bordering the river is primarily undeveloped in the upper reaches of the watershed, and becomes more developed and industrial downstream. There is a pronounced population density gradient from the town of Raymond, with 100 persons per square mile (the northern-most region in the watershed) to the city of Portland, with 3,000 persons per square mile (the southern-most region in the watershed).

There are 8 hydroelectric developments along the river's length. In addition to the five Presumpscot River Project dams, there are two developments upstream and one downstream (table 5). The Eel Weir Hydroelectric Project, owned by S.D. Warren, and the North Gorham Hydroelectric Project, owned by FPL Energy Maine Hydro, are located upstream of the Dundee Project. The now defunct Smelt Hill dam, owned by FPL Energy, is located downstream of the Saccarappa Project at the mouth of Casco Bay. The Cumberland Mills dam, a non-jurisdictional dam that provides process water storage for the S.D. Warren paper mill is located immediately downstream of the Saccarappa Project.

4.2 Cumulatively Affected Resources

According to the Council on Environmental Quality's regulations for implementing NEPA (50 CFR §1508.7), a cumulative effect is the effect on the environment that results from the incremental effect of the action when added to the past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other 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.

Table 5. Hydroelectric projects on the Presumpscot River (Source: S.D. Warren, 1999a as modified by staff).

Project name	FERC No.	Installed capacity (kW)	Drainage area (sq mi)	Surface area (acres)	Approx RM
Eel Weir[a]	2984	1,800	436	29,184 (Sebago Lake)	25
North Gorham[b]	2519	2,250	436	98	23.6
Dundee[a]	2942	2,400	445	197	21.9
Gambo[a]	2931	1,900	493	151	18.6
Little Falls[a]	2941	1,000	500	29	16.9
Mallison Falls[a]	2931	800	501	8	16.4
Saccarappa[a]	2897	1,350	567	87	11.3
Smelt Hill[b, c]	7118	1,125	641	16	3

[a] Owned and operated by S.D. Warren.
[b] Owned and operated by FPL Energy Maine Hydro LLC (formally owned by Central Maine Power Company).
[c] Smelt Hill is currently inoperable as a result of a flooding event in October 1996.

We evaluate the cumulative effects of the proposed action and alternatives with regard to other existing and foreseeable hydroelectric development and non-hydro activities in the Presumpscot River Basin upstream and downstream from the projects. Based on information in the license applications, agency comments, other filings related to the projects, and preliminary staff analysis, we have identified: (1) temperature and dissolved oxygen (DO); (2) American eel; (3) anadromous fish; (4) recreational access; and (5) the Cumberland and Oxford Canal Historic District as resources that may be cumulatively affected by the proposed action or action alternatives. The aforementioned resources may be affected by the continued operation of the Presumpscot River projects, removal of one or more of the minor dams, or a dam removal alternative in combination with other activities in the Presumpscot River Basin.

4.2.1 Geographical Scope

The geographic scope of the analysis defines the physical limits or boundaries of the proposed actions' effects on the resources. Because the proposed actions affect the resources differently, the geographic scope for each resource varies.

In this case, the scope of our analysis encompasses the main stem and tributaries of the Presumpscot River from the Eel Weir Project, located at the outlet of Sebago Lake upstream of the Dundee Project, downriver to the currently inactive Smelt Hill Project located about 8 miles downstream of the Saccarappa Project. We chose this geographic scope for our analysis of potential effects on temperature and DO, American eels, anadromous fish, recreational access to project lands and waters, and the Cumberland and Oxford Canal Historic District because the effects of project operations are limited to this area and, in this case, the abovementioned resources are directly and indirectly affected by project operations.

4.2.2 Temporal Scope

The temporal scope of our cumulative analysis includes a discussion of past, present, and future actions and their potential cumulative effects on each resource. Based on the license term, the temporal scope looks 30 to 50 years into the future, concentrating on the effect on resources from reasonably foreseeable future actions. The historical discussion is, by necessity, limited to the amount of available information for each resource.

4.3 Proposed Action and Action Alternatives

4.3.1 Water Resources

4.3.1.1 Affected Environment

Water Use and Quantity

The water of the Presumpscot River is used for hydroelectric generation, millworks, municipal and industrial wastewater treatment facility discharges, and recreation. The S.D. Warren paper mill in Westbrook is the largest daily consumptive user of Presumpscot River water, withdrawing up to an estimated 28 cfs for process water. There are numerous seasonal homes along the upper section of the river that also draw water for domestic use.

Table 7 Monthly observed flows (cfs) from 1976 to 1995 at the Sebec Lake gage, Presumpscot River, Maine (Source: USGS STORET Database, 2001, as modified by staff).

Month	Observed mean	Observed maximum	Observed minimum	Required minimum[a]
January	672	2,490	175	25
February	745	2,460	131	25
March	683	2,320	0	25
April	724	3,400	0	75
May	839	3,330	50	75
June	691	3,390	50	75
July	485	844	0	50
August	519	1,330	50	50
September	490	1,320	50	75
October	454	1,330	175	75
November	513	1,500	170	25
December	672	2,490	170	25

[a] As required by the 1997 LLMP.

Table 8. Monthly observed flows (cfs) from 1976 to 1995 at the Westbrook gage, Presumpscot River, Maine (Source: USGS STORET Database, 2001, as modified by staff).

Month	Observed mean	Observed maximum	Observed minimum
January	925	5,390	240
February	1,006	5,760	194
March	1,342	9,760	274
April	1,440	8,010	245
May	1,207	8,530	155
June	902	6,540	117
July	576	1,430	39
August	624	7,080	196
September	571	1,730	121
October	652	3,020	215
November	877	4,880	185
December	992	5,280	240

Class A and B waters must have DO concentrations at or above 7.0 parts per million (ppm)[11] or 75 percent saturation, (whichever is higher), and may be used for such purposes as water supply after treatment and disinfection, fishing, water-based recreation, industrial process and cooling supply, hydropower, navigation, and fish and aquatic life habitat. Class C designated uses are the same as for Class A and B, but the DO concentrations should be at least 5 ppm or 60 percent of saturation (whichever is higher).

[11] Maine State Water Quality Classifications for ambient water standards, such as DO, are presented in ppm which is equivalent to milligrams per liter (mg/L) as stated in data presented by S.D. Warren and the FOPR.

The waters must also meet state maximum concentration standards for *E. coli* bacteria. Class A and GPA waters must attain *E. coli* concentrations as they naturally occur or less than or equal to 194 MPN[12]/100 milliliter (ml), respectively. Class B waters must remain at or below 427 MPN/100 ml (instantaneously), and Class C waters must remain at or below 949 MPN/100 ml.

The MDEP reports that the river attained the applicable water quality standards above Saccarappa dam (MDEP, 1996a). However, more recent results from DO monitoring in the Presumpscot River from Dundee dam to the Saccarappa tailwater in 1997 show DO concentrations that generally complied with the applicable standards with periodic incidences of violations (Woodard & Curran, 1997). Morning DO concentrations ranged from 6.0 to 9.7 mg/L, and evening DO concentrations ranged from 6.5 to 9.2 mg/L. The water column was not stratified.

Results from water temperature monitoring in the Presumpscot River project impoundments and tailwaters varied only slightly (Woodard & Curran, 1997; KA, 1998b). The water temperature was fairly uniform throughout the river and did not indicate progressive warming of downstream waters. The water temperatures in 1997 and 1998 were consistent with historical USGS data.

The MDEP, however, did model non-attainment of DO in some sections of the river in 1993 (MDEP, 1995; 1996b) and collected monitoring data in 1999 and 2001. MDEP's 2000 305(b) Water Quality Assessment Report has identified portions of the river near Windham and Gorham as "non-attainment. The MDEP's waste load allocation study results showed that an 8-mile segment of the river from the Gambo to Saccarappa dams may not meet Class B standards for DO under simulated critical summer low-flow/high-temperature conditions (MDEP, 1995; 1996b). The MDEP attributed the low DO concentrations to the proximity of several impoundments, lack of natural re-aeration below the dams, biological respiration from algae, and non-point source pollution. S.D. Warren maintains that although existence of the projects may contribute to non-attainment, non-point source pollution from several of the tributaries and the resulting nutrient loading to the river must be recognized as a major source of reduced DO.

The Presumpscot River Watch (PRW) monitored *E. coli* levels in 1990 (prior to the implementation of temperature-based flows in 1995) at 10 locations from Dundee Pond to below the tailwaters of the Saccarappa Project. Average *E. coli* levels ranged from 9 to 375 MPN/100 ml and were considered below the regulatory standard.

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[12] MPN = Most Probable Number.

However, the Presumpscot River between the Saccarappa dam and Casco Bay does not always attain Class C *E. coli* standards, which the MDEP attributes to combined sewer overflow discharges and inadequately treated point source discharges (MDEP, 1996a).

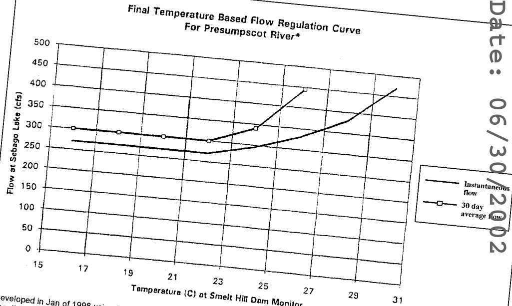
The MDEP monitored biological oxygen demand (BOD) at three locations in the Gambo impoundment and one location on the Little River. Average BOD concentrations ranged from 4.1 to 4.9 mg/L. There is no state standard for ambient water BOD concentrations. However, the results were within concentrations for relatively good water quality (MDEP, 1996b).

Total phosphorus concentrations in the river reaches were within suggested EPA Ambient Water Quality Criteria guidelines (below 25μg/L), except below the Saccarappa dam, where levels exceeded 25 μg/L (MDEP, 1996b; GPCOG, 1993). The total suspended solids concentrations monitored during the PRW study were low, ranging from 0.64 to 1.43 mg/L (GPCOG, 1993). Higher concentrations were measured in the tributaries (specifically in the Little River), where potential sources include agricultural runoff.

S.D. Warren manages flows in the Presumpscot River to meet state water quality standards. In the past, S.D. Warren voluntarily provided minimum flow releases from Sebago Lake that increased as a function of water temperature to maintain adequate DO levels in the river below Westbrook Mill. The increased minimum flows specified in LLMP are intended to improve DO levels throughout the river. In July 1998, S.D. Warren and the MDEP formally agreed on the temperature-based summer flow plan (figure 7), which the Commission found to be consistent with the LLMP. The flow plan was subsequently incorporated into the amended LLMP in 2001. Since the implementation of the LLMP, the water quality of the Presumpscot River has improved.

Sediments

Surface substrate in the Little Falls, Mallison Falls, and upper part of the Saccarappa impoundment consist of sand, gravel, cobble, boulders, and bedrock with only small amounts of silt/clay (Berger, 2001). The surface sediments in the lower part of the Saccarappa impoundment consist of a layer of predominantly fine-grained sediment (silt/clay). The upstream project impoundments (Dundee and Gambo) may be similar in substrate composition to the Little Falls and Mallison Falls impoundments, although there may be a greater occurrence of fine-grained sediment because the upper reservoirs are larger and deeper than Little Falls and Mallison.



*Developed in Jan of 1998 using S.D. Warren proposed license BOD5 of 6780 and 3565 lb/day, respectively for a daily maximum and monthly average. River design flows at Westbrook are 7Q10 of 300 cfs and 30Q10 of 330 cfs, respectively. Instantaneous flow curve results in compliance of minimum Class C (5 ppm and 60% saturation) and SC (70% saturation) DO standards. The 30 day average flow curve results in compliance of the 30 day average DO standard (3.5 ppm). Temperatures of 26 C and 30 C assumed ceilings for daily and 30 day average river temperatures, respectively.

Figure 7. Final temperature-based flow regulation curve for Presumpscot River (Source: KA, 1998b).

The volume of sediment in the Little Falls, Mallison Falls, and Saccarappa impoundments is not known. S.D. Warren informed the Commission on July 14, 2000, that it had no quantitative information of the actual volume or types of sediment behind the dams. S.D. Warren indicates that spring flows are sufficient to remove any sediment that may have accumulated the previous year.

The fine-grained sediments in the impoundments are not expected to be contaminated, although analytical data were not available. Historically, the Presumpscot River provided power for a variety of manufacturing purposes such as pulp and paper, steel, and wood flour mills. The available information about the historical manufacturing along the river suggests that the discharge volumes were low. Industrial activities with potentially contaminated wastewater discharges in the watershed of the Presumpscot River between Sebago Lake and the city of Westbrook appear to have been minor. Further, there do not appear to have been major industrial activities over the last several decades.

4.3.1.2 Environmental Consequences

S.D. Warren's Proposed Action and Modifications

Water Quantity

S.D. Warren proposes to continue ROR operations at all five projects, and to improve daily headpond control to reduce impoundment fluctuations that can affect water quality and water quantity. S.D. Warren also proposes to develop a means for monitoring compliance with bypass flow requirements at the Dundee, Gambo, and Mallison Falls projects. S.D. Warren does not propose any specific operational range or drawdown limits, or any upgrades to existing facilities to assist with minimizing impoundment fluctuations. However, S.D. Warren does propose to avoid drawdowns of the five impoundments during the months of May and June, and to notify personnel at the MDIFW Region A Fisheries Headquarters prior to any drawdown. If a drawdown event occurs, S.D. Warren would implement specific refill procedures in accordance with the Sebago Lake LLMP, as described in section 2.1.2.

Because reduced impoundment fluctuations, seasonal limitations on drawdown, and refill procedures primarily affect fisheries resources, we provide our detailed analysis of these proposed measures in section 4.3.2.2, *Aquatic Resources.*

The FWS, in its Section 10(j) conditions, recommends that the Commission require S.D. Warren to maintain ROR operations, such that instantaneous outflow equals

inflow, and minimize impoundment fluctuations to protect water quality and fisheries resources. The FWS also recommends that the licensee prepare a plan, in consultation with the FWS, USGS, MDEP, MDMR, MASC, and MDIFW, to monitor minimum flows and headpond elevations at all five projects.

The MDIFW, in its letter dated January 31, 2001, supports S.D. Warren's proposal to avoid drawdowns in May and June, with provisions for contacting MDIFW personnel prior to any planned drawdown. It also requests that the applicant prepare a plan to monitor minimum flows and headpond elevations at all five projects in consultation with the agencies.

In its letter dated April 18, 2001, responding to agencies' and NGO's terms and conditions, S.D. Warren states that the agency recommendations related to project operations and flow monitoring were largely consistent with previous S.D. Warren proposals. S.D. Warren installed new staff gages at all five of the projects to improve its daily operations monitoring program. S.D. Warren currently records measurements of daily headpond elevation, tailwater elevation, flow, and generation data. S.D. Warren maintains that these recent improvements made to daily station monitoring would accommodate FWS and MDIFW requests to prepare a plan to monitor minimum flows and impoundment levels.

The proposed continued operation of the projects in a ROR mode would maintain existing hydraulic conditions and simulate natural conditions to the extent flow is regulated by the upstream Eel Weir Project. Because habitat suitability, fish passage, aesthetics, and historic resources could be affected by inconsistent flow releases and water surface elevations, compliance with recommended flow releases and ROR operations should be monitored. The use of staff gages at publicly accessible locations, if feasible, would enable independent verification of water levels in the headpond and the tailwater, which would provide a general measure of ROR operations at the projects.

Instrumentation to monitor headpond elevations is already in place to document compliance with ROR operations. However, we agree with the FWS and MDIFW that it would be necessary to monitor flows in the bypassed reaches to ensure compliance with the recommended minimum flow requirements. Thus, we conclude that a plan for monitoring headpond elevations and minimum flows at all five projects would be warranted.

The headpond elevation and minimum flow monitoring plan should include provisions for: (1) measuring and documenting headpond and tailrace water surface elevations and minimum flow releases; (2) providing documentation of the flows and

water surface elevations to the resource agencies and the Commission, as appropriate; and (3) installing a remote alarm system, or comparable alternative, that can be used to notify an offsite operator if failure of any project component results in a potential deviation from minimum flow requirements or ROR operations, or could potentially cause damage to any structure since S.D. Warren does not propose to have personnel onsite at the projects.

Because developing and implementing a headpond elevation and minimum flow monitoring plan with these provisions would affect project economics, we address the cost in section 5, *Developmental Analysis*, and make our final recommendations in section 6.1, *Comprehensive Development and Recommended Alternative*.

Water Quality

S.D. Warren proposes to continue ROR operations at all projects, and to provide seasonally adjusted minimum flows to the bypassed reaches at the Dundee, Gambo, and Mallison Falls projects. S.D. Warren proposes no further measures to protect or enhance water quality in the Presumpscot River.

The MDEP, which has not acted on S.D. Warren's application for WQC, commented that the minimum flows proposed by S.D. Warren were not sufficient to meet water quality standards in any of the five bypassed reaches. Its calculations show that year-round minimum bypass flows of 60, 80, and 50 cfs would be needed at the Dundee, Gambo, and Mallison Falls projects, respectively, to provide, on average, 75 percent wetted conditions in the bypassed reaches for fisheries protection. However, because transect data were not collected during flow studies below the Little Falls or Saccarappa dams, the MDEP could not determine what flows would be needed to provide 75 percent wetted conditions for these two bypassed reaches.

MDEP's February 11, 2002 flow recommendations, which were discussed at the February 19, 2002, 10(j) meeting, include provisions for spillage of flows at two of the projects during low-flow, high-temperature conditions. They recommend spillage of 50 cfs at Dundee and 100 cfs at Gambo (in addition to the bypassed reach minimum flows discussed above), whenever water temperatures (as measured at Gambo dam) exceed 22 degrees Celsius (C). This recommendation is based on MDEP modeling studies (a copy of which was provided to staff on April 1, 2002), which indicate that this level of spillage is required to meet DO standards for the river. Providing this level of spillage at the projects, during low-flow, high-temperature conditions, would be an appropriate interim measure to enhance DO levels and ensure that water quality standards are met. However, since this level of spillage during low-flow periods would result in a major

loss of generation,[13] the licensee should also be required to monitor the effectiveness of this spillage in maintaining DO standards, and investigate alternative measures (such as turbine venting, air/oxygen injection, etc.) that could be implemented to also meet water quality standards. Our final recommendations are summarized in section 6.1, *Comprehensive Development and Recommended Alternative.*

The MDIFW, in its January 31, 2001, letter, recommends minimum flows of 30 cfs at Dundee in April, May, and October, and 57 cfs from June through September; a flow of 40 cfs from April through October at Gambo; and flows of 40 cfs at Mallison Falls in April, May, and October, and 63 cfs from June through September.

The FWS, in its Section 10(j) conditions, recommends ROR operations and year-round minimum flow of 57 cfs at Dundee, 40 cfs at Gambo, 60 cfs at Mallison Falls. Neither the FWS nor the MDIFW are requesting minimum flows at the Little Falls and Saccarappa projects.

S.D. Warren, in its April 18, 2001, reply comments, indicates that the MDEP, MDIFW, and FWS reached agreement on minimum flows for Dundee, Gambo, and Mallison Falls on March 9, 2000. S.D. Warren adopted the agreed-upon flows pending the MDEP's issuance of the WQC.

Because minimum flows primarily benefit fisheries resources, we provide our detailed analysis of the agency minimum flow recommendations in section 4.3.2.2, *Aquatic Resources.*

Uninterrupted river flows provided by operating in ROR mode minimizes water retention time in the project impoundments, thereby lessening the potential for reduced DO levels. In addition, continued project operation in ROR mode would protect existing water quality by maintaining existing flows downstream of the projects, which would promote circulation through the impoundments, minimize solar warming, and assist with flushing of accumulated sediments potentially trapped behind the project dams. We agree with S.D. Warren and the agencies that continued ROR operation would protect water quality.

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[13] The amount of generation losses cannot be reasonably estimated because the frequency and duration of spillage cannot be predicted (depends on water temperature, which would vary from year to year).

Water quality surveys performed by S.D. Warren, the MDEP, and the FOPR indicate that the few instances of noncompliance with state DO and temperature standards in the river typically coincided with periods of low stream flows. We anticipate that the proposed minimum flows to the bypassed reaches would help provide continuity of flows, enhance mixing and aeration of river water, and effectively increase the water quality and waste assimilation capacity of the river. Should temperatures exceed 22 degrees C downstream of Gambo, the additional spillage recommended by MDEP would serve to further increase DO and decrease water temperatures. We agree that S.D. Warren should comply with the state of Maine water quality standards. Therefore, the headpond and minimum flow monitoring plan should provide for water temperature monitoring at the Dundee and Gambo projects.

Implementation of the recreational enhancements proposed by S.D. Warren (as discussed in section 4.3.5.2) could affect water quality. The recreational enhancements proposed by S.D. Warren would require ground-disturbance near the water's edge and would have the potential to transport sediments into the river. We expect that S.D. Warren would use best management practices to ensure that construction of the proposed canoe portage and car-top boat access locations would not affect water quality in the Presumpscot River, and we recommend that erosion control measures be identified as part of the final recreation plan.

Dam Removal Alternatives

Interior, the state of Maine resource agencies, American Rivers/FOPR, MCASF/Friends of Sebago Lake, and TU all filed comments and recommended that the Commission consider removal of three dams as an alternative to licensing. For our analysis, we consider the following alternatives: (1) removal of Little Falls, Mallison Falls, and Saccarappa dams; (2) removal of Saccarappa dam only; and (3) removal of Little Falls and Mallison Falls dams only. These three alternatives may potentially affect water resources within the project area.

Removal of Little Falls, Mallison Falls, and Saccarappa Dams

Water Quantity

Removal of all three minor project dams would not have any major effect on the hydrology of the Presumpscot River downstream of the Saccarappa dam because the hydropower projects are operated in a ROR mode. Because all of these dams are currently operated in a ROR mode, flows would be unchanged under any removal scenario.

Flooding

We considered hydraulic effects in June and July (similar to August and September) as representative of critical spawning periods and high recreational use. During June and July, the water surface level would decrease from 2 to 4 feet within the Little Falls impounded reach, approximately 5 feet within the Mallison Falls impounded reach, and up to 10 feet within the Saccarappa impounded reach (Berger, 2001). The decrease in elevation would be greatest in the lowermost section of the respective reaches.

In general, the removal of any one dam would not significantly affect water surface elevations past the next upstream dam. Also, because flows would remain unchanged downstream of the Saccarappa Project, removal of the Saccarappa dam would not affect the downstream floodway width.

If the three dams were removed, the water surface elevation under a 100-year flood would decrease by approximately 1 foot at the Little Falls dam site, 3 feet at the Mallison Falls site, and 10 feet at the Saccarappa site. The floodway widths along the Little Falls and Mallison Falls impoundments would remain largely unchanged. Removal of the Saccarappa dam would reduce the river elevation significantly under different flooding scenarios. Removal of the Saccarappa dam would allow the river generally to stay within the channel under the 100-year flooding scenario, resulting in a decrease in floodway width in the lower third of the impoundment by about 500 feet on the northern shore and 100 feet on the western shore. In one location, the decrease in floodway width along the western shore is 800 feet (Berger, 2001).

Removal of the three minor project dams would transform this impounded reach of the Presumpscot River into a shallower, higher velocity, more riverine reach. We provide additional analysis of the potential effects of the dam removal alternatives and associated effects of water quantity changes on fisheries resources in section 4.3.2.2.

Water Quality

Removal of the three minor project dams would likely have minimal effects on water quality. Some of the parties recommending dam removal believe that removing the dams would result in a decrease in water temperatures as the impoundments are reduced in size and water velocities increase. We are not convinced that water temperatures would significantly decline, because: (1) of the small size of the existing impoundments; (2) the likely continued dominating influence of the larger upstream impoundments and Sebago Lake on water quality and temperatures in the lower river; and (3) the relatively

minor hydraulic changes that would occur in two of the reaches (Little Falls and Mallison Falls) after dam removal. The existing impoundments are shallow, with depths generally less than 10 to 15 feet, except in a few locations in Saccarappa impoundment that exceed 20 feet. These impoundments do not stratify and remain isothermal year-round. Reducing the water level in these reaches by only 2 to 10 feet, through dam removal, would increase water velocities and reduce residence time, but likely would not result in significant reductions in water temperatures.

During the summer low-flow period, which would typically have the highest water temperatures, flows in the Presumpscot River are largely releases from Sebago Lake, and would likely continue to be in the future. Our hydrologic analysis (based on USGS flow data) indicates that at the July 90-percent flow exceedance level, outflows from Sebago Lake account for 92.5 percent of the flow at Little Falls and 88.1 percent of the flow at Saccarappa. Releases from Sebago Lake are governed by FERC requirements for the Eel Weir Project (as per a settlement agreement regarding lake levels and flow releases) and by a water temperature/flow curve agreement between S.D. Warren and the MDEP for controlling summer water temperatures in the lower Presumpscot River. Temperatures in the lower Presumpscot River during the summer months reflect the temperature of these releases, and are likely to remain so even if these dams were removed.

Low DO concentrations that may occur at times within the existing three impoundments would be eliminated. Transformation of the three impoundments to free-flowing river reaches would likely provide some enhancement of DO levels due to reaeration by exposed riffles and rapids. Water quality problems from point sources during low flow periods are not expected to become an issue because the minimum flow releases from Sebago Lake, established under the LLMP, would continue to provide adequate dilution flows downstream.

Sediments

The initial removal of all three dams may result in some flushing of a limited amount of fine-grained sediment (silt/clay) downstream, although the amount of accumulated sediments, based on field observations (Berger, 2001), is not expected to be significant. Most of this sediment would come from the lower portion of the Saccarappa impoundment. There could be a short-term increase in turbidity, but this would likely subside after a relatively short period of time.

Hydrology

Because ROR operations throughout the river would be unchanged with the removal of Saccarappa dam, there would not be any major effect on the downstream hydrology of the Presumpscot River.

Flooding

Under June and July flows, the water surface elevation would decrease up to 10 feet within the Saccarappa impounded reach. The decrease in elevation would be greatest in the lowermost section of the Saccarappa impounded reach. Water surface elevations upstream of Little Falls and Mallison Falls dams would be unchanged.

Under flooding scenarios, removal of the Saccarappa dam only would reduce the river elevation considerably in the Saccarappa impounded reach. Backwater effects upstream of the natural Saccarappa falls location with and without the Saccarappa dam would be noticeable all the way up to Mallison Falls dam. Relative to the existing condition (dam in place), the water surface elevation would be lower by a few feet in the uppermost section of the Saccarappa impounded reach. Toward the Saccarappa dam, the water surface elevation would be over 10 feet lower with the dam removed. Removal of the dam would allow the river to generally stay within the channel under the 100-year flooding scenario, resulting in a decrease in floodway width of approximately 500 feet on the northern shore and 100 feet on the western shore in the lower third of the Saccarappa impounded reach. In one location, the decrease in floodway width along the western shore would be 800 feet.

Water Quality

As with the alternative to remove all three minor project dams, we would not expect any significant change in water quality in this reach. The low DO concentrations that may occur at times within the existing Saccarappa impoundment would be eliminated. Also, dam removal would not likely significantly decrease the water temperatures in the river. While water velocities would increase and residence time would decrease, water temperatures should remain largely unchanged from existing temperatures.

Sediments

Sediments mobilized by the removal of the Saccarappa dam would be trapped by the Cumberland Mills impoundment, at least initially. The sediment in the Cumberland Mills impoundment already consists primarily of fine-grained sediment; therefore, aquatic habitat would not likely be adversely affected. Over time, the sediment may be transported over the Cumberland Mills dam during high flows and work its way toward Casco Bay. Because this process is likely gradual, the effect at any given time on the reaches downstream of the Cumberland Mills dam is considered minimal.

Information on the chemistry of the fine-grained sediment is not available. However, the likelihood of contaminated sediments in the Saccarappa impoundment is small because there was limited historical industrial activity in the study area and no industrial activity over the last several decades. Moreover, the impoundments appear to be flushed to a great extent by annual high water.

Removal of Little Falls and Mallison Falls Dams

Hydrology

Because ROR operations throughout the river would be unchanged with the removal of Little Falls and Mallison Falls dams, there would not be any major effect on the downstream hydrology of the Presumpscot River.

Flooding

Under June and July flows, the water surface elevation would decrease from 2 to 4 feet within the Little Falls impounded reach, and approximately 5 feet within the Mallison Falls impounded reach. Water surface elevations upstream of Little Falls and Mallison Falls dams would be unchanged.

If Little Falls and Mallison Falls dams were removed, the water surface elevation under a 100-year flood would decrease by approximately 1 foot and 3 feet, respectively. The floodway widths along the Little Falls and Mallison Falls impounded reaches would remain largely unchanged.

As with the alternative to remove all three minor project dams, we would not expect any significant change in water quality in these two reaches. Effects from the erosion of sediments also would be minimal.

4.3.1.3 Cumulative Effects

We would expect water quality in the Presumpscot River to experience a cumulative beneficial effect as a result of increased flows to the bypassed reaches and limitations in drawdowns at the project impoundments.

Removal of Mallison Falls and Saccarappa dams would have no hydrologic or hydraulic effect on the operation or generation at Dundee or Gambo. Removal of Little Falls dam would have no hydrologic or hydraulic effect on the operation or generation at Dundee, and would have no hydrologic effect at Gambo. Removal of the Little Falls dam may increase head slightly at Gambo due to reduced backwater effects from the downstream impoundment. Staff's hydraulic analysis indicated that removal of Little Falls dam would increase head at Gambo between 0.5 and 0.9 foot during June and July low flows, and around 0.2 foot under flood flows. The generation gained due to increased head is assumed to be minor.

4.3.1.4 Unavoidable Adverse Effects

We would expect localized, short-term increases in turbidity and sedimentation associated with the construction of recreational facilities along the shoreline of the impoundment and downstream areas (see section 4.3.5).

4.3.2 Aquatic Resources

4.3.2.1 Affected Environment

Resident Species

The existing fishery resources of the 12-mile reach of the Presumpscot River bounded by the Dundee, Gambo, Little Falls, Mallison Falls, and Saccarappa projects include self-sustaining resident warmwater species and the American eel. The eel is a catadromous species that spawns at sea and returns to freshwater (as juveniles) to rear. The current warmwater recreational fishery includes smallmouth bass, largemouth bass, yellow perch, brown bullhead, and chain pickerel. There are also small numbers of

coldwater salmonid species such as brook trout, brown trout, and landlocked Atlantic salmon that have been collected in this stretch of the river. The origin of the salmonids is probably from continued stocking efforts by the state of Maine.

S.D. Warren conducted a baseline fisheries investigation of the five projects, which examined species composition and relative abundance, smallmouth bass spawning, growth rates, condition factors, and types of available habitat (IA and DES, 1998). Table 9 presents data on the species composition and relative abundance from the baseline survey and from an American eel upstream migration study conducted by S.D. Warren in 2000 (KA, 2000). The eel study examined eel populations below each of the five dams and enumerated incidental fish collections.

A total of 17 species was collected during the 1997 baseline study. The five most abundant species were pumpkinseed (18.8 percent), smallmouth bass (16.1 percent), American eel (14.5 percent), common shiner (10.6 percent), and golden shiner (9.5 percent). Two additional species were collected during the 2000 study that were not found during the 1997 study: blacknose dace (11 individuals) and a single burbot. Other species, not found during either study, but listed by S.D. Warren as occurring within the project area, include black crappie and white perch.

S.D. Warren states that the MDIFW rated the habitat quality from the outlet of Sebago Lake downstream past the Dundee and Gambo projects to Route 202[14] as "high," and the fishing quality of the same reach of river as "medium." For the reach of river from Route 202 downstream (including the Mallison Falls and Saccarappa projects), the MDIFW rated the habitat quality as "medium," and the fishing quality as "low." Natural reproduction was still listed as "high."

The composition of the fish community at the five projects is similar to those reported for other nearby impoundments. There were differences in overall species composition between the more complex lacustrine impoundments (Dundee and Gambo) and the more riparian, lotic impoundments (Little Falls, Mallison Falls, and Saccarappa). Fish habitat diversity and quality is generally higher at the Dundee and Gambo impoundments, compared to the three downstream impoundments. Data from a smallmouth bass spawning survey, conducted as part of the baseline fisheries study, indicate more suitable smallmouth bass habitat is available in the Dundee and Gambo impoundments (table 10).

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[14] Route 202 crosses the Presumpscot River immediately upstream of the Little Falls dam. Thus, the Little Falls impoundment would be included within this reach.

Table 9. Species and number of fish collected in project waters (Source: IA and DE&S, 1998; KA, 2000b).

Common name	Dundee		Gambo		Little Falls		Mallison		Saccarappa	
	IMP	BYP/TW[a]	IMP	BYP/TW[a]	IMP	BYP/TW[a]	IMP	BYP/TW[a]	IMP	BYP/TW
American eel	13	776	51	635	39	36	49	227	60	181
Landlocked Atlantic salmon	-	1	-	-	1	-	-	-	-	-
Burbot	-	1	-	-	-	-	-	-	-	-
Brook trout	-	3	-	-	2	2	-	8	-	1
Brown trout	-	4	1	1	-	1	-	6	19	2
Blacknose dace	-	-	-	9	-	-	-	-	-	-
Chain pickerel	7	-	-	-	1	-	-	-	9	-
Golden shiner	10	-	14	-	20	-	-	-	94	5
Brindle shiner	-	-	43	-	-	-	-	-	-	-
Common shiner	2	12	122	3	31	1	-	-	-	5
Fallfish	-	6	5	48	1	4	2	13	21	3
White sucker	5	2	36	1	46	5	2	10	33	3
Brown bullhead	5	1	61	-	8	-	-	-	3	-
Banded killifish	-	-	2	-	3	-	-	-	-	-

Table 9. Species and number of fish collected in project waters (Source: IA and DE&S, 1998; KA, 2000b).

Common name	Dundee		Gambo		Little Falls		Mallison		Saccarappa	
	IMP	BYP/TW[a]	IMP	BYP/TW[a]	IMP	BYP/TW[a]	IMP	BYP/TW[a]	IMP	BYP/TW
Fourspine stickleback	-	-	6	-	1	-	-	-	-	-
Pumpkinseed	53	46	141	6	19	5	5	1	56	6
Smallmouth bass	77	133	22	100	19	155	82	102	35	126
Largemouth bass	4	3	-	-	1	-	-	-	-	1
Yellow perch	80	4	33	6	3	1	1	-	1	-
TOTAL	256	992	537	809	195	210	141	417	331	343
Total Species	10	13	13	9	15	9	6	7	10	10

Note: IMP = impoundment, BYP/TW = bypassed reach and tailwaters.

[a] These collections were made specifically targeting American eel immediately below each of the five dams.

Table 10. Nearshore spawning habitat assessment for smallmouth bass within the project impoundments (Source: IA and DES, 1998).

		Quality of spawning habitat			
Impoundment	No. of distinct nearshore habitats	High (percent)	Medium (percent)	Low (percent)	Not suitable (percent)
Dundee	34	15	22	63	0
Gambo	26	2	37	61	0
Little Falls	15	0	32	43	25
Mallison Falls	9	0	32	48	20
Saccarappa	29	2	19	72	7

Presumpscot River smallmouth bass growth rates are similar to those reported for the Penobscot River, but lower than those from the Androscoggin River. For a given age class, Presumpscot River smallmouth bass are similar in length to Androscoggin River smallmouth bass that are 1 year younger. IA and DES (1998) theorized that low productivity and the predominance of clay substrates throughout much of the impoundments may limit growth rates in the Presumpscot River.[15]

Length frequency distributions of smallmouth bass collected in 1997 indicated a reduced year class for age 1+ fish in all impoundments, with age 2+ fish dominant in all impoundments except Dundee, where age 3+ fish dominated. Very few older smallmouth bass were collected within the study area. In October 1996, there was a major flood event on the Presumpscot River. It is unknown what effect the flooding had on smallmouth bass or other fish populations, but it is likely that flushing downstream, stranding, and mortalities occurred as a result of the flood. Another event likely affecting smallmouth bass populations was the drawdown of the Gambo impoundment the first week in June, 1996. The drawdown, conducted by request of MDOT and the town of Windham, coincided with the smallmouth bass spawning and nesting period and likely had a negative effect on the 1996 smallmouth bass year class. Substantial drawdowns are uncommon along this reach, however, during normal operations.

[15] Field investigations conducted by Berger (2001) in the Little Falls, Mallison Falls, and Saccarappa impoundments, however, did not find a predominance of clay substrates.

The MDIFW maintains a coldwater fishery in the upper reaches of the Presumpscot River. The MDIFW stocks coldwater species including brook trout, brown trout, and landlocked Atlantic salmon each year between the Eel Weir dam (at Sebago Lake) and the Gambo tailrace, as well as within some of the larger Presumpscot River tributaries. The MDIFW has also stocked the tailrace area of the Mallison Falls Project. The 1999 salmonid stocking records for the Presumpscot River and its immediate tributaries (from upstream to downstream) are presented in table 11. Limited natural reproduction of landlocked Atlantic salmon, brown trout, and brook trout has been reported in the Presumpscot River and its tributaries, although the exact extent is not known.

Table 11. Number and species of salmonids stocked by MDIFW in Presumpscot River and its tributaries, 1999 (Source: S.D. Warren, 2000).

River	Impoundment where tributary enters Presumpscot River	Species	Number stocked[a]
Pleasant River	Gambo	Brook trout	1,850
Pleasant River	Gambo	Brown trout	2,000
Presumpscot River[b]	N/A	Brook trout	3,869
Presumpscot River[b]	N/A	Brown trout	2,220
Presumpscot River[b]	N/A	Landlocked Atlantic salmon	400
Colley Wright Brook	Saccarappa	Brook trout	3,000 fry
Little River North Branch	Saccarappa	Brook trout	400
Little River North Branch	Saccarappa	Brown trout	400
Little River	Saccarappa	Brook trout	900
Little River	Saccarappa	Brown trout	1,200
Piscataqua River	Smelt Hill	Brook trout	2,600
Piscataqua River	Smelt Hill	Brown trout	800

[a] Except where noted, stocked fish measured from 6 inches to 24 inches in length.

[b] Fish are currently stocked in the tailraces of the Dundee, Gambo, and Mallison Falls projects.

Anadromous Species

In the early 1600's, the Presumpscot River supported populations of Atlantic salmon, American shad, river herring (alewife and blueback herring), and rainbow smelt. Native American tribes used these species for food and fertilizer. European settlers started building mills along the river in the mid-1600's, and the first documented dam was constructed in the 1730's. Decreasing runs of anadromous species prompted objections from local Native American tribes, and in 1741, the court required the installation of fish passage facilities at all dams on the Presumpscot River. In 1802, a dam was built at the head of tide without fish passage. By the 1850's, alewife and shad populations were decimated and sea-run Atlantic salmon were almost extirpated from the system. An 1867 report on the status of anadromous fish in Maine prompted a statewide program to construct fishways and by 1887, all the dams on the Presumpscot River had fishways in place. Over the 10-year span following fish passage completion, the fishways fell into disrepair or were destroyed by flooding. Attempts to augment salmon populations through fry stocking in 1880 and 1890 were largely unsuccessful. Atlantic salmon were still reported in the tributaries to Sebago Lake in 1867, 1880, and 1882, but no runs of anadromous species were reported after 1900 (letter from George D. Lapointe, Commissioner, MDMR, Augusta, ME, January 24, 2001; letter from Judith M. Stolfo, Agency Counsel, Interior, Newton, MA, February 2, 2001).

Although the construction of dams appeared to be the primary cause of the extirpation of anadromous fish runs from the river, water pollution has also been well documented as a problem in the lower Presumpscot River and in some of its tributaries. DeRoche (1967) states that the lower 8 miles of the river below Westbrook "...frequently attains nuisance conditions during periods of low flow and high water temperature," and that "All anadromous and freshwater fish habitat has been destroyed..." in that reach (p. 15). As noted above, historical accounts indicate that fishways were constructed at the major dams on the river by the 1880's, but were then allowed to fall into disrepair and abandoned. It is likely that fish restoration efforts (fish passage construction and fry stocking) were negatively affected by poor water quality, resulting in low fish returns, and may have been a factor in the abandonment of those efforts.

In addition, there is evidence that illegal fishing ("poaching") also occurred in the Presumpscot River Basin. In the 1882 State of Maine "Fisheries and Game Commissioner's Report" (included in the February 2, 2001, filing of comments, recommendations, and terms and conditions by AR&FOPR), illegal "poaching" of "large salmon" (believed to be sea-run fish resulting from fry stocking in the 1870's) was reported in the Crooked River, a tributary to Sebago Lake, over a period of 2 to 3 years.

Such illegal fishing would be another factor that would adversely affect any salmon restoration efforts at that time.

The size of the historical anadromous fish populations and the precise distribution within the basin, however, are not known. The falls that occurred on the river historically may have restricted the upstream migrations of some of these species (shad, herring, alewife).[16] However, salmon likely were more successful than the clupeid species in negotiating these barriers, and probably had a greater distribution within the basin, reportedly migrating into the tributaries of Sebago Lake.

Currently, anadromous species such as Atlantic salmon, American shad, alewife, and blueback herring do not occur in project waters. The lower Presumpscot River (downstream of Cumberland Mills dam) was open to anadromous fish migrations (primarily alewife and a few shad) with provision of fish passage facilities at the Smelt Hill dam from 1990 to 1996. Subsequently, in 1996, the powerhouse and fish passage facilities were severely damaged by flooding and rendered inoperable. The number and species of fish passed by the Smelt Hill dam while the fish lift was in operation are presented in table 12. For the 2 years after the flood (1997 and 1998), alewife were stocked into Highland Lake by the owners of the Smelt Hill dam.[17] Since 1999, gates on the dam have been left open to allow for passage of anadromous fish, which may occur at certain river flows and tidal conditions. In 2000 and 2001, the MDMR again augmented alewife populations in Highland Lake by stocking (Wippelhauser et al., 2001).

Table 12. Anadromous fish passed upstream at the Smelt Hill dam (Source: S.D. Warren, 1999; S.D. Warren, 2000).

Year	Fish lift operational period	River herring (blueback herring and alewife)	American shad	Atlantic salmon
1994	No dates available	~27,000	12	0
1995	May 1 to June 21	27,313	1	0
1996	May 3 to June 20	5,322	31	0
1997	No data - flood destroyed fish lift and other project facilities.			

[16] The sites of these falls are now either inundated by impoundments or serve as sites where dams were constructed.

[17] The outlet from Highland Lake, Mill Brook, enters the Presumpscot River between the Smelt Hill and Cumberland Mills dams. Highland Lake is believed to be the primary spawning area for alewife entering the lower Presumpscot River.

Catadromous Species

The American eel occurs throughout the five-project reach of the Presumpscot River. During the 1997 fisheries study, eel accounted for between 5.1 percent and 34.8 percent of the catch within each impoundment. During the 2000 collections, American eel comprised from 17 to 78 percent of the catch recorded within each bypassed reach and tailrace, although the 2000 efforts specifically targeted the eel and may not reflect the actual species composition of the reaches. The total number of eels collected below the dams in 2000, however, was much higher than the number collected in 1997. Table 13 lists the number of eels collected, the catch per unit effort (CPUE), the percent of the catch comprised of eels in 1997, and the length range for eels collected during both the 1997 and 2000 studies. It is likely that the CPUE rates for American eels are a conservative estimate because of their ability to recover from electroshocking and escape capture.

American eel were the second most frequently collected species at the three lower projects, and the third most commonly collected species overall, accounting for 14.5 percent (212 individuals) of all fish collected in the 1997 survey. Dundee and Gambo had a lower proportion of eels compared to the three downstream projects. This may be indicative of inhibited upstream migration past the dams, or a natural decrease in the number of small and medium-sized eel numbers as distance from saltwater increases (Smogur, 1995, as cited by KA, 2000).

Additional eel sampling was conducted by S.D. Warren during 2000 (KA, 2000). The study was conducted to determine the upstream migration patterns, migratory success, and population levels of eels occurring within project waters. Eels were collected in each project tailrace, indicating that, even without fish passage facilities at Cumberland Mills dam and at the operating hydroelectric projects on the river, some portion of the migrating juvenile eels (elvers) are able to migrate upstream over or past the dams. The overall upstream passage efficiency of American eel, however, is not known, in part because eels entering freshwater habitats may remain 6 to 13 years and, in some cases, up to 25 years before migrating to the ocean to spawn, and do not all complete their upstream migrations within one year.

Table 13. Summary of data on American eel collected in 1997 and 2000 at the projects (Source: KA, 1998d; 2000).[a]

Project	Total number collected		Average CPUE (fish/hour)		Eel percentage of catch	Length range (mm)	
	1997[b]	2000[c]	1997[b]	2000[b]	1997[c,d]	1997[b]	2000[c]
Dundee	13	N/A	5.5	N/A	5.1	290-720	N/A
Gambo	51	776	15.3	144.5	9.5	160-700	95-585
Little Falls	39	635	24.6	80.3	20.0	175-600	80-665
Mallison Falls	49	36	42.7	11.0	34.8	160-620	93-580
Saccarappa	60	277	29.5	68.6	18.1	140-660	90-580
Cumberland Mills dam	N/A	181	N/A	36.2	N/A	N/A	70-640

[a] The 2000 eel sampling events were conducted in the tailrace or bypassed reach below each dam and thus are counted as collected from the downstream impoundment.

[b] Electrofishing only.

[c] Electrofishing and eel traps.

[d] The 2000 eel study specifically targeted American eel so percent of total catch data would not be representative of relative species occurrence within project waters.

Three nighttime migration surveys (July 26 and August 3 and 7) were conducted during the summer of 2000 at the five projects, to determine upstream migratory success, identify the number of eels attempting migration, and examine the migration routes used by the eels (KA, 2000). Although eel abundance was low (0-20 eels observed) during many of the surveys, the following observations were made. At the Saccarappa dam, only about 20 eels were observed on July 26 and August 3, although higher numbers were observed on August 7, when a total of 80 eels were seen on two portions of the dam. The Mallison Falls dam had the highest occurrence of eels attempting to migrate on all survey dates. About 100-200 eels were observed clinging to the rock face at the Mallison Falls dam on July 26, and another 50-100 were observed on August 3 and August 7. The eels were congregating near and within an abandoned draft tube opening that is a source of limited leakage from the dam. At the Little Falls dam, only a few

(estimated about 3) eels were observed in the bypassed reach on July 26 and August 3, with none observed on August 7. At the Gambo dam, about a dozen eels were observed clinging to the spillway on July 26 and August 3. At the Dundee dam, an estimated 6 eels were observed on August 3.

The only observed passage of eels over any of the dams was at the Saccarappa Project on August 3, when 5 eels were observed passing in 45 minutes, and on August 7, when 4 individuals were observed successfully navigating over the dam. Two eels were also seen to fall from the face of the dam back into the pool below, during the August 7 observation.

Recently, there has been significant pressure on eel populations from commercial fishing. In 1995, a concentrated fishery began for elvers (juvenile American eels) as they migrated up the Presumpscot River due, in part, to prices of up to $300 per pound for exported eels. In 1999, the state of Maine put a cap on the number of eel collection licenses. That same year, the price for exported elvers dropped significantly and the fishery located below the Smelt Hill dam effectively shut down. There was no reported fishing activity in 2000. Also, during the mid-1990's, there were two commercial harvesters of adult American eel at Sebago Lake (S.D. Warren, 1999f). These harvesters relinquished the site after only 1 or 2 years, citing fishing difficulties. There is currently no commercial fishery reported for any life stage of American eel on the Presumpscot River (letter dated January 31, 2001, from Betsy Elder, MSPO, Hydropower Coordinator, MDNR).

The American eel continues to be a species of high interest to state and federal agencies because of the commercial importance of the species, and its apparent decline in recent years. A multi-state/federal effort is currently underway to protect and restore the species to its former range and abundance (MDIFW and MDMR, 1996; ASMFC, 2000).

The Atlantic States Marine Fisheries Commission (ASMFC) published the Interstate Fishery Management Plan for American Eel in April, 2000, and cited Maine as the leading state in modernizing its elver/eel fishery regulations. The goal of the plan is to "protect and enhance the abundance of American eel in inland and territorial waters of the Atlantic states and jurisdictions and contribute to the viability of the American eel spawning population; and provide for sustainable commercial, subsistence, and recreational fisheries by preventing overharvest of any eel life stage." The primary objectives of the plan are:

- improve knowledge of eel utilization at all life stages through mandatory reporting of harvest and effort by commercial fishers and dealers and enhanced recreational fisheries monitoring;

- increase understanding of factors affecting eel population dynamics and life history through increased research and monitoring;

- protect and enhance American eel abundance in all watersheds where eel now occur;

- where practical, restore American eel to those waters where they had historical abundance but may now be absent, by providing access to inland waters for glass eel, elvers, and yellow eel and adequate escapement to the ocean for pre-spawning adult eel; and

- investigate the abundance of eel at the various life stages necessary to provide adequate forage for natural predators and support ecosystem health and food chain structure.

Fisheries Management

The MDIFW has managed the Presumpscot River to promote a season-long, naturally reproducing recreational bass fishery, and a limited seasonal salmonid fishery (by stocking) for brown trout, brook trout, and landlocked Atlantic salmon in the tailraces of the Dundee, Gambo, and Mallison Falls projects. The MDIFW modified its stated management goals near the end of 1998 to include extension of the open water fishing season for the Presumpscot River in the vicinity of the projects through the month of October, pending the implementation of minimum flows. At the time of filing the applications for relicensing, the open water fishing season was from April 1 to September 30 in the vicinity of the five projects. The upper reaches of the Presumpscot River are open year-round for fishing.

In the past, the Presumpscot River was not managed for restoration of wild stocks of salmonid species. In its Atlantic Salmon Restoration and Management Plan (for the years of 1995-2000), the Atlantic Sea-Run Salmon Commission (now called the Maine Atlantic Salmon Commission) listed the Presumpscot River as a low priority for salmon restoration efforts. Similarly, the 1982 Statewide River Fisheries Management Plan for the Presumpscot River stated that the MDMR objective was to provide fish passage for alewife and American shad at the Smelt Hill dam (downstream of the Cumberland Mills and Saccarappa dams) and at Highland Lake. As previously described, fish passage was

provided at both the Smelt Hill dam and Highland Lake in the early 1990's. Passage was interrupted at the Smelt Hill dam after the October 1996 flood, which rendered the fish lift inoperable. Current access for migratory fish to the reach upstream from the dam is via sluice gates that remain open, pending final decisions on the removal of the dam, which is now scheduled to occur in 2002.

Recently, there have been changes in the stated fisheries management goals for the Presumpscot River. In a letter dated January 31, 2001, the MSPO, on behalf of the MDMR, MDIFW, and MASC submitted the "Interim Goals for Fisheries Management." The MSPO stated two specific reasons for re-examining the existing fisheries management plan: (1) the recent closure of pulping operations at the Westbrook paper mill and the perceived increase in water quality associated with the closure; and (2) the announcement of an initiative to remove the Smelt Hill dam, following recommendations made by the USACOE. In December 2001, the MDMR, MDIFW, and MASC issued a "Draft Fishery Management Plan for the Presumpscot River Drainage" (Wippelhauser et al., 2001), which supercedes the January 2001 "Interim Goals for Fisheries Management." The objective of the December 2001 plan is "...to guide future decisions on fisheries management in the Presumpscot River...," with the goals reflecting "...a balance between the disparate missions of the three agencies." Although two agencies (the MDIFW and MASC) still have some concerns about potential management conflicts, the three agencies support the plan, with the understanding that any future management conflicts would be mutually resolved, with regular meetings among the agencies.

Similar to the January 2001 "Interim Goals for Fisheries Management," the new management goals for the Presumpscot River and connected waterbodies include: (1) provide migratory routes, spawning, and rearing habitat for restoration of anadromous species including alewife, blueback herring, American shad, striped bass, and Atlantic salmon, and possibly Atlantic sturgeon, rainbow smelt, sea-run brook trout, sea-run brown trout, and tomcod; (2) provide migratory routes and habitat suitable for the catadromous American eel; (3) sustain the production of existing riverine species and targeted anadromous and catadromous species; (4) manage the fisheries in accordance with interstate fishery management plans; (5) promote the existing and potential commercial and sport fisheries for both diadromous and resident species; (6) establish a recreational fishery for stocked trout in the mainstem; and (7) manage specific tributaries for the production of wild brook trout. The overall management goals are designed for two phases. Phase 1 would restore anadromous fishes up to the base of Gambo dam, and Phase 2 would restore anadromous fishes up to the base of Eel Weir dam. Phase 2, however, would not proceed until the three fisheries agencies have evaluated the results of Phase 1, and have agreed to continue with Phase 2. The Presumpscot River is also

divided into eight reaches (with Sebago Lake being the ninth reach), with specific management measures tailored to each reach.

Primary measures proposed to accomplish the plan's objectives include: (1) removal of the Smelt Hill dam; (2) immediate construction of eel passage facilities at the other dams on the river; (3) construction of fish passage facilities for anadromous species in a phased approach, consistent with Interior's final fishway prescription (see section 3.6); (4) establishment of year-round minimum flows below specific dams; (5) stocking of hatchery trout in specific reaches of the mainstem river, and in specific tributaries; (6) maintenance/enhancement of MDIFW access for stocking, and adequate public access for fishing; (7) promulgation of appropriate supporting regulations; and (8) habitat mapping and population monitoring studies, as required, and as funding allows.

The December 2001 plan also includes order of magnitude estimates for the anadromous fish production potential, for existing habitat in the Presumpscot River Basin (without removal of the S.D. Warren dams) that would be made available to these species if the plan was fully implemented. The surface area of aquatic habitat for each river reach and tributary was estimated using datasets from the Maine Office of GIS. The total potential run sizes given in the plan are as follows:

- American shad: 73,900
- Blueback herring: 450,200
- Alewife: 147,700
- Atlantic salmon: 386.

The plan states that the objective is to restore American shad and blueback herring up to the base of North Gorham dam, alewife up to the base of Cumberland dam, and Atlantic salmon up to the base of Eel Weir dam. The plan further states that the estimate for alewife is the production potential for Highland Lake, although the potential could approach 200,000 fish if alewife were able to access Knight's Pond and Forest Lake, in the Piscataqua River drainage. The number of Atlantic salmon adults is stated to be the number of adult salmon required to maintain the run, although the plan also estimates a sport catch of 190 salmon. The plan does not state that these population estimates are specific management goals, but only order of magnitude estimates of production potential.

Although the plan appears to focus more on the restoration of anadromous species, resident species management is a component of the plan. This is directed primarily at providing fisheries for stocked and native trout in the basin, although the plan states that angling for other resident warmwater and coolwater species should be

promoted. The plan, however, provides few specifics on stocking levels for trout, or other measures for enhancement of the resident fishery.

Threatened or Endangered Species

No federally listed endangered or threatened fish species were encountered during either the 1997 fisheries survey or the 2000 eel study, and none are believed to occur in the vicinity of these projects. By letter dated May 3, 2001, the FWS provided a list of federally threatened or endangered species that are known to occur in the state of Maine, which included the Atlantic salmon and shortnose sturgeon. However, the FWS indicated that only one federally listed threatened or endangered species, the small whorled pogonia (see section 4.3.3), is known to occur in the vicinity of the five Presumpscot River projects.

4.3.2.2 Environmental Consequences

S.D. Warren's Proposed Action and Modifications

Effects of Project Operations on Resident Species

Daily impoundment fluctuations or maintenance drawdowns can adversely affect fish populations by decreasing spawning success and reducing juvenile survival. Drawdowns can expose spawning nests and dewater eggs and larvae, or cause shallow spawning fish to abandon nests, resulting in higher predation on the eggs and larvae that remain in the nest. Drawdowns also displace juvenile fish from shallow vegetated areas that provide refuge from predators. Impoundment fluctuations may also reduce prey for juvenile fish by stranding and dewatering benthic macroinvertebrates and decreasing prey production.

S.D. Warren proposes three environmental measures associated with impoundment fluctuations that would likely affect aquatic resources: (1) continue operating all five projects in a ROR mode, with daily monitoring of headpond elevations to facilitate better head control and minimize water level fluctuations; (2) avoid drawdowns of the five impoundments during the months of May and June, and notify MDIFW personnel prior to a drawdown; and (3) after drawdown events, implement specific refill procedures in accordance with the Sebago Lake LLMP, either increasing flows from Eel Weir, or if the LLMP limits releases, operating the projects to retain 25 percent of available flows for impoundment refill, while passing the remaining 75 percent downstream. S.D. Warren does not propose any specific operational range or

drawdown limits. Neither do they propose any mechanical upgrades to existing facilities to help minimize impoundment fluctuations.

The FWS, in its letter dated February 2, 2001, recommends that S.D. Warren continue ROR operations and keep impoundment fluctuations to a minimum at all five projects. The FWS also recommends that, as part of a detailed SMP, S.D. Warren include information on the protection of fish and wildlife resources within the project area.

The MDIFW, in its letter dated January 29, 2001 (attached to the MSPO letter of January 31, 2001), supports S.D. Warren's proposal to avoid drawdowns in May and June and recommends that S.D. Warren notify MDIFW personnel prior to any planned drawdown.

In its response to agency- and NGO-recommended terms and conditions, dated April 18, 2001, S.D. Warren states that the agency recommendations related to project operations were largely consistent with previous S.D. Warren proposals.

The 1998 baseline fisheries survey suggests that spawning success is not adversely affected by the current average daily impoundment fluctuations of approximately 0.4 foot, but that major drawdowns of the impoundments can have a negative effect on smallmouth bass spawning nests.

While infrequent, there have been impoundment drawdowns in excess of about 2 or 3 feet below the dam crest at three of the projects. We reviewed daily water surface elevation data that included readings from January 1, 1997, through December 31, 1998. The data indicate that typical day-to-day fluctuations are generally less than 1 foot for all five projects, but that there have been two larger drawdowns at the Little Falls Project (2 feet in October 1997 and 3.5 feet in April 1998); two larger drawdowns at the Mallison Falls Project (3 feet in November 1998 and 3 feet in December 1998); and one larger drawdown at the Saccarappa Project (1.75 feet in June 1997). The drawdown at Saccarappa occurred because the flashboards at Cumberland Mills dam needed to be replaced.[18] The causes of the other drawdowns were either trashrack cleaning, flashboard failure, or project operations. Late-spring or early-summer drawdowns of 2

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[18] Saccarappa was drawn down to provide storage space for any unexpected upriver flow events, and control of the lower river, so that flashboard replacement could safely occur at Cumberland Mills dam, without interruption by higher flows released from the Saccarappa Project.

feet or more may dewater shallow water centrarchid nests (e.g., smallmouth bass and pumpkinseed) resulting in mortalities from egg exposure, stranding, or nest abandonment.

Smallmouth bass typically nest in water that is 2 to 20 feet deep, but average nests are about 3 feet deep. Pumpkinseed nest in water that is 6 to 12 inches deep (Smith, 1985). Based on these spawning depths, we conclude that S.D. Warren's proposed operations would reduce, but not eliminate, the potential for nest dewatering during daily or spring drawdowns at the projects. The frequency of nest dewatering and juvenile fish displacement in the impoundments, however, would decrease.

Increased flows from Eel Weir would likely decrease the effect of drawdowns by reducing refill times, and would benefit aquatic resources. When the LLMP precludes increasing flow releases from Sebago Lake, there is a provision to pass 75 percent of inflow downstream, while retaining the other 25 percent of inflow to refill an impoundment. This plan would allow refilling of the drawn down impoundment while still providing flows to downstream habitats.

S.D. Warren's proposal to reduce daily fluctuations would reduce the frequency of juvenile fish displacement from shallow refuge habitats and reduce the frequency of dewatering benthic prey resources in the impoundments. We conclude that avoiding drawdowns in May and June would improve recruitment of juvenile fishes, and should, in general, enhance the fishery.

Bypassed Reach Minimum Flows

Applicant and Agency Recommendations

The five projects have bypassed reaches that currently receive no minimum flows during normal project operations, except leakage during low-flow periods and spillage during high-flow periods. As a result, the reaches provide aquatic habitat of limited value because of dewatering and intermittent low and high flows. Without sustained flows, the reaches cannot support either fish species or macroinvertebrate populations.

S.D. Warren conducted habitat surveys of the five bypassed reaches (KA, 1997), and determined, in consultation with the fishery agencies, that only three of the reaches had potential habitat worthy of enhancement with minimum flows (Dundee, Gambo, and Mallison Falls). Both the Little Falls and Saccarappa bypassed reaches were believed to provide limited potential habitat because of either relatively short lengths or unsuitable substrate (such as bedrock). Following the habitat surveys, S.D. Warren conducted flow

demonstration studies at Dundee, Gambo, and Mallison Falls (KA, 1998c) to determine the minimum flows that would allow the establishment of a seasonal put-and-take trout fishery in the bypassed reaches, which was the primary management objective of the MDIFW at the time of the study. Any such fishery would depend on the annual stocking of adult brook and brown trout, because it is believed that little natural reproduction of trout would occur within the reaches (letter from Steven A. Timpano, Environmental Coordinator, MDIFW, Augusta, ME, January 29, 2001).

Based on the studies, S.D. Warren originally proposed the following minimum flows for the bypassed reaches in its license applications:

- Dundee: 20 cfs year-round, with 30 cfs in April, May, and September;
- Gambo: 30 cfs year-round, with 40 cfs in April, May, and September; and
- Mallison Falls: 20 cfs year-round, with 40 cfs in April, May, and September.

After S.D. Warren's initial flow proposal, additional negotiations with the agencies occurred. S.D. Warren reports that on March 9, 2000, the MDEP convened a settlement meeting among the MDEP, MDIFW, FWS, and S.D. Warren, in an attempt to resolve the minimum flow issues associated with the projects (letter from Nancy J. Skancke, Counsel for S.D. Warren Company, Law Offices of GKRSE, Washington, D.C., April 18, 2001). According to S.D. Warren, all parties at the meeting agreed to a minimum flow schedule for fisheries that would provide flows to the bypassed reaches only from May 1 through November 30.[19] This agreed-upon flow schedule was contingent on the final resolution of minimum flows as part of the 401 WQC process. The MDEP has not yet taken final action on the 401 Certification, but on February 11, 2002, presented its recommended minimum flows to S.D. Warren, for the five Presumpscot River projects (letter from Dana Paul Murch, Dams & Hydro Supervisor, MDEP, to Thomas P. Howard, Project Engineer, S.D. Warren, February 11, 2002).

S.D. Warren stated, in its comments of January 4, 2002, on the DEIS, that it agrees with the minimum flows recommended by staff in the DEIS. Table 14 summarizes the agencies' recommendations for minimum flows made in response to the REA notice; S.D. Warren's current proposal for minimum flows made in its comments of January 4, 2002, on the DEIS; and the MDEP proposal of February 11, 2002.

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[19] The agreement was for a minimum flow of 60 cfs in the Dundee and Mallison Falls bypassed reaches, and 33 cfs in the Gambo bypassed reach (see table 14).

Table 14. Summary of agency recommendations for minimum bypassed reach flows (cfs) (Source: Staff)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dundee:												
FWS	57	57	57	57	57	57	57	57	57	57	57	57
MDIFW	ND[a]	ND[a]	ND[a]	30	30	57	57	57	57	30	ND[a]	ND[a]
SDW [b]	20	20	20	30	57	57	57	57	57	30	30	30
MDEP [c]	40	40	40	40	60	60	60	60	60	60	60	40
Gambo:												
FWS	40	40	40	40	40	40	40	40	40	40	40	40
MDIFW	ND[a]	ND[a]	ND[a]	40	40	40	40	40	40	40	ND[a]	ND[a]
SDW [b]	30	30	30	40	40	40	40	40	40	40	30	30
MDEP [c]	60	60	60	60	60	60	60	60	60	60	60	60
Mallison:												
FWS	63	63	63	63	63	63	63	63	63	63	63	63
MDIFW	ND[a]	ND[a]	ND[a]	40	40	63	63	63	63	40	ND[a]	ND[a]
SDW [b]	20	20	20	40	60	60	60	60	60	40	20	20
MDEP [c]	40	40	40	40	60	60	60	60	60	60	60	40

[a] Not Determined - the MDIFW has recommended that "suitable" year-round flows be established, but has not made a specific flow recommendation.

[b] S.D. Warren, in its reply comments dated April 18, 2001, did not indicate that it has agreed to minimum flows during the winter months, although its earlier proposals included year-round flows. In its reply comments addressing the comments on the DEIS, dated January 4, 2002, S.D. Warren agreed to the year-round minimum flows proposed by staff in the DEIS (see below).

[c] MDEP also recommends additional spillage flows of 50 cfs in the Dundee bypassed reach and 100 cfs in the Gambo bypassed reach whenever water temperatures exceed 22 degrees C, and year-round leakage minimum flows of 26 cfs at Little Falls and 13 cfs at Saccarappa.

The MASC generally agrees with the FWS minimum flow recommendations, but also recommends that appropriate bypassed reach flows be determined for Atlantic salmon spawning, egg incubation, and juvenile rearing. The MDIFW also recommends that S.D. Warren assess the timing and magnitude of minimum flows to determine effects on fish stranding and flushing. The MDIFW further recommends that S.D. Warren make timed deepwater releases from Dundee impoundment, to provide seasonally cooler water to the Dundee bypassed reach. S.D. Warren stated its opposition to all three of these state agency recommendations.

Table 14 indicates that there is general agreement on minimum flows for May through September at the Dundee and Mallison Falls projects, but disagreement on fall, winter, and early spring flows, plus the minimum flows at the Gambo Project. FWS is proposing to maximize habitat year-round, while S.D. Warren and the MDIFW are proposing to maximize habitat during the trout fishing season, with lower during the remainder of the year.[20]

Our Analysis

With general agreement among S.D. Warren, the MDIFW, the FWS, and MDEP on minimum flows for the May through September period (except at the Gambo Project), the focus of our analysis was to determine appropriate minimum flows at Gambo, and for the October through April period at Dundee and Mallison Falls.

S.D. Warren's initial flow proposal included 20-cfs minimum flows through the winter period at Dundee and Mallison Falls, and 30 cfs at Gambo. We assume that this proposal was based on the results of the minimum flow studies and interpolation of the results of the studies. The overall results of the minimum flow studies are summarized in table 15. Because the MDEP uses the aquatic life criteria of 75 percent of full bank flow for their minimum flow recommendations, table 16 includes a summary of the estimated wetted width data collected during the minimum flow studies.[21]

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[20] The MDEP also recommends maximize habitat year-round at the Gambo Project, but seasonally lower flows at the Dundee and Mallison Falls projects.

[21] Field data collected by KA do not directly equate to the MDEP analysis conducted to produce the flow recommendations shown in table 14. The MDEP analysis indicates higher flows to achieve the 75-percent wetted width criteria than do the field estimates shown in table 16. We, however, used the field data because they are based on observed conditions at measured flow releases, while it is not entirely clear how the MDEP wetted width data were derived.

Table 15. Results of flow demonstration studies conducted in the Dundee, Gambo, and Mallison Falls bypassed reaches (Source: KA, 1998c).

Project	Study flow (cfs)	Brown trout WUA (sq. feet)	Percent of max. WUA	Brook trout WUA (sq. feet)	Percent of max. WUA
Dundee	5[a]	10,186	32.6	16,593	47.7
	30	26,333	84.3	32,713	94.0
	57	31,248	100.0	34,793	100.0
Gambo	41[a]	7,370	100.0	9,736	100.0
	60	6,346	86.1	9,366	96.2
Mallison Falls	3[a]	227	3.0	346	3.0
	25	4,132	54.4	6,331	55.1
	63	7,597	100.0	11,488	100.0

[a] The lowest flow studied at each project was the existing leakage.

Table 16. Average wetted width at study transects, as estimated in the field (Source: KA, 1998c).

Project	Study flow	Percent wetted[a]
Dundee	5	62.5
	30	87.3
	57	96.8
Gambo	41	78.3
	60	86.8
Mallison Falls	3	55.0
	25	92.3
	63	98.7

[a] Average wetted width among all study transects at each site. Four transects were established at Dundee and Gambo, and three were established at Mallison Falls.

The study results indicate that for the Dundee bypassed reach, which is the longest and has the most diverse habitat of the three studied reaches, habitat value increases rapidly from the leakage flow of 5 cfs up to the intermediate flow of 30 cfs. Even the leakage flow, however, has fair habitat value, providing from 32 to 47 percent of the maximum WUA observed (for the two species of trout), and a wetted width of 62 percent. The highest flow studied (57 cfs) shows the best habitat value, although WUA increases by only 6 to 16 percent (for the two evaluation species), and wetted width by only about 10 percent, from a 30-cfs flow. Because only three flows were assessed in this study, the habitat value for other flow levels can only be estimated by straight line interpolation between the three studied flows. Table 17 provides the results of interpolation of the Dundee study results at flows ranging from 5 to 30 cfs.

Based on table 17, S.D. Warren's earlier proposal to provide 20 cfs at Dundee during most months would provide an estimated WUA of 19,874 square feet for brown trout and 26,265 square feet for brook trout. These equate to about 64 and 76 percent of the maximum WUA, respectively. A 20-cfs flow would also provide a wetted channel width of about 77 percent. These data indicate that 20 cfs would provide a reasonable level of habitat over the winter and early spring months, when the number of holdover trout would likely be lower than during the peak of the fishing season, when higher numbers of stocked fish would be present. This would also appear to meet MDEP's criteria that 75 percent of the cross-sectional area of a river channel must be wetted. Flows lower than 20 cfs would also provide fair habitat value, although it would be more appropriate to provide a higher level of protection/enhancement in the Dundee bypassed reach because it is the longest and most diverse of the studied reaches, and would have the best potential for providing a high-quality put-and-take trout fishery.

Thus, based on our analysis of aquatic habitat, we originally concluded that a minimum bypassed reach flow of 20 cfs would provide adequate protection of aquatic habitat during the winter months, while flows that would provide higher or maximum habitat value would be appropriate during the trout fishing season. Such a flow regime for the Dundee bypassed reach would adopt some of the flows recommended by the agencies and S.D. Warren, as well as flows based on our analysis described above. A summary of this flow regime is as follows:

- January through March: 20 cfs
- April: 30 cfs
- May through September: 57 cfs
- October: 30 cfs
- November/December: 20 cfs.

The November through March flows are based on our analysis described above; the April and October flows are consistent with the recommendations of the MDIFW; while the May through September flows are consistent with the recommendations of Interior, the MDIFW, MDEP, and S.D. Warren (see table 14).

Table 17. Interpolated and field-derived WUA and wetted width estimates for the Dundee bypassed reach (Source: Staff, based on data from KA, 1998c).

Flows	Brown trout WUA (sq. feet)	Percent of max. WUA	Brook trout WUA (sq. feet)	Percent of max. WUA	Percent wetted
5	10,186	32.6	16,593	47.7	62.5
10[a]	13,415	42.9	19,817	57.0	67.5
15[a]	16,645	53.3	23,041	66.2	72.4
20[a]	19,874	63.6	26,265	75.5	77.4
25[a]	23,104	73.9	29,489	84.8	82.3
30	26,333	84.3	32,713	94.0	87.3

[a] Interpolated flows.

Section 10(j) Negotiations

Because staff's initial minimum flow recommendations, included in the DEIS (described above), did not fully adopt those of the FWS, Commission staff and FWS staff met in Portland, Maine, on February 19, 2002, pursuant to Section 10(j) of the FPA, to discuss and resolve the proposed minimum flows for the Dundee, Gambo, and Mallison Falls projects. Others in attendance at the meeting included: MDEP, MDIFW, MDMR, MASC, MSPO, Friends of the Presumpscot River (FOPR), Friends of Sebago Lake, the Casco Bay Estuary Project (CBEP), American Rivers, and Kleinschmidt, representing the licensee, S.D. Warren. Approximately one week before the meeting, the MDEP presented its final recommended minimum flows to S.D. Warren, for the five Presumpscot River projects (letter from Dana Paul Murch, Dams & Hydro Supervisor,

MDEP, to Thomas P. Howard, Project Engineer, S.D. Warren, February 11, 2002). A copy of this letter was also provided to Commission staff, other state and federal agencies, and at least one intervenor (FOPR).

The MDEP recommendation was a major discussion point in the meeting, with MDEP explaining the basis for their recommendation. The MDEP indicated that it would be sending Commission staff copies of reports and the analysis that were used to develop their recommendations (this information was sent on April 1, 2002, and was considered by staff in its final analysis). The MDEP also indicated that it intended to meet with S.D. Warren regarding these recommendations, and that, depending on any negotiations with S.D. Warren, the minimum flows to be required by MDEP in the WQC may be different than those now recommended.

The FWS reiterated its recommendation for higher year-round minimum flows to support a year-round trout fishery to be established by the MDIFW. FWS also suggested that additional instream flow studies may be needed to determine minimum flow needs for species that were not considered during the earlier flow studies, but that are now proposed for reintroduction to the Presumpscot River (anadromous species). Staff questioned whether FWS could agree to interim minimum flows, as part of any license order, with a license requirement to conduct additional studies and to modify the flows, once the additional species are reintroduced to the specific project reaches. FWS staff indicated that such a scenario may be acceptable, assuming that future studies and flows are tied to specific measurable events. The FWS and Commission staff, however, did not agree on specific interim flow releases.

Staff's Final Analysis

Staff has reconsidered its previous minimum flow recommendations at Dundee, as a result of comments on the DEIS, discussions during the 10(j) meeting, and the MDEP minimum flow recommendations. Although we understand that MDEP may require minimum flows that may be different from those recommended by staff, if it issues WQC for the projects, we present our recommendations based on our analysis of the information available at this time.

We previously recommended seasonal minimum flows in the bypassed reach, assuming a seasonal stocked-trout fishery. The MDIFW has stated that natural reproduction of trout within the Presumpscot River bypassed reaches is unlikely and is not a management objective (letter from Steven A. Timpano, Environmental Coordinator, MDIFW, Augusta, ME, January 29, 2001). The most recent Draft Fishery Management Plan, issued in December 2001 (Wippelhauser et al., 2001), also identifies

the objective of providing a fishery for stocked trout within the project bypassed reaches. Under the staff-recommended flows, habitat value would be maximized during the trout fishing season (May through September), but would be maintained at lower levels during the fall-winter, and early-spring periods, to protect any over-wintering trout that may have survived the sport fishery, and macroinvertebrate production. Both the FWS and MDIFW commented that the staff recommendations do not consider the potential requirements of a potential year-round fishery, that the MDIFW has indicated would be implemented once adequate instream flows are established, adequate angler access is provided, and adequate stocking access is developed. The MDIFW, however, did not propose specific flow releases for the entire over-winter period.

Although it is the MDIFW's objective to provide a year-round fishery in the future, it appears that obstacles related to public access and stocking access may still need to be overcome before this becomes a reality. In addition, neither FWS nor MDIFW have presented any specific data to indicate that minimum flows of 20 cfs, over the winter period, would not support any winter fishery that may develop in the reach. Based on the applicant's instream flow study, a flow of 20 cfs would still provide about 70 percent of the maximum WUA for adult brook and brown trout, and about 77 percent wetted area on the transects surveyed in the study. The ratio of staff-proposed winter to summer flows (20 cfs/57 cfs) is 35 percent, which is slightly higher than the winter/summer ratio at the upstream Eel Weir Project bypassed reach (33 percent or 25 cfs/75 cfs), which the MDIFW has characterized as a "good" winter fishery, with 34 percent of the annual effort recorded between November 1 and March 31. A flow of 25 cfs has apparently provided sufficient habitat and wetted area to support the successful winter fishery at Eel Weir. The MDEP, in its recommendations of February 11, 2002, also recommends seasonal flows, although at a higher level (40 cfs) than proposed by staff.

Staff has not seen any new information since the DEIS was issued, that would indicate it's proposed flows would not adequately protect aquatic habitat in the Dundee bypassed reach. We conclude that our recommended flows should be implemented, with the added requirement that additional flow studies be conducted, and adjustments in flows made, as necessary, should specific triggering events occur (such as development of a major winter fishery, or introduction of anadromous species to the reach). Our recommended flow regime would also be more cost-effective to implement than any of the agency-recommended flows, compared to the potential value of a fishery that might be established. Both the FWS and MDIFW present estimates of the potential value of future bypassed reach fisheries (letter from Lee E. Perry, Commissioner, MDIFW, to David P. Boergers, Secretary, FERC, November 26, 2001; letter from Michael J. Bartlett, Supervisor, New England Field Office, FWS, to David P. Boergers, Secretary, FERC,

December 6, 2001).[22] The FWS estimates that fisheries in the three bypassed reaches (Dundee, Gambo, and Mallison Falls), with a total length of 2,050 ft (about 38 percent of the length of the Eel Weir bypassed reach), would have an annual economic benefit of about $30,000 (the annual economic benefit of the Eel Weir fishery has been estimated to be $100,000). We estimate, based on the Dundee bypassed reach length of 1,075 ft (about half of the total length of the three reaches), that a Dundee fishery may be worth about $15,000 annually.

The effects of minimum flows in the Dundee bypassed reach on project generation and economics, however, are addressed in section 5, *Developmental Analysis,* and our final recommendations are summarized in section 6.1, *Comprehensive Development and Recommended Alternative.*

Gambo Project

Staff's Initial Analysis

The Gambo bypassed reach is the shortest reach proposed for minimum flow enhancement, and is also the reach that receives the highest level of leakage from the dam. During the minimum flow studies (KA, 1998c), the lowest flow studied was a leakage flow of 41 cfs, which also had the highest habitat value (for WUA), compared to the other flow investigated (60 cfs; table 15). Flows of 60 cfs and above likely cause excessive turbulence and higher velocities, reducing the habitat value.

No other flows were investigated as part of this study. Therefore, we cannot interpolate habitat values at flows less than 41 cfs. However, lower flows would likely have fair to good habitat value, although this value cannot be quantified. It is also not known whether S.D. Warren would be able to significantly reduce the leakage to a lower "controlled" flow. S.D. Warren's initial flow proposal was for a flow of 30 cfs during most months, but later this proposal was amended to a flow of 33 cfs for May through November, indicating that additional flow control may be possible.

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[22] The FWS and MDIFW letters are not consistent in how they estimate the value of the fishery. For our analysis, however, we will use the maximum value estimated by the two agencies. Thus, we use the FWS estimate for the Dundee bypassed reach, and the MDIFW estimate for the value of the Gambo and Mallison Falls bypassed reaches.

Because the studied flow of 41 cfs provided the best habitat value (maximum WUA for brook and brown trout), we agree with the FWS and MDIFW that this flow should be provided during the trout fishing season (April through October). We also agree that a minimum flow should be provided during the winter months. As noted for Dundee, however, maximum habitat value would not be necessary during the winter months, because fewer holdover trout would likely be present, and a somewhat lower flow would likely protect aquatic habitat and macroinvertebrate production.

Because no quantitative data are available for flows less than 41 cfs, we can only generally estimate the habitat value of lower flows. A minimum flow of 30 cfs was earlier proposed by S.D. Warren for the winter months, as part of its flow proposal in the license application. This flow is 75 percent of the studied flow that provided the best habitat value (41 cfs), and likely would provide relatively good habitat value for the over-winter period. Flows lower than 30 cfs may also provide fair habitat value for the winter months, but it is unclear whether S.D. Warren would be able to reduce the leakage flow to less than 30 cfs.[23] Therefore, we initially concluded that the following minimum flows would provide adequate protection of aquatic habitat in the Gambo bypassed reach:

- November through March: 30 cfs
- April though October: 40 cfs

These recommended flows are consistent with FWS and MDIFW recommendations for April through October, and are consistent with MDIFW's recommendation for some level of flow protection over the winter months (table 14).

Section 10(j) Negotiations

Staff's previous minimum flow recommendation was the same as FWS for the period of April through October (40 cfs), but we recommended 30 cfs for the November through March period. This again was based on the assumption, as described above, that lower flows would be adequate for the over-winter period. We, however, have no instream flow data at a flow of 30 cfs, because the lowest flow studied (due to excess leakage) during the applicant's field investigation was 41 cfs. We had assumed that since 41 cfs provided 100 percent of the maximum WUA for brook and brown trout, that 75 percent of that flow (30 cfs) would provide adequate over-winter habitat.

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[23] During the flow study, leakage could not be reduced to less than 41 cfs.

MDEP's recent flow recommendation was for a year-round flow of 60 cfs. According to MDEP, this recommendation is based on the aquatic life standard, and would represent about 60 percent of bank full conditions. MDEP indicates that 75 percent of bank full conditions (which is the criteria normally recommended by MDEP) would be 80 cfs, but that level of flow would provide less than optimal conditions for salmonids because of high velocities. Based on the applicant's instream flow studies, WUA for trout is maximized at a flow of 41 cfs, and is 86 percent of maximum at 60 cfs, indicating that higher velocities and turbulence would likely reduce habitat suitability at higher flow levels (as MDEP indicated).

Staff's Final Analysis

Although staff does not agree with the MDEP recommendation for Gambo (because 60 cfs would reduce the amount of suitable habitat for trout), in deference to the year-round recommendations of MDEP and FWS, and since no instream flow data are available at 30 cfs, we are now recommending a year-round minimum flow in the Gambo bypassed reach of 40 cfs. As previously noted, this would provide 100 percent of the WUA for trout, and would not be significantly more costly than the previous staff recommendation. As for Dundee, we also recommend that additional flow studies be conducted, with the possibility for adjustment of the flows, should specific triggering events occur.

The MDIFW estimated that the potential value of bypassed reach fisheries at Little Falls[24] and Mallison Falls would be $20,000 annually (letter from Lee E. Perry, Commissioner, MDIFW, to David P. Boergers, Secretary, FERC, November 26, 2001). Prorating according to the length of the Gambo bypassed reach (300 ft), we estimate that the value of a fishery in the reach would be about $6,150 annually.

The effects of minimum flows in the Gambo bypassed reach on project generation and economics are addressed in section 5, *Developmental Analysis,* and our final recommendations are summarized in section 6.1, *Comprehensive Development and Recommended Alternative.*

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[24] The MDIFW has not previously proposed a fishery in the Little Falls bypassed reach, so we assume that the MDIFW letter may have intended to address the Gambo bypassed reach fishery. In any event, since the Little Falls and Gambo bypassed reaches are about the same length (300 ft), we assume the value derived for Little Falls would also apply to Gambo.

The Mallison Falls bypassed reach is the second longest of the study reaches, at more than twice the length of the Gambo reach. Three flow levels were assessed during the flow demonstration studies (KA, 1998c), and the habitat value of three additional flows was assessed based on straight line interpolation of the data. Table 18 provides a summary of both field-derived and interpolated habitat data for the Mallison Falls bypassed reach.

Table 18. Interpolated and field-derived WUA and wetted width estimates for the Mallison Falls bypassed reach (Source: Staff, based on data from KA, 1998c).

Flows	Brown trout WUA (sq. feet)	Percent of max. WUA	Brook trout WUA (sq. feet)	Percent of max. WUA	Percent wetted
3	227	3.0	346	3.0	55.0
15[a]	2,357	31.0	3,611	31.4	75.3
20[a]	3,245	42.7	4,971	43.3	83.8
25	4,132	54.4	6,331	55.1	92.3
40[a]	5,500	72.4	8,367	72.8	94.8
63	7,597	100.0	11,488	100.0	98.7

[a] Interpolated flows.

The Mallison Falls data indicate that there is minimal habitat value at the leakage flow of 3 cfs, although more than half of the stream channel is wetted. The MDEP's criteria of 75 percent wetted area appears to be met at a flow of 15 cfs, but the WUA remains relatively low at only 31 percent of the maximum WUA. A flow of 20 cfs (proposed earlier by S.D. Warren) provides about 43 percent of the maximum WUA and 84 percent wetted area, while 25 cfs provides about 55 percent of the maximum WUA and 92 percent wetted area. A flow of 40 cfs (proposed by the MDIFW for some months) would provide more WUA (about 73 percent of the maximum WUA), but only about 3 percent more wetted area than a flow of 25 cfs.

As described for Dundee and Gambo, high or maximum habitat (WUA) would not be necessary in the winter because fewer fish would likely be present than during the fishing season. Relatively high wetted width would be important, however, to protect macroinvertebrate populations. We initially concluded that the over-winter flow with the best combination of fair WUA value and relatively high wetted width would be 20 cfs. Thus, the following seasonal minimum flows would provide adequate protection of aquatic habitat in the Mallison Falls bypassed reach:

- January through March: 20 cfs
- April: 40 cfs
- May through September: 60 cfs
- October: 40 cfs
- November/December: 20 cfs.

The November through March flows are based on our analysis described above, the April and October flows are consistent with the recommendations of the MDIFW, while the May through September flows are consistent with the recommendations of FWS, MDIFW, and MDEP, and slightly higher than flows proposed by S.D. Warren (see table 14). The November through March flows would provide about 40 percent more WUA than the baseline leakage flow and about 29 percent more wetted area. The April through October flows would provide from 70 to 97 percent more WUA and about 44 percent more wetted area than leakage.

Section 10(j) Negotiations

We previously recommended seasonal flows in the bypassed reach, to maximize the habitat during the open-water fishing season, and to provide adequate over-winter flows for protection of aquatic habitat and any holdover trout. As noted for the other projects, both FWS and MDIFW commented that the staff-proposed flows did not consider a potential over-winter fishery that MDIFW is now proposing. In addition, the MDEP flow recommendations of February 11, 2002, although also recommending seasonal flows, recommends higher flows during the over-winter period (40 cfs), compared to staff (20 cfs). FWS is still recommending flows to provide maximum habitat value year-round.

The flow previously recommended by staff for the period of November through March was 20 cfs. This would provide only about 43 percent of the maximum WUA for trout and about 84 percent wetted area. This flow would provide less over-winter trout habitat than that proposed for Dundee (70 percent of the maximum WUA) and Gambo (100 percent of the maximum WUA).

Staff's Final Analysis

To be consistent with the flow recommendations at the other projects, in consideration that the Mallison Falls bypassed reach is the second longest of the three projects, and in deference to the recommendations of MDEP and FWS, staff is now recommending, for the months of November through March, a minimum flow of 40 cfs. This flow would provide about 73 percent of the maximum WUA (similar to Dundee) and about 95 percent wetted area. As recommended for the other projects, additional flow studies should be required, with the possibility for adjustment of the flows, should specific triggering events occur.

Using the MDIFW letter as the basis, we estimate, based on the length of the bypassed reach (675 ft), that the potential value of a fishery would be about $13,850 annually. This estimate is similar to the cost of providing our recommended minimum flows in this reach.

The effects of minimum flows in the Mallison Falls bypassed reach on project generation and economics are addressed in section 5, *Developmental Analysis,* and our final recommendations are summarized in section 6.1, *Comprehensive Development and Recommended Alternative.*

Minimum Flow Studies for Atlantic Salmon

The MASC recommended, in a letter dated January 31, 2001, that S.D. Warren conduct a study, in consultation with the MASC, to determine appropriate bypassed reach flows for Atlantic salmon spawning, egg incubation, and juvenile rearing. The MASC stated, however, that this requirement would be contingent upon the MASC conducting a habitat assessment of the Presumpscot River and making a decision to initiate Atlantic salmon restoration in the river.

S.D. Warren responded, in its letter dated April 18, 2001, that this is a new request by the MASC, which did not recommend such a study during the earlier consultations on the minimum flow studies. S.D. Warren further states that it does not intend to conduct further minimum flow studies, but that information included in the studies conducted to date (KA, 1997; 1998c) could be used by the MASC to evaluate potential salmon habitat in the bypassed reaches.

In its comment letter on the DEIS (letter from Norman R. Dube', Fisheries Scientist, MASC, to David P. Boergers, Secretary, FERC, November 27, 2001), MASC stated that they were not consulted, nor did they participate in the previous instream flow

studies. They, however, indicate that they support the year-round minimum flows recommended by FWS, in that these flows would adequately protect the life stages of Atlantic salmon that would utilize the bypassed reaches.

We previously discussed that it would be premature to require a study of minimum flow needs for Atlantic salmon and other anadromous species, until they are introduced to the bypassed reaches. We have, however, also recommended minimum flows that are closer to the flows recommended by FWS, and that additional instream flow studies be conducted, with the possibility for adjustment of the flows, should specific triggering events occur. These events would include the reintroduction of anadromous species to the specific reaches. We conclude that these provisions would adequately provide for any future instream flow requirements for Atlantic salmon, should they be different than the minimum flows required by any new license.

Fish Stranding

The MDIFW requested, in its letter dated January 29, 2001, that studies be conducted at the five projects to assess the timing and magnitude of flow releases to minimize fish stranding and flushing from the reaches (during high flows).

S.D. Warren responded, in its letter dated April 18, 2001, that this is a new request by the MDIFW, which did not recommend such a study during earlier consultation on the minimum flow studies. S.D. Warren notes that the inflows to the projects are mostly determined by the Sebago Lake LLMP, and that the MDIFW participated in its development. The LLMP is so restrictive that spillage flows do occur more frequently from the lake than in previous operations, resulting in a higher frequency of spills at the five projects. S.D. Warren reports that only the Gambo Project has a small, manually operated gate that may divert flows from the bypassed reach, while the other projects, where minimum flows are recommended, do not have such gates. S.D. Warren indicates that it would use the Gambo canal gate to its capacity for routing spillway water around the bypassed reach, but notes that some flows would exceed the gate's capacity and would still be spilled into the bypassed reach.

Normal continuous minimum flows into the bypassed reaches would not change significantly over short periods of time; therefore, the potential for stranding or flushing is small during minimum flow periods. During spillage conditions, S.D. Warren would have little flow control capabilities that could significantly modify the timing and magnitude of flows. We agree, however, that S.D. Warren should include in any flow monitoring plans for the projects (see section 4.3.1.2, *Water Resources*), a provision to monitor the timing and magnitude of spillage events, along with limited observations in

the bypassed reaches, to determine the potential for stranding and flushing of fishes. If monitoring indicates that a potential problem exists, additional consultation with the agencies would be required to determine any potential corrective actions. We anticipate that any observations of the bypassed reaches would be limited in nature, to verify that concentrations of stranded fish are not present after the cessation of high spill events. We are not recommending extensive follow-up studies.

Deepwater Releases from Dundee Dam

The MDIFW recommends in its letter dated January 29, 2001, that S.D. Warren make timed deepwater releases from Dundee dam seasonally to provide cooler water to the Dundee bypassed reach, to benefit the coldwater fishery.

S.D. Warren states in its reply comments, dated April 18, 2001, that it opposes deepwater releases because water temperature data indicate that Dundee Pond does not stratify (there is no cold water hypolimnion), and the deep gates on Dundee dam are not designed for continuous operations. S.D. Warren states that the gates are typically only used for occasional maintenance activities that require complete pond drawdowns, and continuous operations would require more frequent complete drawdown of Dundee Pond to remove the debris that may clog the gates.

We agree with S.D. Warren. Water temperature data provide no evidence that Dundee Pond stratifies to the point where a large pool of cold, hypolimnetic water would be available for releases downstream. During sampling in late-June 1997, there was a temperature gradient of 8.5 degrees C from surface to bottom, although the cooler water (more than 2 degrees cooler than the surface waters) only occurs in the lower 4 meters of the 12-meter-deep water column. There was also a DO gradient of 2.6 mg/L from surface to bottom, with the lowest readings also confined to the lower 4 meters of the water column. The temperature and DO gradients, however, appeared to weaken through the summer, with a temperature gradient of only about 1.5 to 2.0 degrees C and a DO gradient of 0.9 to 1.8 mg/L through July and August.

These data indicate that the water column exhibits weak stratification in early summer, although it is generally well-mixed during the mid- and late-summer months. Mid-summer is the time period when lake stratification is typically the strongest in temperate zone lakes (Ruttner, 1973). Dundee Pond probably does not stratify because the releases from Sebago Lake result in relatively high inflow to Dundee Pond through the summer (the July 90-percent exceedance flow into Dundee is about 300 cfs; the July 50-percent exceedance flow is 423 cfs). Although Dundee Pond is the largest of the five

impoundments, it is only 1.7 miles long, with an area of 197 acres and negligible storage capacity (S.D. Warren, 1999a).

Based on annual flow data from the USGS gage at the outlet of Sebago Lake (USGS No. 01064000), 1997 was a "typical" year, with an average annual flow of 731 cfs, only slightly higher than the period of record average annual flow of 640 cfs.[25] These data indicate that the 1997 data are likely typical of summer conditions in Dundee Pond, and that it appears unlikely that extended deepwater releases could be made that would benefit the proposed downstream trout fishery. Even if a small pool of cooler water were to be available in early summer, it would likely be quickly depleted by any continuous release.[26] In addition, there would be technical problems associated with the operation of the deep gates at Dundee dam. The expense of any potential technical solution may outweigh any brief benefits from a short period of cooler water releases. We conclude that deepwater releases from Dundee dam would not provide any meaningful benefit and are not warranted.

Passage of American Eel

The five projects may affect both upstream and downstream eel migrations. The projects represent potential barriers or delaying factors to upstream migration of elvers and young yellow-stage eels. The projects also cause an undetermined level of turbine mortality on yellow-stage eels and downstream migrating silver eels.

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[25] Average annual flows for the period of record (1902 to present) range from 242 cfs (1985) to 1,056 cfs (1952).

[26] We estimate that Dundee Pond may have a total storage capacity of about 5,300 acre-feet (197 acres times an estimated average depth of 27 feet [S.D. Warren reports the depth as ranging from 10 to 44 feet]). If we estimate that the pool of cooler water were to occupy the lower one-third of the reservoir volume (based on the temperature data), about 1,750 acre-feet of cooler water would be available (it would actually be less because the deeper zone of the reservoir occupies less area than the shallow zones). If this pool of cooler water was to be entirely drafted from the reservoir (which is unlikely because of reservoir level restrictions), a continuous minimum flow of 57 cfs (only using this pool of cooler water) would deplete this pool within 15 days (but would also draw down the reservoir by at least 9 feet).

Upstream Eel Passage

Currently there are no upstream eel passage facilities at any of the five project dams. S.D. Warren proposes to provide upstream eel passage at the Dundee Project. S.D. Warren assessed the need for upstream eel passage at the remaining four projects and concluded that additional measures to facilitate upstream eel passage were not warranted (KA, 2000; letter from Nancy J. Skancke, GKRSE, to Magalie Roman Salas, Secretary, FERC, April 11, 2002).

The FWS, on February 5, 2002, submitted its final fishway prescription for the five projects, including prescriptions for the upstream passage of American eel. The FWS prescribes the installation of separate upstream passage facilities for American eel at each of the five projects.

The MDMR, MDIFW, and MASC, in their December 2001 "Draft Fishery Management Plan for the Presumpscot River Drainage" (Wippelhauser et al., 2001), also call for the construction of separate upstream eel passage facilities, within two years after issuance of any new licenses.

While research on American eel has been conducted for decades, there are little data available on the exact habitat requirements, behavior, and migratory patterns of this panmictic species.[27] In the past 10 years there has been increased focus on American eel for two main reasons: (1) significant declines in elver recruitment to the St. Lawrence and other rivers along the eastern United States (Castonguay et al., 1994a, 1994b; Lary et al., 1998; Haro et al., 2000); and (2) large increases in demand for all eel stages (except for the leptocephalus stage) as growout stock for aquaculture, food, or bait (CAEMM, 1996).

The factors most often cited for the decline in populations include anthropogenic effects such as loss of available habitat from the construction of dams, entrainment or impingement at hydroelectric facilities, water quality or toxicity issues, fishing pressure, commercial harvesting of sargassum (affecting larval populations), oceanographic influences such as changes in Gulf Stream current patterns or other climatic changes.

The data set available for eel collections or harvest on the Presumpscot River is insufficient to determine whether there have been significant decreases in glass eel and

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[27] Panmictic species are widely distributed species in which random spawning occurs throughout the population, resulting in complete mixing of the gene pool.

elver recruitment similar to these found by other researchers. There is, however, discernable evidence of upstream migration delays caused by hydroelectric dams.

Results from the 1997 baseline fisheries study indicated that CPUE values for the Dundee impoundment were much lower than the next lowest CPUE (5.5 eels per hour in Dundee compared to 15.3 eels per hour in the Gambo impoundment). S.D. Warren, cites this difference in CPUE as evidence of potential migratory delay at Dundee dam, which is the tallest of the five projects dams. Total length data collected during the eel study indicate that elvers are able to access the tailrace area of each of the five projects, up to the base of Dundee dam (minimum sizes ranged from 2.8 to 3.7 inches). Sampling was not conducted, however, at the base of the North Gorham Project, upstream of the Dundee impoundment, to determine the presence of elvers at that dam.

The success rate of upstream migration over or past dams without fishways is unknown. Factors such as dam height, roughness of the spillway material, angle of the spillway surface, flashboard height, flow levels and potential pathways around the dam are all confounding factors in determining percent success rates for migrating elvers and yellow eels.

Several hundred eels were observed at the base of the five project dams during the upstream eel migration study (KA, 2000), during a total of 12, 45-minute night-time counts. Nine of these eels were confirmed migrating over the Saccarappa dam, although it is unlikely that all possible passage routes were observed by the investigators at all the projects. A study of a pipe style upstream eel passage device by Mitchell (1985, as cited in Clay, 1995) found that 150 eels per hour were passing out of the pipe and over the dam. Intuitively, this suggests much higher success rates for eels using upstream eel passage compared to unaided eels. Two other studies examining upstream passage efficiency variously describe upstream migration success as 57 percent (Dumont et al., 2000) and 85 to 90 percent (Verdon, 1998). Review of these studies suggests that overlapping size class ranges between year classes and sexes, multiple year migrations, and extended residency times all complicate the process of estimating passage efficiency.

Based on the information presented above, we conclude that, although some eels are successfully migrating upstream over the project dams, the lack of eel passage facilities at the dams is likely limiting the upstream movement of eels, at a time when fishery management agencies are making significant commitments to protecting and restoring the species. Providing upstream passage at each dam would increase access and provide American eels an additional 12.2 miles of river (North Gorham dam tailrace to the tailrace of Saccarappa dam). Tributaries such as the Pleasant River, Black Brook, Colley Wright Brook, the Little River, and Inkhorn Brook would also be made more

accessible to eels. Haro et al. (2000) states that in the case of hydroelectric dams, the benefit of upstream eel passage must be weighed against the cost of turbine mortality when eels later migrate downstream. Haro et al. (2000), however, further states that the increase in production by simply moving eels into underutilized habitats upstream of barriers may outweigh decreases in reproductive contribution caused by turbine mortality.

Although some eels would be lost to turbine entrainment, we conclude that installation of upstream eel passage at all five facilities would provide a net benefit to the American eel, due to the increased access to upstream habitats. S.D. Warren has stated its continuing objection to a requirement for upstream eel passage at the lower four project dams (letter from Nancy J. Skancke, GKRSE, to Magalie Roman Salas, Secretary, FERC, April 11, 2002). Upstream eel passage facilities recommended by staff, however, are relatively low cost facilities that would likely benefit the eel population. Because installation of upstream eel passage facilities would affect the economics of the projects, we address the costs in section 5, *Developmental Analysis*, and make our final recommendation in section 6.1, *Comprehensive Development and Recommended Alternative*.

Downstream Eel Protection and Passage

S.D. Warren proposes two enhancements to benefit downstream migrating American eels: (1) suspending generation for four hours per night during four, one-week periods (generally between the end of August and the end of October), to promote safe downstream passage of silver life stage eels; and (2) conducting a 3-year downstream monitoring study to determine peak seasonal and daily timing of downstream eel migration.

The FWS, on February 5, 2002, submitted its final fishway prescription for the five projects, including prescriptions for the downstream passage of American eel. The FWS prescribed generation shutdowns for 8 hours per night, from September 1 through October 31, to allow downstream migration of American eels. They also prescribe a 3-year monitoring study to evaluate the effectiveness of the shutdowns. The MDMR, MDIFW, and MASC agree with the FWS prescription for downstream passage of eels (Wippelhauser et al., 2001). Finally, American Rivers and the FOPR, in a letter dated February 2, 2001, state that S.D. Warren should facilitate downstream eel passage.

Turbine mortality generally increases as total length of eels increases. This is a potential major adverse effect on eels because of their size when they migrate downstream past hydroelectric facilities. Mortality studies on European eel indicate

injury rates from turbine passage as high as 15 to 50 percent. In the case of large eels (greater than 27 inches), mortality ranged from 40 to 100 percent (McGrath, 2000; ASMFC, 2000; Haro et al., 2000; Berg, 1986 as cited in Haro et al., 2000; Monten, 1985 as cited in Haro et al., 2000). At other hydropower sites in North America, American eel turbine mortality estimates range from 6 to 37 percent (table 19).

Table 19. Summary of results of turbine mortality studies at various North American hydropower projects (Source: Staff).

	Minetto dam	Luray dam	Beauharnois dam	Beauharnois dam	Raymondville dam
Location	New York	Virginia	Quebec	Quebec	New York
River name	Oswego	Shenandoah	St. Lawrence	St. Lawrence	Raquette
Type of turbine	Francis	Francis	Francis	Propeller	Propeller
Hydraulic head	17.5	16	79	79	21.5
Approximate 48-hr eel mortality (percent)	6	9	16	24	37
Reference	NMPC, 1995a	Allegheny Power Service Corporation, 1995	Richard Verdon, Hydro Quebec, personal communica-tion	Richard Verdon, Hydro Quebec, personal communica-tion	NMPC,1995b

The Presumpscot River projects have Francis turbines and hydraulic heads ranging from 14 to 52 feet. Turbine mortality at the Presumpscot River projects may be similar to mortality estimates from the projects with the same turbine type (i.e., Minetto, Luray, and Beauharnois), which range from 6 to 16 percent, with an apparent increase in

mortality with increased head. However, mortality rates would also depend on turbine size, with smaller turbines increasing the potential for blade strike on the adult eels. The units on the Presumpscot River are smaller than at some of the projects listed in table 19. Based on this information and on the results of European testing, the mortality rate for eels could also be higher than 6 to 16 percent.

Studies from other hydroelectric projects suggest that delayed mortality rates may be high for American eel. At the Luray/Newport Hydro Project (FERC No. 2425) on the Shenandoah River in Virginia, researchers reported a 1 percent immediate mortality rate for American eels passing through Francis turbines. However, delayed mortality (after 44 hours) was 8 percent (Allegheny Power Service Corporation, 1995). At the Beauharnois Project on the St. Lawrence River, researchers reported that a substantial number of the eels passing through the Francis turbines received internal injuries and the 48-hour mortality rate was 16 percent, with most of the mortality occurring several hours after passage (Richard Verdon, Hydro Quebec, personal communication).

The long-term effects of turbine mortality on outmigrating eels from projects on the Presumpscot River are unknown. Some researchers have suggested that the American eel population is declining, although the cause for the decline in the eel population is unknown (Castonguay et al., 1994a). Castonguay et al. (1994b) investigated oceanographic changes, commercial overfishing, chemical contamination, and habitat modifications (includes hydropower development) as potential causes of the eel decline, but their analysis was inconclusive. Nonetheless, Castonguay et al. (1994a) suggested that increased eel passage survival at hydropower projects would aid in the recovery of the American eel population.

We conclude that providing measures to facilitate downstream migration of eels at the five Presumpscot River projects could improve the survival rate of adults during their spawning migration. Depending on density-dependent effects and compensatory mechanisms experienced by eels during their time in the ocean, increased survival at the projects could also increase the numbers of Presumpscot River eels contributing to the American eel spawning population, and aid in the recovery of the American eel population.

Current data on the migratory patterns of silver eels suggest that the downstream migratory period may encompass two or more months, from the end of August to the end of October (CAEMM, 1996). However, one study on the Saint Lawrence River reported that 80 to 85 percent of all migrants were caught during 10 to 15 days in mid-October, even though the migration period occurred from mid-September to early-November. The MDMR provided data on the timing of eel migrations in its comment letter on the DEIS

(letter from George D. LaPointe, Commissioner, MDMR, to David P. Boergers, Secretary, FERC, November 28, 2000). MDMR presented data from 19 eel weir sites in Maine, which indicate that the eel migration period ranges from 2 to 13 weeks, and averages 8 weeks, generally from late August into early-November. These data also indicate that the migration is often "spotty," not necessarily occurring in consecutive weeks, or in the same weeks from year to year. The duration of the peak of the run (we define as ≥10 percent of the run occurring in one week), however, was generally only three or four weeks (range of from one to five weeks).

The time and duration of night-time migrations are not well understood. Studies on the depth of migration have found a general trend for eels to migrate along the bottom at night during the first quarter of a new moon after a rain storm.[28] These results, however, are not consistent either, as some research has shown that eels will change their position in the water column to avoid obstructions while migrating. Finally, eels may migrate via a variety of avenues past a hydroelectric project (i.e., through the powerhouse, through gates or sluices, and over spillways) on their way downstream. A study in France by Durif et al. (2000) tracked 16 eels using telemetry tags. They observed that most of these eels migrated downstream after a heavy rainfall, avoiding the powerstation by passing an overflow dam.

The final FWS mandatory fishway prescription calls for an 8-hour per night, 8-week generation shutdown for downstream eel passage. Staff, however, does not agree that such a blanket shutdown period would be necessary to protect most of the downstream migrating eels. An 8-week shutdown period as required by FWS would likely protect most of the migrants, but there would also be periods of spillage, of perhaps one or more weeks, when no eels would be present to pass. S.D. Warren clarifies in its comments on the DEIS (letter from Nancy J. Skancke, GRKSE, to Linwood A. Watson, Jr., Acting Secretary, FERC, January 4, 2002), and in its comments on the FWS final fishway prescription (letter from Nancy J. Skancke, GKRSE, to Magalie Roman Salas, Secretary, FERC, April 11, 2002), that its proposed shutdown periods for eel passage would be keyed to any four 7-day periods when peak movement is occurring, not necessarily four consecutive week or bi-weekly periods. The precise timing of the shutdowns would be timed according to the results of their proposed 3-year monitoring study. According to S.D. Warren, they estimate, using the MDMR data, that their proposed timed shutdowns would protect an average of 87 percent of the run.

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[28] Initial research has shown a negative association between migrating eels and light (even as little as 1 candlepower).

MDMR estimated that shutdowns of four consecutive weeks would protect only 43 to 47 percent of the run.

If the S.D. Warren shutdowns could be timed to coincide with the peak of the eel migration, their proposed shutdown schedule (4 hours per night, 7 days in a row, four times per downstream migration season) would likely be adequate to protect downstream migrating eels. The key to the success of the shutdowns, however, would be whether the shutdowns could be timed to coincide with peak eel movement, using "real-time" monitoring. S.D. Warren would need a monitoring program that could successfully detect when peak eel movement is occurring, or is about to occur. This movement depends on a number of environmental variables (river flow, water temperature, light levels, etc.), and predicting when peak movement would occur, could be a difficult task. Thus, the 3-year monitoring study during the shutdowns, to determine the environmental variables that are important for movement, and to develop methodologies for real-time monitoring of eel movement, would be an important part of any measures for protecting downstream eel passage.

We recommend that S.D. Warren conduct the 3-year monitoring program, with these objectives in mind, and that the details of the program be developed in consultation with the resource agencies and other interested stakeholders. The final study plan should be filed for Commission approval.

Properly timed shutdowns represent a significant benefit to downstream eel migrations that would likely result in increased survival of silver eels (and some yellow eels) in the Presumpscot River. Whether this would result in more ocean spawning and increases in elver recruitment is impossible to predict. Our recommended measures, however, are consistent with the fishery management goals of the MDIFW, MDMR, and MASC (Wippelhauser et al., 2001), as well as the Interstate Fishery Management Plan for American Eel (ASMFC, 2000), by protecting existing stocks, increasing habitat accessibility, and helping to maintain balanced populations of anadromous, catadromous, and riverine fish species, consistent with the habitat potential of the Presumpscot River.

We conclude that providing shutdowns for downstream eel passage at all five facilities would benefit the American eel. Because the timing and duration of these shutdowns would affect the generation and economics of the projects, we address the costs in section 5, *Developmental Analysis*, and make our final recommendation in section 6.1, *Comprehensive Development and Recommended Alternative*.

Anadromous Fish Restoration and Passage

Continued operation of the five projects as proposed by S.D. Warren would continue to obstruct the upstream and downstream passage of anadromous species that may gain access to the project reaches, should the downstream Smelt Hill dam be removed and S.D. Warren install fish passage facilities at its non-jurisdictional Cumberland Mills dam. No anadromous species currently have access to the project reaches. As previously noted, there is the high likelihood that Smelt Hill dam will be removed (USACOE, 2001), provided that funding and all regulatory approvals are obtained. S.D. Warren, however, has not proposed fish passage at Cumberland Mills dam. As a result, several of the commenting parties have indicated that they will be seeking action to compel S.D. Warren to install fish passage at Cumberland Mills dam, under Maine state law.

S.D. Warren stated, in earlier comments, that the consulted agencies did not recommend fish passage for anadromous species during pre-filing consultations, and that this issue has been raised only since about the time of the Commission's scoping meetings, held in the project area in August 1999. During scoping, several NGO groups strongly recommended that the Commission consider dam removal or installation of fish passage facilities, to allow restoration of anadromous species to the Presumpscot River. The FWS, the state of Maine resource agencies, American Rivers/FOPR, MCASF/Friends of Sebago Lake, and TU all filed comments and recommended license terms and conditions that similarly state that the Commission should order the removal of the three minor project dams (Saccarappa, Mallison Falls, and Little Falls). Alternatively, most of the parties recommended that the Commission order the installation of fish passage facilities for anadromous species at all five dams. The most recent joint "Draft Fishery Management Plan for the Presumpscot River Drainage," prepared by MDMR, MDIFW, and MASC (Wippelhauser et al., 2001), calls for the construction of fish passage facilities and the restoration of anadromous species to the Presumpscot River, as a major management objective, although does not specifically recommend dam removal. The FWS, by letter dated February 5, 2002, filed its final fishway prescriptions for the Presumpscot River projects, pursuant to Section 18 of the FPA. Table 20 summarizes FWS's final fishway prescriptions, and table 2 in section 3.6, *Fishway Prescription,* presents the FWS design populations for its prescribed fishways.

S.D. Warren reiterated in its letters of April 18, 2001, and January 4, 2002, that it opposes removal of any of its dams (the dam removal alternative is discussed in detail later in this section), and opposes the installation of fish passage facilities for anadromous species, at any of its dams (letter from Nancy J. Skancke, GKRSE, to Magalie Roman Salas, Secretary, FERC, April 11, 2002). S.D. Warren further questions

Table 20. Summary of fish passage facilities included within FWS's final fishway prescription (Source: FWS final fishway prescription dated February 5, 2002).

Project	Upstream passage	Downstream passage	Estimated construction cost	Other features
Saccarappa	Phase 1: [a, b] Single Denil ladder in tailrace, with spillway entrance. Separate eel fishway Phase 2: Second Denil ladder in spillway channel. Convert first Denil ladder to a fish lift.	Phase 1: Install trashracks with 1-in. spacing, with bypass sluiceway. Shutdowns for eels Phase 2: Same	Phase 1: $2.31 million (upstream) $410,000 (downstream) Phase 2: $1.61 million (upstream)	Counting/trapping/ sorting facilities for Denil fishways and fish lift
Mallison Falls	Phase 1: Single Denil ladder in spillway. Separate eel fishway Phase 2: Convert Denil ladder to a fish lift.	Phase 1: Install trashracks with 1-in. spacing, with bypass sluiceway. Shutdowns for eels Phase 2: Same	Phase 1: $1.035 million (upstream) $520,000 (downstream) Phase 2: $830,000 (upstream)	Counting/trapping/ sorting facilities for Denil fishway and fish lift
Little Falls	Phase 1: Single Denil ladder in tailrace, with spillway entrance channel. Separate eel fishway Phase 2: Convert Denil ladder to a fish lift.	Phase 1: Install trashracks with 1-in. spacing, with bypass sluiceway. Shutdowns for eels Phase 2: Same	Phase 1: $1.51 million (upstream) $630,000 (downstream) Phase 2: $1.075 million (upstream)	Counting/trapping/ sorting facilities for Denil fishway and fish lift

Table 20. Summary of fish passage facilities included within FWS's final fishway prescription (Source: FWS final fishway prescription dated February 5, 2002).

Project	Upstream passage	Downstream passage	Estimated construction cost	Other features
Gambo	Phase 1: Separate eel fishway Phase 2: Construct fish lift in spillway	Phase 1: Shutdowns for eels Phase 2: Install trashracks with 1-in. spacing, with bypass sluiceway	Phase 1: $55,000 (upstream) Phase 2: $1.795 million (upstream) $720,000 (downstream)	Counting/trapping/sorting facilities for fish lift
Dundee	Phase 1: Separate eel fishway Phase 2: Construct fish lift in tailrace	Phase 1: Shutdowns for eels Phase 2: Overlay screens on trashracks, with two bypass sluiceways	Phase 1: $130,000 (upstream) Phase 2: $4.2 million (upstream) $780,000 (downstream)	Counting/trapping/sorting facilities for fish lift

[a] FWS is proposing two phases for construction of fish passage facilities. Phase 1 would include construction of eel passage at all projects, and passage for anadromous species at Saccarappa, Mallison Falls, and Little Falls projects. Phase 2, which would include construction of passage facilities for anadromous species at the Gambo and Dundee projects, and upgrading of facilities at the three lower projects, would not occur until the Phase 1 facilities are reaching their design capacity, and the resource agencies decide to proceed with Phase 2.

[b] The actual schedule for construction would be based on the number of anadromous fish returning to the river, except that upstream passage for American eel would be constructed within two years after licensing, and the upstream passage for anadromous fish at Saccarappa would be completed within two years after passage is achieved at the downstream Cumberland Mills dam. Fish passage would be constructed at the upstream projects based on specific trigger numbers (when passage at an existing facility reaches 20 percent of the estimated spawning population that would use the habitat above that facility, construction would be triggered at the next upstream dam). Facility upgrades would occur whenever the design capacity of the Phase 1 facilities are met or exceeded (see table 2).

whether anadromous fish restoration upstream of Cumberland Mills dam is attainable, and states that an investment in fish passage is not justifiable or in the public interest. S.D. Warren also questions the potential anadromous fish production potential for the Presumpscot River, estimated by the agencies, and whether enough suitable habitat remains in the basin, particularly for Atlantic salmon, for restoration to succeed.

Anadromous fish production potential

S.D. Warren is correct that this issue was not raised during pre-filing consultation with resource agencies. This, however, does not preclude our analysis of the issue, since it was raised during scoping, and most agencies and NGO's have recommended anadromous fish passage as part of their recommended terms and conditions for any licenses that may be issued. In addition, anadromous fish restoration is now one of the major fishery management goals for the Presumpscot River, by the three Maine fishery agencies (Wippelhauser et al., 2001).

As noted above, no anadromous species currently occur in any of the project reaches, because of the presence of two dams downstream (Smelt Hill and Cumberland Mills). The first dam on the river, Smelt Hill, was equipped with a fish lift, until the lift was destroyed by flooding in 1996. Since 1999, the sluice gates on the dam have been opened during the upstream migration period for river herring and American shad, which may allow some fish to pass upstream under some river and tidal conditions. Prior to the destruction of the Smelt Hill fish lift, annual counts of up to 27,000 river herring and 31 shad were recorded. River herring, probably primarily alewife, spawn in Highland Lake, which has a small fishway on the lake outlet, allowing herring access to the lake via a tributary stream to the lower Presumpscot River (Mill Brook) downstream of Cumberland Mills dam (letter from George Lapointe, Commissioner, MDMR, Augusta, ME, January 24, 2001). The few shad observed may be a small remnant Presumpscot River population, or strays from other rivers.

Although the Maine agencies have recently established the goal to restore anadromous species to the Presumpscot River, and this goal is reflected in the FWS final fishway prescription, none of the agencies have yet established an active restoration program on the river. The MDMR, the state agency responsible for management of shad and river herring, however, has been trucking alewife into Highland Lake since the destruction of the fish facilities at Smelt Hill, and recently has taken ownership of Smelt Hill dam, so that the dam can be removed during 2002. As for Atlantic salmon, the MASC also has had no active restoration program for salmon in the Presumpscot River Basin. The MASC, however, previously indicated that it was reevaluating its objectives for the river, and developing work plans to begin an assessment of the potential salmon

habitat in the basin, so it can estimate potential smolt production (letter from Norman R. Dube, Fisheries Scientist and Environmental Coordinator, MASC, January 5, 2001). In its comment letter on the DEIS (letter from Norman R. Dube', Fisheries Scientist, MASC, to David P. Boergers, Secretary, FERC, November 27, 2001), the MASC presents estimated habitat units and potential smolt production for the tributaries to the river.[29] As one of the "authors" of the recent (December 2001) fishery management plan for the river, MASC is now proposing restoration of Atlantic salmon as far upstream as the Eel Weir dam, but not into Sebago Lake. The plan's goals also include restoration of anadromous clupeids (American shad and river herring) as far upstream as North Gorham dam. The plan estimates that the existing Presumpscot River Basin has the potential to produce the following run sizes of anadromous fishes:

- American shad: 73,900
- Blueback herring: 450,200
- Alewife: 147,700
- Atlantic salmon: 386.

The MDMR estimated the production potential of shad, blueback herring, and alewife, by estimating the area of existing aquatic habitat in the Presumpscot River and its tributaries, that would be available to these species if fish passage were provided, and multiplied this area by production per acre estimates derived from Maine waters and other rivers in New England (Wippelhauser et al., 2001; letter from Gail Wippelhauser, Marine Resources Scientist, MDMR, to Gordon Russell, FWS, Old Town, ME, January 9, 2002). S.D. Warren has criticized previous MDMR estimates, because they are based on extrapolation of estimated production of fish per acre from other river systems, including outside of Maine, and are not based on knowledge of the specific habitat. In its most recent filing (letter from Nancy J. Skancke, GKRSE, to Magalie Roman Salas, Secretary, FERC, April 11, 2002), S.D. Warren also criticizes the latest MDNR potential run size calculations, because the passage or stocking rates for the anadromous clupeids (shad and herring) exceed by many times the rates typically used by MDMR for other rivers in Maine. S.D. Warren states that the MDMR-recommended run sizes for the Presumpscot River are "grossly overestimated."

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[29] It is not clear whether MASC estimated habitat units based on field surveys, or a "desktop analysis." In its letter, MASC indicates that the staffs of both MASC and MDIFW "...analyzed all tributaries below Sebago Lake for their potential to produce Atlantic salmon." The details of this analysis, however, were not provided.

Although we understand S.D. Warren's criticisms, the method used by the MDMR for estimating potential alosid production is consistent with the practice used on other rivers in the northeast. Estimating potential alosid production is not a precise science, and, in fact, MDMR states that their estimates should be considered "order-of-magnitude" population estimates.

We have reviewed MDMR's estimates, and although we have used the same methodology in our estimates of production potential, we make the following observations:

- The MDMR assumes that all alewife production would occur downstream of Cumberland Mills (in Highland Lake), and only blueback herring production would occur in the river and tributaries upstream of Cumberland Mills. This may be an over-simplification of what may occur if fish passage were provided, and as a result may result in an over-estimation of blueback herring/river herring production. If river herring (alewife and blueback herring) were passed upstream, the existing, primarily impoundment habitat in the river may more favor alewife than blueback herring. Blueback herring are known to prefer spawning in faster current and over hard substrates, while alewife will readily utilize ponded habitat over soft substrates (Fay et al., 1983). Since MDMR uses a production of 600 fish per acre for blueback herring and 235 fish per acre for alewife, by dedicating all upriver habitat to blueback herring, the total river herring production may be inflated.

- The MDMR estimates use only one production per acre rate for each species, instead of a range of production per acre rates, as we presented in the DEIS for American shad. Although the specific production rates used by MDMR may be in the "reasonable" range, a range of rates may be more appropriate for clupeid species, because of the wide variability in production that is characteristic of clupeid populations. Any future run sizes would depend on a multitude of factors, both man-induced (fishing mortality, fishway efficiencies, turbine mortality) and natural (high or low flows, water temperatures, natural mortality in the river and in the ocean), and these may change from year to year.

- The MDMR estimates do not appear to consider the efficiency of fish passage facilities, and the potential losses/delays that may occur as fish pass multiple dams and fishways. The MDMR, in its comments on the DEIS (letter from George D. LaPointe, Commissioner, MDMR, to David P. Boergers, Secretary, FERC, November 28, 2001), commented that Commission staff failed to consider passage inefficiencies in its dam removal analysis, where it compared various dam removal

alternatives to the alternative of retaining all the dams, with fish passage facilities. We agree with MDMR's comments that the production potential of the river should factor-in the efficiencies of fish passage over multiple dams. Otherwise, the production potential with fishways is over-estimated.

Based on MDNR's additional data, and on the above observations, we have re-calculated the production potential of the Presumpscot River Basin for anadromous clupeids (shad and river herring), assuming the construction of fish passage facilities. Using a spreadsheet analysis, we factor-in upstream and downstream passage efficiency, based on the number of dams that each population component (each river segment, reservoir, or tributary cohort) must pass. We assume that Smelt Hill dam is removed (100 percent passage efficiency), a 95 percent passage efficiency at Cumberland Mills dam, and 90 percent passage efficiency at all the hydroelectric dams. Because clupeids must pass downstream as juveniles and upstream as adults (we did not consider repeat spawners), they are exposed to passage efficiencies at least twice in their life history, and therefore the total passage efficiency at each dam is the square of the one-way efficiency (i.e., 0.9 x 0.9). We also calculate the cumulative passage efficiency for passage over multiple dams.

Based on the aforementioned analysis, the MDMR estimate for shad production potential in the river basin is reduced from 73,900 to about 42,000 fish (table 21). Most of the reduction in potential occurs in the upper part of the river, where fish must pass multiple dams, and therefore have the lowest success (efficiency) in completing their life cycle. The staff estimate for shad production potential, using a range of production rates, ranges from about 10,600 to 60,200 (using a production rate of from 25 to 142 shad per acre, from St. Pierre [1979]).

For estimating river herring (alewife and blueback herring) production potential, we modified our spreadsheet analysis to account for differential habitat use by the two species. We first assumed the habitat usage that MDMR assumed: alewife would spawn only in Highland Lake, and bluebacks would spawn in the remainder of the river. Factoring-in passage efficiency, the alewife estimate remains the same as MDMR (fish from Highland Lake are not subjected to any dam passage), but the blueback estimate is reduced from 450,200 to 254,200 (table 21). We, however, further modified the spreadsheet analysis to reflect our comment above, that alewife would probably also spawn in the other reaches of the river made available by fishway construction. For blueback herring, we assume that they would not spawn in Highland Lake, but would spawn in all the other reaches. For those reaches where both alewife and blueback herring would be spawning, we assume that production would be one-half alewife and one-half bluebacks (because the impoundments would not be the most suitable blueback

herring spawning habitat). This analysis results in an increase in the estimated alewife production (from the MDMR estimate) from 147,700 to about 198,000, but a decrease in the blueback herring estimate from 450,200 to about 127,000 (table 21). The increase in the alewife production potential is due to allocating more habitat to alewife. The decrease in the blueback production potential is due to halving their production in reaches where alewife are also spawning, as well as factoring-in passage efficiency over multiple dams.

Table 21. Anadromous fish production potential for the Presumpscot River Basin, as estimated by MDMR, MASC, and staff (Source: staff).

Species	MDMR	MDMR (corrected)[a]	MASC[b]	Staff (low)[c]	Staff (high)[c]
American shad	73,900	42,000	-	10,600	60,200
Alewife	147,700	-	-	-	198,000
Blueback herring	450,200	254,200	-	-	127,000
Atlantic salmon	-	-	124 - 620	62	186

[a] Staff adjusted the MDMR estimates for shad and blueback herring by factoring-in dam passage efficiencies, which MDMR had not done in its estimates for these species (letter from Gail Wippelhauser, MDMR, to Gordon Russell, FWS, Old Town, ME, January 9, 2002).

[b] MASC's estimate for salmon production was included in the letter from Norman R. Dube', Fisheries Scientist, MASC, to David P. Boergers, Secretary, FERC, November 27, 2001.

[c] Staff estimated a range of production potential for shad and salmon, but made only single estimates for alewife and blueback herring.

Prior to issuance of the DEIS, none of the agencies had estimated the potential production of Atlantic salmon for the Presumpscot River Basin. In its comments on the DEIS, however, MASC presents their estimates for existing salmon rearing habitat units in the mainstem river and in the major tributary streams (letter from Norman R. Dube', Fisheries Scientist, MASC, to David P. Boergers, Secretary, FERC, November 27, 2001). As noted above, the basis for these estimates is not provided, but for the purposes of this analysis, we will use the MASC habitat estimates. MASC also indicates that they have factored-in a downstream passage mortality rate of 10 percent (or survival/passage

efficiency of 90 percent) at each dam, in their estimates of production potential. Since a salmon restoration program would likely begin with fry, parr, or smolt stocking, with the objective of creating a run of returning adult salmon, salmon would be exposed to dam passage only as outmigrating smolt.[30] Using a marine survival rate of from 1 percent to 5 percent, MASC predicts that the existing habitat in the basin could produce an adult run of from 124 to 620 fish (table 21).

Staff agrees with much of the MASC analysis, although is unable to verify how the existing habitat units were estimated, and believes that their marine survival rates are much higher than what has typically occurred for Maine salmon over the past 30 + years. Although we have indicated that we would accept the MASC habitat estimates, the total habitat units estimated for the Presumpscot River (5,283 units), appears "high" compared to the size of the drainage, and in consideration of the developed nature of the area. The Presumpscot River Basin downstream of Sebago Lake (which is the part of the basin proposed for salmon restoration) has a drainage area of 209 square miles (the total basin is about 650 square miles, but the basin area at the USGS gage at the outlet of Sebago Lake is 441 square miles). Other salmon rivers in Maine of comparable size include the East Machias (251 square miles), Narraguagus (232 square miles), and Sheepscot (228 square miles). The number of habitat units reported for those rivers is as follows: East Machias (2,145 units), Narraguagus (6,015 units), and Sheepscot (2,845 units) (Baum et al., 1997). An estimate of 5,283 units for the Presumpscot River is about twice that of the East Machias and Sheepscot Rivers, and approaching the same number of units as the Narraguagus River.

It would seem unlikely that a river such as the Presumpscot, located in a highly developed area of southern Maine, with documented marginal water quality in some locations, both in the mainstem and in the tributaries (as previously discussed in this FEIS, and as pointed out by several of the comments on the DEIS), would have comparable or more salmon habitat than three of Maine's better salmon rivers located in less-developed areas, and that still support small runs of wild salmon. Even if the estimated habitat units for the Presumpscot River are correct, because some of this habitat has been degraded by low DO, high water temperatures, and non-point source pollution, the future salmon production from any marginal habitat would likely be less

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[30] Returning adult salmon would ultimately also be exposed to upstream dam passage, depending on the availability of fishways, and the hatchery broodstock requirements. During the initial years of a restoration program, most adults would likely be trapped at the lower dams, for use as broodstock, and few adults would be allowed to pass upstream to spawn naturally.

than from the more pristine habitat in the other salmon rivers. Although both MASC and staff use a production of 3 smolts per habitat unit (which is the "rule of thumb" estimate in Maine [Baum, 1997]), this could overestimate salmon production.

The issue of marine survival has been a major subject of discussion by many agencies and other entities commenting on the DEIS. Many comments cite higher rates of marine survival from rivers in Maine decades ago, or from rivers in Canada and in Europe, and suggest that staff failed to consider the potential for higher return rates 30 to 50 years into the future, as ocean conditions improve. MASC states that rates of from 1 percent to 5 percent are typically used for planning purposes, or in population modeling by MASC and other agencies, and that the survival rates of 0.5 percent to 1.5 percent used by staff are overly "pessimistic" (letter from Norman R. Dube', Fisheries Scientist, MASC, to David P. Boergers, Secretary, FERC, November 27, 2001).

We understand that higher marine survival rates have historically occurred, and that MASC uses higher rates for planning purposes, but staff's objective is to present as realistic an analysis as possible, as to what the adult returns may be from a restoration program on the Presumpscot River. The recent (30 + years) of salmon returns in Maine simply do not support using rates higher than the 0.5 percent to 1.5 percent rates used by staff. Baum (1997) presents 25 years of marine survival data for hatchery-reared smolts stocked in the Penobscot River, and this shows a range of survival from about 0.3 to 1.4 percent, with an average of about 0.5 percent. The survival rate has not been above 1.0 percent since about 1980. Baum et al. (1997), in projecting potential adult salmon returns for all of Maine's salmon rivers (the Presumpscot River was not on the list), uses a "sliding scale" of ocean survival, depending on the location of the river. The "downeast" rivers are assigned a rate of 2 to 4 percent, the "central-Maine" rivers are given a rate of 1 to 3 percent, while the southern Maine rivers (the Kennebec, Androscoggin, and Saco) are assumed to have a return rate of from 0.5 to 1.5 percent (identical to the rate used by staff).

Staff further researched actual return rates, by examining data from the Saco River, which is the next major river basin just to the south of the Presumpscot. Table 22 presents the Saco River data from Saco River Coordinating Committee (1999). These data show that, based on the number of smolts stocked, and the return of adult fish one and two years later, [31] that the marine survival is relatively consistent, at between 0.1 and 0.2 percent, with only one year showing a return as high as 0.5 percent.

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[31] Saco River salmon return as 76 percent two sea-winter (2SW) fish and 21 percent one sea-winter (1SW) fish (Saco River Coordinating Committee, 1999).

Table 22. Calculated Atlantic salmon marine survival for smolt stocked in the Saco River, Maine, 1991 to 1997 (Source: Staff, with data from Saco River Coordinating Committee [1999]).

Year	Smolt stocked	Year of return	No. of returning adults	Percent survival
1991	10,300	1992-93	54	0.5
1992	19,800	1993-94	21	0.1
1993	20,100	1994-95	40	0.2
1994	20,000	1995-96	39	0.2
1995	19,700	1996-97	34	0.2
1996	20,000	1997-98	19	0.1
1997	20,200	1998-99	50	0.2

The analysis in the previous paragraph may in fact be an over-estimation of marine survival, because it does not account for smolts emigrating from the river as a result of fry and parr stocking. For the years 1991 through 1997, from 97,000 to 376,000 salmon fry per year (stocked in 6 of the 7 years), and 30,200 to 63,300 salmon parr per year (stocked in 3 of the 7 years), were released into the Saco River Basin. These fish should rear in the river for one to two years, emigrate as smolts, and return as adults in one or two years.[32] Limited natural spawning has also been observed in recent years (an estimated 15 redds were observed in 1997, according to Saco River Coordinating Committee [1999]). Any smolts resulting from natural spawning are also not included in the calculation of marine survival, because there is no estimate of wild smolt production. Since any smolts resulting from fry/parr stocking and natural spawning are not accounted for, the actual ocean survival rate for the Saco River is less than the rates presented in table 22.

Since the Saco River is geographically close to the Presumpscot River in southern Maine, and has a salmon program that is primarily hatchery supported (as any salmon program in the Presumpscot River likely will be), it may be a good surrogate for predicting potential ocean survival rates for the Presumpscot River. As such, staff use of a survival rate of from 0.5 to 1.5 percent for the Presumpscot River is more than justified, and in fact may be overly optimistic.

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[32] The survival of fry and parr to the smolt stage is not known in the Saco River, so the number of smolts resulting from this stocking cannot be estimated.

As with shad and river herring, we developed a spreadsheet to estimate potential salmon production in the Presumpscot River Basin, and potential adult returns from a restoration program. We assumed full seeding of all salmon habitat in the basin (probably would be by fry stocking), based on the MASC estimates of salmon habitat, a production rate of 3 smolt per habitat unit, and a marine survival rate of 0.5 to 1.5 percent. We also factored-in downstream passage survival over the several mainstem dams, with the survival of each river reach cohort of smolt depending on the number of dams that it must pass during its downstream migration. Using this spreadsheet, we estimate potential adult returns of from 62 to 186 fish, if all existing habitat in the basin were fully seeded with salmon (see table 21).

We also estimated the basin production potential for the anadromous species, assuming the removal of Smelt Hill dam, but no further action in the basin to either remove dams or install fish passage facilities. For clupeids, spawning and rearing would be limited to the tributaries and mainstem downstream of Cumberland Mills dam. For salmon, full production would occur from existing rearing habitat in the basin, assuming full seeding of this habitat by fry stocking. Using the spreadsheets described above, we estimate that the existing Presumpscot River habitat would have the following production potential:

- Atlantic salmon: 62 - 186
- American shad: 3,250 - 18,460
- Alewife: 163,091
- Blueback herring: 39,000.

These estimates indicate that the salmon potential would be the same as with fish passage, because of the assumption that the habitat is fully seeded, regardless of whether or not adult salmon would reach spawning areas. This may be acceptable to the agencies in the short-term, as an adult broodstock source is developed, but the agency long-term objective is to establish natural spawning in the river (Wippelhauser et al., 2001). For the clupeids, existing habitat downstream of Cumberland Mills could support a sizable run of alewife (because of the potential of Highland Lake), but only about 30 percent of the potential for shad and blueback herring, if they were provided access to upstream habitat.

Based on both agency and staff analysis, the potential production of American shad and river herring would be maximized, if fish passage facilities are constructed. Past operation of the Smelt Hill dam fish lift indicates that there is a small alewife run and possibly a remnant shad run in the lower river. These runs could serve as the "seed stock," if these fish were provided access to the potential habitat upstream of the dams,

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