ORIGINAL

FEDERAL ENERGY REGULATORY COMMISSION



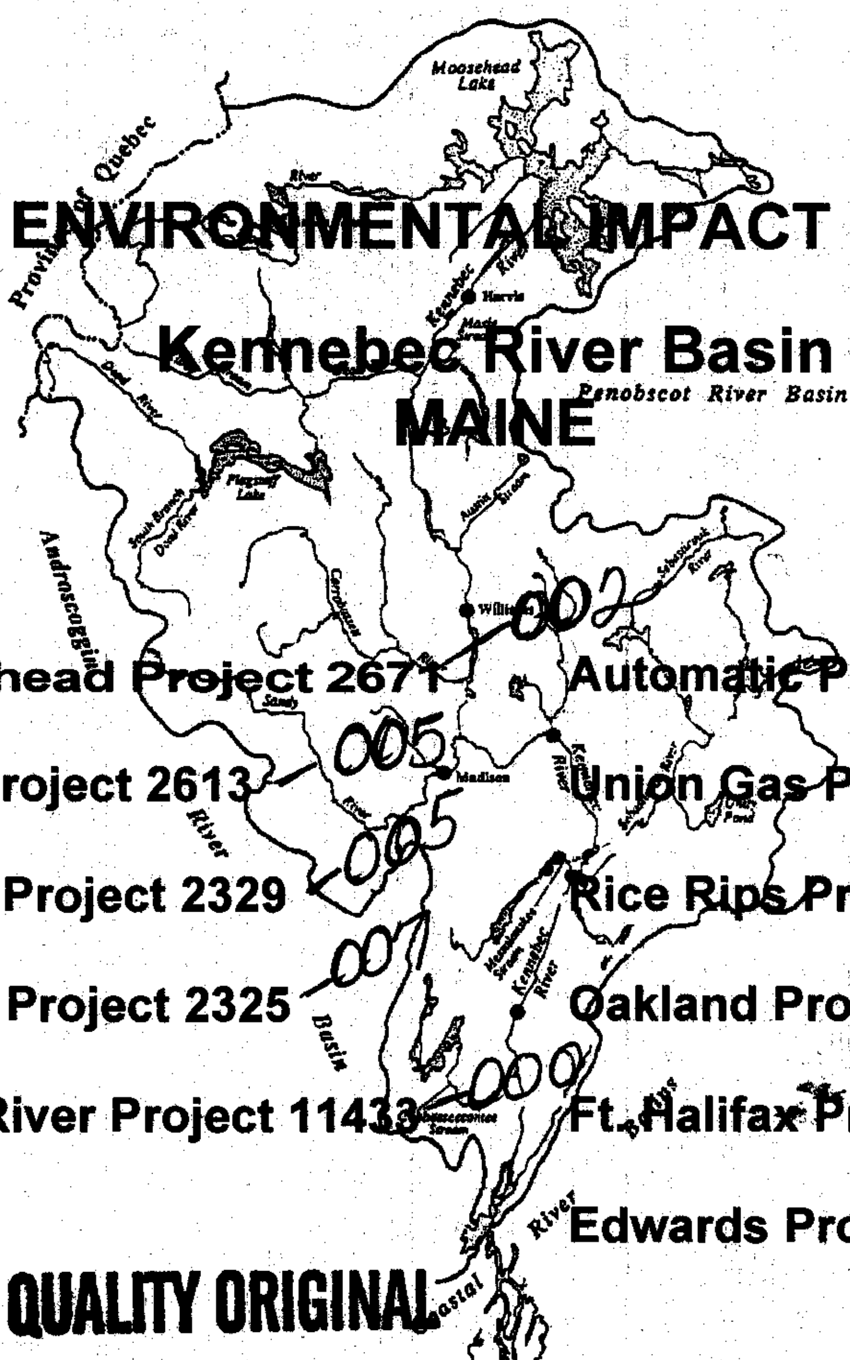
OFFICE OF HYDROPOWER LICENSING

July 1997

FERC/FEIS-0097

# FINAL ENVIRONMENTAL IMPACT STATEMENT

## Kennebec River Basin
## MAINE




Moosehead Project 2671 - 002

Moxie Project 2613 - 005

Wyman Project 2329 - 005

Weston Project 2325 - 001

Sandy River Project 11433 - 009

Automatic Project No. 2555 - 001

Union Gas Project No. 2556 - 004

Rice Rips Project No. 2557 - 004

Oakland Project No. 2559 - 003

Ft. Halifax Project 2552 - 007

Edwards Project 2389 - 012

POOR QUALITY ORIGINAL



970730-0440-3

FERC/FEIS-0097

FEDERAL ENERGY REGULATORY COMMISSION
OFFICE OF HYDROPOWER LICENSING

# FINAL ENVIRONMENTAL IMPACT STATEMENT

## LICENSE APPLICATION FOR TEN EXISTING HYDROELECTRIC PROJECTS IN THE KENNEBEC RIVER BASIN AND LICENSE SURRENDER FOR ONE EXISTING PROJECT

FERC Project Nos.

| | |
|---|---|
| 2671 | Moosehead |
| 2613 | Moxie |
| 2329 | Wyman |
| 11433 | Sandy River |
| 2325 | Weston |
| 2552 | Fort Halifax |
| 2559 | Oakland |
| 2557 | Rice Rips |
| 2555 | Automatic |
| 2556 | Union Gas |
| 2389 | Edwards |

Additional copies of the EIS are available from:

Federal Energy Regulatory Commission
Public Reference and Files Maintenance Branch
888 First Street, N.E.
Washington, DC 20426

FEDERAL ENERGY REGULATORY COMMISSION
**WASHINGTON, DC 20426**

TO THE PARTY ADDRESSED

Attached is the final Environmental Impact Statement (FEIS) for the Kennebec River Basin in Maine, Commission Docket Nos. 2671, 2613, 2329, 2325, 11433, 2555, 2556, 2557, 2559, 2552, and 2389.

This FEIS documents the views of the Commission's staff and concerned resource agencies, governments, non-governmental organizations, and citizens regarding the relicensing of the projects included in the Kennebec River Basin. Before the Commission makes a decision on licensing it takes into account all concerns relevant to the public interest.

Attachment

**COVER SHEET**

a. Title: License application for 10 existing hydroelectric projects (FERC Nos. 2671, 2329, 2325, 2552, 2559, 2557, 2555, 2556, 2389, and 11433) in the Kennebec River Basin, and license surrender for one existing project (FERC No. 2613).

b. Environmental Impact Statement

c. Lead Agency: Federal Energy Regulatory Commission

d. Abstract: Kennebec Water Power Company, Central Maine Power Co., Edwards Manufacturing Company, the city of Augusta, and the town of Madison filed applications for the Moosehead, Moxie, Wyman, Weston, Fort Halifax, Oakland, Rice Rips, Automatic, Union Gas, Edwards, and Sandy River Hydroelectric Projects located on the Kennebec River, Moxie Stream, Sandy River, Sebasticook River, and Messalonskee Stream in Maine.

Primary environmental resource issues are potential impacts on: (1) geology and soils resources, (2) water quality and quantity, (3) fishery resources, (4) terrestrial resources, (5) aesthetic resources, (6) cultural resources, (7) recreation resources, and (8) cumulative interactions among projects.

The staff's recommendation is to license nine projects as proposed with additional environmental measures, grant the surrender of the Moxie Project license and retire the Edwards Project and remove Edwards dam.

e. Contact: Joe Davis
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426
(202) 219-2865

f. Transmittal: This environmental impact statement, prepared by the Commission's staff in connection with applications filed by: (1) Kennebec Water Power Company for the existing Moosehead Project (FERC Project No. 2671); (2) Central Maine Power Company for the existing Wyman Project (FERC No. 2329), Weston Project (FERC No. 2325), Fort Halifax Project (FERC No. 2552), Oakland Project (FERC No. 2559), Rice Rips Project (FERC No. 2557), Automatic Project (FERC No. 2555), and Union Gas Project (FERC No. 2556); (3) Central Maine Power, Scott Paper Company, Madison Paper Industries, Edwards Manufacturing Co., and Merrimil Limited Partnership (the Owners) for the Moxie Project (FERC No. 2613); (4) Edwards Manufacturing Company and the city of Augusta for the existing Edwards Project (FERC No. 2389); and (5) the town of Madison, Department of Electric Works, for the unlicensed Sandy River Project (FERC No. 11433) is being made available to the public on or about July 28, 1997, as required by the National Environmental Policy Act of 1969 and the Commission's Regulations Implementing the National Environmental Policy Act (18 CFR Part 380).

**FOREWORD**

The Federal Energy Regulatory Commission (Commission), pursuant to the Federal Power Act (FPA)[1] and the U.S. Department of Energy Organization Act[2] is authorized to issue licenses for terms up to 50 years for the construction and operation of nonfederal hydroelectric developments subject to its jurisdiction, on the necessary conditions:

> That the project adopted. . . shall be such as in the judgment 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)...[3]

The Commission may require such other conditions not inconsistent with the provisions of the FPA as may be found necessary to provide for the various public interests to be served by the project.[4] Compliance with such conditions during the license period is required. Section 385.206 (1996) of the Commission's Rules of Practice and procedure allows 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.[5]

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1 16 U.S.C. Sec. 791(a)-825(r).

2 42 U.S.C. Sec. 7101-7352.

3 16 U.S.C. Sec. 803(a)(1).

4 16 U.S.C. Sec. 803(g).

5 18 CFR Sec. 385.206 (1996).

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ACHP | Advisory Council on Historic Preservation |
| Acres | Acres International |
| ADA | Americans with Disabilities Act of 1990 |
| AF | acre-feet |
| AO | American Outfitters |
| ASRSC | Atlantic Sea-Run Salmon Commission |
| ATC | Appalachian Trail Conference |
| BPR | Bureau of Parks and Recreation |
| cfs | cubic feet per second |
| CMP | Central Maine Power |
| Commission or FERC | Federal Energy Regulatory Commission |
| Commerce | U.S. Department of Commerce |
| CRMP | Cultural Resource Management Plan |
| CWA | Clean Water Act |
| DEIS | Draft Environmental Impact Statement |
| DO | dissolved oxygen |
| DOE | U.S. Department of Energy |
| EA | Environmental Assessment |
| Edwards | Edwards Manufacturing Company |
| EIA | Energy Information Administration |
| FPA | Federal Power Act |
| fpm | feet per mile |
| fps | feet per second |
| FWS | U.S. Fish and Wildlife Service |
| GWh | gigawatt hours |
| HEP | Habitat Evaluation Procedure |
| IFIM | Instream Flow Incremental Methodology |
| Interior | U.S. Department of Interior |
| KA | Kleinschmidt Associates |
| KHDG | Kennebec Hydro Developers Group |
| KVTC | Kennebec Valley Tourism Council |
| kW | kilowatts |
| KWD | Kennebec Water District |
| KWP | Kennebec Water Power Company |
| LMA | labor market area |
| MDEP | Maine Department of Environmental Protection |
| MDHS | Maine Department of Human Services |
| MDIFW | Maine Department of Inland Fisheries and Wildlife |
| MDMR | Maine Department of Marine Resources |
| MDOC | Maine Department of Conservation |
| MEPRO | Maine Professional River Outfitters |
| MEW | Town of Madison, Department of Electric Works |
| mgd | million gallons per day |
| mg/kg | milligrams per kilogram |
| mg/l | milligrams per liter |
| $\mu$g/l | micrograms per liter |
| MLURC | Maine Land Use Regulatory Commission |
| MNHP | Maine Natural Heritage Program |
| MSHPO | Maine State Historic Preservation Officer |

| | |
|---|---|
| msl | mean sea level |
| MSPO | Maine State Planning Office |
| MW | megawatts |
| NAI | Normandeau Associates, Inc. |
| NEPOOL | New England Power Pool |
| NERC | North American Electric Reliability Council |
| NGO | non-governmental organizations |
| NHPA | National Historic Preservation Act |
| NMFS | National Marine Fisheries Service |
| NOI | Notice of Inquiry |
| NPCC | Northeast Power Coordination Council |
| NPS | National Park Service |
| NRCS | Natural Resources Conservation Service |
| NRHP | National Register of Historic Places |
| ORNL | Oak Ridge National Laboratory |
| Owners | Owners of the Moxie Project |
| PA | Programmatic Agreement |
| PCPI | per capita personal income |
| ppm | parts per million |
| SCORP | State Comprehensive Outdoor Recreation Plan |
| SMP | Shoreland Management Plan |
| WMP | Waterfowl Management Plan |
| WQC | Water Quality Certification |
| WUA | Weighted Usable Area |

## EXECUTIVE SUMMARY

This Final Environmental Impact Statement (FEIS) evaluates the potential site-specific and cumulative environmental consequences, economic costs, and related benefits associated with proposed changes in operation and minor construction at 11 existing hydroelectric projects in the Kennebec River Basin, Maine. It also evaluates the effects of retiring the Edwards Project and removing Edwards dam.

The Federal Energy Regulatory Commission (FERC or Commission) is considering an application for relicensing submitted by the Kennebec Water Power Company (KWP) for the Moosehead Project (FERC No. 2671), the major storage reservoir in the basin. FERC is also considering applications for relicensing submitted by Central Maine Power Company (CMP) for the following hydroelectric generating stations: the Wyman Project (FERC No. 2329), the Weston Project (FERC No. 2325), both on the main stem of the Kennebec River; the Fort Halifax Project (FERC No. 2552), near the mouth of the Sebasticook River; and the following Messalonskee Stream Projects: Oakland (FERC No. 2559), Rice Rips (FERC No. 2557), Automatic (FERC No. 2555), and Union Gas (FERC No. 2556). Subsequent to filing its license application, CMP was granted a request to transfer its license for the Automatic Project to the Kennebec Water District (KWD). The Edwards Manufacturing Company (Edwards) submitted a relicensing application for the Edwards Project (FERC No. 2389), the lower-most dam on the Kennebec River, and was later joined by the City of Augusta as co-applicant. The licenses of all of the above 9 projects (the remaining 2 projects are discussed in the following paragraphs) expired on December 31, 1993, and they are all operating on annual licenses until new license(s) are issued. This FEIS will serve as a support document for the Commission's decision on each of the relicense applications.

The Owners[1] of the Moxie Project (FERC No. 2613), a consortium of downstream hydroelectric project owners that historically have received benefits from project releases, originally filed[2] an application to relicense this relatively small storage project located on Moxie Stream, but subsequently withdrew it and notified the Commission that jurisdictional

[1] CMP, Scott Paper Company, Madison Paper Industries, Edwards, and Merimil Limited Partnership.

[2] CMP filed this original application on behalf of the Owners on December 22, 1991.

activities had ceased at the project as of December 31, 1993.[3] On January 12, 1994, the Commission issued a notice that the Owners had filed, in essence, an application for the surrender of the license for the project. The analysis herein for the Moxie Project, which assumed a surrender proceeding, has not been deleted even though an order finding licensing not required for the Moxie Project was issued on July 8, 1997.[4]

On September 22, 1989, the Commission determined that the Sandy River Project (FERC No. 11433), located on the Sandy River and previously unlicensed, is required to be licensed. Consequently, the town of Madison, Department of Electric Works (MEW), owners of the project, filed an application for an original license.

The 11 projects included in this EIS have been operated to generate electricity since the early 20th century. In most cases, the dams associated with these projects were constructed during the 19th century.

The Moosehead Project stores water during high flow periods and gradually releases flow during low flow periods. Releases from Moosehead Lake are often intermittent depending on energy demand at downstream generating projects and inflow. The Wyman Project, located on the Kennebec mainstem, operates in a peaking mode with daily flows typically fluctuating between about 500 and 6,000 cubic feet per second (cfs). Below the Wyman Project is the Williams Project (FERC No. 2335). Wyman's fluctuating flows are dampened by the relatively constant flows released at the Williams Project, resulting in typical daily water level changes of 6 feet in the Williams impoundment. Because these fluctuations are caused by variable releases from the upstream Wyman Project, we assess the effects of the Williams impoundment fluctuations in this EIS. The Weston and Edwards Projects are well downstream of the Williams Project and operate in a run-of-river mode (outflow equals inflow).

Releases from the five projects on the Sebasticook River and Messalonskee Stream are generally intermittent except during high spring flows. The Sandy River Project generally operates in a run-of-river mode.

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3 The Owners stated that, except for a small winter drawdown to protect the shoreline and docks from ice damage, the project has been operated in a run-of-river mode since December 31, 1993. They further stated that Moxie represents only 1.5 percent of the total storage in the Upper Kennebec River Basin and has not provided generation storage value of any great significance to downstream project owners for many years.

4 An Order Finding Licensing Not Required for the Moxie Project was issued on July 8, 1997 (80 FERC ¶ 62,019).

In general, the applicants propose to continue operating the projects as they have in the past, with additional environmental measures agreed to during prefiling consultation with resource agencies and interested parties. CMP proposes to upgrade turbines at the Weston Project to increase the installed capacity by 2 megawatts (MW). Although Edwards originally proposed a substantial project upgrade (3.5 to 11.0 MW), it revised its proposal to reflect upgrades of existing units that would not increase the project's hydraulic capacity but would increase the generating capacity by 1.0 MW.

Major issues raised concerning all of the proposed projects include:

- Seasonal or daily impoundment water level management regimes that would be protective of fish, wildlife, and recreational interests.
- Monitoring recreation use so that appropriate recreational measures can be implemented.
- Protection of historic and archeological resources.
- Maintaining production of non-polluting, renewable electrical energy.

Whether or not Edwards dam should be removed, primarily to benefit anadromous fisheries, is also a major issue assessed in this EIS.

In Table ES-1, we summarize issues pertaining to one or more projects.

In general, we agree with the environmental protection and enhancement measures proposed by the applicants. However, in some cases, we propose additional environmental protection and enhancements based on agency comments and staff analysis. In Table ES-2, we compare those environmental enhancements where we differ substantially from the applicant's proposal, and we summarize the environmental impacts of each, including the no-action alternative.

Our review of the economics of the projects with our recommended protection and enhancement measures indicates that six of the nine generating projects still have positive economic benefits. The Sandy River, Fort Halifax, and Edwards Projects would have negative economic benefits. These three projects had negative economics as proposed by the applicants using our assessment methods. We further note that the annual cost of removing Edwards dam is about $530,000 less than the annual cost of licensing the project with appropriate protection and enhancement measures.

Based on our independent analysis, we conclude that the license surrender (Moxie) and licensing of 9 of the 10 projects (Moosehead, Wyman, Sandy River, Weston, Fort Halifax, Oakland, Rice Rips, Automatic, and Union Gas) as proposed with the additional staff-recommended protection and enhancement measures would be best adapted to comprehensive plans for improving or developing the waterways of the Kennebec River Basin. A summary of our analysis and recommendations for the Edwards Project follows.

**Edwards Project**

A major issue in this proceeding is anadromous fish passage at Edwards dam and whether or not Edwards dam should be removed. A state and federal fish and wildlife agencies' management goal is to restore all nine anadromous fisheries -- Atlantic salmon, American shad, alewife, blueback herring, American eel, shortnose sturgeon, Atlantic sturgeon, striped bass, and rainbow smelt -- to their native habitat.[5]

The state and federal fish and wildlife agencies, the state of Maine, and environmental intervenors support the removal of Edwards dam, while the licensees are opposed to project retirement and dam removal.

Table ES-3 summarizes the major effects of the applicant's proposal for the Edwards Project; the staff's licensing alternative, which would leave the dam in place and require fish passage as prescribed by Interior and Commerce; and the project retirement and dam removal alternative.

Based on our independent analysis, we conclude that retirement of the Edwards Project and removal of Edwards dam would be best adapted to a comprehensive plan for improving or developing the waterway of the Kennebec River Basin. We base our recommendation primarily on the following factors:

(1) the prescribed fishways are needed and appropriate, but the cost of installing them (about $10 million) makes licensing the project about 1.7 times more costly than retiring the project and removing the dam;

(2) removing the dam would allow shortnose sturgeon, Atlantic sturgeon, striped bass, and rainbow smelt access to the 17 miles of historic (pre-dam) spawning habitat between Edwards dam and Lockwood dam;

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[5] Active restoration efforts are ongoing to return alewives and American shad to their historical range on the Kennebec River; however, there are no active restoration efforts for Atlantic salmon, American eel, Atlantic sturgeon, shortnose sturgeon, striped bass, and rainbow smelt.

(3) compared to licensing, project retirement and dam removal would result in an overall increase in wetland habitat, recreational boating, and fishing benefits;

(4) project retirement and dam removal should not result in any substantial adverse environmental or social effects; and

(5) project retirement and dam removal would be consistent with: (a) all applicable comprehensive plans including the state of Maine's Comprehensive Management Plan for the Kennebec River, (b) state and federal fish and wildlife agency management goals and objectives for the Kennebec River Basin's anadromous fisheries, and (c) the recommendations of the State of Maine and the state and federal fish and wildlife agencies.

Table ES-1.    Environmental issues raised during licensing proceedings

| | Project | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Issue | Moosehead | Moxie | Wyman | Sandy River | Weston | Fort Halifax | Oakland | Rice Rips | Automatic | Union Gas | Edwards |
| Water quality | X | | X | X | | X | | X | | | |
| Flow fluctuations | X | | X | | | | | | | X | |
| Limitations to maximum flows | | X | X | | | | | | | | |
| Appropriate downstream flows | X | X | X | | | X | X | X | X | X | |
| Minimum bypassed reach flows | | | | | | | | X | | | |
| Physical enhancements for fisheries | X | | X | | | X | | X | | | |
| Upstream and downstream fish passage | X | | | X | X | X | | | | | X |
| Fish screening | | | | | | | X | | | | |
| Sturgeon habitat enhancements | | | | | | | | | | | X |
| Endangered species | | | | | | | | | | | X |
| Wetland and waterfowl monitoring | X | | X | | | | X | | | | |
| Shoreland protection | X | X | X | | | X | | | | | |
| Communication of flow information to the public | X | X | | | | | | | | | |
| Provision of recreational boating and angler access | X | | X | X | X | X | | X | X | X | X |

Table ES-1. (cont.)

| Issue | Project | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Moosehead | Moxie | Wyman | Sandy River | Weston | Fort Halifax | Oakland | Rice Rips | Automatic | Union Gas | Edwards |
| Recreational boating flow releases | X | X | | | | | | | | | |
| Enhancements to the Appalachian Trail | | | X | | | | | | | | |
| Provision of day-use recreational use | X | | X | | X | X | X | | | X | X |
| Provision of appropriate camping areas | X | | X | | | | | | | | X |
| Dam removal | | | | | | | | | | | X |

Table ES-2. Summary comparison of proposed projects and alternatives on generation, environmental enhancements, and environmental impacts[1] (Source: Staff)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| All | Annual Generation (GWh) | 491.468 | 499.576 | 500.322* |
| All where Applicants control significant shorelands | Land Use | Land use within 250 feet of waters edge regulated by state or local ordinances. | No change. | Buffer zone values protected for duration of license and width of buffer increased for additional protection at some sites regardless of status of shoreland ordinances. |
| Moosehead | Fisheries (East Outlet) | 200-cfs minimum flow. | 500-cfs minimum flow - would increase habitat for all salmonid life stages. | 500-cfs minimum flow, with a target of 1,000-2,000 cfs between generation releases from October 15 through May 31, would increase salmonid spawning habitat over CMP's flow and seasonally improve habitat for juvenile and adult landlocked Atlantic salmon. Some salmonid eggs dewatered during dry winters. Winter target flow would adversely affect all life stages of brook trout but spawning. Summer target flow of 1,000 cfs would enhance juvenile and adult salmon habitat and riverine angling, but could adversely affect salmon fry and brook trout. |
| | Wetland and Wildlife | Continue present mode of lake level management under informal MDIFW agreement. | Formalize lake level management agreement. | Flow, water level, loon, and wetland monitoring would provide a basis for annual meeting between KWP, agencies, and NGOs to make periodic adjustments to project operations within the framework established by our recommendations. |

Table ES-2. (cont.)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| Moosehead (cont.) | Recreation | Unauthorized camping would continue indiscriminately along shorelines of Moosehead Lake, and East and West Outlets. | No change. | Consultation with agencies and NGOs would allow consideration of concerns of all in planning of primitive camping, and other enhancements. |
| Moxie | Lake level management | Continued run-of-river operation with a small winter drawdown to protect the shoreline and docks from ice damage. | No change. | No change. |
| Wyman | Lake level management | Continued drawdowns of up to 8 feet without formal consultation with non-hydroelectric project owners would continue during the spring for floodwater management. | No change. | Resource and civil defense agency notification prior to drawdown and reporting to the Commission after drawdown would minimize un-needed drawdowns and associated adverse impacts on fish and wildlife. |
| | Fisheries | 490-cfs minimum flow. | 1,200-cfs minimum flow, or inflow, whichever is less. Would ensure drawdowns limited to 2 feet, unless for flood control. Modest enhancement to rainbow trout and landlocked salmon habitat. Releases of less than 1,200 cfs could occur in dry years. | Flat 1,200-cfs minimum flow using top 2 feet from May 15 to and including July 31 and top 4 feet for rest of year would maintain minimum flow under nearly all conditions. Drawdowns of up to 4 feet, if regularly occurring, could adversely affect fish and wildlife. Our recommended lake level monitoring would form the basis for determining if the effects from the 4-foot drawdowns require further studies. |

Table ES-2. (cont.)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| Wyman (cont') | | No additional aquatic macroinvertebrate sampling. | Support provisions of WQC, which include macroinvertebrate sampling. | Additional macroinvertebrate sampling in 1,000-foot reach downstream of dam would confirm that Maine's aquatic life standard is met with our recommended releases. |
| | Fisheries, Wetlands, and Wildlife | Peaking releases at Wyman cause daily fluctuations in Williams reservoir of up to 6 feet. | No change. | Feasibility study to reduce daily fluctuations based on increased minimum flows at Wyman would provide basis for determining if altered rule curve should be implemented in river flow regulation. |
| | | Daily impoundment fluctuations would continue to inhibit fish and wildlife value of drawdown zone. | No change. | Developing and implementing a shoreline enhancement plan could compensate for diminished ecological value of riparian zone caused by project operations. |
| Weston | Recreation | Boaters and anglers use rugged, steep path near the Skowhegan foot bridge to gain access to south side shoreline near dam. | No change. | Establishing a formal tailrace access path would lesson danger during steep descent to rivers edge to those seeking tailrace access. Formal trail would increase number of users along the shoreline, which could be dangerous without use of caution. |

Table ES-2. (cont.)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| Fort Halifax | Fisheries | Leakage flow between generation cycles may not be sufficient for upstream zone of passage; would be sub-optimal for salmonids and shad. | Increasing minimum flow to 150 cfs from April to November would provide a zone of passage for anadromous fish and enhance habitat for brown trout, juvenile salmon, and juvenile shad but would decrease habitat for smallmouth bass. | Operating in a run-of-river mode from May through June could provide better attraction flows for upstream migrants. Providing a minimum flow of 400 cfs or inflow for the rest of the year could further enhance salmonid and juvenile shad habitat; instream structures could reduce impact on smallmouth bass; cost to project relatively high. |
| Rice Rips | Water Quality | Occasional violations of state's DO standards occur during the summer. | Occasional violations of state's DO standard could still occur in Rice Rips impoundment and downstream reaches of Messalonskee Stream even with planned reduction of discharge from Oakland Water Treatment Plant. | Proposed water quality monitoring plan would document expected improvement in water quality or provide a basis for recommending additional corrective actions. |
| | Fisheries | Habitat in bypassed reach for brown trout limited by lack of cover and warm temperature. Minimum flows limited to leakage from Rice Rips dam. | Little change in bypassed reach with minimum flow of 15 cfs; if experimental stocking discontinued, limited impact on warmwater fishery. | Minimum flow of 25 cfs in bypassed reach would enhance brown trout habitat. Implementation of bypassed reach habitat enhancement plan would add cover and shade, which could improve brown trout fishery. Could also increase angler interest in this reach, which MDIFW could incorporate in deliberations regarding continuation of experimental stocking program. |

Table ES-2. (cont.)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| Rice Rips (cont') | Recreation | Existing recreation facilities would be used by public. Public access to Rice Rips impoundment would remain limited, informal public use of area proposed for greenbelt/multi-use area would most likely continue. | No change. | Greenbelt/multi-use area would be developed and provide a valuable local recreational enhancement as long as properly designed to minimize public risk near gorge area. Carry-in boat access would also be developed, which would enhance access to impoundment and take advantage of expected improved water quality. Landowner conflicts with increased public access may need to be resolved. |
| Union Gas | Fisheries | Leakage flow from dam would maintain existing fish population in tailwaters. | Minimum flow of 15 cfs ensures historic leakage flow always provided to tailwaters. | Minimum flow of 100 cfs or inflow would typically provide 5 to 16 cfs more than CMP's proposed flow from July through September. This would slightly enhance brown trout habitat in tailwaters but would preclude generation at all four Messalonskee Projects when inflow is less than 100 cfs. |
| | Recreation | Existing recreation facilities would be used by public. Public access to Union Gas tailwaters would remain available but limited. | No change. | Improved public access to Union Gas tailwaters would be provided and new angling access for people with disabilities created. |

Table ES-2. (cont.)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| Edwards | Fisheries | Existing fish pump would continue to be used to assist anadromous fish restoration plans. Recent data suggest improved effectiveness for alewives, but effectiveness for other targeted anadromous species unknown or doubtful. | Construction of fish lift and downstream passage facilities that would pass salmon, shad, and river herring, but without studies, effectiveness could not be determined. | Construction of spillway and powerhouse fish lifts would provide passage for salmon, shad, and river herring. Inclined flume would provide upstream passage for eels. Angled bar rack and multi-level gated bypass would provide non-turbine passage for all downstream migrating fish species. Studies would be performed to determine passage effectiveness.[3] |
| | | Some shortnose sturgeon spawning may occur directly below the dam. | No change. | Spillage of 6,000 cfs from dam from April 15 through May would enhance shortnose sturgeon spawning and incubation.[3] |
| | Fisheries | Some Atlantic sturgeon spawning may occur directly below the dam. | No change. | Spillage of 4,500 cfs from dam during July would enhance Atlantic sturgeon spawning and incubation.[3] |
| | | Funding for anadromous fish restoration limited to fish pump operation. | Besides constructing and operating fishways, Edwards would initially stock 25,000 Atlantic salmon parr at an upstream location and 10,000 smolt for 4 years below Edwards dam. Would provide an estimated 40 to 100 additional adult salmon per year for angling and restoration purposes. | Our recommendation to provide like funds to general anadromous fish restoration fund would allow resource agencies to make restoration management decisions and would partially offset costs incurred by KHDG signatories. Would not preclude salmon stocking.[3] |

Table ES-2. (cont.)

| Project | Resource Area | No Action[2] | Applicants' Latest Proposal | Projects as Proposed Plus Staff Modifications |
|---|---|---|---|---|
| Edwards (cont.) | | Fishway sorting confined to state and KHDG personnel sorting of fish pump collections. | Fish lift collections sorted by others or all fish passed to impoundment. | Funding of fish lift, sorting, and reporting by Edwards. Undesirable species and sturgeon, striped bass, and smelt returned to tailwaters, targeted anadromous fish passed to impoundment or trucked to target sites under direction of resource agencies.[3] |
| | Dam Removal | Dam remains in place. | Dam remains in place. | Dam is removed. |

* Without the Edwards Project, annual generation would be 479.064

1 We include only substantive measures that differ between the applicants' originally proposed (or later modified) and our proposed enhancements.

2 Measures listed under the no-action alternative describe existing conditions.

3 Staff modifications that would be recommended if the dam remains in place.

Table ES-3. Comparison of Alternatives for the Edwards Project

| | Applicants' Proposal | Staff's Licensing Alternative | Project Retirement and Dam Removal Alternative |
|---|---|---|---|
| Fish passage for: Atlantic salmon, American shad, alewife, blueback herring, American eel | Would provide passage but with substantial migration delays and other inefficiencies | Would provide passage but with some inefficiencies | Eliminates all passage inefficiencies |
| Fish passage for: shortnose sturgeon, Atlantic sturgeon, striped bass, and rainbow smelt | No passage provided -- there are no known passage technologies available that could effectively pass these species | No passage provided -- there are no known passage technologies available that could effectively pass these species | Eliminates all passage inefficiencies |
| Levelized net annual costs (thousands $ and mills/kWh) | $496.7<br>21.7 | $1,317 .6<br>61.9 | $786.1 [6]<br>N/A |
| Soils and water quality | No effect | No effect | Possible short-term increase in erosion and sedimentation along the exposed shoreline |

[6] The estimated cost of the dam removal alternative includes the carrying charges of the net investment for the existing project ($6,373,500), dam removal ($2.6 million), and mitigation for the effects of dam removal ($150,000).

Table ES-3. (cont.)

| | Applicants' Proposal | Staff's Licensing Alternative | Project Retirement and Dam Removal Alternative |
|---|---|---|---|
| Terrestrial Resources | Reduction in impoundment fluctuations would enhance wildlife and wetlands | Reduction in impoundment fluctuations would enhance wildlife and wetlands | Restoring 15 miles of impounded conditions would result in more diverse aquatic habitat and a net increase in wetlands |
| Recreational resources | Minor improvements: rebuild existing boat ramp, create new picnic and primitive camping areas | Minor improvements: rebuild existing boat ramp, create new picnic and primitive camping areas | Creation of a new whitewater boating opportunity and increase in the diversity of angling experiences |
| Consistency with comprehensive plans | Consistent with all applicable plans except one: the state of Maine's Comprehensive Management Plan for the Kennebec River | Consistent with all applicable plans except one: the state of Maine's Comprehensive Management Plan for the Kennebec River | Consistent with all applicable plans |

# 1.0 PURPOSE AND NEED FOR ACTION

In this section, we describe: (1) the purpose of the action, (2) whether or not there is a need in the region for the power that the projects would produce, (3) the scope of the Environmental Impact Statement (EIS), (4) the Kennebec Hydro Developers Group (KHDG) agreement, and (5) the organization of the EIS.

## 1.1 PURPOSE OF ACTION

The Commission must decide whether or not to issue licenses for 10 existing hydroelectric projects in the Kennebec River Basin (Moosehead, Wyman, Sandy River, Automatic, Union Gas, Rice Rips, Oakland, Fort Halifax, and Edwards) and whether or not to surrender the license for one existing storage project (Moxie). Table 1-1 lists all of the projects that are evaluated in the EIS, and Figure 1-1 shows their location.

The Commission, pursuant to the Federal Power Act (FPA)[1] and the U.S. Department of Energy (DOE) Organization Act,[2] is authorized to issue licenses for up to 50 years for constructing and operating nonfederal hydroelectric developments subject to its jurisdiction, on the following necessary conditions:

> [T]hat the project adopted...shall be such as in the judgment 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)...[3]

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[1] 16 U.S.C. §§791(a)-825(r).

[2] 42 U.S.C. 7101-7352.

[3] 16 U.S.C. Sec. 803(a).

Table 1-1. Kennebec River Basin hydroelectric projects evaluated in this EIS (listed upstream to downstream)

| Project | Applicant | FERC Project Number | Existing Capacity (MW) | Total Proposed Capacity (MW) |
|---|---|---|---|---|
| Moosehead | Kennebec Water Power Co. | 2671 | None | None |
| Moxie | Central Maine Power Co. et al. | 2613 | None | None |
| Wyman | Central Maine Power Co. | 2329 | 72.0 | 72.0 |
| Williams[1] | Central Maine Power Co. | 2335 | N/A | N/A |
| Sandy River | Town of Madison, Dept. of Electric Works | 11433 | 0.5 | 0.5 |
| Weston | Central Maine Power Co. | 2325 | 12.8 | 14.8 |
| Fort Halifax | Central Maine Power Co. | 2552 | 1.5 | 1.5 |
| Oakland | Central Maine Power Co. | 2559 | 2.8 | 2.8 |
| Rice Rips | Central Maine Power Co. | 2557 | 1.6 | 1.6 |
| Automatic | Central Maine Power Co./ Kennebec Water District | 2555 | 0.8 | 0.8 |
| Union Gas | Central Maine Power Co. | 2556 | 1.5 | 1.5 |
| Edwards | Edwards Manufacturing Co./ city of Augusta | 2389 | 3.5 | 4.5 |
| Totals | | | 97.0 | 100.0 |

Source: staff.

[1] Because the Williams Project Environmental Assessment called for the review of the impacts of fluctuations at the time of the Wyman Project relicensing proceedings, we consider these impacts in this EIS.

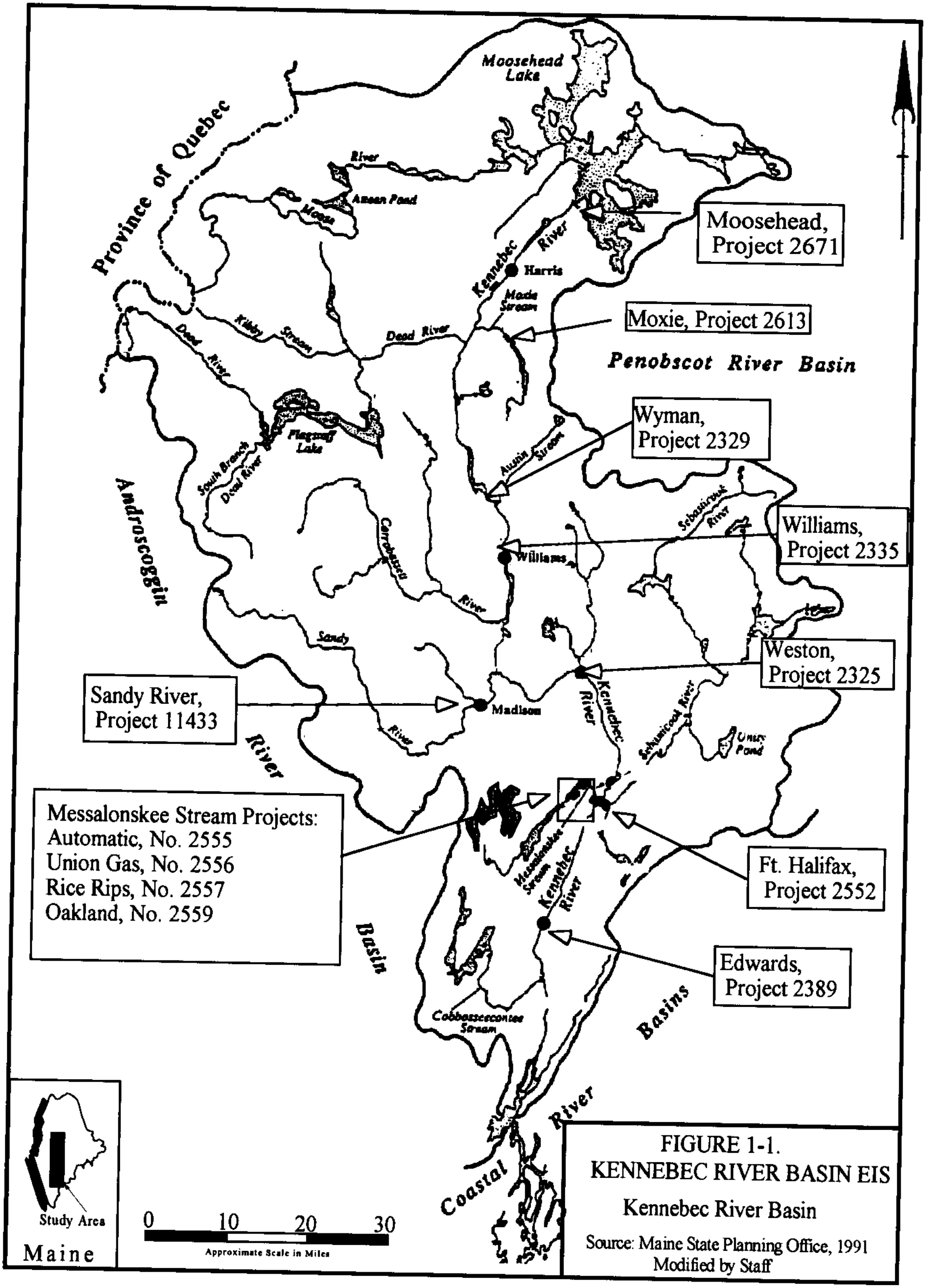


FIGURE 1-1.
KENNEBEC RIVER BASIN EIS
Kennebec River Basin
Source: Maine State Planning Office, 1991
Modified by Staff

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.[4] Compliance with such conditions during the licensing period is required. Section 385.206 (1987) of the Commission's Rules of Practice and Procedure allows 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.

## 1.2 NEED FOR POWER

The Kennebec Water Power Company (KWP) (comprising five companies[5] with generating facilities on the river) owns the Moosehead Headwater Storage Project and manages storage in the upper Kennebec to provide an average annual flow of about 3,600 cubic feet per second (cfs), as measured at Madison, Maine. The same five companies own the Moxie Project.

### 1.2.1 Central Maine Power

Central Maine Power (CMP) applied for new licenses for nine of its (or its affiliates -- KWP and the Owners of the Moxie Project) hydroelectric projects: Moosehead, Moxie, Wyman, Weston, Fort Halifax, Oakland, Rice Rips, Automatic, and Union Gas.

The first project to generate energy was the Fort Halifax Project in 1908, followed by Rice Rips in 1918; Weston in 1923, Oakland, Union Gas, and Automatic in 1924; and Wyman in 1930.

The nine CMP-affiliated projects are in the New England Power Pool (NEPOOL) subregion of the Northeast Power Coordination Council (NPCC) Regional Electric Reliability Council region. As reported in the 1995 Electricity Supply and Demand report issued by the North American Electric Reliability Council (NERC), NEPOOL forecasts an average annual increase in peak capacity demand of 1.1 percent during the summer months and 1.3 during the winter months for the 1995 to 2004 planning period. During the same period, NEPOOL forecasts an annual decrease in planned capacity of 0.5 percent during the summer months and 0.3 percent during the winter months.

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[4] 16 U.S.C. 803(g).

[5] These five companies are Central Maine Power, Scott Paper Company, Madison Paper Industries, Edwards Manufacturing Company, and Merimil Limited Partnership (the Owners).

NEPOOL forecasts a capacity margin[6] ranging from a high of 27.9 percent during winter 1995 to a low of 10.9 percent during summer 2004. The 10.9 percent capacity margin forecasted for the NEPOOL region in 2004 does not provide sufficient flexibility for reliable energy production.

Considering the extended periods of time during which CMP and CMP's customers have benefitted from the hydropower output of CMP's projects and NEPOOL's growth rate projections, the Commission's staff (the staff) concludes that the short-term and long-term needs of CMP for the electricity generated by the projects are adequately established.

### 1.2.2 Madison Electric Works

The town of Madison, Department of Electric Works (MEW), operates the Sandy River Project. It was constructed in 1903. The town of Madison uses the electricity that is generated.

The town of Madison has depended on low-cost electric power from the Sandy River Project for about 66 years. This long period of operation established both the short-term and long-term needs for electric power in this region.

### 1.2.3 Kennebec Water District

In November 1991, CMP, the owner of the Automatic Project, filed an application for license. Subsequently, CMP filed a request to transfer its license to the Kennebec Water District (KWD). On January 3, 1995, the Commission approved the transfer of license to KWD.

The Automatic Project was constructed in 1924. The project was owned and operated by CMP until transfer to KWD. KWD uses the power to replace purchases from CMP. Excess power generated at the project is sold to CMP. This long period of operation has established both the short-term and long-term needs for electric power from this project.

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[6] Capacity margin is the difference between the planned capacity and the capacity demand. Capacity margin is needed to replace generating capacity removed from service because of unscheduled or forced outages of generating or transmission equipment, to replace capacity removed from service for scheduled maintenance, to serve loads greater than anticipated, to compensate for adverse hydrologic conditions, and for system control (FERC, 1979).

### 1.2.4 Edwards Manufacturing Company

Edwards dam was constructed by the Kennebec Dam Company in 1837. In 1913, the first electric generator was installed. The energy generated was first used in the textile mills associated with the dam. Edwards Manufacturing Company (Edwards) originally purchased the project in 1882, sold it in 1945, and repurchased the project in 1989. The energy generated at Edwards was first sold to CMP beginning in the mid 1960's.

Edwards and the city of Augusta own and operate the Edwards Project. They continue to sell the power that the project generates to CMP to meet the NEPOOL demand.

We establish the need for power in the NEPOOL region in Section 1.2.1 and therefore conclude that the electricity generated by the Edwards Project is also needed.

## 1.3 SCOPE OF THE EIS

On June 13, 1993, the Commission issued a notice of intent to prepare an EIS for eight hydroelectric developments and two headwater reservoirs in the Kennebec River Basin. At that time, the staff also implemented a scoping process to determine issues that the EIS would address and to solicit comments. The staff conducted site visits to 10 developments on November 17 through 19, 1993, and issued Scoping Document 1 in December 1993 for public review and comment. The staff subsequently revised Scoping Document 1, and issued it in June 1994.

The potential licensing of the Sandy River Hydroelectric Project was included in the scope of the EIS. This previously unlicensed project was found to be within the Commission's jurisdiction. The staff included it in the scope of the EIS because it is the most downstream project on a major tributary of the Kennebec River, habitat upstream of the dam is targeted for anadromous fish restoration, and the Sandy River license application was ready for environmental analysis.

Interested individuals, organizations, and agencies were invited to participate in two public scoping meetings on July 13 and 14, 1994, in Augusta, Maine. In September 1994, Scoping Document 2 was issued in which the staff responded to comments received and outlined the issues to be addressed in the EIS.[7]

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[7] Because the Williams Project Environmental Assessment called for the review of the impacts of fluctuations at the time of the Wyman Project relicensing proceedings, we consider these impacts in this EIS.

The staff reviewed and considered all comments from the scoping process and addressed each, as appropriate. We consider the effects of proposed operations at the 10 projects under consideration for a license or relicense and the one project under consideration for license surrender on operations of other storage and generation projects in the Kennebec River Basin, overall energy requirements of the region, and the cumulative effects of the 11 projects on the environmental resources of the basin.

By filing dated April 1, 1993, the Owners of the Moxie Project withdrew their license application. By filing dated December 22, 1993, the Owners stated that as of the expiration date of the original license (December 31, 1993), they would cease all jurisdiction activities at the project. Further, the Owners advised that they were transferring the project to the town of The Forks. On January 12, 1994, the Commission issued public notice of the establishment of a surrender proceeding for the Moxie license. The Owners protested by letter filed April 15, 1994, and asserted that the Commission no longer had jurisdiction over the project.[8] The Owners of Moxie requested that the Moxie Project not be included in this EIS. The analysis herein for the Moxie Project assumed a surrender proceeding.

CMP received permission from the Commission on February 12, 1990, to apply for one license for its four separately licensed projects on Messalonskee Stream (Oakland, Rice Rips, Automatic, and Union Gas). The single project would be named the Messalonskee Project. CMP also requested that the Commission consider the four projects on Messalonskee Stream as one project in the EIS because of the extent to which the projects' operations are integrated. In our analysis, we treat each development both individually and cumulatively, and the projects retain their individual project numbers.

On November 16, 1993, CMP applied for approval of transfer of the license for the Automatic Project to KWD, a quasi-municipal corporation in Waterville, Maine. The Commission approved the transfer on January 3, 1995.

On June 21, 1993, the Commission issued an Environmental Assessment (EA) for the Weston Project. The Commission subsequently determined that the Weston Project should be included in this EIS.

The Commission issued a draft EIS for the Kennebec River Basin un January 1996.

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[8] An Order Finding Licensing Not Required for the Moxie Project was issued on July 8, 1997 (80 FERC ¶ 62,019).

On June 4, 1996, Edwards and the city of Augusta, Maine, joint licensees for the Edwards Project, filed a motion to remove the pending proceeding to relicense that project from the pending consolidated proceeding for the multiple projects in the Kennebec River Basin, alleging that a Commission staff member violated the Commission's separation of function rule. The motion requested that the Commission initiate separate *de novo* review of the Edwards Project application. On December 20, 1996, the Commission issued an order[9] denying Edwards' request. However, it ordered new staff, with no prior involvement in the Edwards proceedings, to be assigned to review the existing record and conduct a new review under Section 10(j) of the FPA. In addition, the Commission ordered that the staff contract with Oak Ridge National Laboratory (ORNL) to prepare an independent study of the cost of removing Edwards dam. In a subsequent order dated March 14, 1997, the Commission reaffirmed its prior decision and directed that the ORNL report be substituted for the one that had been prepared by Stone & Webster for the draft EIS.

### 1.4 KHDG AGREEMENT

On January 27, 1987, owners of seven hydroelectric projects upstream of Edwards dam on the Kennebec and Sebasticook Rivers entered into a negotiated settlement agreement with Maine fishery agencies to facilitate the restoration of alewives, American shad, and Atlantic salmon in accordance with the existing management plans for all three species. Edwards and MEW are not parties to the agreement. Projects assessed in this EIS that are affected by the agreement are the Weston and Fort Halifax projects.

The Kennebec Hydro Developers Group (KHDG) projects and associated owners are Fort Halifax, Shawmut, and Weston (all owned by CMP); Lockwood (owned by Merimil Limited Partnership); Hydro-Kennebec (owned by Scott Paper Company); Benton Falls (owned by Benton Falls Associates); and Burnham (owned by Pittsfield Hydro Co., Inc.; now Consolidated Hydro Maine, Inc.). Figure 1-2 shows the locations of the KHDG facilities. The KHDG agreement is the basis for the installation of upstream and downstream passage measures. Upstream passage is scheduled to be in place by May 1, 1999, at Lockwood, Hydro Kennebec, Fort Halifax, and Benton Falls; by May 1, 2000, at Shawmut and Burnham; and by May 1, 2001, at Weston according to the agreement.

FERC issued orders on January 25, 1989, amending the licenses of six of the seven KHDG projects to incorporate the terms of the KHDG agreement (the Burnham Project was not considered jurisdictional at that time although it is now).

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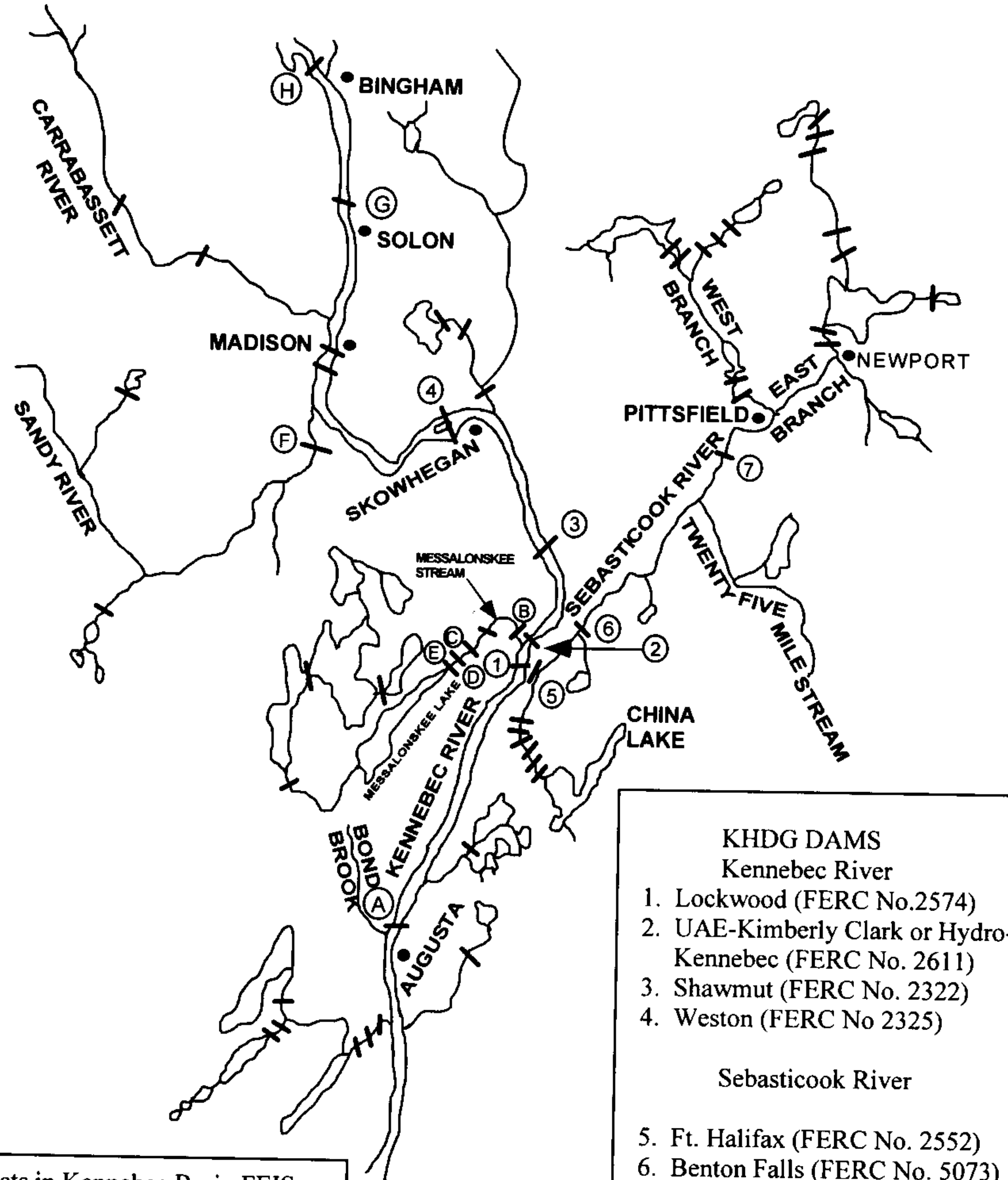
[9] 77 FERC ¶ 61,285.




KHDG DAMS

Kennebec River

1. Lockwood (FERC No.2574)
2. UAE-Kimberly Clark or Hydro-Kennebec (FERC No. 2611)
3. Shawmut (FERC No. 2322)
4. Weston (FERC No 2325)

Sebasticook River

5. Ft. Halifax (FERC No. 2552)
6. Benton Falls (FERC No. 5073)
7. Burnham (unlicensed)

Projects in Kennebec Basin FEIS but not under KHDG agreement:

A. Edwards
B. Automatic
C. Union Gas
D. Rice Rips
E. Oakland
F. Sandy River
G. Williams
H. Wyman

FIGURE 1-2.

KENNEBEC RIVER BASIN EIS

Location of KHDG Dams

Source: staff.

These orders indicated that amending the licenses to reflect the KHDG agreement would provide a definitive program and schedule for anadromous fish restoration in the Kennebec River Basin. The orders further stated that the amendments provide adequate provisions for FERC to require necessary changes that may be necessary for successful anadromous fish restoration. American Rivers intervened and filed a timely appeal of these orders, and state resource agencies intervened in support of the amendments.

FERC issued an EA of the amendments in March 1991 and issued an order denying rehearing, amending the licenses, and lifting the stays of the 1989 orders on October 22, 1992. The order stated that "(t)aking into account the analysis in the EA and the unknown resolution and timing of fish passage at Edwards dam, we conclude that the license amendments in this proceeding, incorporating the 1986 restoration plan, are a reasonable course of action and should be affirmed."

On April 23, 1997, KHDG filed a request for license amendments with the Commission. The filing requests, among other things, that the installation of permanent fish passage facilities not be required until, at a minimum, there are both: (a) permanent fish passage available at Edwards dam or dam removal and (b) a biological assessment process determines that restoration efforts have advanced sufficiently to require fish passage facilities.

Any delay in the installation of permanent fish passage facilities at the KHDG dams would delay the restoration goals for alewives, American shad, and Atlantic salmon.

At this time, the April 23, 1997, KHDG filing is pending and will be addressed in a separate proceeding.

## 1.5 ORGANIZATION OF THE EIS

This EIS includes nine main sections, with the following information:

- Executive Summary: Summary of our environmental and economic analyses and the conclusions drawn for each project.
- 1.0 Purpose and Need for Action: Description of (1) the purpose of the EIS, (2) whether or not there is a regional need for the power that the projects would produce, (3) the KHDG agreement, and (4) the content of the EIS.

- 2.0 Proposed Actions and Alternatives: Description of the facilities and environmental measures proposed by the applicants and two principal alternatives to the proposed action: (1) our additional recommended enhancement measures and (2) the no-action alternative. In this section, we also include an economic comparison of the alternatives.

- 3.0 Affected Environment: Description of the existing regional and site-specific environmental conditions that define the baseline for our analyses of adverse or beneficial impacts of each alternative.

- 4.0 Environmental Consequences: Analysis of environmental effects, beneficial and adverse, cumulative and site-specific, of each alternative. For each resource area, we first describe the applicants' proposals. We then describe what alternative actions or measures agencies, nongovernmental organizations, and individuals recommend and our conclusions and supporting analyses. For each resource area, we then summarize cumulative environmental effects.

- 5.0 Staff's Conclusions: Description of (1) our conclusions about significant environmental effects of each alternative; (2) our economic evaluation of each alternative; (3) an overall comparison of the proposed projects and alternatives on energy generation, cost, and environmental impacts and enhancements; and (4) our recommendations, the consistency of our recommendations with comprehensive plans for the project area, and specific fish and wildlife agency recommendations.

- 6.0 Literature Cited

- 7.0 List of Preparers

- 8.0 List of Recipients

- Appendices

# 2.0 PROPOSED ACTIONS AND ALTERNATIVES

In Section 2.1, we describe the facilities and environmental measures proposed by the applicants for new or original licenses and, in the case of Moxie, license surrender. In Section 2.2, we present statutory requirements for the projects, including water quality certification (WQC) conditions and Section 18 fishway prescriptions. We then describe two principal alternatives to the proposed action: (1) licensing the proposed projects with additional staff-recommended enhancements (Section 2.3) and (2) the no-action alternative (Section 2.4). No action would mean that the projects would continue to operate as they currently do. In Section 2.5, we provide our analysis of other alternatives considered, including denying the applications; federal takeover and operation of the projects; and issuing nonpower licenses. We also include an economic comparison of the proposed actions and the alternatives (Section 2.6).

## 2.1 PROJECTS AS PROPOSED

### 2.1.1 Project Facilities and Operations

In this section, we describe each of the 11 projects, beginning with the most upstream. They are all on the Kennebec River and its tributaries. (See Section 1.1, Figure 1-1 for project locations.) Most projects would continue their present mode of operation under the applicants' proposal.

*2.1.1.1 Moosehead Project* (Figures 2-1, 2-2, and 2-3)

The project consists of: (1) two dams with: (a) a 1,004-foot-long earth and concrete East Outlet dam ranging in height from 15 to 20 feet and (b) an 830-foot-long, 14-foot-high earth and concrete West Outlet dam; and (2) a reservoir having a surface area of 74,200 acres and a storage capacity of 544,880 acre-feet (AF). The dams were originally built in about 1835 to facilitate log drives.

KWP currently releases minimum flows of 200 and 25 cfs at the East and West Outlet dams, respectively. KWP proposes to continue the existing storage operation of the Moosehead Project. KWP also proposes to release a minimum flow of 500 cfs or inflow from the East Outlet, however, and a minimum flow of 80 cfs (October through April) and 120 cfs (May through September) from the West Outlet.

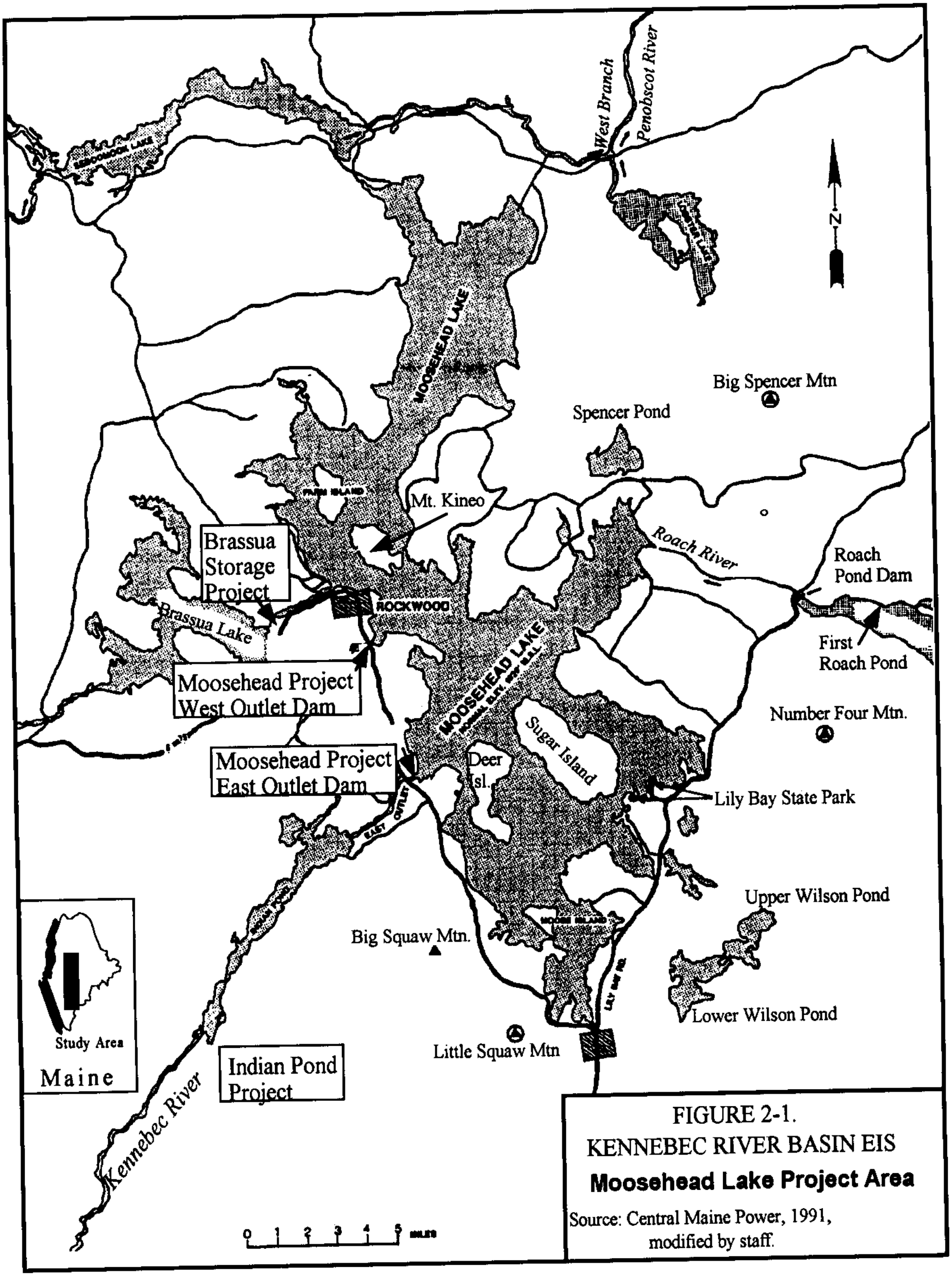



FIGURE 2-1.
KENNEBEC RIVER BASIN EIS
**Moosehead Lake Project Area**

Source: Central Maine Power, 1991,
modified by staff.

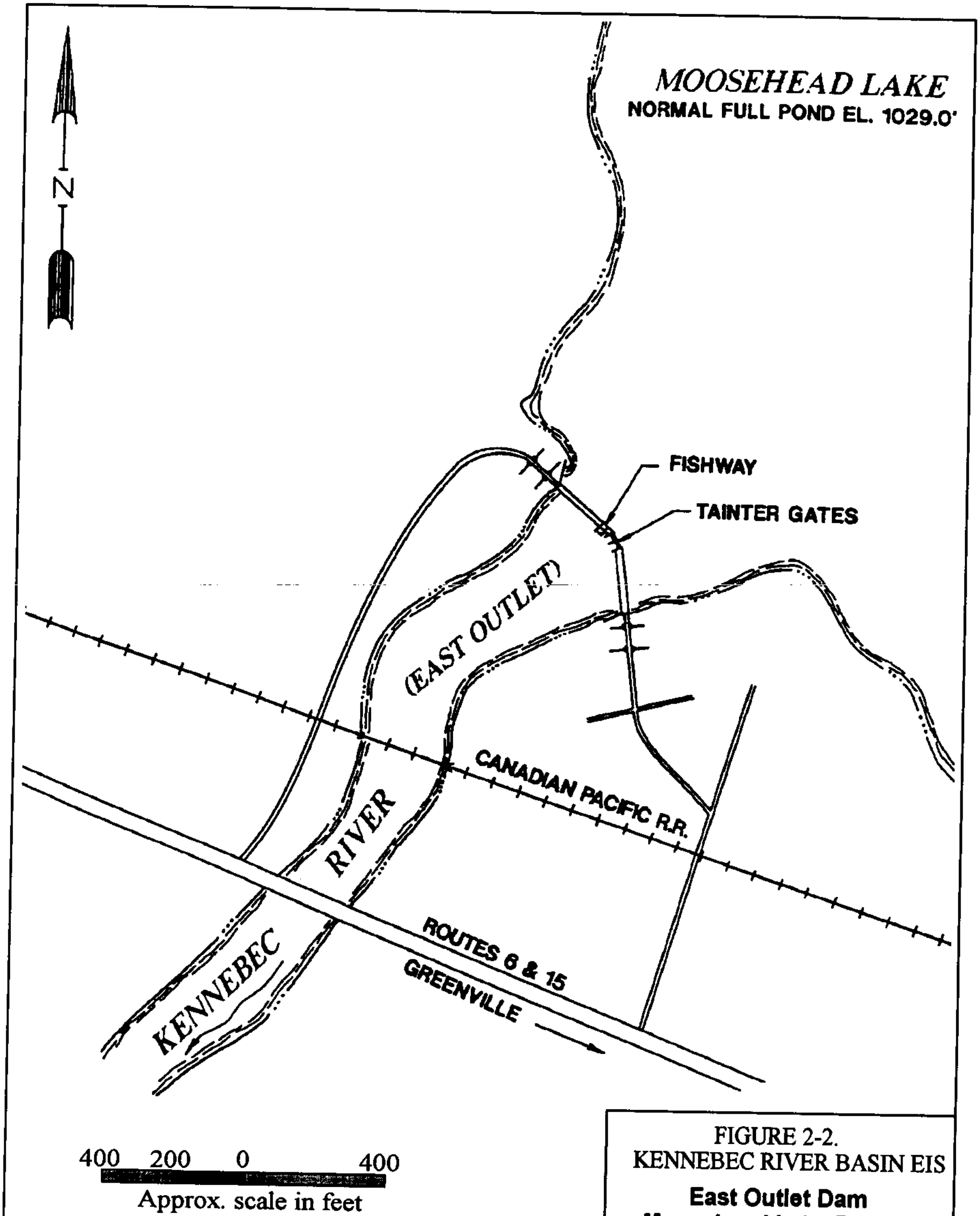



FIGURE 2-2.
KENNEBEC RIVER BASIN EIS
**East Outlet Dam**
**Moosehead Lake Project**
Source: Central Maine Power Modified by Staff

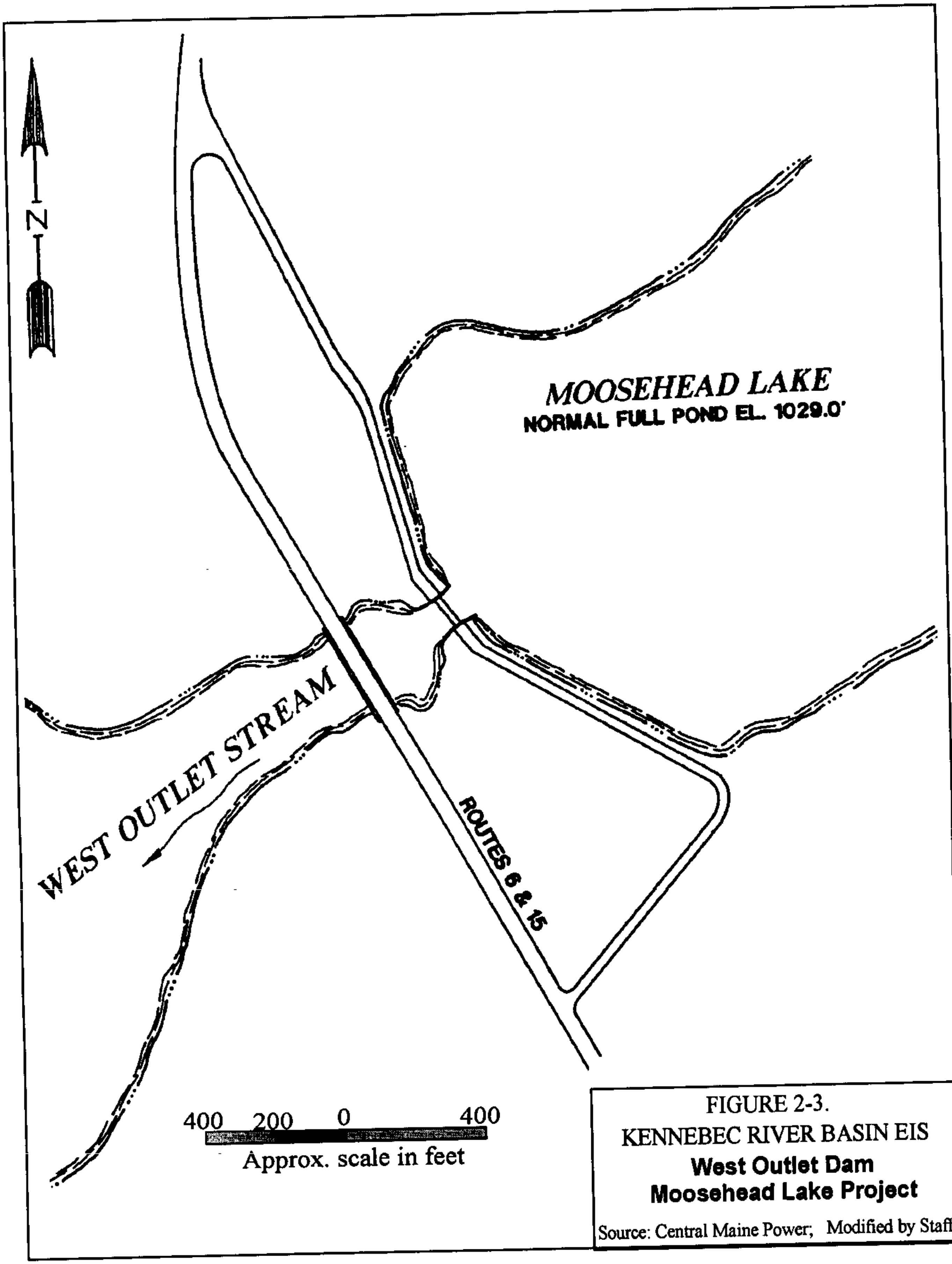



FIGURE 2-3.
KENNEBEC RIVER BASIN EIS
**West Outlet Dam**
**Moosehead Lake Project**
Source: Central Maine Power; Modified by Staff

### 2.1.1.2 *Moxie Project*[1] (Figure 2-4)

The project consists of: (1) a 570-foot-long, 19-foot-high concrete gravity dam with (a) a 124-foot-long concrete nonoverflow section, (b) a 172-foot-long spillway section, (c) a 37-foot-long gate section with one 6-foot-high steel gate and two 8-foot-high timber gates, and (d) a 238-foot-long spillway section; (2) three concrete closure dams, east of the main dam and consisting of (a) 169-foot-long closure dam "A," (b) 201-foot-long closure dam "B" with 80 feet topped with 1.5-foot-high pin-supported flashboards and 10 feet topped with 1-foot-high pin-support flashboards, and (c) 29-foot-long closure dam "C"; (3) an earthen dike 140-feet-long with a concrete core; (4) a 7.5-mile-long impoundment with a gross storage capacity of 14,700 AF; and (5) appurtenant facilities. The first dam was constructed near the site of the existing dams in 1912 to facilitate log drives.

The Owners and The Forks propose to: (1) operate the project in a run-of-river mode[2] (except during the spring refill and fall drawdown period); (2) release 25 to 44 cfs or inflow, whichever is less, during the spring refill period; (3) maintain the impoundment at full pond from after the spring refill period to November 15; and (4) draw down the impoundment to an unspecified elevation after November 15 to prevent ice damage to shoreline structures.

Subsequent to the filing of the application for a new license in 1991, meetings were held between resource agencies, other interested parties, and the Owners. These meetings resulted in the development of a "consensus scenario" of project operations that the Owners forwarded to FERC (letter dated March 31, 1993). The consensus scenario calls for maintaining full pond (elevation 970.3 feet) from May 1 to and including October 15, and minimizing fluctuations to within 0.5 foot during this period. Between October 15 and November 15, the pond would be

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[1] We treat the Moxie Project as proposed by the Owners in their contract for Sale of Real Estate and by The Forks in a letter dated December 15, 1993, detailing its proposed operation of the project.

[2] Operating the project in run-of-river mode means that the amount of water flowing into the project's reservoir equals the amount of water released from the project to the river downstream. This operating mode would minimize changes in reservoir water surface elevations and tailrace flows, however, due to operation constraints and flash flood events, there may be some minor fluctuations in reservoir elevations.

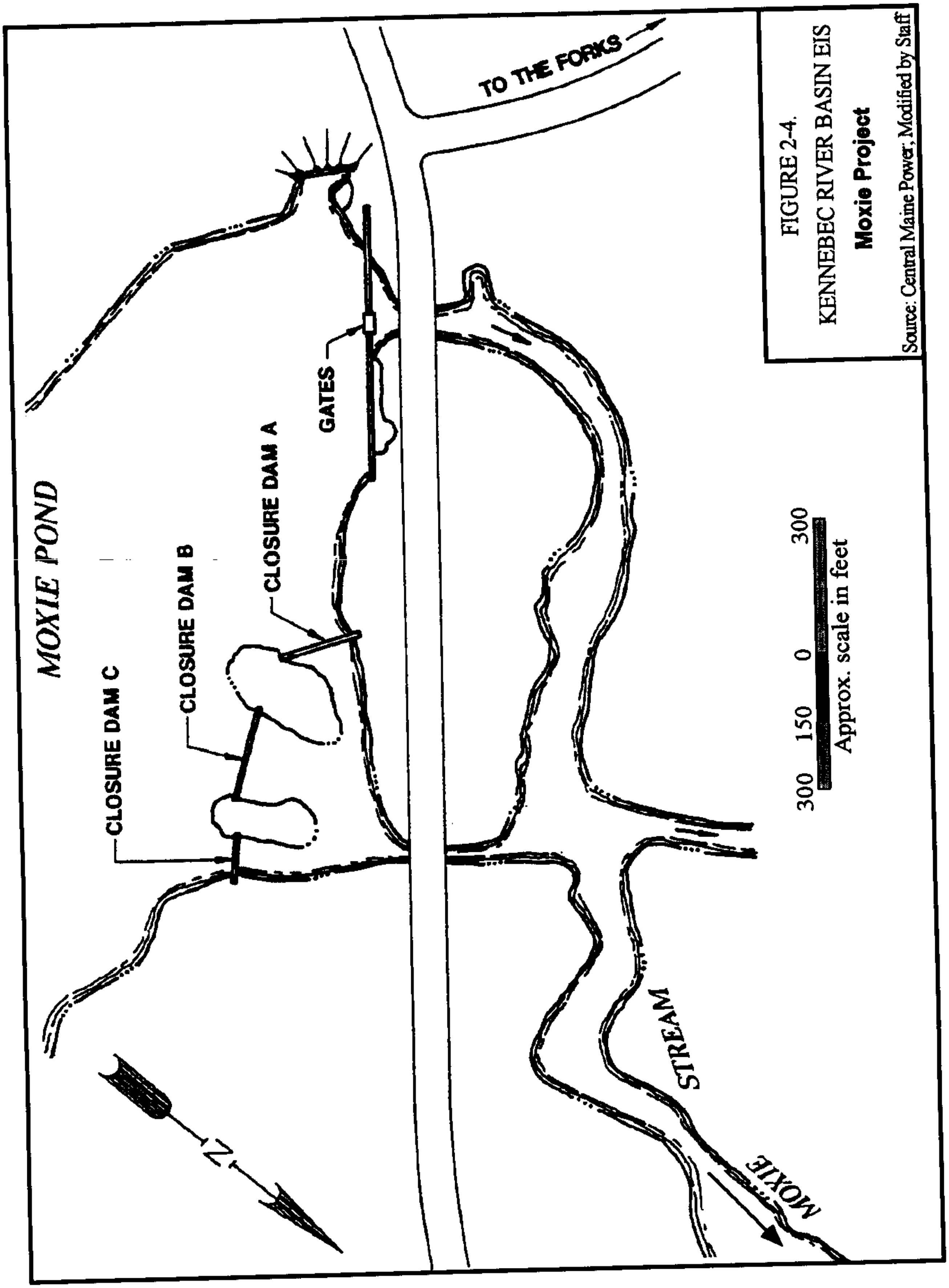


FIGURE 2-4.
KENNEBEC RIVER BASIN EIS
**Moxie Project**
Source: Central Maine Power; Modified by Staff

drawn down up to 1.5 feet and held at this level until it is refilled in the spring.

*2.1.1.3 Wyman Project* (Figure 2-5)

The project consists of: (1) a 3,246-foot-long concrete and earth dam with (a) a 438-foot-long, 84-foot-high (maximum height), gated, concrete gravity spillway section with a broome gate, three Taintor gates, three deep stanchion stoplog gates, a sluice way, and three shallow stanchion stoplog gates, (b) a 168-foot-long by 248-foot-wide intake structure and powerhouse section, and (c) an earthen embankment section, 2,640 feet long by 279 feet high, with a reinforced concrete core wall; (2) a reservoir with a gross storage capacity of 208,910 AF; (3) an intake structure with intake racks, a gatehouse, and six headgates each 11 feet wide by 22 feet high; (4) the reinforced concrete powerhouse, houses three generating units, each with a rating capacity of 24,000 kilowatts (kW); and (5) appurtenant facilities. The project was constructed between 1928 and 1932 for hydroelectric generation purposes.

CMP currently releases a minimum flow of 490 cfs at the project. It proposes to continue the peaking operation and to release a minimum flow of 1,200 cfs from May 16 to and including July 31 using the top 2.0 feet of Wyman Lake (elevation 483 to 485 feet) to augment natural inflow. From August 1 to and including May 15, a minimum flow of 1,200 cfs would be released using the top 4.0 feet (elevation 481 to 485 feet) of Wyman Lake to augment natural flow. It also proposes to maintain impoundment water levels between elevations 483.0 and 485.0 from May 16 through July 31 and between elevations 481.0 and 485.0 from August 1 to May 15 with the option to draw down the impoundment up to 8 feet in the spring for flood control.

*2.1.1.4 Sandy River Project* (Figure 2-6)

The project consists of: (1) a 331.4-foot-long, 14.9-foot-high concrete gravity dam with a granite core consisting of: (a) a 79-foot-long abutment on the southwest side of the spillway, (b) a 102-foot-long forebay, (c) a 5-foot-high by 11-foot-wide sluice gate, and (d) 2.6-foot-high pin-supported flashboards; (2) a 2.5-mile-long, 150-acre impoundment with a gross storage capacity of 1,050 AF; (3) an intake structure with gate hoists and 1.5-inch clear spacing trashracks; (4) a brick and masonry powerhouse, 32.5 feet wide by 46.5 feet long, housing one horizontal Francis turbine and one vertical Kaplan turbine and two General Electric generators with a rated capacity of 547 kW; and (5) appurtenant facilities. The project was constructed in 1903 for the purpose of hydroelectric generation.

MEW proposes to change the Sandy River Project operation from peaking to run-of-river, provide a 196-cfs minimum flow (or

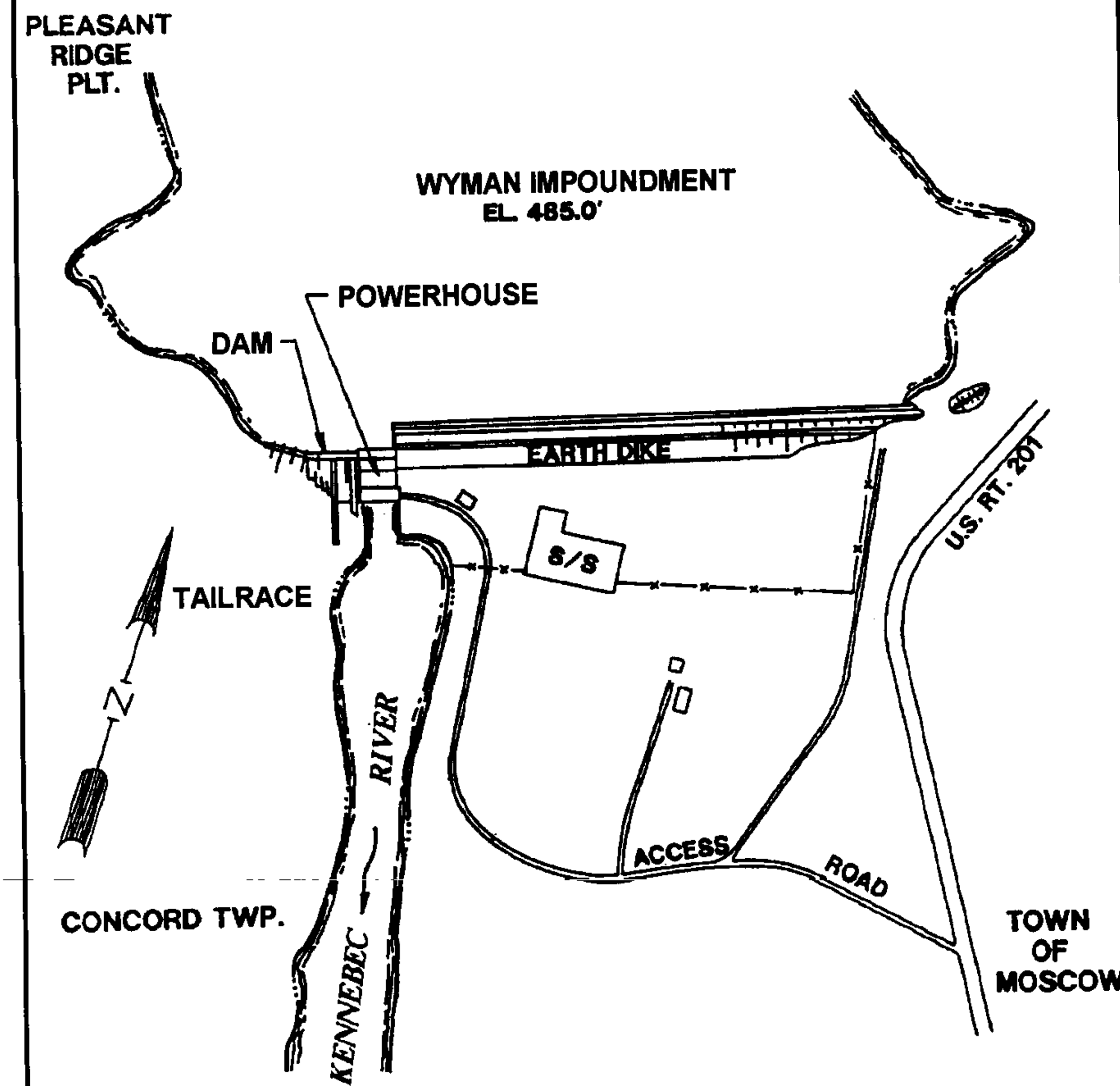


FIGURE 2-5.
KENNEBEC RIVER BASIN EIS
**Wyman Project**

Source: Central Maine Power; Modified by Staff

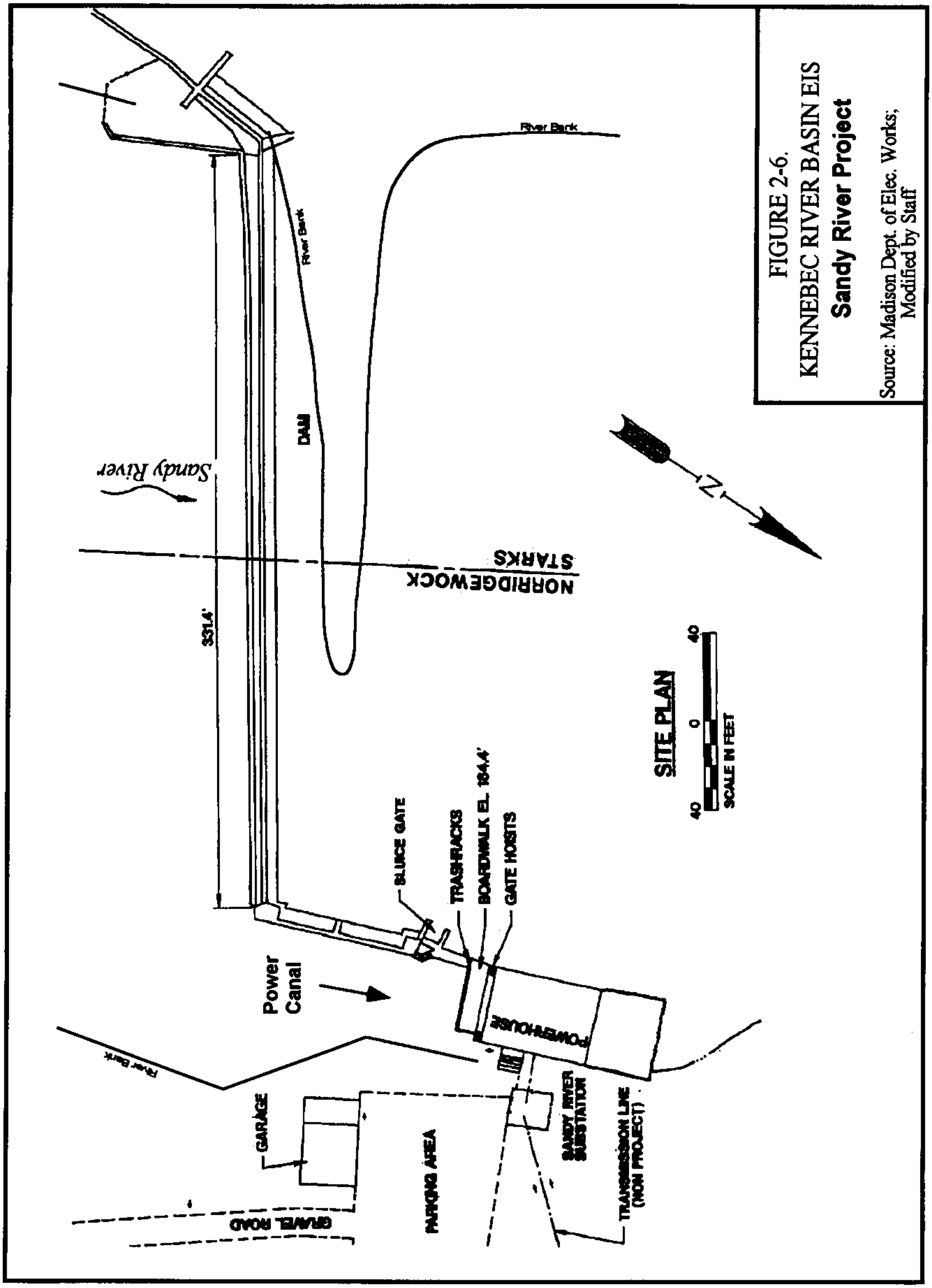


FIGURE 2-6.
KENNEBEC RIVER BASIN EIS
**Sandy River Project**

Source: Madison Dept. of Elec. Works;
Modified by Staff

inflow, if less), and to install upstream and downstream fishways by May 1, 2002. This would decrease average annual generation from 3 to 2.786 GWh.

*2.1.1.5 Weston Project* (Figure 2-7)

The project consists of: (1) a broad V-shaped North Channel dam with a (a) 75-foot-long concrete retaining wall, (b) a 23-foot-long nonoverflow section, (c) a 244-foot-long stanchion section with five bays, (d) a 170-foot-long section with 7-foot-high flashboards, (e) a 93-foot-long gate section with 28-foot-wide by 16-foot-high Taintor gates, and (f) an earth-filled abutment with a concrete core wall; (2) a South Channel dam with a (a) 125-foot-long intake section with four intake bays, (b) a 33-foot-long concrete spillway section, (c) a 24-foot-long sluice section, (d) a 188-foot-long stanchion section with five bays, and (e) a 22-foot-long concrete nonoverflow section; (3) a concrete, masonry, and steel powerhouse 90 feet high by 41 feet wide by 188 feet long, housing four generating units with a rating of 14,750 kW; (4) a 12.4-mile-long impoundment with a gross storage capacity of 18,600 AF; and (5) appurtenant facilities. The first dams at the Weston site were constructed in 1811 to provide water power to local mills.

CMP proposes to maintain run-of-river operation at the Weston Project and to pass a minimum flow of 1,947 cfs (or inflow, if less). CMP also proposes to replace the existing turbine runners with more efficient runners and to operate upstream and downstream fish passage. This would increase average annual generation from 81.9 to 89.5 GWh.

*2.1.1.6 Fort Halifax Project* (Figure 2-8)

The project consists of: (1) a concrete Ambursen dam, 553 feet long and 29 feet high consisting of from south to north (a) an 80.5-foot-long nonoverflow section with one 4-foot by 3-foot slide gate, (b) a 353-foot-long spillway section with 4-foot-high pin-supported flashboards, and (c) a 121-foot-long intake/powerhouse section with a waterwheel flume; (2) an impoundment about 5.2 miles long with a gross storage capacity of 5,000 AF and surface area of 417 acres at pool elevation of 51.5 feet; (3) a 30-foot-long concrete retaining wall adjacent to the powerhouse section; (4) a brick powerhouse, housing two turbine-generator units with a total installed capacity of 1,500 kW; (5) a tailrace; (6) a transmission line; and (7) appurtenant facilities. The project was constructed between 1907 and 1908 for the purpose of hydroelectric generation.

CMP currently releases a minimum flow of 20 cfs at the Fort Halifax Project from April through November during operation of an interim downstream fish passage facility. CMP proposes a minimum flow of 150 cfs from April to November, which includes

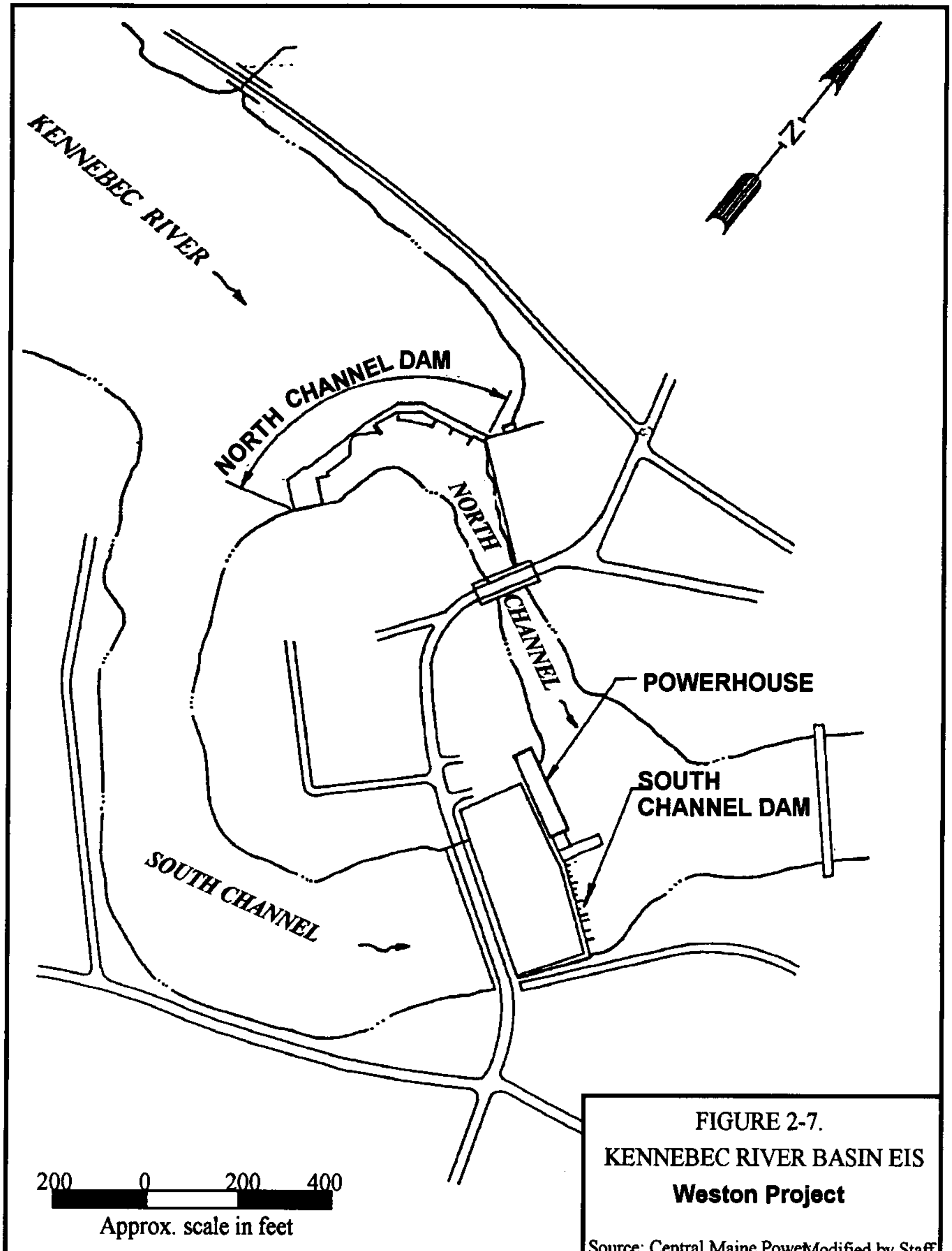


FIGURE 2-7.
KENNEBEC RIVER BASIN EIS
**Weston Project**

Source: Central Maine Power Modified by Staff

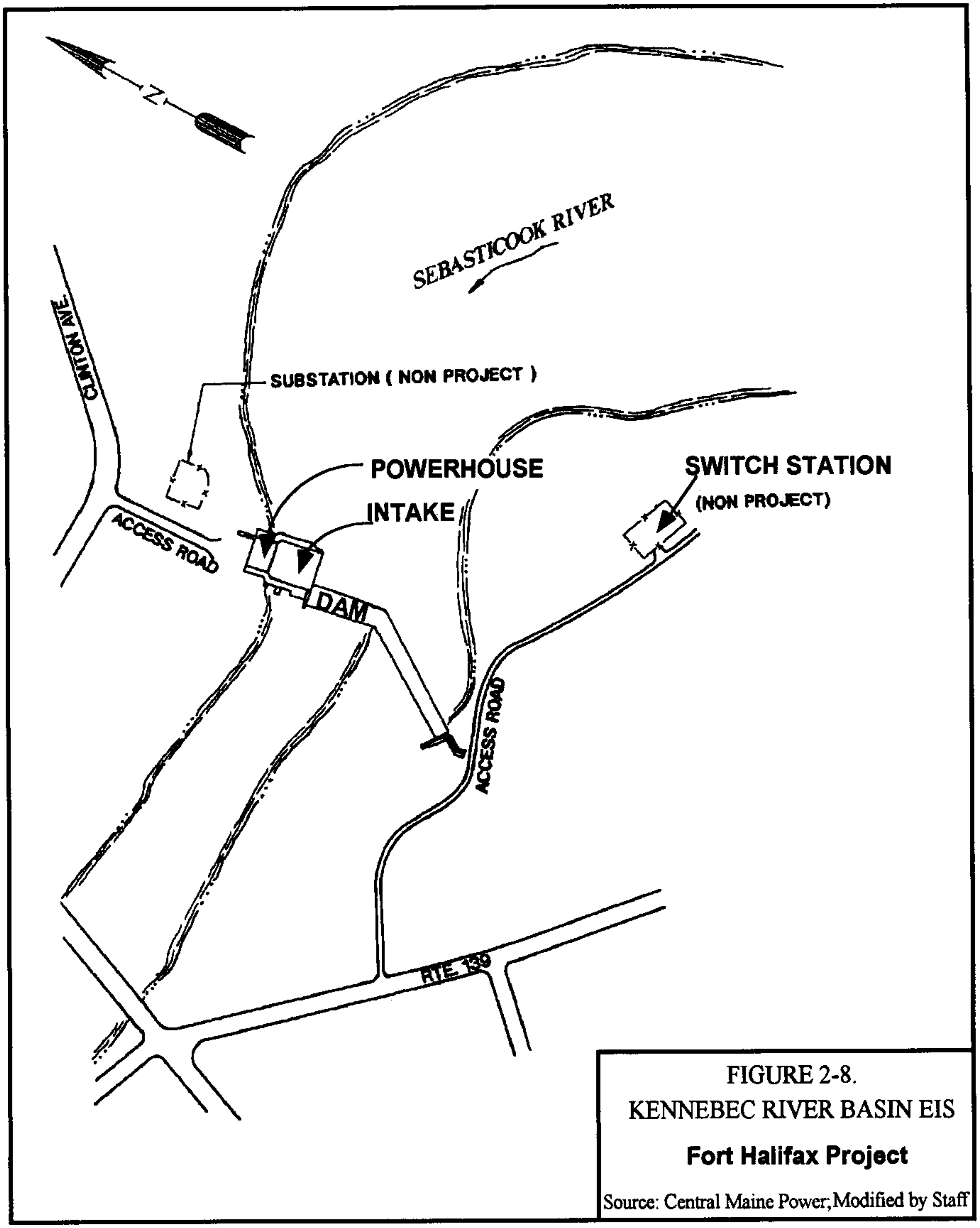


FIGURE 2-8.
KENNEBEC RIVER BASIN EIS
**Fort Halifax Project**
Source: Central Maine Power;Modified by Staff

upstream and downstream fish passage flows, and continued peaking operation. This would decrease the average annual generation from 7.822 to 7.032 GWh.

*2.1.1.7 Oakland Project* (Figures 2-9, 2-10, and 2-11)

The Oakland Project consists of two developments: Oakland and Messalonskee Lake. The developments are separated by about 0.8 mile, and Messalonskee Lake is upstream of Oakland.

The Messalonskee Lake Development consists of: (1) an L-shaped masonry gravity dam, 12.5 feet high and 150 feet long, with (a) a 108-foot-long spillway section, topped with 2-foot-high flashboards, (b) two 10-foot-high by 12-foot-wide Taintor gate sections, and (c) a wastegate 10 feet high by 4 feet wide; and (2) a storage reservoir, 3,500 feet wide, 15 miles long with a gross storage of 110,000 AF. The dam was originally constructed in 1915 to facilitate hydroelectric generation.

Because natural flows sufficient for efficient generation (570 cfs) occur only about 15 percent of the time on a long-term basis, CMP releases about 570 cfs from Messalonskee dam when inflow is less than 570 cfs for periods that are usually 8 hours long. Messalonskee Lake is allowed to fill between releases. Releases generally occur during 1 or 2 periods per day from mid-September through February, 2 or 3 periods per day from March through early June, and one period or less per week July through mid-September.

The Oakland Development consists of: (1) a concrete gravity dam with (a) a 63-foot-long spillway section, (b) an intake section, 51 feet long by 35 feet wide with a deck elevation of 213.3 feet with (i) a fiberglass-lined 10-foot-diameter steel penstock 466 feet long, and (ii) a 32-foot-long by 25-foot-wide surge tank, (c) a gate section with one Taintor gate, 6 feet high by 12 feet wide, and (d) a 353-foot-long spillway section with 4-foot-high, pin-supported flashboards; (2) a concrete-steel with stone masonry powerhouse, 90 feet high by 38 feet wide by 38 feet long, housing one vertical Francis turbine and Allis-Chalmers generator with a rated capacity of 2,800 kW; (3) a 0.4-mile-long impoundment with a gross storage capacity of 50 AF; and (4) appurtenant facilities. The dam was constructed in 1901 and the generating station constructed in 1924.

In addition to continuing run-of-river operation at the Oakland Development, CMP proposes to pass a minimum flow of 15 cfs at the Messalonskee Lake Development and the Oakland Development. This would decrease the average annual generation from 9.408 to 8.916 GWh.

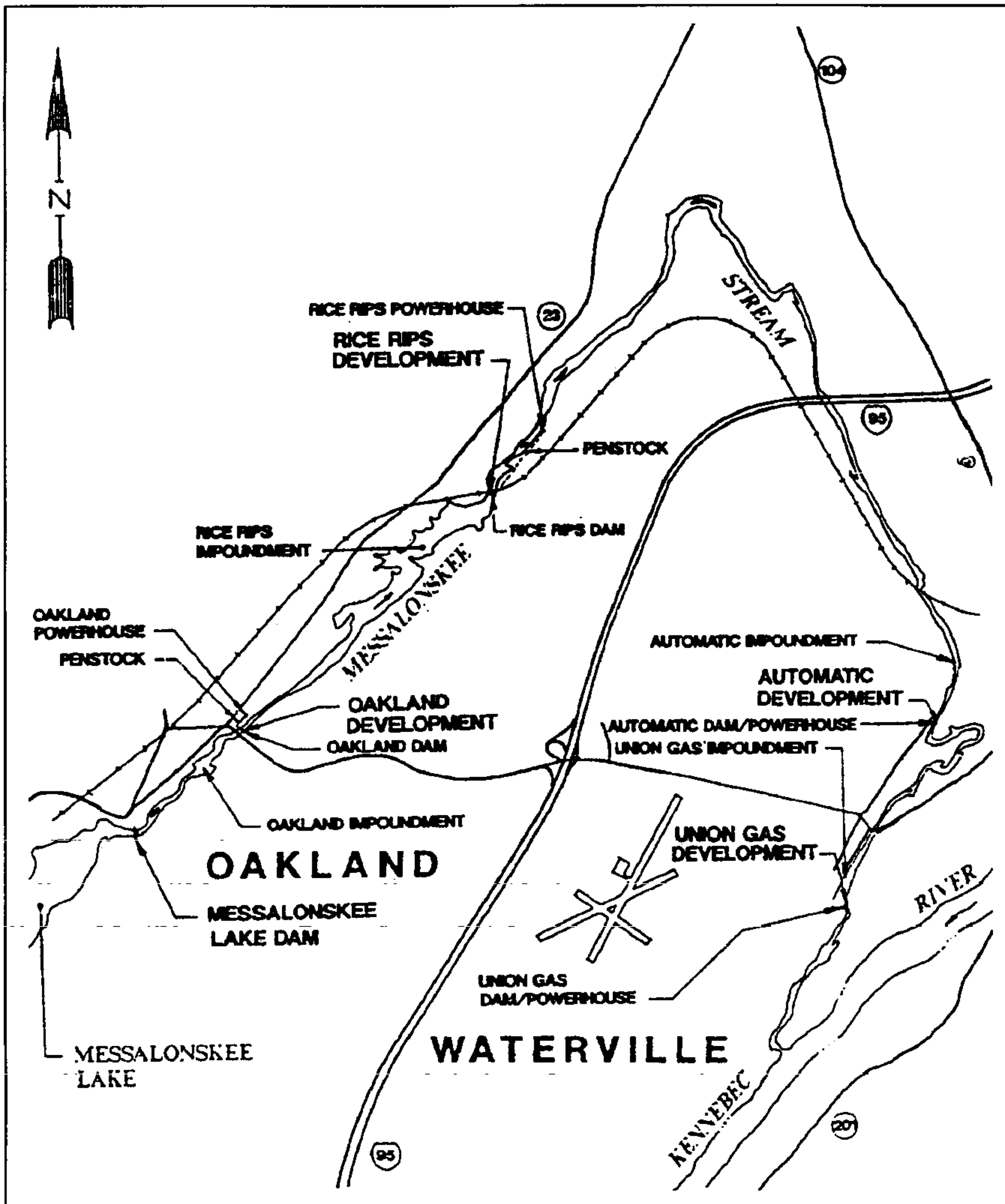


FIGURE 2-9.
KENNEBEC RIVER BASIN EIS
**Messalonskee Stream Project Area**
Source: Central Maine Power; Modified by Staff

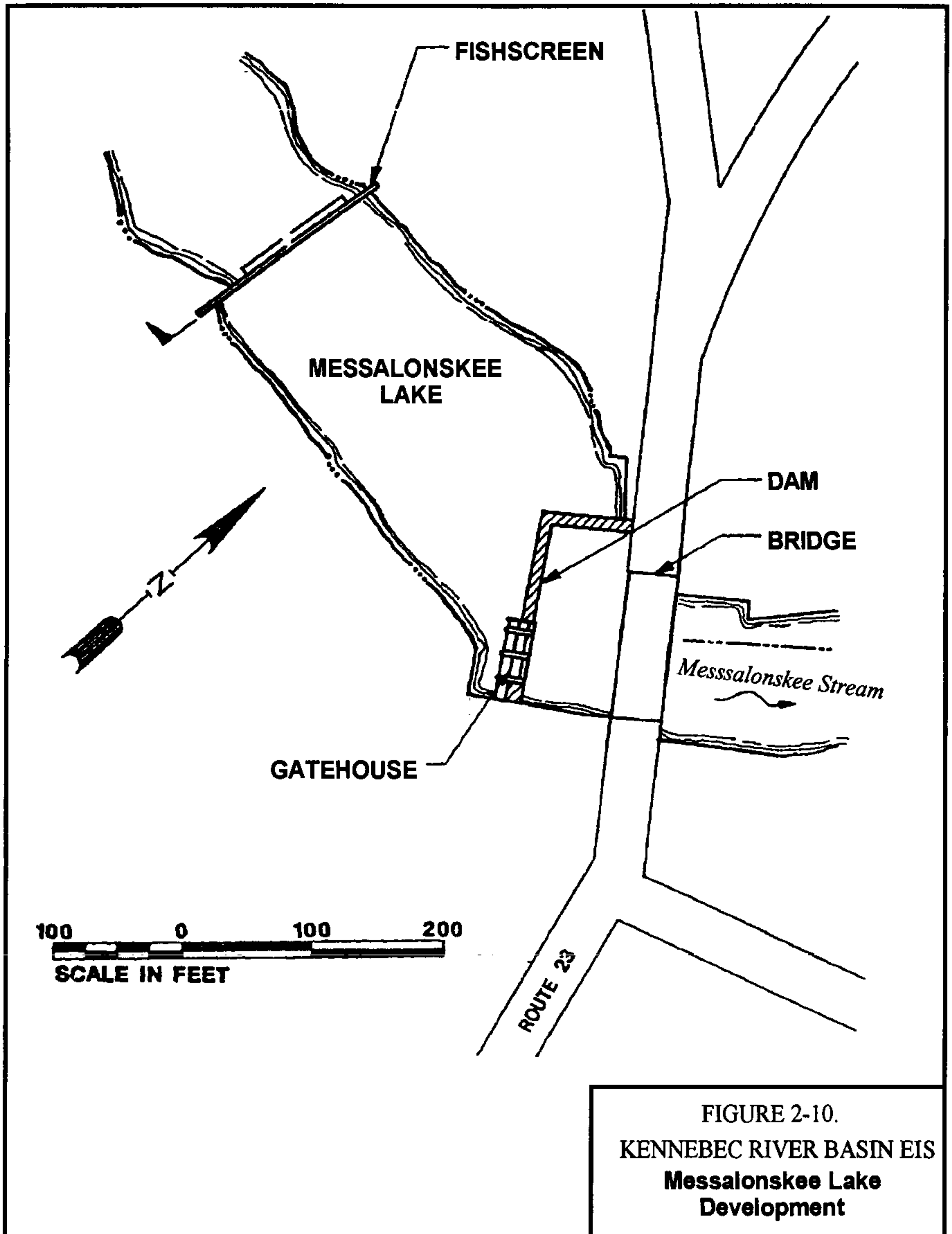


FIGURE 2-10.
KENNEBEC RIVER BASIN EIS
**Messalonskee Lake Development**
Source: Central Maine Power; Modified by Staff

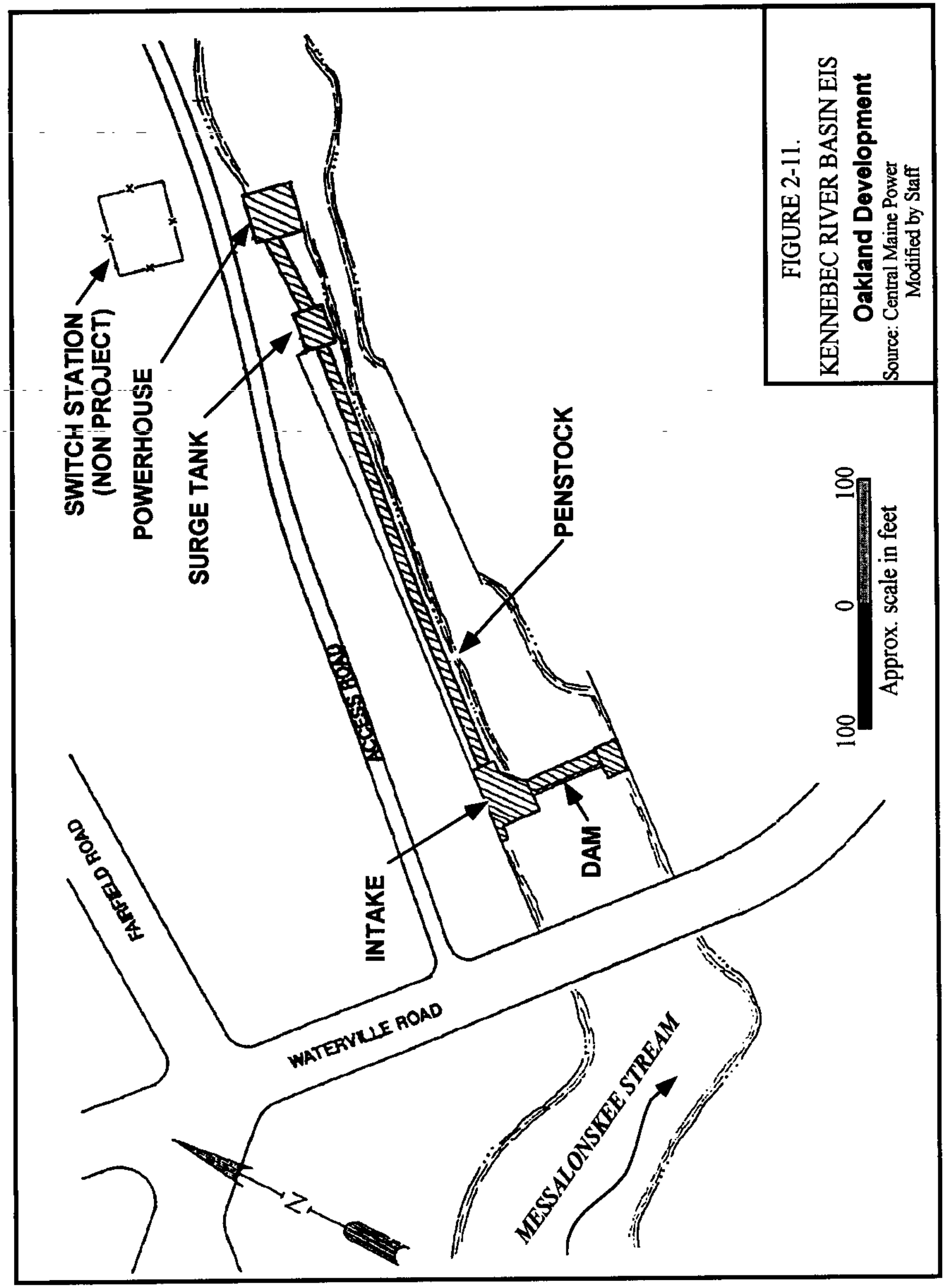


FIGURE 2-11.
KENNEBEC RIVER BASIN EIS
**Oakland Development**
Source: Central Maine Power
Modified by Staff

*2.1.1.8 Rice Rips Project* (Figure 2-12)

The project consists of: (1) a 220-foot-long concrete Ambursen dam with (a) a 51-foot-long nonoverflow embankment with a concrete core wall, (b) a gated concrete intake section, 41 feet long by 30 feet wide with (i) a wooden staved 10-foot-diameter, steel penstock 2,293 feet long, (ii) a 150-foot-diameter surge pond that exits to a 25-foot-wide intake structure, and (iii) a 67-foot-long secondary spillway section east of the intake structure, and (c) a 27-foot-long primary spillway section with 5-foot-high hinged flashboards; (2) a concrete-steel with brick powerhouse, 60 feet high by 31 feet wide by 43 feet long, housing one vertical Francis turbine and General Electric generator with a rated capacity of 1,600 kW; (3) a 1.6-mile-long impoundment with a gross storage capacity of 1,000 AF; and (4) appurtenant facilities. The project was originally constructed in 1908.

CMP proposes to pass a minimum flow of 15 cfs into the bypassed reach and continue run-of-river operation of the Rice Rips Project. This would decrease average annual generation from 5.641 to 5.346 GWh.

*2.1.1.9 Automatic Project* (Figure 2-13)

The project consists of: (1) an 81-foot-long, 33-foot-high concrete gravity dam with (a) a 33-foot-long nonoverflow section, (b) a 20-foot-long by 2-foot-wide gated section with one Taintor gate, 14 feet high by 16 feet wide, (c) a 30-foot-long spillway section topped with 2-foot-high flashboards, (d) an intake section beneath the spillway, and (e) an earthen section containing a 30-foot-long retaining wall; (2) a concrete and brick powerhouse, 63 feet high by 19 feet wide by 31 feet long, housing one horizontal Francis turbine and General Electric generator combination with a rated capacity of 800 kW; (3) a 4.5-mile-long impoundment with a gross storage capacity of 900 AF; and (4) appurtenant facilities. The project was originally constructed in 1924.

KWD proposes to provide a minimum flow of 15 cfs and to continue run-of-river operation at the Automatic Project. This would not decrease the average annual generation of 2.903 GWh, however, because the project currently has a leakage of 15 cfs.

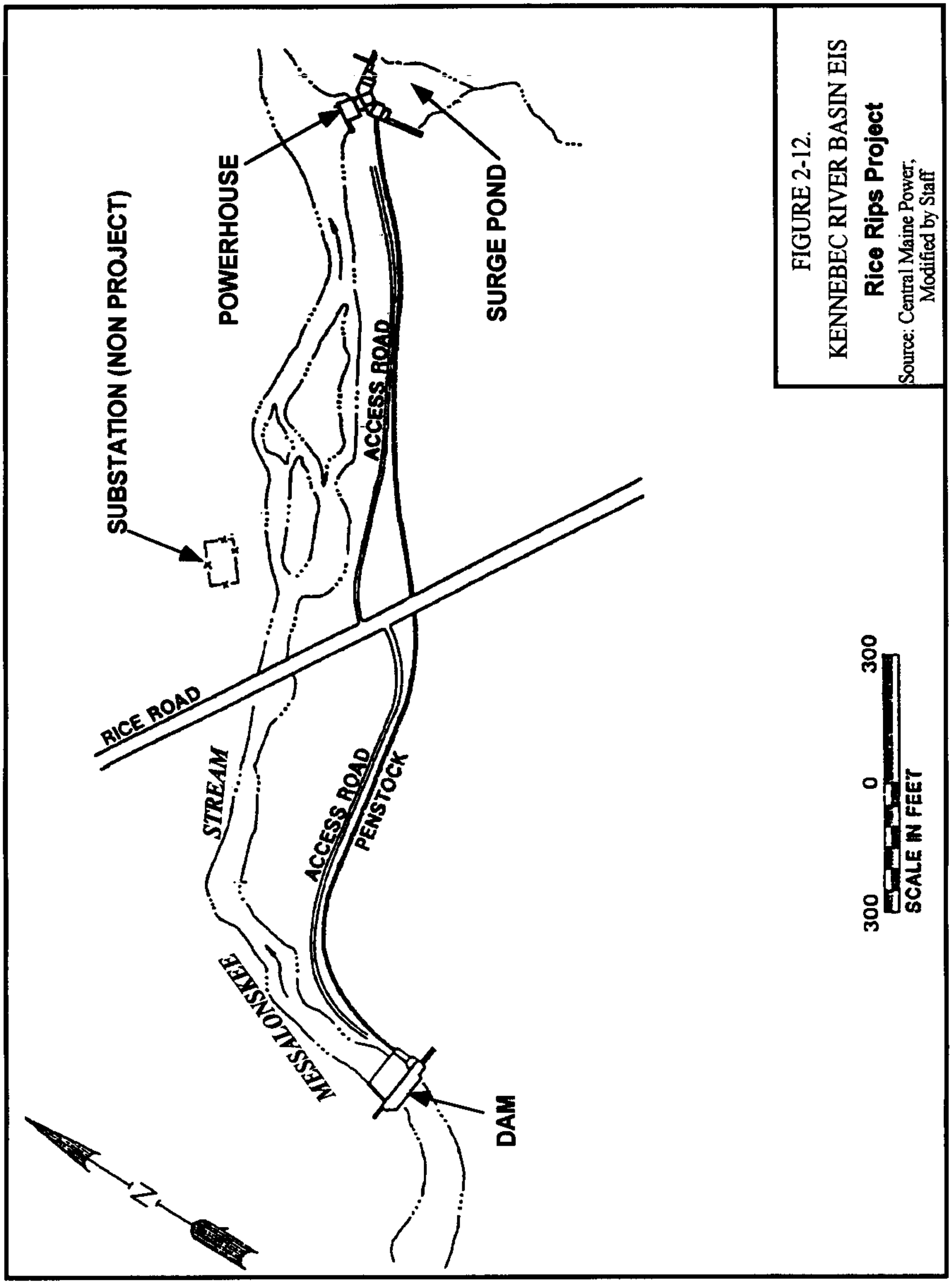


FIGURE 2-12.
KENNEBEC RIVER BASIN EIS
**Rice Rips Project**
Source: Central Maine Power;
Modified by Staff

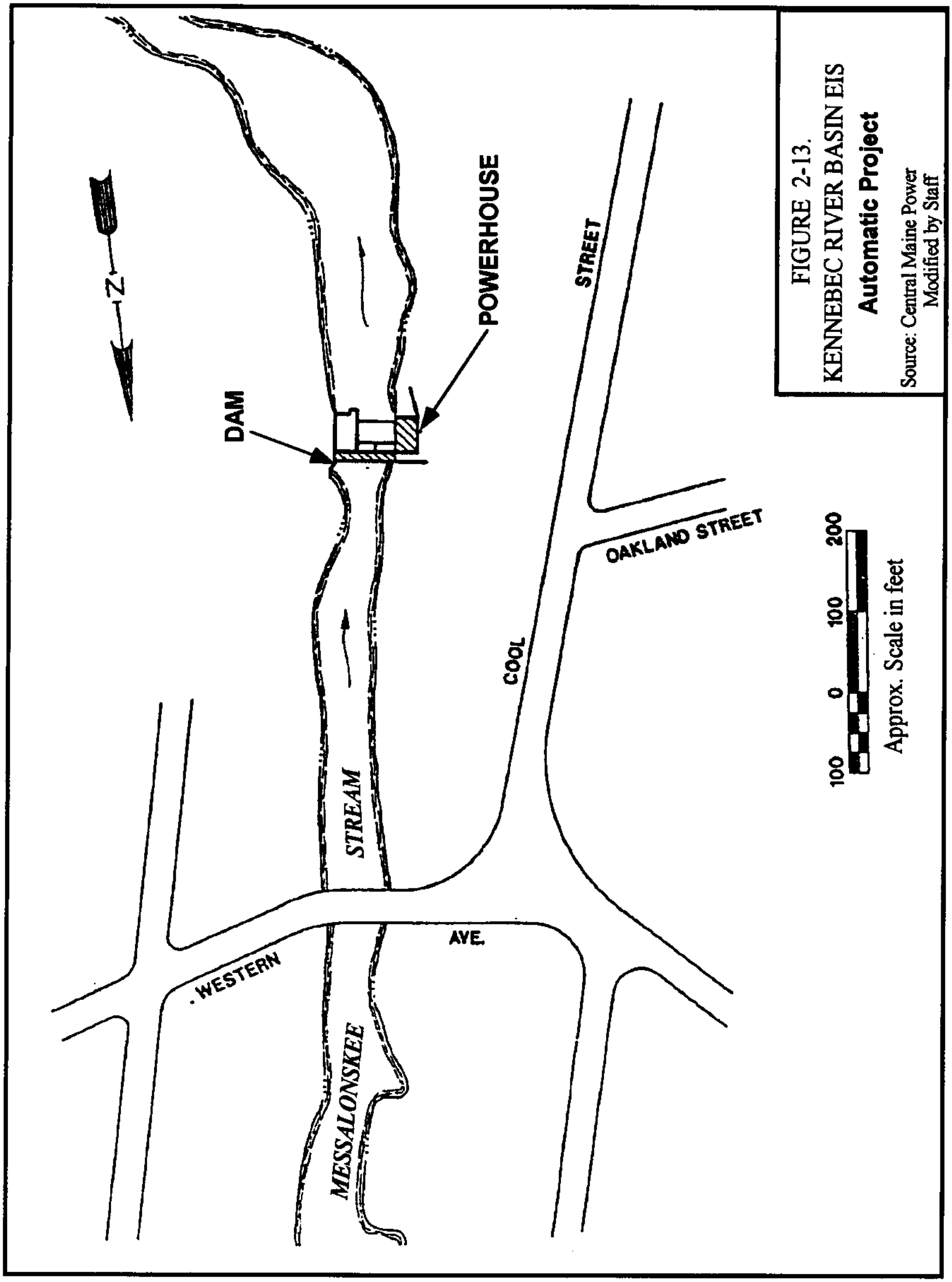


FIGURE 2-13.
KENNEBEC RIVER BASIN EIS
**Automatic Project**
Source: Central Maine Power
Modified by Staff

*2.1.1.10 Union Gas Project* (Figure 2-14)

The project consists of: (1) a 343-foot-long, 31-foot-high stone-masonry gravity dam with (a) a nonoverflow section, measuring 122 feet from the east river bank to an angle point, where it continues 15 feet to the gate section and 54 feet downstream, (b) a 32-foot-long gated intake section with (i) three 8-foot-high by 6-foot-wide deep gates and (ii) a 32-foot by 11-foot wooden gatehouse, (c) a 32-foot-long spillway section topped with 18-inch-high, pin-supported flashboards, (d) a 41-foot-long masonry intake section with two 8-foot-diameter intakes, and (e) a 73-foot-long stone masonry nonoverflow section; (2) a concrete-stone masonry powerhouse, 50-feet-high by 46-feet-wide by 60-feet-long, housing one vertical Francis turbine and General Electric generator combination with a rated capacity of 1,500 kW; (3) a 1.5-mile-long impoundment with a gross storage capacity of 600 AF; and (4) appurtenant facilities. CMP acquired the project in 1911, and the existing project was constructed in 1924.

CMP proposes to maintain the Union Gas Project as a peaking facility and to release a minimum flow of 15 cfs. This would decrease average annual generation from 4.994 to 4.733 GWh.

*2.1.1.11 Edwards Project* (Figure 2-15)

The existing project consists of: (1) a 917-foot-long capped timber crib dam with (a) an 850-foot-long primary spillway topped with 4.5-foot-high flashboards, and (b) a 67-foot-long bulkhead spillway abutting the primary spillway; (2) an 80-foot-long by 24-foot-wide masonry gatehouse with seven vertical lift gates; (3) a 450-foot-long by 15-foot-deep power canal; (4) two structural steel powerhouse buildings, each with one turbine and a third masonry building 117 feet long by 85 feet wide with seven vertical turbines for a rated capacity of 3,500 kW; (5) a vacuum pump fish lift; (6) a trashrack and downstream bypass fish passage; (7) an electric substation and transmission line; (8) an impoundment with a surface area of 1,143 acres and a usable storage of 4,234 AF; and (9) appurtenant facilities. In 1837, construction of the original dam at this site was completed to provide water power for local mills.

Edwards originally proposed to (a) install a new unit that would be housed in a new concrete and steel powerhouse, 140 feet long and 63 feet wide by 50 feet high; (b) remove the existing gatehouse and replace it with a 125-foot-long by 25-foot-wide gate structure; (c) widen the existing power canal; (d) continue run-of-river operation; (e) install fish passage that would have a minimum flow of 100 cfs; (f) retire two of the existing nine turbines; and (10) install an inflatable rubber crest gate that would increase the elevation of the reservoir by 1 foot.

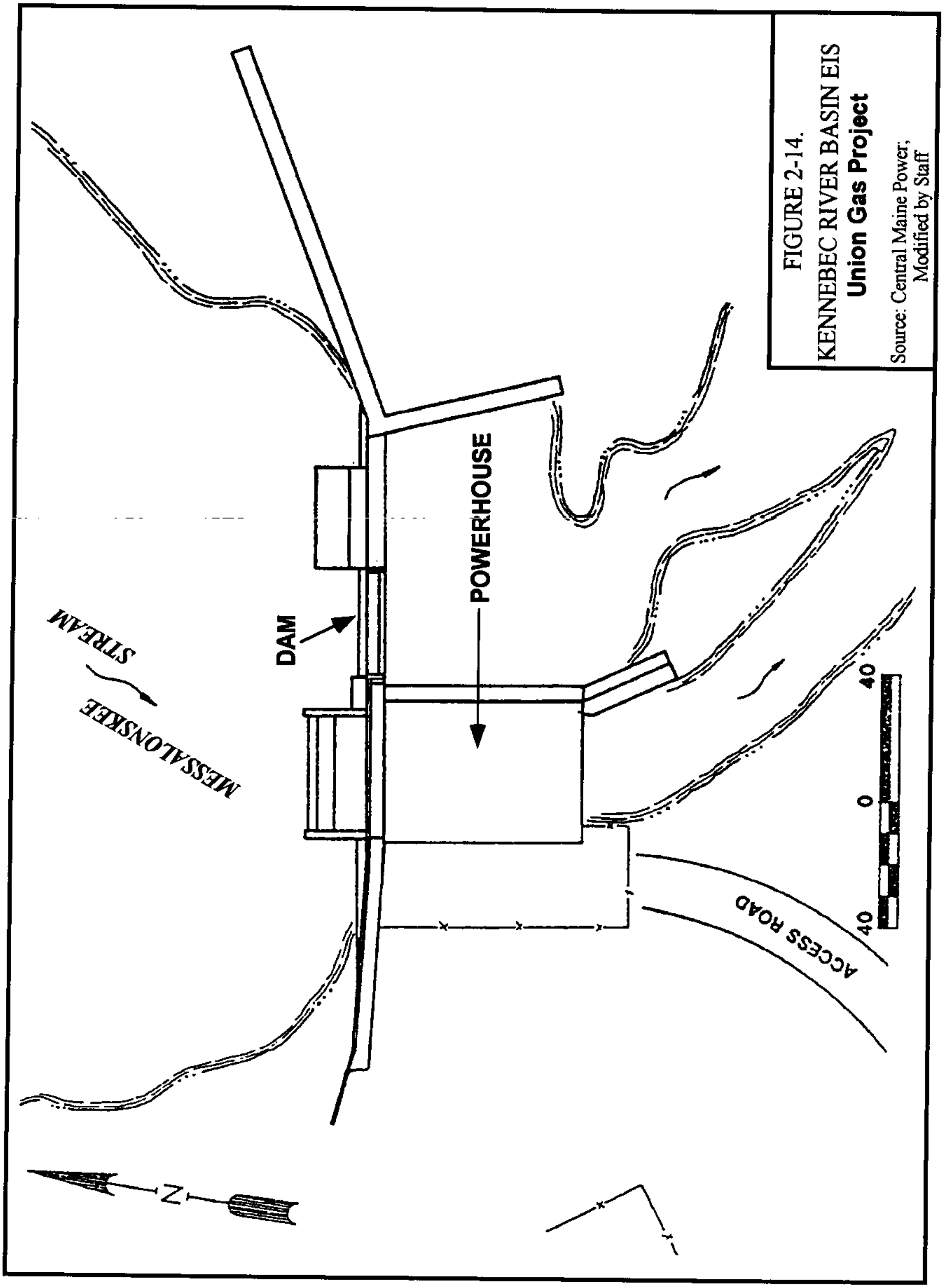


FIGURE 2-14.
KENNEBEC RIVER BASIN EIS
**Union Gas Project**
Source: Central Maine Power;
Modified by Staff

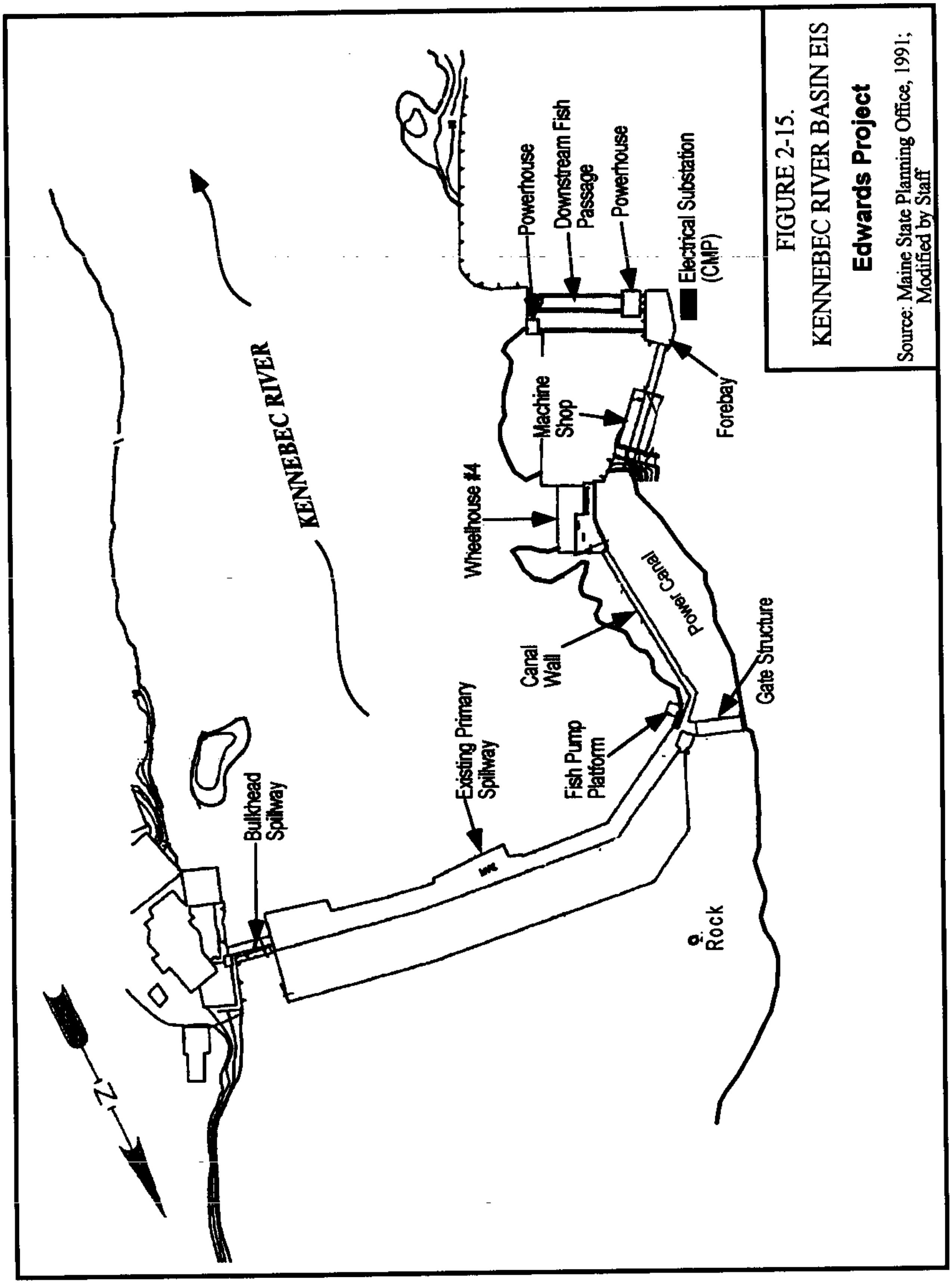


FIGURE 2-15.
KENNEBEC RIVER BASIN EIS
**Edwards Project**
Source: Maine State Planning Office, 1991; Modified by Staff

Under its revised proposal, Edwards would only upgrade existing units without increasing the hydraulic capacity of the project. The fishways would be essentially the same as the interim fishways proposed by Edwards in 1990; the minimum design populations of the fish lift were 82,000 alewives, 40,000 American shad, and 250 Atlantic salmon. In reply comments filed with the Commission on May 23, 1996, Edwards agreed to increase the hopper size of its single entry fish lift to 2,500 gallons. Edwards indicates that this would increase the design capacity of the fish lift to 1,548,000 alewives, 371,000 American shad, and 7,500 Atlantic salmon, and would address agency concerns about alewives overcrowding the fish lift. Edwards would install the fishways and rubber crest gate as originally proposed along with other originally proposed environmental enhancements. The upgrade would increase the rated capacity from 3.5 MW to 4.5 MW. Average annual generation would increase from 20 to 23 GWh.

### 2.1.2 Proposed Environmental Measures

#### *2.1.2.1 Moosehead*

KWP proposes to:

- formalize the informal lake level agreement with the Maine Department of Inland Fisheries and Wildlife (MDIFW) to achieve lowest annual lake elevation (1,024.5 feet) by October 10 and meet annually with MDIFW to review lake level management objectives;
- formalize the following operating guideline to minimize frequency of major flow fluctuations at the East Outlet: changes in flow of greater than 1,000 cfs followed by changes in flow in the opposite direction of greater than 1,000 cfs within any 7-day period would be limited to once per month;
- provide a year-round minimum flow of 500 cfs in the East Outlet;
- maintain the existing fishway and operate Taintor gates in conjunction with the fishway at the East Outlet;
- provide a minimum flow of 80 cfs (October through April) and 120 cfs (May through September) in the West Outlet;
- investigate feasibility of East Outlet spawning habitat improvements;
- maintain existing ramping limitation of 350 cfs per minute for the East Outlet gate operation;

- provide a continuous phone recording to provide information on flows in the East and West Outlets;
- meet annually with whitewater boating outfitters to discuss potential schedules for East Outlet water releases that accommodate rafting needs to the extent possible and minimize negative effects on fish habitat;
- purchase land to provide a public boat landing on the west shore of Moosehead Lake in Rockwood (completed and open to public in summer 1993);
- improve the existing East Outlet parking area and put-in site for whitewater boaters and anglers (completed);
- monitor recreation use in the project area using the FERC Form 80 recreation assessment; and
- complete the Phase II cultural resource surveys and implement Phase III mitigation plan.

*2.1.2.2 Moxie*

The Owners of the Moxie Project and The Forks propose to:

- evaluate the need for dam stabilization and complete dam repairs and stabilization measures specified in the Contract for Sale of Real Estate and the Commission within 12 months of closing (Owners);
- operate existing boat launch and picnic area (The Forks);
- operate the project in an instantaneous run-of-river mode except during the spring refill or fall drawdown periods;
- during the spring refill period, maintain an instantaneous minimum flow of 25 to 44 cfs or inflow, whichever is less;
- maintain the impoundment at full pond (el. 970.3 feet) from after the spring refill period to October 15; and
- draw the impoundment down up to 1.5 feet between October 15 and November 15 to prevent ice damage to shoreline structures.

### *2.1.2.3 Wyman*

CMP proposes to:

- provide a minimum flow of 1,200 cfs from May 16 through July 31 using the top 2.0 feet of Wyman Lake (elevation 483 to 485 feet) to augment natural inflow;
- provide a minimum flow of 1,200 cfs from August 1 through May 15 using the top 4.0 feet (elevation 481 to 485 feet) of Wyman Lake to augment natural flow;
- maintain impoundment water levels between elevations 483.0 and 485.0 from May 16 through July 31 and between elevations 481.0 and 485.0 from August 1 to May 15 with the option to draw down the impoundment up to 8 feet in the spring for flood control;
- conduct a study to assess the impact of the required minimum flow release on the macroinvertebrate community in the first 1,000 feet below Wyman dam;
- implement and monitor a program to provide cover and velocity refuges for adult salmonids below Wyman dam;
- restrict the simultaneous shutdown of all three generating units in case of emergencies that occur during downramping;
- construct and maintain a new canoe portage trail with adequate signage around the east end of Wyman;
- limit normal impoundment fluctuation to within 2 feet of full pond elevation with the option to drawdown the impoundment up to 8 feet in the spring;
- develop and implement a loon management program;
- complete archeological surveys and protect archeological sites;
- review all nonroutine maintenance activities annually with the Maine State Historic Preservation Officer (MSHPO);
- develop and implement a trail plan to improve recreation trails in the project vicinity, including the Appalachian Trail;
- construct and maintain a hard-surface boat ramp at the Moscow public landing;

- redevelop and maintain the Caratunk day-use area with the addition of a restroom and two sheltered picnic tables (completed in 1991);
- continue leasing Pleasant Ridge Recreation Area to the town of Pleasant Ridge and assist with operating costs;
- provide and maintain primitive campsites along the shoreline near Houston Brook Falls (completed in 1991);
- provide parking for ice anglers and remove all abandoned ice fishing shacks;
- install boat barriers and safety signs; and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

*2.1.2.4 Sandy River*

MEW proposes to:

- operate in run-of-river mode and provide a continuous minimum flow of 196 cfs (or inflow, if less) downstream of the project;
- maintain the reservoir water level at the top of the flashboards, and develop and implement a plan to monitor the water surface elevation;
- monitor dissolved oxygen (DO) and temperature in the bypassed reach during worst case conditions for 2 years;
- install upstream and downstream fishways by May 1, 2002;
- file a plan for monitoring the effectiveness of the fish passage facilities;
- conduct Phase III archeological data recovery;
- review all nonroutine maintenance activities annually with the MSHPO;
- remove the existing gate to the access road;
- allow public parking at the existing powerhouse parking lot;
- install a car-top boat launch upstream of the existing boat barrier;

- provide foot access to the tailrace; and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

*2.1.2.5 Weston*

CMP proposes to:

- operate in run-of-river mode, providing a minimum flow of 1,947 cfs (or inflow, if less) downstream of the project;
- install upstream and downstream fish passage facilities by May 2001 per the KHDG agreement;
- limit reservoir water level fluctuations to within 1 foot of full pond during normal operation;
- minimize scheduled maintenance drawdowns from June 1 to August 1 each year;
- conduct Phase III archeological data recovery;
- review all nonroutine powerhouse maintenance activities annually with the MSHPO;
- construct additional parking and evaluate lengthening the boat ramp at Oosoola Park in Norridgewock;
- provide canoe portage around the project;
- lower the height of logging piers for safer boating;
- add seating, landscaping, and interpretive signs at the Arnold Trail commemorative site near the powerhouse; and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

*2.1.2.6 Fort Halifax*

CMP proposes to:

- provide a minimum flow of 150 cfs from April to November;
- conduct yearly summer water quality monitoring and release flushing flows if DO drops below 5 parts per million (ppm);

- install upstream and downstream fish passage facilities per the KHDG agreement (downstream passage operational in 1993; the upstream fish passage installation deadline is May 1, 1999);
- limit impoundment fluctuations to no more than 2.5 feet;
- protect archeological sites;
- review all nonroutine maintenance activities annually with the MSHPO;
- improve the existing canoe portage trail and carry-in boat access site, associated parking, and access road at the south end of the dam;
- construct a hard-surface boat launch at a new location on the impoundment upstream of the dam;
- install interpretive signs at the powerhouse; and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

*2.1.2.7 Oakland*

CMP proposes to:

- limit Messalonskee Lake fluctuations to no more than 0.5 foot during the summer and 1.0 foot for the remainder of the year;
- maintain a stable water level at the Oakland impoundment within 1 foot of full pond;
- provide a minimum flow of 15 cfs at Messalonskee Lake dam and the Oakland Development;
- evaluate replacement of the fish screen at Messalonskee Lake dam with a screen that has larger spacing (subject to agencies' agreement on bar spacing) and maintain the fish screen;
- implement a waterfowl management plan;
- review all nonroutine maintenance activities annually with the MSHPO;
- implement recommendations of the Phase II archeological surveys;

- improve the existing day-use area near Messalonskee Lake dam;
- provide interpretive signs at Oakland dam identifying it as CMP's first hydroelectric project;
- monitor recreation use in the project area using the FERC Form 80 recreation assessment; and
- investigate the need for a greenbelt or multi-use area managed for timber and other purposes on the east side of Messalonskee Stream between the Oakland and the Rice Rips Projects.

*2.1.2.8 Rice Rips*

CMP proposes to:

- maintain a stable reservoir water level within 1 foot of full pond;
- provide a minimum flow of 15 cfs to the Rice Rips bypassed reach;
- implement recommendations of the Phase II archeological surveys;
- improve public parking for anglers along Rice Rips Road;
- investigate the feasibility of a carry-in boat access site to the Rice Rips impoundment;
- monitor recreation use in the project area using the FERC Form 80 recreation assessment; and
- evaluate the need for a greenbelt or multi-use area managed for timber or other purposes on the east side of Messalonskee Stream.

*2.1.2.9 Automatic*

KWD proposes to:

- maintain a stable reservoir water level within 1 foot of full pond;
- provide a minimum flow of 15 cfs;
- review all nonroutine maintenance activities annually with the MSHPO;

- implement recommendations of the Phase II archeological surveys;
- improve the parking area at North Street Park;
- investigate the need for additional parking at a second carry-in site on the Automatic impoundment (investigation completed by CMP); and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

*2.1.2.10 Union Gas*

CMP proposes to:

- provide a minimum flow of 15 cfs;
- implement a new downramping sequence to reduce the rate of tailwater elevation decrease;
- review all nonroutine maintenance activities annually with the MSHPO;
- implement recommendations of the Phase II archeological surveys;
- investigate the need for additional parking and tailrace walk-in access;
- construct the Couture Field boat launch on the Kennebec River in Waterville (completed in 1989); and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

*2.1.2.11 Edwards*

Edwards and the city of Augusta propose to:

- operate in a run-of-river mode;
- install an inflatable rubber crest gate to stabilize the impoundment water level; this crest gate would replace the existing wooden flashboards;
- install permanent upstream and downstream fish passage facilities;
- initiate a salmon stocking program;

- complete a Phase II cultural resource survey and protect archeological data;
- assist in the development of an east-side boat launch at Sevenmile Stream in Vassalboro;
- construct a west-side day-use park and fishing access for people with disabilities at the site of the old mill in Augusta;
- evaluate the feasibility of developing a riverfront trail and picnic area at the Sidney boat launch;
- provide primitive campsites at Sevenmile Island; and
- provide canoe portage around Edwards dam.

## 2.2 STATUTORY REQUIREMENTS

### 2.2.1 Water Quality Certification/Coastal Zone Management Consistency

Section 401(a)(1) of the federal Clean Water Act (CWA) requires an applicant for a federal license or permit for any activity that may result in a discharge into navigable waters of the United States to provide to the licensing or permitting agency a certification from the state in which the discharge originates that such discharge will comply with certain sections of the CWA. A state WQC, therefore, is a prerequisite for obtaining a Commission license.

If and when a WQC for a hydroelectric project is issued, the State of Maine deems that the project is consistent with state coastal zone management policy (personal communication between J. Downing, Stone & Webster, and T. Burroughs, MSPO, October 25, 1996). The Edwards Project is the only project within Maine's coastal zone that has not yet been issued a WQC. State action on the Edwards WQC application, which was refiled on December 12, 1996, is on hold until after the FEIS in this proceeding is issued (letter from D. Murch, MDEP, to M. Isaacson, Edwards, dated December 12, 1996).

Table 2-1 presents the status of the WQCs for the Kennebec River Projects considered in this EIS.

Table 2-1. Kennebec River Basin hydroelectric projects WQCs

| Project | Project No. | Date Granted |
|---|---|---|
| Moosehead | 2671 | 10/20/94 |
| Moxie | 2613 | withdrawn |
| Wyman | 2329 | 8/18/95 |
| Sandy River | 11433 | 2/24/94 |
| Weston | 2325 | 11/17/92 |
| Fort Halifax | 2552 | 7/26/94 |
| Oakland | 2555 | 8/28/95 |
| Rice Rips | 2556 | 8/28/95 |
| Automatic | 2557 | 8/28/95 |
| Union Gas | 2559 | 8/28/95 |
| Edwards | 2389 | pending |

Source: MDEP, MLURC, staff.

Section 401(d) of the CWA provides that state certifications shall set forth conditions necessary to ensure that applicants comply with specific portions of the CWA and with appropriate requirements of state law. Pursuant to this section, any lawful conditions attached to a Section 401 certification for a project that is ultimately licensed by the Commission will be included as part of the Commission license. Based on the Commission's Order Issuing License issued on October 22, 1996, to Great Northern Paper, Inc., only those measures included in a WQC considered to be within the scope of Section 401 become part of any license issued.[3] In the following section, we present the WQC conditions listed in the MLURC and MDEP certifications, and the staff's findings with respect to their inclusion in any Commission-issued license order.

Some conditions apply to all or most of the projects. We summarize the conditions that are common to several projects first, and then we provide project-specific conditions. Many of the conditions include language requiring state agency approval, schedules for implementing specific measures, or the reservation of authority to require structural or operational changes which we believe are beyond the scope of Section 401. Thus we do not

[3] See Great Northern Paper, Inc. 77 FERC ¶61,068 at pp. 61,271-72 (1996).

recommend those portions of the conditions become part of any license issued.

The general conditions and staff's recommendations for their inclusion in any license orders issued for these projects are as follows:

(1) **All variances from plans and proposals contained in the application and supporting documents must be reviewed and approved by MLURC or MDEP.** This condition removes the Commission's authority, potentially precluding the Commission from exercising its balancing responsibilities specified in the FPA. Section 401 provides that a state may issue its certification, at which point the federal licensing or permitting agency is responsible for making the certification a part of the license or permit.[4] (Moosehead, Wyman, Sandy River, Weston, Fort Halifax, Messalonskee)

(2) **Applicants shall secure and appropriately comply with all applicable federal, state, and local licenses, permits, authorizations, conditions and orders required for the operation of the project.** This condition is too broadly worded and vague and the means of enforcement are unclear. We do not recommend that it become part of any licenses issued for these projects. (Moosehead, Wyman, Sandy River, Weston, Fort Halifax, Messalonskee)

(3) **WQCs shall be effective on the dates of issuance of new hydropower project licenses by FERC and shall expire with the expiration of the FERC licenses.** As noted above, Section 401(a)(1) of the CWA prohibits the Commission from issuing a new license unless the certification agency has issued (or waived) certification. This condition's provision for expiration of the certification upon expiration of the new license conflicts with Section 15(a)(1) of the FPA, which requires the Commission, upon expiration of the term of a new license, to issue an annual license under the same terms and conditions as those contained in the prior license until a new license is issued or the project is otherwise disposed of as provided in Section 15 or any other applicable section of the FPA. This condition is outside the scope of Section 401, and therefore, we do not recommend that it become part of any licenses issued for these projects. (Moosehead, Wyman, Sandy River, Weston, Fort Halifax, Messalonskee)

(4) **Applicants shall submit plans for providing and monitoring minimum flows. These plans must be reviewed and approved by MLURC or MDEP Bureau of Land Quality Control.** We agree that minimum flow monitoring plans are necessary and

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[4] See Great Northern Paper, Inc., supra.

recommend that such plans be part of any licenses issued for these projects. (Moosehead, Wyman, Sandy River, Weston, Fort Halifax, Messalonskee)

(5) **Applicants shall submit plans for providing and monitoring water levels in the impoundments. These plans must be reviewed and approved by the MLURC or MDEP Bureau of Land Quality Control.** We agree that monitoring water levels in the impoundment is necessary. (Moosehead, Wyman, Sandy River, Weston, Fort Halifax, Messalonskee)

(6) **Applicants shall submit drawings and plans for fish passage facilities, prepared in consultation with state and federal fisheries agencies and subject to the review and approval of fisheries agencies, FERC, and MDEP Bureau of Land Quality Control.** We agree that the licensees should develop drawings and plans for fish passage facilities in consultation with state and federal fisheries agencies. (Sandy River, Weston, Fort Halifax)

(7) **Applicants shall submit a schedule for implementation of proposed recreational facilities. The schedule shall be reviewed and approved by the MDEP Bureau of Land Quality Control.** We agree that the licensees should file a schedule for implementation of the proposed recreational facilities. (Sandy River, Weston, Fort Halifax, Messalonskee)

The project-specific conditions and the staff's recommendations for their inclusion in any license orders issued for these projects are as follows.

*2.2.1.1 Moosehead*

MLURC issued a WQC for the Moosehead Project in 1994 subject to nine conditions. Conditions 3, 7, 8, and 9 are general conditions. The following are the specific conditions contained in the WQC for the Moosehead Project.

*Condition 1* requires that except for operational emergencies beyond the applicant's control, the project must be operated such that the following minimum flows are maintained by KWP: (1) at the East Outlet, a continuous minimum flow of at least 500 cfs from East Outlet dam; the rate of change of flow shall be restricted to no more than 350 cfs per minute; changes in flow of more than 1,000 cfs, which are followed by changes in flow of 1,000 cfs in the opposite direction within any seven day period shall be limited to no more than once in any 30 day period; (2) KWP shall also establish on an annual basis a target flow between 1,000 and 2,000 cfs during the fall spawning season between October 15 and November 15, in consultation with MDIFW; (3) at the West Outlet, a continuous minimum flow of at least 80 cfs from West Outlet dam shall be maintained from October 1 to April 30; from May 1 to September 30, a continuous minimum flow of at least 120 cfs from West Outlet dam shall be maintained. We recommend that this condition become part of any license issued for this project.

*Condition 2* requires that KWP achieve draw down of Moosehead Lake (from full pond elevation of 1,029 feet) to its lowest impoundment level by a target date of October 10th annually, to a target elevation of 1,024.5 feet. The condition further recommends that if climatic conditions or circumstances beyond the applicant's control do not allow attainment of a lake level of 1,024.5 feet by October 10th, KWP, without consultation, may draw down the lake level by a maximum of two feet beyond the October 10th level, but not lower than elevation 1,024.5 feet. After October 10th, any reduction in lake level below elevation 1,024.5 feet or two feet below the October 10th lake level, shall only be made in consultation and agreement with the MDIFW and the Commission. We conclude that the drawdown limitations recommended by MLURC to protect lake trout spawning habitat while maintaining flood control capabilities (see Section 4.1.3.1). Therefore, we recommend that Condition 2 become part of any license issued for this project.

*Condition 4* requires that KWP submit a plan for MLURC review and approval implementing all proposed fisheries, fishing, recreational, habitat, and navigational enhancements required in the WQC. The enhancements recommended in this EIS support recreational opportunities and have the potential to increase the development around Moosehead Lake. MLURC is responsible for the balancing of land uses and the protection of the natural resources of Moosehead Lake. We conclude that KWP should develop and submit a plan to MLURC for the implementation of the fisheries, fishing, recreational, habitat, and navigational enhancements required in any license issued for this project.

*Condition 5* requires that KWP develop a monitoring plan to evaluate the effects of the proposed operation's impoundment water fluctuations on loon nesting success rate. Condition 5 further recommends that KWP plan for mitigation or habitat enhancement measures to compensate for such impacts. We agree with MLURC that loon habitat monitoring is necessary. Therefore, we recommend that Condition 5 become part of any license issued for this project.

#### *2.2.1.2 Wyman*

MDEP issued a WQC for continued operation of the Wyman Project during 1995 subject to the following conditions. Conditions 7, 8, and 9 are general conditions. The following are the project-specific conditions contained in the WQC for the Wyman Project.

*Condition 1* requires that, except for temporary modifications during approved maintenance or for operating emergencies beyond the applicant's control, CMP provide a minimum flow of 1,200 cfs from May 16 to and including July 31 using the top 2.0 feet of Wyman Lake (elevation 483 to 485 feet) to augment natural inflow. From August 1 to and including May 15, a minimum flow of 1,200 cfs shall be released using the top 4.0 feet (elevation 481 to 485 feet) of Wyman Lake to augment natural flow.

Condition 1 further requires that CMP submit plans for providing and monitoring the minimum flows for MDEP approval. We agree with the flow regime proposed by CMP and recommended in the WQC, and recommend that this portion of Condition 1 become part of any license issued for the project.

*Condition 2* requires that, except as temporarily modified by approved maintenance activities, inflows to the project area, or by operating conditions beyond CMP's control, or except as needed for flood control, CMP maintain impoundment water levels between elevations 483.0 and 485.0 from May 16 through July 31 and between elevations 481.0 and 485.0 from August 1 to May 15. Condition 2 allows CMP to draw down the impoundment up to 8 feet in the spring for purpose of flood control. Condition 2 further recommends that CMP submit plans for providing and monitoring the impoundment water levels for MDEP approval. We agree with the limitation on drawdowns proposed by CMP and recommended in the WQC, and recommend that this portion of Condition 2 become part of any license issued for the project.

*Condition 3* requires that CMP, in consultation with MDEP, conduct a study to assess the impact of the required minimum flow release on the macroinvertebrate community in the first 1,000 feet below Wyman dam. Condition 3 recommends that CMP submit a study plan within one year of license issuance for MDEP approval, and provides for MDEP modification of the required minimum flow as needed to meet Class C aquatic life standards. The assessment would document the expected improvement in aquatic life caused by increased minimum flows. Therefore, we recommend that the macroinvertebrate study be included in any license issued for this project.

*Condition 4* requires that CMP implement and monitor a program to provide cover and velocity refuges for adult salmonids below Wyman dam within one year after license issuance. Condition 4 further recommends that CMP modify this program as deemed necessary by state and federal fisheries agencies and the MDEP based on results from the monitoring plan. We agree that the fisheries enhancement plan would benefit fishery resources and recommend that CMP develop a detailed plan for implementation of the provisions of the prototype instream enhancement program dated September 10, 1992 (see Section 4.1.3.3). Therefore, we recommend that Condition 4 become part of any license issued for this project.

*Condition 5* requires that CMP, for the purposes of downramping, restrict the simultaneous shutdown of all three generating units in case of emergencies that occur during downramping. Restricting the simultaneous shutdown of all three generating units would reduce the impacts of downramping on fisheries resources. Therefore, we recommend that Condition 5 become part of any license issued for this project.

*Condition 6* requires that CMP construct and maintain a new canoe portage trail with adequate signage around the east end of Wyman dam within one year of license issuance; continue to allow public access across project lands to popular fishing areas; continue to lease the Pleasant Ridge Municipal Recreational Area to the town of Pleasant Ridge for $1.00 per year; develop a trail plan, for MDEP approval, related to the Appalachian Trail crossing on the Kennebec and to other trail issues in the project vicinity within one year of license issuance; and provide recreation facilities as proposed and shall review recreational needs and conditions at the project on a regular basis in conjunction with FERC requirements. We agree that recreational enhancements and monitoring are necessary (see Section 4.1.7.3).

*2.2.1.3 Sandy River*

MDEP issued a WQC for continued operation of the Sandy River Project in 1994 subject to the following conditions. Conditions 5,6, and 7 are general conditions. The following are the project-specific conditions contained in the WQC for the Sandy River Project.

*Condition 1* requires that except for temporary modifications during approved maintenance or for operating emergencies beyond the applicant's control, MEW operate the project in a run-of-river mode while maintaining a minimum flow of 196 cfs, or inflow, whichever is less. We agree that the minimum flows specified in the WQC are necessary to protect fish and wildlife resources. Therefore, we recommend that Condition 1 become part of any license issued for this project.

*Condition 2* requires that, except as temporarily modified by approved maintenance activities, inflows to the project area, or by operating conditions beyond MEW's control, MEW maintain impoundment water levels within one foot of the normal full pond elevation of 180.5 feet, while flashboards are in place. Condition 2 further recommends that MEW submit plans for providing and monitoring the impoundment water levels for MDEP approval. We agree that the limitation on draw downs are necessary to protect fish and wildlife resources and recommend that this portion of Condition 2 become part of any license issued for the project.

*Condition 3* requires that MEW install and maintain upstream and downstream fish passage facilities by May 1, 2002, and to submit, after consultation with state and federal fisheries agencies, functional design drawings, construction schedule, and operating and maintenance plans for Commission, FWS, and MDEP approval. The schedule provided by MDEP is consistent with the schedule specified by Interior. We agree that fishways should be installed by May 1, 2002. Therefore, we recommend that Condition 3 become a part of any license issued for this project.

*Condition 4* requires that MEW maintain and improve recreation facilities within the project boundaries by removing the existing gate that blocks traffic from entering the project's access road; developing a car-top boat launch area upstream of the existing boat barrier; developing a foot access trail leading to the tailrace area of the dam; and initiating periodic reviews of recreational needs in conformance with the Commission's recreational monitoring requirements. We agree that recreational enhancements and monitoring are necessary (see Section 4.1.7.4) and recommend that Condition 4 become part of any license issued for this project.

### *2.2.1.4 Weston*

MDEP issued a WQC for continued operation of the Weston Project during 1992 subject to seven conditions. Conditions 5, 6, and 7 are general conditions. The following are the project-specific conditions contained in the WQC for the Weston Project.

*Condition 1* requires that, except for temporary modifications during approved maintenance or for operating emergencies beyond the applicant's control, CMP operate the project in a run-of-river mode while maintaining a minimum flow of 1,947 cfs, or inflow, whichever is less. Condition 1 further requires that CMP submit plans for providing and monitoring the minimum flows for MDEP approval. We agree that the minimum flows specified in the WQC are necessary to protect fish and wildlife resources. Therefore, we recommend that Condition 1 become part of any license issued for the project.

*Condition 2* requires that, except as temporarily modified by approved maintenance activities, inflows to the project area, or by operating conditions beyond CMP's control, CMP maintain impoundment water levels within one foot of the normal full pond elevation of 156.0 feet, and that to the extent possible, limit scheduled maintenance drawdowns from "ice-out" to August 1 of each year. Condition 2 further requires that CMP submit plans for providing and monitoring the impoundment water levels for MDEP approval. We agree that the limitation on draw downs is necessary to protect fish and wildlife resources and recommend that this portion of Condition 2 become part of any license issued for the project.

*Condition 3* requires that CMP install and maintain upstream and downstream fish passage facilities by May 1, 2001, as outlined in the Agreement between KHDG and the state of Maine, and to submit, after consultation with state and federal fisheries agencies, functional design drawings, construction schedule, and operating and maintenance plans for Commission, FWS, and MDEP approval. The schedule provided by MDEP is consistent with that specified by Interior. We agree that fishways should be installed by May 1, 2001. Therefore, we recommend that Condition 3 become part of any license issued for this project.

*Condition 4* requires that CMP maintain and improve recreation facilities within the project boundaries and submit a schedule for implementing the improvements for approval. Condition 4 requires landscaping an area in front of the powerhouse; improving parking at Oosoola Park; creating a canoe portage trail around the dam; and monitoring recreational facility status and needs. We agree that recreational enhancements and monitoring are necessary (see Section 4.1.7.5) and recommend that Condition 4 become part of any license issued for this project.

### *2.2.1.5 Fort Halifax*

MDEP issued a WQC for continued operation of the Fort Halifax Project during 1994 subject to eight conditions. Conditions 6, 7, and 8 are general conditions. The following are the project-specific conditions contained in the WQC for the Fort Halifax Project.

*Condition 1* requires that, except for temporary modifications during approved maintenance, modifications due to low DO, or for operating emergencies beyond CMP's control, CMP operate the project in a run-of-river mode while maintaining a minimum flow of 150 cfs, or inflow, whichever is less, from April through November, and leakage (5-20 cfs) for the remainder of the year. Condition 1 further requires that CMP submit plans for providing and monitoring the minimum flows for MDEP approval. We agree that the minimum flows specified in the WQC are necessary to protect fish and wildlife resources. Therefore, we recommend that Condition 1 become part of any license issued for the project.

*Condition 2* requires that, except as temporarily modified by approved maintenance activities, inflows to the project area, or by operating conditions beyond CMP's control, CMP maintain impoundment water levels within 2.5 feet of the normal full pond elevation of 51.5 feet. Condition 2 further requires that CMP submit plans for providing and monitoring the impoundment water levels for MDEP approval. We agree that the limitation on draw downs is necessary to protect fish and wildlife resources and recommend that this portion of Condition 2 become part of any license issued for the project.

*Condition 3* requires that CMP continue to operate the permanent downstream fish passage facilities and install and evaluate the effectiveness of upstream fish passage facilities in accordance with the agreement between the KHDG and the state of Maine dated January 22, 1987. Condition 3 further requires that CMP, at least 60 days prior to construction of upstream fish passage facilities, submit, after consultation with state and federal fisheries agencies, functional design drawings, construction schedule, and operating and maintenance plans for Commission, FWS, and MDEP approval. We agree that movement of anadromous fish in the Sebasticook River is necessary. Therefore, we recommend that Condition 3 become part of any license issued for this project.

*Condition 4* requires that CMP monitor DO levels in the Fort Halifax impoundment and modify the operation of the project to run-of-river when DO approaches unacceptable levels. Condition 4 further stipulates that when run-of-river operation leads to low DO levels, CMP should implement a reservoir drawdown and impoundment flushing regime. Condition 4 requires that CMP, within six months of license issuance, submit a DO monitoring plan for MDEP approval. We agree that monitoring DO levels in the Sebasticook River is necessary and recommend that Condition 4 become part of any license issued for this project.

*Condition 5* requires that CMP maintain and improve recreation facilities within the project boundaries and submit a schedule for implementing the improvements for approval. Condition 5 requires constructing an informational interpretive sign; developing and constructing a new boat launch upstream of the dam; formalizing and improving the existing canoe portage trail; utilizing the existing carry-in boat landing as a canoe take-out area near the south end of the dam; and reviewing recreational needs and conditions at the project on a regular basis in accordance with the Commission's requirements. We agree that recreational enhancements and monitoring are necessary (see Section 4.1.7.6) and recommend that Condition 4 become part of any license issued for this project.

*2.2.1.6 Messalonskee Projects*

MDEP issued a WQC for continued operation of the four Messalonskee Projects during 1995 subject to nine conditions. Conditions 7, 8, and 9 are general conditions. The following are the project-specific conditions contained in the WQC for the

Messalonskee Projects (Messalonskee Lake and Oakland, Rice Rips, Automatic, and Union Gas Projects).

*Condition 1* requires that, except as temporarily modified by approved maintenance activities, emergencies beyond the applicants' control, or upon mutual agreement between the applicant and MDEP, the applicants maintain an instantaneous minimum flow of 15 cfs through all project developments, including the Rice Rips bypass, at all times, using the top 0.5 foot of Messalonskee Lake to augment natural flows. Condition 1 further requires that CMP and KWP submit plans for providing and monitoring the minimum flows for MDEP approval. We agree that the minimum flows specified in the WQC are necessary to protect fish and wildlife resources. Therefore, we recommend that Condition 1 become part of any license issued for the project.

*Condition 2* requires that, except as temporarily modified by approved maintenance activities, inflows to the project area, or by operating conditions beyond the applicants' control, the applicants maintain impoundment water levels: (1) within 0.5 foot of the normal full pond from June 1 through August 31 and within 1.0 foot of full pond the remainder of the year at Messalonskee Lake; (2) within 1.0 foot of full pond at Oakland, Rice Rips, and Automatic Projects; and (3) within 1.3 feet of full pond at the Union Gas Project. Condition 2 further requires that the applicants submit plans for providing and monitoring the impoundment water levels for MDEP approval. We agree that the limitation on draw downs is necessary to protect fish and wildlife resources and recommend that this portion of Condition 2 become part of any license issued for these projects.

*Condition 3* requires that the applicants sample DO, temperature, and chlorophyll *a* in Messalonskee Stream and record flow out of Messalonskee Lake dam and identify periods of generation during sampling. Condition 3 further requires that the applicants provide a water quality sampling plan to MDEP for review and approval within six months of license issuance. MDEP reserves the right, after proper notification and hearing, to require structural or operational changes if monitoring indicates that water quality standards are not met. We agree that water quality sampling is necessary to ensure that water quality standards are met and recommend that Condition 3 become part of any license issued for this project.

*Condition 4* requires that CMP implement its proposed new downramping sequence at the Union Gas Development as outlined in the supporting documentation for the application for 401 certification. We agree that the proposed downramping sequence would help to protect fisheries resources and recommend that Condition 4 become part of any license issued for this project.

*Condition 5* requires that CMP implement the "Messalonskee Lake Waterfowl Management Plan" and begin conducting wetland assessments and waterfowl surveys needed to maintain or enhance waterfowl nesting at Messalonskee Lake within two years of license issuance. Condition 5 further requires that CMP, based on the results of the studies, maintain or modify water levels as deemed appropriate by MDEP as necessary to protect nesting waterfowl. We agree that wetland assessments and waterfowl surveys are necessary to develop a basis for enhancement of wildlife resources (see Section 4.1.4.8). Therefore, we recommend that Condition 5 become part of any license issued for these projects.

*Condition 6* requires that the applicants install project identification signs at all projects; improve parking at the Rice Rips and Automatic Projects; evaluate the feasibility of creating a carry-in access site to the Rice Rips impoundment; and evaluate the feasibility of a "green-belt/multi-use" area between the Oakland and Rice Rips Projects. Condition 6 further requires that the applicants submit a schedule, for MDEP approval, for implementing the recreational enhancements. We agree that recreational enhancements and monitoring are necessary (see Sections 4.1.7.8 and 4.1.7.9) and recommend that Condition 6 become part of any license issued for these projects.

### 2.2.2 Section 18 Fishway Prescriptions

Section 18 of the FPA provides the secretaries of the U.S. Department of Interior (Interior) or the U.S. Department of Commerce (Commerce) the authority to prescribe fishways[5] at Commission-licensed projects. Interior or Commerce has requested the following measures and provisions for the Kennebec River Basin projects.

Interior reserved authority to prescribe fishways in the future, should the need arise, at the Moosehead, Wyman, Oakland, Rice Rips, Automatic, and Union Gas Projects. In addition, at Moosehead, Interior prescribed (letter dated October 10, 1993) that KWP provide optimum attraction flow by operating the northernmost Taintor gate when only one gate is to be used to release flows.

For the Sandy River Project, Interior (letter from A. Radant, Interior, dated May 25, 1994) establishes dates for

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[5] Section 18 of the FPA states that: "The Commission shall require the construction, maintenance, and operation by a licensee at its own expense of...such fishways as may be prescribed by the Secretary of Commerce or the Secretary of Interior, as appropriate."

resource agency consultation regarding functional design drawings, completion of construction, and post-construction effectiveness monitoring for upstream and downstream fishways. Interior also reserved its authority to prescribe construction, operation, and maintenance of fishways at the Sandy River Project.

Interior (letters from J. Deason, Interior, Washington, DC, February 3, 1993 and letter from W. Patterson, Interior, Boston, MA, March 11, 1993) has stated that license conditions similar to articles contained in the amended Weston and Fort Halifax licenses (dated January 25, 1989 and modified October 22, 1992, implementing the provisions of the KHDG Agreement) should be included in any new license issued for the projects including reservation of Interior's authority to prescribe fishways. Furthermore, Interior notes that this would ensure that all fishways at the Weston and Fort Halifax projects would be designed, constructed, maintained, operated, and evaluated in accordance with fishery agency specifications. Given the inclusion of these conditions, Interior states that additional prescriptions pursuant to Section 18 of the FPA are not now needed.

For the Fort Halifax Project, Commerce (letter from R. Roe and A. Giedt, NMFS, Gloucester, MA, March 25, 1993) requires finalization of the downstream fishway at the earliest possible date (a downstream permanent fishway is already in place and its operation is being fine-tuned), and establishes dates for resource agency consultation regarding functional design drawings, completion of construction, and post-construction effectiveness monitoring for upstream fishways that are consistent with the KHDG agreement. Commerce has reserved the right to set more specific prescriptions for fishways at the Fort Halifax Project pending the outcome of future activities, including studies and consultation pursuant to the KHDG agreement and the Edwards dam proceedings.

In separate letters dated October 7, 1996, Commerce and Interior submitted final Section 18 fishway prescriptions that they indicated should be implemented if the Commission proceeds with relicensing the Edwards Project rather than requiring dam removal. These prescriptions are essentially identical, and both agencies indicated that they supersede all previous prescriptions (Commerce submitted preliminary fishway prescriptions in letters dated April 8, 1996, and June 2, 1995; Interior submitted preliminary fishway prescriptions in letters dated April 4, 1996, and June 5, 1995). Commerce's and Interior's final prescriptions are listed below:

1) Reservation of authority to modify the final prescriptions or submit new prescriptions;

2) Construct a powerhouse fish lift;

3) Construct a spillway fish lift;

4) Construct an elevated fish transport channel to route fish from the powerhouse fish lift to the spillway fish lift;

5) Construct and fund the operation of a counting and sorting facility;

6) Construct an upstream fishway for American eel elvers;

7) Construct a downstream bypass consisting of angled bar racks, surface and bottom entrances, and a sluiceway or flume leading to a tailrace plunge pool;

8) Relocate the existing trash sluice to accommodate the fish lift exit channel;

9) Install a 20 foot section of rubber dam to enhance the effectiveness of attraction flows;

10) Install a steel walkway providing access to the spillway lift and counting and sorting facilities;

11) Relocate the existing trash boom to keep debris away from the fish lift;

12) Specification of design populations for American shad (371,000), alewives (1,548,000), Atlantic salmon (2,000 Commerce; 3,500-7,500 Interior), blueback herring (unquantified), and American eel (unquantified);

13) Specification that the fishways shall be operated and maintained at the licensee's expense from April 1 through November 30 for upstream migrations and from May 1 through December 31 for downstream migrations;

14) Specification that the upstream passage facilities shall be designed to operate at flows up to 27,000 cfs and downstream facilities shall be capable of operating whenever generation occurs;

15) Specification that the licensee shall construct, operate, and maintain the prescribed fishways to provide safe and timely passage for the design populations of Atlantic salmon, American shad, alewives, blueback herring, and American eels at their own expense (Interior only);

16) Specification that the licensee, in consultation with the agencies, shall develop a plan for and conduct effectiveness

evaluations for the prescribed fish passage facilities and operations;

17) Specification that the licensee shall develop a plan for and perform the necessary work to keep the fishways in proper order and clear of trash and logs;

18) Specification that the licensee shall provide the agencies access to the fishways for inspections of compliance with the prescriptions;

19) Specification that the fishways shall be operational within 2 years after the issuance of the license (Interior specifies by April 1 of the second year after license issuance);

20) An allowance for a 5 year deferment in the construction of the powerhouse fish elevator and the elevated fish transport channel;

21) Specification that if the licensee chooses staged construction, all second stage facilities must be completed within 5 years of the completed spillway facility or 7 years after issuance of the license (Interior specifies by April 1 of the fifth year after completion of the spillway facility or the seventh year after the issuance of the license); and

22) Specification that, to ensure immediate and timely contribution of the fishways to the ongoing anadromous fish restoration program in the Kennebec River above Edwards dam, items 12, 13, 14, 16, 17, 18, 19, and 21 listed above shall be included and incorporated by the licensee to ensure the effectiveness of the fishways pursuant to Section 1701(b) of the 1992 National Energy Policy Act (Interior only).

*Discussion*

Essentially, Interior's "prescription" for the Sandy River Project merely establishes a schedule for building and fine-tuning upstream and downstream fishways. No fishways are prescribed at this time. Adherence to a schedule is not a measure directly related to the specific passage facilities or necessary to ensure their effectiveness in passing fish. This element of the prescription would also interfere with the Commission's authority over the timing of construction of project works.

Moreover, Interior does not envision the submission of functional design drawings until April 30, 1999. Because Interior does not make specific prescriptions for fishways that can be included in a license at this time, we consider Interior to have reserved its authority to prescribe fishways at the Sandy

River Project, although we do recommend adherence to the schedule that Interior proposes.

Although Interior has not actually prescribed a specific fishway at Weston and Fort Halifax, we recommend including a reservation of such authority to Interior at both projects. We also recommend including conditions that are similar to existing license conditions that incorporate the terms of the KHDG agreement into the licenses of both projects.

Interior's recommendation regarding operation of the Taintor gates at Moosehead to provide attraction flows is not a fishway prescription, because the Taintor gates are not fishway structures. Aside from requiring particular operation of the Taintor gates, however, Interior may prescribe attraction flows for the existing fishway, and because KWP intends to operate the gates as proposed by Interior, we would recommend inclusion of a license condition requiring such operation.

As discussed for Interior's Sandy River Project prescriptions, we consider elements of Commerce's prescription for the Fort Halifax Project that pertain to adherence to a schedule to be outside the scope of Section 18. A schedule is not directly related to specific facilities and would interfere with the Commission's authority over the timing of construction at hydroelectric projects. Because Commerce has not submitted a more specific description of the upstream facilities that it desires, we consider Commerce's "prescription" to be a reservation of future authority to prescribe upstream fishways (a downstream permanent fishway is already in place and its operation is being fine-tuned).

Commerce and Interior have provided prescriptions that include detailed conceptual design of upstream and downstream fishways for the Edwards Project. However, we conclude that some of these prescriptions are outside of the scope of Section 18. Items 19, 20, and 21 are not valid Section 18 prescriptions because they pertain to construction schedules, are not related to the design or effectiveness of the facilities, and could interfere with the Commission's authority over the timing of other project construction.

Items 5 and 10, construction of a counting and sorting facility and construction of an access walkway to the counting and sorting facility, are also outside the scope of Section 18 because they are not structures that are necessary to pass fish. We review the environmental benefits of these items in Section 4.1.3.12 and, based on this analysis, we recommend their inclusion in any license issued for the project. Items 16 and 18 are not valid Section 18 prescriptions because these items are not directly related to the functioning of specific physical passage items. However, we review the environmental benefits of items 16 and 18 in Section 4.1.3.12 and, based on this analysis, we recommend their inclusion in any license issued for the project. Item 22 also is not a valid Section 18 prescription because it is not related to the functioning of specific physical passage items and it encroaches on the Commission's authority over project works and operations.

Furthermore, we consider the element of Interior's prescription to require FWS approval of fishways and related studies and Commerce' prescription that fishways be designated and operated according to NMFS specifications to be outside the scope of Section 18 because they encroach on the Commission's authority over project works and operations. Nevertheless, we would recommend that Edwards consult with resource agencies regarding the schedule, design, and effectiveness studies in any license issued for this project.

## 2.3 PROPOSED PROJECTS WITH ADDITIONAL STAFF RECOMMENDATIONS

An alternative to licensing the projects as proposed is to license them with modifications to facility design or operation, resource protection, or enhancement measures. In the following section, we describe the staff's recommended enhancements and modifications to the projects as proposed.

### 2.3.1 Moosehead

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- establish a target flow of between 1,000 and 2,000 cfs between releases for generation purposes from October 15 to and including May 31 on an annual basis in consultation with MDIFW;
- provide a target flow of 1,000 cfs from June 1 through October 14 between releases for generation purposes and establish criteria for reducing flows below the target flow while maintaining the 500 cfs minimum flow;
- implement a pond water level and flow monitoring plan;
- include MDIFW, MDOC, and TU in KWP's annual meetings regarding lake level management and flow releases;
- enhance salmonid spawning habitat in the East Outlet by grading and adding gravel;
- provide and maintain a safe take-out on the East Outlet for whitewater boating;

- establish primitive camping areas and assess other recreational enhancements, after consultation with resource agencies and user groups, along the East Outlet, West Outlet, and Moosehead Lake;
- survey shoreland for potential recreation sites;
- implement a loon monitoring plan;
- implement a wetland monitoring plan; and
- develop a Comprehensive Land Management Plan for Moosehead Lake.

### 2.3.2 Moxie

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- limit out-flows during fall drawdown to a maximum of 145 cfs (or inflow, if greater);
- during the spring refill period, maintain an instantaneous minimum flow of 25 cfs, or inflow, whichever is less; and a target flow that is similar to the maximum flow released during drawdown;
- release 25 cfs or inflow, whichever is less, from the north or south gate from June to and including September, if feasible;
- implement a pond water level and flow monitoring plan; and
- monitor for potential ice damage and shoreline erosion due to modified pond-level regime.

### 2.3.3 Wyman

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- release a flat minimum flow of 1,200 cfs using the top 2 feet of storage from May 15 to and including July 15 and the top 4 feet of storage for the rest of the year. If above minimum flows cause violations of drawdown restrictions, release a minimum flow of 1,200 cfs or inflow, whichever is less;
- if impoundment level is drawn down more than 2 feet on regular basis because of the previous recommendation, implement a fish and wildlife impact assessment plan;

- establish pre-action agency notification to establish the basis for emergency drawdowns of up to 8 feet for flood control purposes, and include notification and reporting procedures in the lake water level monitoring plan;

- implement a lake water level and flow monitoring plan;

- implement a stream enhancement prototype study and, if appropriate, expand the placement of velocity refuges;

- install warning signs downstream of the Wyman Project to alert anglers and recreationists of potential rapid increases in flow;

- implement a plan to create constant-level ponds or alternative shoreline enhancements adjacent to the Williams Project impoundment to provide fish and wildlife habitat where currently there is little because of daily impoundment fluctuations;

- conduct a study to evaluate the feasibility of reducing the daily fluctuations in the Williams impoundment by altering the existing water management regime; and

- implement a Shoreland Management Plan.

### 2.3.4 Sandy River

- develop an erosion and sedimentation control plan designed to identify options to stabilize erodible soils on the floodplain adjacent to the impoundment and distribute to abutting property owners; and

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31.

### 2.3.5 Weston

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;

- implement a lake water level and flow monitoring plan;

- implement a plan to provide tailrace access for recreational purposes; and

- implement a Shoreland Management Plan.

### 2.3.6 Fort Halifax

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- provide run-of-river flow to the tailwaters during May and June and 400 cfs for the rest of the year and develop and implement a plan to provide instream structures in the tailwaters;
- implement a lake water level and flow monitoring plan; and
- implement a Shoreland Management Plan.

### 2.3.7 Oakland (including Messalonskee Lake)

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- provide a minimum flow of 100 cfs or inflow, whichever is less; and
- implement a lake water level and flow monitoring plan.

### 2.3.8 Rice Rips

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- provide a minimum flow of 100 cfs or inflow, whichever is less;
- ensure implementation of a water quality monitoring plan;
- implement a lake water level and flow monitoring plan;
- design and implement a bypassed reach fish habitat enhancement plan;
- provide a minimum flow of 25 cfs or inflow, whichever is less, in the Rice Rips bypassed reach;
- designate the area investigated as a greenbelt or multi-use area; and
- develop a carry-in boat access site on the Rice Rips impoundment.

### 2.3.9 Automatic

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- provide a minimum flow of 100 cfs or inflow, whichever is less;
- implement a lake water level and flow monitoring plan; and
- if an improved, safe parking area cannot be constructed at North Street Park, as KWD proposes, provide public access to the impoundment at an alternative site.

### 2.3.10 Union Gas

- minimize scheduled maintenance and inspection drawdowns from ice-out to and including July 31;
- provide a minimum flow of 100 cfs or inflow, whichever is less;
- implement a lake water level and flow monitoring plan; and
- develop tailrace fishing access to accommodate people with disabilities.

### 2.3.11 Edwards (Staff Licensing Alternative)

We recommend retirement of the Edwards Project and complete removal of the dam. However, should the Commission decide to issue a new license for the Edwards Project, we would recommend the following mitigation and protection measures.[6]

- maintain the impoundment within 1 foot of full pond (elevation 25 feet);
- implement a pond water level and flow monitoring plan;
- install, operate, and maintain fishways as prescribed by Commerce and Interior;
- perform upstream and downstream fishway effectiveness studies for shad, river herring, salmon, and eels;

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[6] The Commission also should consider the need for a project decommissioning fund in any license issued for the Edwards Project.

- provide funding for an anadromous fish restoration fund to be managed by state and federal fisheries agencies;
- operate a fishway sorting facility to enhance anadromous fish restoration efforts; return sturgeon, striped bass, and smelt to the project tailwater; and prevent upstream passage of undesirable species;
- release any sturgeon, striped bass, and smelt collected in the upstream passage facilities downstream of the dam;
- install a steel walkway and provide agency access to the sorting facility and upstream passage facilities;
- release 6,000 cfs or inflow (whichever is less) from April 15 to May 31 to enhance shortnose sturgeon spawning habitat;
- release 4,500 cfs or inflow (whichever is less) during July to enhance Atlantic sturgeon spawning habitat;
- rebuild the existing Sidney boat launch;
- develop a riverfront trail and picnic area near the Sidney boat launch;
- consult with MDOC prior to development of primitive campsites on Sevenmile Island; and
- monitor recreation use in the project area using the FERC Form 80 recreation assessment.

### 2.3.12 Edwards (Retirement and Dam Removal Alternative)

- develop and implement a detailed erosion and sedimentation control plan for stabilization of sensitive areas;
- extend the Sidney boat ramp;
- monitor concentration of *E coli* of human origin near the dam;
- implement a water quality monitoring program;
- revegetate the riverbank immediately upstream of the dam and in sensitive areas;
- stabilize the eight known archeological sites affected by shoreline fluctuations;
- redesign and extend the Statler Paper Company outfall pipe to be at least 3 feet below the water level at summer flows of 4,500 cfs;

- suggest that communities revise shoreland protection ordinances; and
- consult with the MSHPO after drawdown to determine the need for a Phase I reconnaissance survey of newly exposed areas.

## 2.4 NO-ACTION ALTERNATIVE

Under the no-action alternative, there would be continued unlicensed operation of the Sandy River Project, and the other 10 projects would continue to operate under the terms and conditions of the original licenses, with no change in environmental conditions. We use this alternative to establish baseline environmental conditions for comparison with other alternatives.[7]

## 2.5 OTHER ALTERNATIVES

We considered several other alternatives to the applicants' proposals, including the following:

- denying the applications for new licenses for all of these projects, with surrender or termination of the licenses (retiring projects);
- federal takeover and operation of the projects; and
- issuing nonpower licenses.

Several agencies and intervenors have requested that Edwards perform a study to analyze the economic and environmental consequences of the removal of Edwards dam. The basis of the request is the goal to restore anadromous fish to their historic range in the Kennebec River. Anadromous species targeted by resource agencies include four species for which little is known about their ability to effectively use fishways: Atlantic and shortnose sturgeon, striped bass, and rainbow smelt. These four species are not known to have historically occurred upstream of Waterville. As part of the EIS process, we conducted a study of the effects of removing Edwards dam (SWETS, 1995a and 1995b). In addition, Oak Ridge National Laboratory (ORNL) conducted an independent study of the removal of the Edwards dam (ORNL, 1997). We discuss the conclusions of these studies in Sections 2.6, 4, and 5 of this FEIS.

Several agencies and individuals have recommended that we evaluate the removal of other dams (including Fort Halifax, Weston, Sandy River, and other dams not included in this EIS) in

[7] See Public Service Company of New Hampshire, 68 FERC ¶ 61,177 (1994).

addition to Edwards dam, also based on the goal to restore anadromous fish to their historic range in the Kennebec River. In 1989 (as modified in 1992) the Commission issued amendments to license orders for six hydroelectric projects[8] on the Kennebec River to require installation of upstream and downstream fish passage facilities at each of the six projects, in accordance with the terms of a 1986 agreement between the State of Maine and the KHDG. By incorporating the terms of the KHDG agreement into the licenses of the parties to this agreement, the Commission has endorsed the concept that this agreement represents an effective approach to restoring the targeted anadromous fish to their historic range in the Kennebec River. These targeted species are alewife, American shad, and Atlantic salmon. No agency or individual has presented specific evidence as to why dams other than Edwards dam should be considered for removal. Therefore we have not considered removal of other dams to be within the scope of this EIS.

A second retirement alternative would involve retaining dams other than Edwards and disabling or removing equipment used to generate power. Project works would remain in place and could be used for historic or other purposes. This would require us to identify another governmental agency willing and able to assume regulatory control and supervision of the remaining facility. No agency has stepped forward, and no participant has advocated this alternative; nor do we have any basis for recommending it. Because the power supplied by the generating projects is needed, a source of replacement power would have to be identified. In these circumstances, we do not consider removal of the electric generating equipment to be a reasonable alternative.

We do not consider federal takeover to be a reasonable alternative for existing projects with capacity greater than 1.5 MW.[9] Federal takeover and operation of the projects would require Congressional approval. While that fact alone would not preclude further consideration of this alternative, there is no evidence to indicate that we should recommend federal takeover to Congress. No party has suggested federal takeover would be appropriate, and no federal agency has expressed an interest in operating the projects.

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[8] The six projects are Lockwood (FERC No. 2574), Hydro-Kennebec (FERC No. 2611), Shawmut (FERC No. 2322), Weston (FERC No. 2325), Fort Halifax (FERC No. 2552), and Benton Falls (FERC No. 5073).

[9] The possibility of federal takeover is not applicable to minor projects (capacity less than or equal to 1.5 MW) or to unlicensed projects. Therefore, federal takeover would not apply to the Sandy River, Fort Halifax, Automatic, and Union Gas Projects.

Issuing a nonpower license would not provide a long-term resolution of the issues presented. A nonpower license is a temporary license that the Commission will terminate whenever it determines that another governmental agency will assume regulatory authority and supervision over the lands and facilities covered by the nonpower license. No party has sought a nonpower license although some have implied that a nonpower license could be appropriate for the Moxie Project. We have no basis for concluding that the remaining nine projects (we exclude the Edwards and Moxie Projects) should no longer be operated for power production purposes (either by generation or releases for downstream generation). Thus, nonpower licenses are not realistic alternatives to relicensing in these circumstances.

## 2.6 DEVELOPMENTAL RESOURCES

In this section, we provide an economic comparison of the proposed alternatives by project (Section 2.6.1) and a detailed discussion of proposed enhancement measures (Section 2.6.2). We then discuss the pollution abatement benefits (Section 2.6.3) provided by continued operation of the existing projects, and the reduction or increase in those benefits that could result from our recommended operational changes.

The Commission has concluded that it cannot with confidence predict the absolute or relative costs of operating hydropower projects or the likely alternative sources of electricity for the 30 to 50 year terms for which licenses are issued. Therefore, the Commission's policy is to use current costs to evaluate potential economic factors in licensing.[10]

Except for the Sandy River Project, we have based our estimate of the cost of alternative capacity on an assumed capacity value of $109/kW-year (at a fixed charge rate of 14 percent), which is based on a combined-cycle combustion turbine plant, the least expensive and most likely new capacity alternative, and the cost of alternative energy from natural gas-

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[10] We used a current cost approach to comparing the cost of each project under various alternatives to the cost of a likely source of alternative power, as required by the Commission's order in <u>Mead Paper Corp.,</u> 72 FERC ¶ 61,027 (1995). Under this method, no assumptions are made about future escalation or de-escalation of various costs of producing project power or about future escalation or de-escalation of various costs of producing project power or alternative power, such as fossil fuels and maintenance. The analysis is not entirely a first year analysis because certain costs, such as major capital investments, would not be expensed in a single year. The maximum period used to annualize such costs is 30 years. Also, some future expenses, such as tax depreciation expenses are known and measurable.

fueled electric plants in the New England Division of the country. We base our estimate of the amount of fuel that would be displaced on fuel consumption at a heat rate of 6,200 Btu/kWh. We estimated the 1996 cost of fuel based on the Energy Information Administration's 1995 publication, *Supplement to the Annual Energy Outlook.*[11]

We discuss the cost of alternative capacity and energy for the Sandy River Project in Section 2.6.2.4.

### 2.6.1 Economic Comparison of the Alternatives

We evaluated the costs and power generation impacts at all of the 11 projects and seven other projects in the basin that would be affected by operational changes at upstream projects. In Table 2-2, we present a comparison of the current net annual benefits for each alternative. The current net annual benefit is the difference in the cost to produce power at the hydroelectric project as compared to producing an equivalent amount of power by the most likely alternative source. Positive benefits indicate that it is less expensive to produce power at the hydroelectric project than by the most likely alternative. Conversely, negative benefits indicate that it is more expensive to produce power at the hydroelectric project than by the most likely alternative. In Appendix A, we present the impact on economics of the other downstream projects in the basin.

### 2.6.2 Detailed Economics

In this section, we discuss the details of our economic analyses for the 11 projects being considered for original or new licenses or license surrender (Moxie) in the EIS.

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[11] Supplement to the Annual Energy Outlook, end-use prices; reference - case projections. Source: electric utilities - natural gas, p. 122, table 11. Energy Information Administration, 1995.

Table 2-2. Comparison of current net annual benefits of the project alternatives ($1,000s) (Source: staff)

| Project | No-Action Alternative | Applicant's Proposal | Applicant's Revised Proposal | Staff's Alternative | Dam Removal Alternative |
|---|---|---|---|---|---|
| Moosehead | -$300.3 | -$483.2 | NA | $500.4 | NA |
| Moxie | -$47.3 | -$72.7 | NA | -$73.7 | NA |
| Wyman | $12,935.7 | $12,853.3 | NA | $12,898.1 | NA |
| Sandy River | $99.6 | -$0.1 | NA | -$1.5 | NA |
| Weston | $2,260.2 | $1,357.1 | NA | $1,341.3 | NA |
| Oakland | $319.1 | $270.4 | NA | $249.2 | NA |
| Rice Rips | $155.6 | $122.8 | NA | $94.8 | NA |
| Automatic | $31.7 | $21.2 | NA | $17.0 | NA |
| Union Gas | $106.1 | $79.5 | NA | $66.3 | NA |
| Fort Halifax | $116.1 | -$524.0 | NA | -$551.6 | NA |
| Edwards | -$110.8 | -$2,742.4 | -$496.7 | -$1,317.6[1] | -$786.1 |

[1] The staff's licensing alternative.

### *2.6.2.1 Moosehead*

*Cost of Headwater Benefits*

KWP states that the Moosehead Project is fully depreciated. However, KWP made investments (accumulated debt) as of January 1991, of $955,000 for resource assessment and license application preparation and about $700,000 for Phase I and II archeological mitigation. The total outstanding net investment is about $1,655,000.

In our analysis, we include the carrying costs on the outstanding project net investment, annual operation and maintenance (O&M) costs ($245,500), insurance, taxes, and administrative and general expenses. The annual cost to operate the existing project, without any environmental measures, is about $300,300.

*Cost of Environmental Measures*

In Table 2-3, we show the capital cost and O&M expense of each enhancement, the annual cost, and the applicable project alternative. We discuss the environmental effects of the existing Moosehead Project operations, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-3. Summary of enhancement measures, capital cost of enhancement, annual cost, and applicable alternative considered at the Moosehead Project (Source: staff)

| Enhancement Measures | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|
| Phase III Archeological Mitigation | $800,700 | $102,500 | KWP, staff |
| Archeological Monitoring | $346,700 | $44,400 | KWP, staff |
| Fishway Effectiveness Study | $10,400 | $900 | Interior |
| Macroinvertebrate Study | $62,500 | $5,200 | Interior |
| Fisheries Habitat Enhancement | $29,000 | $2,500 | KWP, staff |
| Flow and water surface elevation monitoring | $20,800 | $1,700 | staff |
| Develop and implement a wetland monitoring program | $57,300 | $4,700 | staff |
| Develop and implement a loon monitoring program | $62,500 | $5,200 | staff |
| Develop Comprehensive Land Management Plan | $40,000 | $3,300 | staff |
| Proposed recreation upgrades | $384,300 | $32,100 | KWP, staff |
| Back-country canoe campsites | $26,000 | $2,200 | staff |
| Recreational use assessment Annual O&M cost | $2,300 | $1,500 | KWP, staff |

[1] KWP - Kennebec Water Power Company proposal; staff - staff's alternative.

In Table 2-4, we present a summary of the economic analysis of the Moosehead Project alternatives. In accordance with the "Kennebec Headwater Benefits Agreement," the cost of the project is shared by the downstream projects. We present a discussion of the distribution of these costs in Appendix B.

Table 2-4. Comparison of economic analyses for Moosehead Lake Project alternatives (Source: staff)

| | Existing Project | KWP's Proposal | Staff's Proposal |
|---|---|---|---|
| Installed capacity (MW) | 0 | 0 | 0 |
| Annual generation (GWh) | 0 | 0 | 0 |
| Annual power value: (thousands $) | $0 | $0 | $0 |
| Annual cost: (thousands $) | $300.3 | $483.2 | $500.4 |
| Current net annual benefit: (thousands $) | -$300.3 | -$483.2 | -$500.4 |

*2.6.2.2 Moxie*

*Cost of Headwater Benefits*

The Owners state that Moxie is not fully depreciated. As of December 31, 1990, the Owners projected an outstanding debt of $73,400 for the project. In addition, the Owners made the following investments (accumulated debt) as of December, 1991: (1) $300,000 for resource assessment and license application preparation; and (2) Phase I and II archeological mitigation at a cost of $17,000. The total outstanding net investment is about $390,400.

We include the carrying costs on the outstanding project net investment, annual O&M costs ($22,600), insurance, taxes, and administrative and general expenses. The annual cost of the existing Moxie Project, without any environmental measures, is about $47,300.

*Cost of Environmental Measures*

In Table 2-5, we show the capital cost and O&M expense of each enhancement, the annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-5. Summary of enhancement measures, capital cost of enhancement, annual cost, and applicable alternative considered at the Moxie Project (Source: staff)

| Enhancement Measures | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|
| Studies on dam stabilization | $83,900 | $7,100 | Owners, staff |
| Dam stabilization implementation | $190,100 | $16,100 | Owners, staff |
| Annual recreational facility maintenance<br>Annual O&M cost: | $3,400 | $2,300 | Owners, staff |
| Recreational use assessment<br>Annual O&M cost: | $2,000 | $1,300 | studied |
| Develop and implement a pond level and flow monitoring plan | $6,000 | $500 | staff |
| Shoreland management plan<br>Capital cost:<br>Annual O&M cost: | $7,800<br>$300 | $900 | studied |
| Monitor for ice damage | $5,200 | $400 | staff |

[1] Owners - the Owners of Moxie Project and after surrender The Forks; staff - staff alternative; studied - originally considered but not recommended by the staff.

In Table 2-6, we present a summary of the economic analysis of the Moxie Project alternatives. In accordance with the "Kennebec Headwater Benefits Agreement," the cost of the project to the Owners is shared by the downstream projects. We present a discussion of the distribution of these costs in Appendix B of the EIS.[12]

[12] Since December 31, 1993, the Moxie Project has operated in a run-of-river mode consistent with environmental and safety concerns. Thus, the Moxie Project no longer provides benefits to downstream hydroelectric projects.

Table 2-6. Comparison of economic analyses for Moxie Project alternatives (Source: staff)

| | Existing Project | Owners' Proposal | Staff's Proposal |
|---|---|---|---|
| Installed capacity (MW) | 0 | 0 | 0 |
| Annual generation (GWh) | 0 | 0 | 0 |
| Annual power value: (thousands $): | $0 | $0 | $0 |
| Annual cost: (thousands $) | $47.3 | $72.7 | $73.7 |
| Current net annual benefits: (thousands $) | -$47.3 | -$72.7 | -$73.7 |

### *2.6.2.3 Wyman*

*Power and Economic Benefits*

Wyman would generate on average about 356,000,000 kWh of energy annually without any additional environmental enhancement measures. CMP states that Wyman is not fully depreciated. As of December 31, 1990, CMP projected an outstanding debt of $5,637,900. In addition, CMP made the following investments (accumulated debt) as of January 1991: (1) $585,000 for resource assessment and license application preparation; (2) $46,000 for Phase I and II archeology studies; and (3) $21,000 for land purchase for recreational facilities. The total outstanding net investment is about $6,289,000.

We include the carrying costs on the outstanding project net investment, annual O&M costs ($919,200), insurance, taxes, and administrative and general expenses in our analysis. We do not include the Wyman Project portion of the costs of the Moosehead and Moxie headwater benefits as estimated in Appendix B.

The annual cost of the existing project, without any environmental measures, is about $1,881,600 (5.3 mills/kWh) for the existing generation of 356.0 GWh of energy annually. We estimate that the cost of alternative power would be about $14,817,300 (41.6 mills/kWh). The existing project, therefore, produces power at an annual cost of about $12,935,700 (36.3 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-7, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-7. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Wyman Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $141,000 | $33,400 | CMP, staff |
| Archeological monitoring | -- | $33,500 | $7,900 | CMP, staff |
| Proposed recreational facilities | -- | $37,200 | $5,800 | CMP, staff |
| Canoe portage trail | -- | $23,200 | $3,600 | CMP, staff |
| Appalachian Trail Crossing Fund | -- | $104,100 | $16,100 | CLF, ATC |
| Loon management: | -- | | | |
| Capital cost: | | $5,800 | $6,700 | CMP, staff |
| Annual O&M cost: | | $5,800 | | |
| Aquatic macroinvertebrate study | -- | $52,100 | $8,100 | staff |
| Recreational facility maintenance | -- | | | |
| Annual O&M cost: | | $10,300 | $10,300 | CMP, staff |
| Recreational use assessment | -- | | | |
| Annual O&M cost: | | $3,800 | $3,700 | CMP, staff |
| Shoreland management plan | -- | | | |
| Capital cost: | | $31,200 | $5,800 | staff |
| Annual O&M cost: | | $1,000 | | |
| Develop and implement a shoreline habitat enhancement plan at Williams | -- | $114,500 | $17,700 | staff |
| Feasibility study to reduce impoundment fluctuations at Williams | -- | $10,400 | $1,600 | staff |
| Instream enhancement structures | -- | $42,700 | $6,600 | staff |
| Develop and implement a pond level and flow monitoring plan | -- | $20,800 | $3,200 | staff |
| Min Flow Alternatives | | | | |
| CMP's Proposal - 750 cfs | 0.561 | -- | $10,900 | CMP |
| Staff - 1,200 cfs | -3.976 | -- | -$77,600 | staff |

[1] CMP - Central Maine Power proposal; staff - staff alternative.

In Table 2-8, we present a summary of the economic analyses of the Wyman Project alternatives.

Table 2-8. Comparison of economic analyses for the Wyman Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 72.0 | 72.0 | 72.0 |
| Annual generation (GWh) | 356.000 | 355.439 | 359.976 |
| Annual power value: | | | |
| (thousands $): | $14,817.3 | $14,806.4 | $14,894.9 |
| (mills/kWh): | 41.6 | 41.7 | 41.4 |
| Annual cost: | | | |
| (thousands $): | $1,881.6 | $1,953.1 | $1,996.8 |
| (mills/kWh): | 5.3 | 5.5 | 5.5 |
| Current net annual benefits: | | | |
| (thousands $): | $12,935.7 | $12,853.3 | $12,898.1 |
| (mills/kWh): | 36.3 | 36.2 | 35.9 |

*2.6.2.4 Sandy River*

Sandy River would generate on average about 3,000,000 kWh of energy annually without any additional environmental enhancement measures. MEW states that Sandy River is not fully depreciated. As of July 15, 1994, MEW projected an outstanding debt of $80,000. In addition, MEW made investments (accumulated debt) as of January 1, 1994, of $100,000 for resource assessment and license application preparation. The total outstanding net investment is about $180,000.

We include the carrying costs on the outstanding net investment, annual O&M costs ($15,300), insurance, taxes, and administrative and general expenses in our analysis.

We based our estimate of the cost of alternative capacity and energy on the town of Madison's avoided cost. The town would replace the power generated by the Sandy River Project with purchases from the Northeast Utilities Service Company. Based on the information contained in the "Bulk Power Supply Service Agreement," which was submitted by MEW on February 14, 1994, in response to our Additional Information Request dated November 23, 1993, we estimate the 1996 capacity value to be $66/kW-year and the energy value to be 33.02 mills/kWh. Our estimate of the capacity value includes both capacity and transmission charges. Our estimate of the energy value is a composite rate including both on-peak and off-peak rates.

The annual cost of the existing project, without any environmental measures, is about $31,700 (10.6 mills/kWh) for the existing generation of 3.0 GWh of energy annually. We estimate the annual cost of alternative power to be about $131,300 (43.8 mills/kWh). Therefore the existing project produces power at an annual cost of about $99,600 (33.2 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-9, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-9. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Sandy River Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Cost (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Develop erosion and sedimentation control plan that addresses control of erodible soils | -- | $15,000 | $1,400 | staff |
| Operate in run-of-river mode | 0.150 | -- | $5,000 | MEW, staff |
| Install automatic headpond sensor system | -- | $7,600 | $700 | MEW, staff |
| Monitor DO and temperature (annual cost) | -- | $1,000 | $1,000 | MEW, staff |
| Construct upstream and downstream fish passage | -- | $866,900 | $80,800 | MEW, staff |
| Provide fish passage flow:<br>Upstream - 18 cfs<br>Downstream - 24 cfs | 0.064 | -- | $2,100 | MEW, staff |
| Prepare plan for monitoring the effectiveness of fish passage | -- | $20,800 | $1,900 | MEW, staff |
| Provide recreation enhancements<br>Capital cost:<br>Annual O&M: | <br>--<br>-- | <br>$1,700<br>$1,100 | $1,200 | MEW, staff |
| Maintain foot access path to tailrace<br>Capital cost:<br>Annual O&M: | <br>--<br>-- | <br>$5,400<br>$200 | $700 | MEW, staff |
| Recreational use assessment (annual cost) | -- | $300 | $300 | MEW, staff |
| Perform Phase III archeological mitigation | -- | $65,100 | $5,900 | MEW, staff |

1 MEW - Madison Electric Works proposal; staff - staff alternative.

In Table 2-10, we present a summary of the economic analysis of the Sandy River Project alternatives.

Table 2-10. Comparison of economic analyses for Sandy River Project alternatives (Source: staff)

| | Existing Project | MEW's Proposal | Staff's Proposal |
|---|---|---|---|
| Installed capacity (MW) | .488 | .488 | .488 |
| Annual generation (GWh) | 3.000 | 2.786 | 2.786 |
| Annual power value: | | | |
| (thousands $) | $131.3 | $124.2 | $124.2 |
| (mills/kWh) | 43.8 | 44.6 | 44.6 |
| Annual cost | | | |
| (thousands $) | $31.7 | $124.3 | $125.7 |
| (mills/kWh)[a] | 10.6 | 44.6 | 45.1 |
| Current net annual benefit | | | |
| (thousands $) | $99.6 | -$0.1 | -$1.5 |
| (mills/kWh)[a] | 33.2 | -0.0 | -0.5 |

[a] Based on alternative's generation.

### *2.6.2.5 Weston*

*Power and Economic Benefits*

Weston generates on average about 81,936,000[13] kWh of energy annually. CMP states that Weston is not fully depreciated. As of December 31, 1990, CMP projected an outstanding debt of $1,326,700. In addition, CMP made investments (accumulated debt) as of January 1991, of: (1) $250,000 for resource assessment and license application preparation; (2) $470,000 for Phase I and II archeology studies; and, (3) $48,000 for land purchase for recreational facilities. The total outstanding net investment is about $2,094,700.

We include the carrying costs on the outstanding net investment, annual O&M costs ($417,300), insurance, taxes, and administrative and general expenses in our analysis. We do not include the Weston Project portion of the costs of the Moosehead and Moxie headwater benefits as estimated in Appendix B.

[13] CMP states that the average annual generation of the existing Weston Project is 81,936,000 kWh. CMP proposes to expand the facility by upgrading the turbines. This proposed upgrade would increase the average annual generation by about 11,200,000 kWh to about 93,136,000 kWh.

The annual cost of the existing project, including carrying charges on the net investment, is about $737,800 (9.0 mills/kWh) for the existing generation of 81.936 GWh of energy annually. We estimate the annual cost of alternative power to be about $2,998,000 (36.6 mills/kWh). Therefore the existing project produces power at an annual cost of about $2,260,200 (27.6 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-11, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of current project operations, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-11. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Weston Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $868,900 | $206,100 | CMP, staff |
| Archeological monitoring | -- | $67,100 | $15,900 | CMP, staff |
| Proposed recreational upgrade | -- | $58,100 | $9,000 | CMP, staff |
| Interpretive facilities upgrade | -- | $16,200 | $2,500 | CMP, staff |
| Construct canoe portage | -- | $17,400 | $2,700 | CMP, staff |
| Lowering of logging piers | -- | $17,400 | $2,700 | CMP, staff |
| Tailrace access trail | -- | $10,400 | $1,600 | staff |
| Recreational facility maintenance | -- | | | |
| Annual O&M cost: | | $2,300 | $2,300 | CMP, staff |
| Recreational use assessment | -- | | | |
| Annual O&M cost: | | $500 | $500 | CMP, staff |
| Upstream & downstream fish passage facilities w/ 300 cfs flow: | | | | |
| Capital cost: | 3.59 | $2,404,500 | $497,700 | CMP, staff |
| O&M cost | -- | $22,900 | -- | -- |
| Fish effectiveness studies | -- | $522,600 | $92,000 | CMP, staff |
| Shoreland management plan | | | | |
| Capital cost: | -- | $23,400 | $4,500 | staff |
| O&M cost: | -- | $800 | -- | |
| Flow & water monitoring | -- | $20,800 | $3,200 | staff |
| Min Flow & Impoundment Fluct Alt | | | | |
| CMP's proposal - 750 cfs at Wyman | 0.039 | -- | $800 | CMP |
| Staff - 1,200 cfs at Wyman | 0.093 | -- | $1,800 | staff |

[1] CMP - Central Maine Power proposal; staff - staff alternative

In Table 2-12, we present a summary of the economic analysis of the Weston Project alternatives.

Table 2-12. Summary of economic analyses for the Weston Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 12.8 | 14.8 | 14.8 |
| Annual generation (GWh) | 81.936 | 89.507 | 89.453 |
| Annual power value: | | | |
| (thousands $): | $2,998.0 | $3,364.4 | $3,363.3 |
| (mills/kWh): | 36.6 | 37.6 | 37.6 |
| Annual cost: | | | |
| (thousands $): | $737.8 | $2,012.7 | $2,022.0 |
| (mills/kWh): | 9.0 | 22.5 | 22.6 |
| Current net annual benefits: | | | |
| (thousands $): | $2,260.2 | $1,351.7 | $1,341.3 |
| (mills/kWh): | 27.6 | 15.1 | 15.0 |

### *2.6.2.6 Fort Halifax*

*Power and Economic Benefits*

Fort Halifax would generate on average about 7,602,000[14] kWh of energy annually without any additional environmental enhancement measures. CMP states that Fort Halifax is not fully depreciated. As of December 31, 1991, CMP projected an outstanding debt of $176,700. In addition, CMP made investments (accumulated debt) of: (1) $372,000 for resource assessment and license application preparation; (2) Phase I and II archeology studies at a cost of $112,000; (3) purchased land for a boat ramp at a cost of $35,000; and (4) installed a downstream fish passage at a cost of $296,000. The total outstanding net investment is about $991,700.

We include that the carrying costs on the outstanding net investment, annual operation, and maintenance costs ($44,500), insurance, taxes, and administrative and general expenses in our analysis.

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[14] CMP states that the average annual generation for the Fort Halifax Project is 7,822,000 kWh. Since filing its application, CMP has constructed and operates a downstream fishway. The estimated annual lost generation due to fish passage flows is 220,000 kWh.

The annual cost of the existing project, without any environmental measures, is about $196,200 (25.8 mills/kWh) for the existing generation of 7.602 GWh of energy annually. We estimate the cost of alternative power to be about $312,300 (41.1 mills/kWh). The existing project, therefore, produces power at an annual cost of about $116,100 (15.3 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-13, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-13. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Fort Halifax Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $612,800 | $145,300 | CMP, staff |
| Archeological monitoring | -- | $145,400 | $34,500 | CMP, staff |
| Interpretive facility upgrade | -- | $5,600 | $900 | CMP, staff |
| Trailered boat launch | -- | $165,500 | $26,000 | CMP, staff |
| Canoe portage trail/improve carry-in boat access | -- | $22,400 | $3,500 | CMP, staff |
| Recreational facility maintenance | -- | | | |
| Annual O&M cost: | | $1,100 | $1,100 | CMP, staff |
| Recreational use assessment | -- | | | |
| Annual O&M cost: | | $400 | $400 | CMP, staff |
| Upstream fish passage facilities | -- | $1,736,400 | $272,300 | CMP, staff |
| Fish passage facilities maintenance | -- | | | |
| Annual O&M cost: | | $21,600 | $21,600 | CMP, staff |
| Upstream fish passage flows - 51 cfs | 0.240 | -- | $4,700 | CMP, staff |
| Fish passage studies: | | | | |
| Downstream | -- | $229,000 | $36,800 | CMP, staff |
| Upstream | -- | $400,800 | $64,400 | CMP, staff |
| 150 cfs minimum flow | 0.330 | -- | $6,400 | CMP |
| ROR and 400 cfs minimum flow | 0.810 | -- | $15,800 | Interior, Commerce, staff |

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Tailwater habitat improvement structures | | $89,500 | $13,700 | Interior, staff |
| Minimum flow facilities | -- | $135,300 | $21,200 | CMP, staff |
| Water quality monitoring | -- | | | |
| Annual O&M cost: | | $1,100 | $1,100 | CMP, staff |
| Shoreland management plan | -- | | | |
| Capital cost: | | $23,400 | $4,500 | staff |
| Annual O&M cost: | | $800 | -- | -- |

1 CMP - Central Maine Power; staff - staff alternative.

In Table 2-14, we present a summary of the economic analyses of the Fort Halifax Project alternatives.

Table 2-14. Summary of economic analyses of the Fort Halifax Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 1.5 | 1.5 | 1.5 |
| Annual generation (GWh) | 7.602 | 7.032 | 7.032 |
| Annual power value: | | | |
| (thousands $): | $312.3 | $301.2 | $301.2 |
| (mills/kWh): | 41.1 | 42.8 | 42.8 |
| Annual cost: | | | |
| (thousands $): | $196.2 | $825.2 | $852.8 |
| (mills/kWh): | 25.8 | 117.3 | 121.3 |
| Current net annual benefits: | | | |
| (thousands $): | $116.1 | -$524.0 | -$551.6 |
| (mills/kWh): | 15.3 | -74.5 | -78.5 |

*2.6.2.7 Oakland*

*Power and Economic Benefits*

Oakland would generate on average about 9,408,000[15] kWh of energy annually without any additional environmental enhancement measures. CMP states that the Messalonskee Stream projects are not fully depreciated. As of January 1991, CMP projected an outstanding debt of $1,807,700 for it's four Messalonskee Stream projects. We used $451,900 as the outstanding debt for the Oakland Project (25 percent of the total outstanding debt). In addition, CMP made investments (accumulated debt) as of January 1991, of: (1) $100,000 for resource assessment and license application preparation; and (2) Phase I and II archeological studies at a cost of $167,200. The total outstanding net investment is about $719,100.

We include the carrying costs on the outstanding net investment, annual O&M costs ($60,600), insurance, taxes, and administrative and general expenses in our analysis.

The annual cost of the existing project, without any environmental measures, is about $170,600 (18.2 mills/kWh) for the existing generation of 9.408 GWh of energy annually. We estimate that the cost of alternative power would be about $489,700 (52.1 mills/kWh). The existing project, therefore, produces power at an annual cost of about $319,100 (33.9 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-15, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

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[15] CMP states that the average annual generation of the Oakland Project is 8,916,000 kWh. Since the submittal of the license application, CMP has repaired the leakage at the Oakland Project. We estimate that the leakage accounted for about 492,000 kWh in lost generation.

Table 2-15. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Oakland Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Cost (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $57,600 | $13,700 | CMP, staff |
| Archeological monitoring | -- | $16,800 | $4,000 | CMP, staff |
| Recreational facilities | -- | $23,200 | $3,600 | CMP, staff |
| Interpretive signage at Oakland Development | -- | $4,700 | $700 | CMP, staff |
| Recreational facility maintenance<br>Annual O&M cost: | -- | $1,300 | $1,300 | CMP, staff |
| Recreational use assessment<br>Annual O&M cost: | -- | $200 | $200 | CMP, staff |
| Minimum flow of 15 cfs | 0.492 | -- | $9,600 | CMP |
| Minimum flow of 100 cfs | 1.339 | -- | $26,100 | Interior, staff |
| Minimum flow gate | -- | $13,900 | $2,200 | CMP, staff |
| Minimum flow instrumentation | -- | $10,400 | $1,600 | staff |
| Greenbelt/Multi-use area | -- | $4,700 | $700 | staff |
| Waterfowl management plan<br>Annual O&M cost: | -- | $3,100 | $3,100 | CMP, staff |
| Develop and implement a minimum flow & pond level monitoring plan | -- | $10,400 | $1,600 | staff |
| Erosion and sedimentation control | -- | $5,200 | $800 | staff |
| New fish screen<br>Capital cost:<br>Annual O&M cost: | <br>--<br>-- | <br>$87,800<br>$10,600 | $24,200 | Interior |
| Maintenance of existing screen at Messalonskee Lake<br>Annual O&M cost: | -- | $10,300 | $10,300 | CMP, staff |

[1] CMP - Central Maine Power proposal; staff - staff alternative.

In Table 2-16, we present a summary of the economic analyses of the Oakland Project alternatives.

Table 2-16. Summary of economic analyses of the Oakland Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 2.8 | 2.8 | 2.8 |
| Annual generation (GWh) | 9.408 | 8.916 | 8.069 |
| Annual power value: | | | |
| (thousands $): | $489.7 | $480.1 | $463.6 |
| (mills/kWh): | 52.1 | 53.8 | 57.5 |
| Annual cost: | | | |
| (thousands $): | $170.6 | $209.7 | $214.4 |
| (mills/kWh): | 18.2 | 23.5 | 26.6 |
| Current net annual benefits: | | | |
| (thousands $): | $319.1 | $270.4 | $249.2 |
| (mills/kWh): | 33.9 | 30.3 | 30.9 |

### *2.6.2.8 Rice Rips*

*Power and Economic Benefits*

Rice Rips would generate on average about 5,641,000[16] kWh of energy annually without any additional environmental enhancement measures. CMP states that the Messalonskee Stream projects are not fully depreciated. As of January 1991, CMP projected an outstanding debt of $1,807,700 for it's four Messalonskee Stream projects. We used $451,900 as the outstanding debt for the Rice Rips Project (25 percent of the total outstanding debt). In addition, CMP made investments (accumulated debt) as of January 1991, of: (1) $100,000 for resource assessment and license application preparation; and (2) Phase I and II archeological studies at a cost of $83,600. The total outstanding net investment is about $635,500.

We include the carrying costs on the outstanding net investment, annual O&M costs ($32,100), insurance, taxes, and administrative and general expenses in our analysis.

[16] CMP states that the average annual generation of the Rice Rips Project is 5,346,000 kWh. Since the submittal of the license application, CMP has repaired the leakage at the Rice Rips Project. We estimate that the leakage accounted for about 295,000 kWh in lost generation.

The annual cost of the existing project, without any environmental measures, is about $129,400 (22.9 mills/kWh) for the existing generation of 5.641 GWh of energy annually. We estimate that the cost of alternative power would be about $285,000 (50.5 mills/kWh). The existing project, therefore, produces power at an annual cost of about $155,600 (27.6 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-17, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-17. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Rice Rips Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $55,500 | $13,200 | CMP, staff |
| Archeological monitoring | -- | $16,800 | $4,000 | CMP, staff |
| Parking at Rice Rips Road | -- | $13,900 | $2,200 | CMP, staff |
| Carry-in access development at impoundment | -- | $23,200 | $3,600 | CMP, staff[2] |
| Green belt/multi-use area | -- | $4,600 | $700 | CMP, staff[2] |
| Recreational facility maintenance Annual O&M cost: | -- | $1,300 | $1,300 | CMP, staff |
| Recreational use assessment Annual O&M cost: | -- | $200 | $200 | CMP, staff |
| Minimum flow of 15 cfs | 0.295 | | $5,800 | CMP |
| Minimum flow of 25 cfs | 0.355 | -- | $6,900 | Interior, staff |
| Minimum flow of 100 cfs | 0.803 | | $15,700 | Interior, staff |
| Minimum flow gate | -- | $12,500 | $1,900 | CMP, staff |
| Minimum flow instrumentation | -- | $10,400 | $1,600 | staff |
| Develop and implement a bypassed reach habitat enhancement | -- | $41,600 | $6,500 | staff |
| Develop and implement a minimum flow & pond level monitoring plan | -- | $2,600 | $400 | staff |
| Develop and implement a water quality monitoring program | -- | $62,500 | $9,700 | staff |

[1] CMP - Central Maine Power proposal; staff - staff alternative.

[2] CMP proposes to evaluate these enhancements; we recommend implementing them.

In Table 2-18, we present a summary of the economic analyses of the Rice Rips Project alternatives.

Table 2-18. Summary of economic analyses of the Rice Rips Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 1.6 | 1.6 | 1.6 |
| Annual generation (GWh) | 5.641 | 5.346 | 4.838 |
| Annual power value: | | | |
| (thousands $): | $285.0 | $279.2 | $269.3 |
| (mills/kWh): | 50.0 | 52.2 | 55.7 |
| Annual cost: | | | |
| (thousands $): | $129.4 | $156.4 | $174.5 |
| (mills/kWh): | 22.9 | 29.3 | 36.1 |
| Current net annual benefits: | | | |
| (thousands $): | $155.6 | $122.8 | $94.8 |
| (mills/kWh): | 27.6 | 22.9 | 19.6 |

*2.6.2.9 Automatic*

*Power and Economic Benefits*

The Automatic Project would generate on average about 2,903,000 kWh of energy annually without any additional environmental enhancement measures. CMP states that the four Messalonskee projects are not fully depreciated. As of January 1991, CMP projected an outstanding debt of $1,807,700 for its four Messalonskee projects. We used $451,900 as the outstanding debt for the Automatic Project (25 percent of the total debt). In addition, CMP made investments (accumulated debt) as of January 1991, of: (1) $100,000 for resource assessment and license application preparation; and (2) Phase I and II archeological studies at a cost of $83,600. The total outstanding net investment is about $635,500.

We include the carrying costs on the outstanding net investment, annual O&M costs ($16,600), insurance, taxes, and administrative and general expenses in our analysis.

The annual cost of the existing project, without any environmental measures, is about $112,400 (38.7 mills/kWh) for the existing generation of 2.903 GWh of energy annually. We estimate that the cost of alternative power would be about $144,100 (49.6 mills/kWh). The existing project, therefore, produces power at an annual cost of about $31,700 (10.9 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-19, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need or lack of need for enhancements in sections 3 and 4 of the EIS. CMP proposed several environmental enhancements at this project that we assume would be implemented by the present licensee, KWD.

Table 2-19. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Automatic Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $55,500 | $7,100 | CMP, staff |
| Archeological monitoring | -- | $16,800 | $2,100 | CMP, staff |
| Parking at North Street Park | -- | $3,400 | $300 | CMP, staff |
| Recreational facility maintenance Annual O&M cost: | -- | $1,300 | $900 | CMP, staff |
| Recreational use assessment Annual O&M cost: | -- | $200 | $100 | CMP, staff |
| Develop and implement a minimum flow and pond level monitoring plan | -- | $2,600 | $200 | staff |
| Minimum flow of 100 cfs | 0.276 | -- | $3,600 | Interior, staff |
| Erosion & sedimentation control | -- | $5,200 | $400 | staff |

[1] CMP - Central Maine Power proposal; staff - staff alternative.

In Table 2-20, we present a summary of the economic analyses of the Automatic Project alternatives.

Table 2-20. Summary of economic analyses of the Automatic Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 0.8 | 0.8 | 0.8 |
| Annual generation (GWh) | 2.903 | 2.903 | 2.627 |
| Annual power value: | | | |
| (thousands $): | $144.1 | $144.1 | $138.7 |
| (mills/kWh): | 49.6 | 49.6 | 52.8 |
| Annual cost: | | | |
| (thousands $): | $112.4 | $122.9 | $121.7 |
| (mills/kWh): | 38.7 | 42.3 | 46.3 |
| Current net annual benefits: | | | |
| (thousands $): | $31.7 | $21.2 | $17.0 |
| (mills/kWh): | 10.9 | 7.3 | 6.5 |

### *2.6.2.10 Union Gas*

*Power and Economic Benefits*

The Union Gas Project would generate on average about 4,994,000[17] kWh of energy annually without any additional environmental enhancement measures. CMP states that the Messalonskee projects are not fully depreciated. As of January 1991, CMP projected an outstanding debt of $1,807,700 for it's four Messalonskee projects. We used $451,900 as the outstanding debt for the Union Gas Project (25 percent of the total outstanding debt). In addition, CMP made investments (accumulated debt) as of January 1991, of: (1) $100,000 for resource assessment and license application preparation; (2) Phase I and II archeological studies at a cost of $83,600; and, (3) constructed a boat launch on the Kennebec River to improve the local recreational opportunities at a cost of $112,000. The total outstanding net investment is about $747,500.

[17] CMP states that the average annual generation of the Union Gas Project is 4,733,000 kWh. Since the submittal of the license application, CMP has repaired the leakage at the Union Gas Project. We estimate that the leakage accounted for 261,000 kWh in lost generation.

We include the carrying costs on the outstanding net investment, annual O&M costs ($41,000), insurance, taxes, and administrative and general expenses in our analysis.

The annual cost of the existing project, without any environmental measures, is about $155,300 (31.1 mills/kWh) for the existing generation of 4.994 GWh of energy annually. We estimate that the cost of alternative power would be about $261,400 (52.3 mills/kWh). The existing project, therefore, produces power at an annual cost of about $106,100 (21.2 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-21, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and the applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of the EIS.

Table 2-21. Summary of enhancement measures, lost generation, capital cost of enhancement, annual cost, and applicable alternative considered at the Union Gas Project (Source: staff)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Phase III archeological mitigation | -- | $55,500 | $13,200 | CMP, staff |
| Archeological monitoring | -- | $16,800 | $4,000 | CMP, staff |
| Evaluate tailrace walk-in access | -- | $5,800 | $900 | CMP, staff |
| Develop disabled-accessible angling at tailrace | -- | $26,000 | $4,000 | staff |
| Recreational facility maintenance Annual O&M cost: | -- | $1,300 | $1,300 | CMP, staff |
| Recreational use assessment Annual O&M cost: | -- | $200 | $200 | CMP, staff |
| Minimum flow of 15 cfs | 0.261 | -- | $5,100 | CMP |
| Minimum flow of 100 cfs | 0.711 | -- | $13,900 | Interior, staff |
| Minimum flow gate | -- | $12,500 | $1,900 | CMP, staff |
| Develop and implement a minimum flow and pond level monitoring plan | -- | $2,600 | $400 | staff |

[1] CMP - Central Maine Power proposal; staff - staff alternative.

In Table 2-22, we present a summary of the economic analyses of the Union Gas Project alternatives.

Table 2-22. Summary of economic analyses of the Union Gas Project alternatives (Source: staff)

| | No-action | CMP's Proposal | Staff's Alternative |
|---|---|---|---|
| Installed capacity (MW) | 1.5 | 1.5 | 1.5 |
| Annual generation (GWh) | 4.994 | 4.733 | 4.283 |
| Annual power value: | | | |
| (thousands $): | $261.4 | $256.3 | $247.6 |
| (mills/kWh): | 52.3 | 54.2 | 57.8 |
| Annual cost: | | | |
| (thousands $): | $155.3 | $176.8 | $181.3 |
| (mills/kWh): | 31.1 | 37.4 | 42.3 |
| Current net annual benefits: | | | |
| (thousands $): | $106.1 | $79.5 | $66.3 |
| (mills/kWh): | 21.2 | 16.8 | 15.5 |

*2.6.2.11 Edwards*

*Power and Economic Benefits*

The Edwards Project would generate on average about 19,984,000 kWh of energy annually without any additional environmental enhancement measures. Edwards states that the project is not fully depreciated. As of 1991, Edwards projected an outstanding debt of $6,373,500. In addition, Edwards made investments (accumulated debt) as of 1994, of $250,000 for repairs to the downstream face of the dam and an additional $80,000 in 1995. The total outstanding net investment is about $6,703,500.

We include the carrying costs on the outstanding net investment, annual O&M costs ($101,900), insurance, taxes, and administrative and general expenses in our analysis. We do not include the Edwards Project portion of the costs of the Moosehead and Moxie headwater benefits as estimated in Appendix B.

The annual cost of the existing project, without any environmental measures, is about $883,300 (44.2 mills/kWh) for the existing generation of 19.984 GWh of energy annually. We estimate that the cost of alternative power would be about $772,500 (38.7 mills/kWh). The existing project, therefore, produces power at an annual cost of about $110,800 (5.5 mills/kWh) more than currently available alternative power.

In its original application for license, Edwards proposed to expand the existing facilities from 3.5 MW to 11.0 MW at a cost of about $31,795,000. The generation of the expanded project would increase from 20 GWh to about 62 GWh annually. Our incremental economic analysis of the proposed expansion shows that the proposed expansion produces power at an annual cost of about $2,338,000 more than currently available alternative power.

On October, 30, 1995, Edwards filed with FERC an Amendment to its Application for License. In it they proposed to upgrade the existing facilities instead of expanding them. Edwards estimated that the upgrade would increase capacity by about 1.0 MW and annual generation by about 3.0 GWh at a cost of about $800,000. Our incremental economic analysis of the proposed upgrade (1.0 MW) shows that the proposed upgrade would produce power at an annual cost of about $38,600 (12.9 mills/kWh) less than currently available alternative power.

*Cost of Environmental Measures*

In Table 2-23, we show the lost generation, capital cost, and O&M expense of each enhancement, annual cost, and applicable alternative. We discuss the environmental effects of the current project operation, enhancement measures, agency recommendations, and the need for enhancements in sections 3 and 4 of this EIS.

Table 2-23. Summary of enhancement measures, lost generation, capital cost of enhancements, annual costs, and applicable alternative considered at the Edwards Project (Source: staff; ORNL, 1997)

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Capacity expansion from 3.5 MW to 11.0 MW (includes O&M costs) | -42.000 | $33,098,800 | $2,338,000 | EMC |
| Capacity upgrade from 3.5 MW to 4.5 MW | -3.000 | $832,800 | -$38,600 | EMCR, staff |
| Minimum flow and impoundment fluctuation alternatives: | | | | |
| CMP's proposal - 750 cfs at Wyman | -0.015 | -- | -$200 | EMC, EMCR |
| Staff alternative - 1,200 cfs at Wyman | -0.034 | -- | -$400 | staff |
| Rubber crest dam | -- | $1,625,500 | $135,900 | EMCR, staff |
| Monitoring of pond levels | -- | $20,800 | $1,700 | staff |
| Fish passage (upstream and downstream) | -- | $2,281,200 | $193,000 | EMC & EMCR |
| | -- | $9,300,000 | $786,900 | Interior, Commerce, MSPO & staff |
| Fish passage flows: | | | | |
| Existing - 35 cfs Apr to Nov | 0.016 | -- | $200 | NA |
| Proposed - 100 cfs Apr to Nov | 0.486 | -- | $6,300 | EMC |
| Staff - 100 cfs year-round plus 35 cfs April to Nov | 0.101 | -- | $1,300 | EMCR |
| 300 cfs Apr to Nov plus 20 cfs in Dec. | 0.100 | -- | $1,300 | Interior, Commerce & MSPO & staff |
| Develop and implement fishway effectiveness studies | -- | $1,200,000 | $104,000 | Interior, Commerce, MSPO & staff |
| Fishway sorting and reporting (includes O&M cost) | -- | $146,400 | $96,600 | staff |
| Phase II archeology mitigation | -- | $102,900 | $8,900 | EMC, EMCR, staff |
| Phase III archeology mitigation | -- | $447,300 | $44,300 | EMC, EMCR, staff |
| Develop compliance plans | -- | $9,600 | $800 | Interior, Commerce, and staff |

| Enhancement Measures | Lost Generation (GWh) | Capital Cost of Enhancements (1996 $) | Annual Costs (1996 $) | Applicable Alternative[1] |
|---|---|---|---|---|
| Archeological monitoring | -- | $89,400 | $8,900 | EMC, EMCR, staff |
| Salmon stocking program | -- | $191,600 | $16,000 | EMC, EMCR |
| Anadromous fish restoration fund | -- | $191,600 | $16,000 | staff |
| Recreational use assessment (includes O&M cost) | -- | $1,700 | $1,100 | staff |
| Erosion and sedimentation control plan | -- | $5,200 | $400 | staff |
| Rebuild Sidney boat ramp | -- | $10,400 | $900 | staff |
| 4,500 cfs Atlantic sturgeon release | 1.317 | -- | $17,000 | Interior, Commerce, MSPO, & staff |
| 6,000 cfs shortnose sturgeon release | 0.359 | -- | $4,600 | Commerce, MSPO, & staff |
| Dam removal[2] | | | | |
| Removal | -- | $2,600,000 | $220,000 | DR |
| Mitigation: | | | | |
| - Sediment & water quality monitoring | -- | $100,000 | $8,500 | DR |
| - Revegetation | -- | $4,800 | $400 | DR |
| - Statler Tissue discharge modifications | -- | $40,000 | $3,400 | DR |
| - Sidney boat launch ramp | -- | $5,000 | $400 | DR |
| Boat launch at Vassalboro | -- | $59,200 | $5,000 | EMC, EMCR, staff |
| Sidney loop trail and picnic area | -- | $9,900 | $800 | EMC, EMCR, staff |
| Sevenmile Island primitive campsites | -- | $4,400 | $400 | EMC, EMCR, staff |
| Augusta Mill Park | -- | $123,600 | $10,300 | EMC, EMCR, staff |
| Canoe portage trail around Edwards dam | -- | $2,200 | $200 | EMC, EMCR, staff |

1 NA - no-action alternative; EMC - Edwards Manufacturing Company proposal; EMCR - Edwards Manufacturing Company Revised Proposal; Staff - staff's licensing alternative; DR - Dam removal alternative.

2 See Table 2-24.

*Dam Removal Costs*

Table 2-24 shows the estimated cost of dam removal.

Table 2-24. Estimated costs of dam removal

| Item description | Cost in millions (1996 $) DEIS estimate[1] | FEIS estimate[2] |
|---|---|---|
| Mobilization | 0.20 | 0.09 |
| Creating initial breach | 1.40 | 0.26 |
| Removing the dam and disposing of debris | 2.90 | 1.49 |
| Stabilizing the east and west embankments | 0.60 | 0.00 |
| Demobilization | 0.20 | 0.09 |
| Engineering | 0.20 | 0.29 |
| Contingency | 1.10 | 0.38 |
| TOTALS | 6.60 | 2.60 |

[1] SWETS, 1995a, 1995b.
[2] ORNL, 1997.

Interior (letter dated April 4, 1996) and the Kennebec Coalition's consultant, Summit Technology (Summit) (comments dated April 8, 1996) indicated that the estimated dam removal cost in the DEIS was high. Interior estimated the cost to be about $4 million and Summit estimated the cost to be about $2 million. Their estimates primarily differ from that used in the DEIS in three areas: rate of draw down (5 feet per week versus 1 foot per week), method of initial breach (cofferdam versus gate structure), and unit costs (lower unit costs based on Means).

In orders dated December 20, 1996 (77 FERC ¶ 61,285) and March 14, 1997 (78 FERC ¶ 61,292), the Commission directed staff to contract with ORNL for an independent study of dam removal costs. The resulting ORNL dam removal report (ORNL, 1997) includes an independent review of various proposed dam removal alternatives and estimated costs for dam removal. The dam removal costs cited in this FEIS are those provided by ORNL in its report.

The ORNL study states that a limit of 5 feet per week drawdown is sufficient protection and allows removal to be completed in a single season. The ORNL cost includes construction of a lined gravel cofferdam, similar to one of the Kennebec Coalition's designs, "that will provide sufficient control during the initial breach," and assumes that the timber cribbing filled with stones and cobbles, timber and concrete decking, and upstream gravel fill from the eastern bulkhead spillway to the western powerhouse will be excavated and removed from the river. As shown in Table 2-24, based on the ORNL study, the estimated cost of dam removal would be about $2.60 million.

We emphasize that the dam removal cost estimate is strictly conceptual. The actual cost could vary following agency consultation regarding the process and site-specific conditions encountered in the field.

In Table 2-25, we present a summary of the economic analyses for the Edwards Project alternatives.

Table 2-25. Summary of economic analyses for the Edwards Project alternatives (Source: staff)

| | Existing Project | Edwards' Proposal | Edwards' Revised Proposal | Staff's Licensing Alternative | Dam Removal Alternative[1] |
|---|---|---|---|---|---|
| Installed capacity (MW) | 3.5 | 11.0 | 4.5 | 4.5 | 0.0 |
| Annual generation (GWh) | 19.984 | 61.529 | 22.914 | 21.258 | 0.0 |
| Annual power value: | | | | | |
| (thousands $): | $772.5 | $2,403.1 | $939.0 | $906.7 | $0.0 |
| (mills/kWh): | 38.7 | 39.1 | 41.0 | 42.7 | NA |
| Annual cost: | | | | | |
| (thousand $): | $883.3 | $5,145.5 | $1,435.7 | $2,224.3 | $786.1 |
| (mills/kWh): | 44.2 | 83.6 | 62.7 | 104.6 | NA |
| Current net annual benefit: | | | | | |
| (thousand $): | -$110.8 | -$2,742.4 | -$496.7 | -$1,317.6 | -$786.1 |
| (mills/kWh): | -5.5 | -44.5 | -21.7 | -61.9 | NA |

1 The estimated cost of the dam removal alternative includes the dam removal and mitigation costs shown in Tables 2-23 and 2-24, the carrying charges of the net investment of the existing project.

### 2.6.3 Pollution Abatement

The Kennebec River Projects evaluated in this EIS annually generate an average of about 491.5 GWh of electricity under existing conditions. This amount of hydropower generation, when contrasted with generation of an equal amount of energy by fossil-fueled facilities, avoids unnecessary emission of a moderate quantity of atmospheric pollutants. Assuming that the 491.5 GWh of hydropower generation would be replaced by an equal amount of natural gas-fired generation, generating electric power equivalent to that produced by the Kennebec River Projects would require combustion of about 5,070 million cubic feet of natural gas annually. Removal of pollutants from the emissions to levels presently achievable by state-of-the-art technology would cost about $243,000 annually.

# 3.0 AFFECTED ENVIRONMENT

In this section, we describe the existing environment in the project areas. First we describe regional environmental resources (Section 3.1), then we discuss resources that may be cumulatively affected (Section 3.2), and then we elaborate on resources at specific sites (Section 3.3). Existing environmental conditions define the baseline for our subsequent analyses of adverse or beneficial effects of each alternative.[1]

## 3.1 REGIONAL RESOURCES

### 3.1.1 General Setting

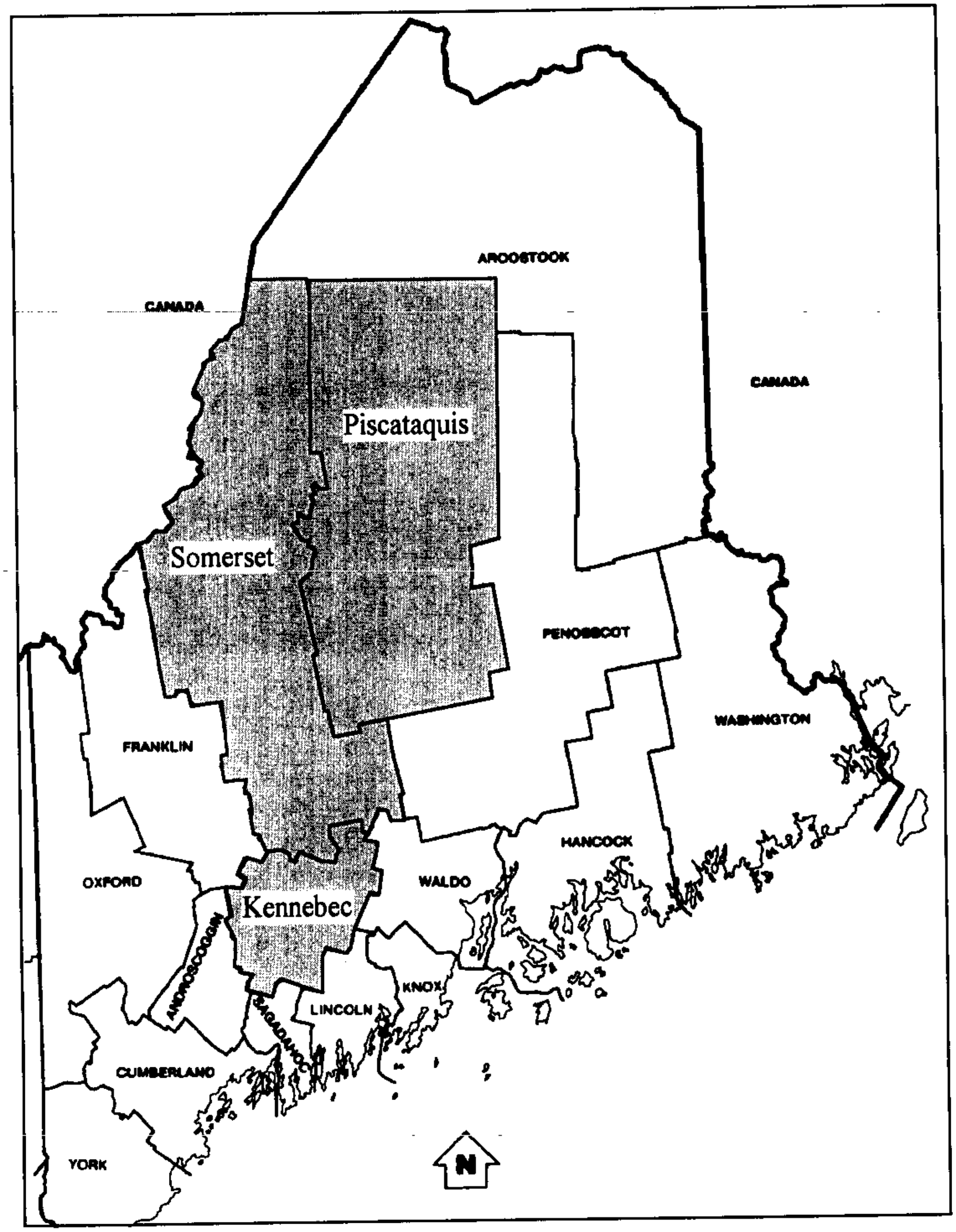
Originating at the border between Canada and the United States, the Kennebec River Basin (figures 1-1 and 3-1) is in Piscataquis, Somerset, and Kennebec Counties in west central Maine and encompasses about 5,870 square miles, about one-fifth of the total area of the state. At its widest point, the basin stretches for 70 miles, and it extends 132 miles south to the Maine coast. Except for one S-shaped curve, at the Weston Project, the Kennebec River flows generally north-south to Merrymeeting Bay at the coast. From its origin to its mean tide at Augusta, the river falls about 1,026 feet with an average gradient of 8.5 feet per mile (fpm).

The Androscoggin River Basin lies to the west, the Penobscot River Basin to the north and east, and a section of the Maine coastal area to the south. The principal downstream tributaries (draining at least 400 square miles) of the Kennebec River Basin are the Kennebec, Moose, Dead, Carrabassett, Sandy, and Sebasticook Rivers (Table 3-1).

The average gradient of the Kennebec River for the first 30 miles from Moosehead Lake downstream is 17 fpm, including numerous rapids. Downstream of the headwater reservoirs, the average gradient of the Kennebec River is 6 fpm. The average gradients of the Moose, Dead, Carrabassett, Sandy, and Sebasticook Rivers are 10, 25, 18, 22, and 6 fpm, respectively.

There are 11 projects on the main stem of the Kennebec River; 10 are hydroelectric dams totalling more than 220 megawatts (MW) of installed capacity. CMP owns and operates five

[1] Unless otherwise indicated, we have obtained our information from the applications for each of the 11 projects considered in this EIS. Section 6 lists complete citations for each application.




Study area county

0 20 40 60 80
Approx. Scale in Miles

FIGURE 3-1.
KENNEBEC RIVER BASIN EIS
Study Area Counties

Source: U.S. Department of Commerce, 1990, modified by staff.

Table 3-1. Principal downstream tributaries of the Kennebec River Basin

| River | Length (Miles) | Drainage Area (Square Miles) |
|---|---|---|
| Kennebec River | 132 | 716 |
| Moose River | 76 | 722 |
| Dead River | 23 | 874 |
| Carrabassett River | 35 | 401 |
| Sandy River | 69 | 596 |
| Sebasticook | 48 | 946 |

of the hydroelectric dams on the main stem.[2] CMP is a co-owner of the Moosehead and Moxie Projects as part of KWP. KWP consortium releases from the upstream reservoirs to provide an average flow of at least 3,600 cfs at the town of Madison.

There are several reservoirs in the upper basin, including: Moosehead Lake (FERC No. 2671), Brassua Lake (FERC No. 2515), First Roach Pond,[3] Flagstaff Lake (FERC No. 2612), and Moxie Pond (FERC No. 2613).

Although storage was originally developed to facilitate transportation of logs to mills at the basin's lower end, it is now used for flood control and power production by downstream electric utility and industrial plants.

Flows above the Williams Project (Figure 1-1) fluctuate daily because of peaking operations at the Wyman Project immediately upstream. Flows are reregulated at the Williams Project to provide stable flows downstream. Projects on the main stem of the Kennebec River downstream of the Williams Project are normally operated in run-of-river mode.

The basin has four distinct seasons with relatively cool summers and severe winters. Annual precipitation averages about 36 inches in the north, 43 inches in the south, and is evenly distributed throughout the year. Average annual temperature is

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[2] CMP owns and operates the Williams Project (FERC No. 2335); Wyman Project (FERC No. 2329); Harris Project (FERC No. 2142); Shawmut Project (FERC No. 2322); and Lockwood Project (FERC No. 2574).

[3] In Kennebec Water Power Co., 68 FERC ¶ 61,180, the Commission determined that First Roach Pond dam is not subject to Commission jurisdiction under Part I of the FPA.

about 42°F. Average monthly temperatures vary from 65 to 70°F in July to 10 to 20°F in January and February. Extremes range from 90 to minus 30°F.

The climate of the basin is characterized by frequent changes in weather. The summers are relatively cool, and the winters are severe, particularly at inland and upland locations. Except for occasional coastal storms, most of the weather changes are the result of movement of air masses generally from the west to the east across the country (FERC, 1993).

About 250,000 acres, or 8 percent of the basin, is cropland. Major agricultural activities include the production of dairy, poultry, and forest products. Leading crops include potatoes, apples, vegetables, hay, and horticultural specialties (FERC, 1993).

Forests are a basic element in the area's economy, and more than 75 percent of the land is wooded. The forests supply the raw material for the numerous wood-using industries. Timber harvesting and pulp and paper manufacturing dominate land and water use in this area. Other industries include textile and shoe manufacturing, food processing, and tanning. The two principal manufacturing centers, Augusta and Waterville, are both on the Kennebec River in the lower part of the basin.

Most of the Kennebec River Basin is located in upland areas, principally the Charlton and Bangor Upland. A large section in the upper part of the basin, including the Dead River and Moosehead Lake areas, is an extension of the White Mountains and composed of rocky granitic lands with large areas of slate and shale. Many of the mountain peaks on the northwestern perimeter of the basin and in the Moosehead Plateau reach elevations of 2,600 feet to 3,900 feet above sea level. Steep hills and mountains cover half of the basin, and rolling hills cover the other half.

The topography of the area gradually changes from mountains and gentle foothills at the headwaters to the wide flat valleys characteristic of a coastal plain. Many lakes and ponds are scattered throughout the basin including the scenic Belgrade Lakes near Waterville. There are 31 major lakes and ponds of more than 1,000 surface acres in the Kennebec watershed. These lakes and ponds cover about 5 percent of the total basin area (FERC, 1993).

### 3.1.2 Geology and Soils

The project area is located in three physiographic provinces: the White Mountain Region, the New England Uplands, and the Seaboard Lowlands.

The White Mountain Region is dominated by irregular uplands and precipitous mountains. Moosehead Lake, the largest in Maine at 117 square miles, fills a glacial depression in the northeast section of this area and, along with the Moose River, forms the headwaters of the Kennebec River. After flowing through Moosehead Lake, two outlets, and the Harris dam impoundment, the main stem of the Kennebec River travels swiftly for 10 miles dropping 22 fpm then an additional 9 miles dropping 9.5 fpm until it reaches the Wyman impoundment.

Further south in the New England Uplands, elevations gradually decline to 500 feet above sea level. The area is characterized by gently sloping highlands rising above wide, flat valleys. The Kennebec River slows to a 5.5-fpm drop through this 60-mile-long region. The river valley, usually bounded by steep walls, widens to include wetlands, broad flood plains, and islands.

Further downstream to the Seaboard Lowlands, the elevation gradually drops below 500 feet. This encompasses all of the lower Kennebec River, skirting Cobbessee and Belgrade Lakes. The main stem corridor is deeply incised and backed by low, steep hills. At Augusta, 45 miles upstream of the mouth, the Kennebec River becomes tidal.

The bedrock geology of the project area consists mainly of metamorphosed sedimentary rock of the Silurian, Devonian, or Ordovician ages. There are also areas of granite bedrock. Rock formations include the Waterville, Vassalboro, Perry Mountain, Smalls Falls, Madrid, Sangerville, and other minor formations. The Moxie Pluton and the Lexington Batholith Formations also intrude into project area bedrock.

The surficial geology of the project area is mainly glacial in origin. The movement of glaciers resulted in the surface formations and their compositions. The Kennebec River flows along the course of a glacial stream that caused an esker and excised, transported, and deposited material from the glacial deposits described in Table 3-2.

### 3.1.3 Water Quantity and Quality

#### *3.1.3.1 Water Quantity*

Flows from the headwater storage facilities on the Kennebec River are regulated to provide a uniform and reliable flow for downstream hydroelectric and industrial users. The regulated flow also provides for flood control, assimilation of discharges from municipal and industrial wastewater treatment facilities, fisheries and wildlife, and recreational uses. The target flow from the upper Kennebec River Basin storage projects (as measured at Madison, Maine) is set once or twice each month based on the

Table 3-2. Surface geology in the project area

| Surface Formation | Description |
|---|---|
| Glacial till | A surficial deposit consisting of a heterogeneous mixture of clay, silt, sand, gravel, cobbles, and boulders |
| Basal till | Deposited and compacted under the glacier and is extremely dense |
| Ablation till | Deposited by melting glaciers from material carried in and on top of the ice. This till is generally less dense, more granular, and stony. |
| Eskers | Long, sinuous ridges of sand and gravel, deposited in tunnels in the glacial ice formed by streams of meltwater running under the glacier. These eskers are interbedded with and mantled by glacio-marine and alluvial deposits. Eskers are actively utilized as sources of sand and gravel. |
| Glacio-marine deposits | Can be deltas: fine-grained glacial stream outwash deposited where the glacial streams flow into the relatively tranquil inland ocean and glacial-marine sediments: a fine grained marine sediment deposited in blanket fashion over the entire tranquil inland ocean. These deposits consist of clay, silt, and fine sand. The deposits are regionally referred to as the Presumpscot Formation. The extent of the marine transgression is shown in Figure 3-2. |
| Alluvial deposits | Post-glacial deposits, consisting of sand, silt, clay, and gravel, that occurred along the Kennebec River flood plain following the uplift of the continental shelf land above sea level after the retreat of the glaciers. Alluvium is common along the river and within the flood plain; however, it is too thin or discontinuous to be extensively delineated. |

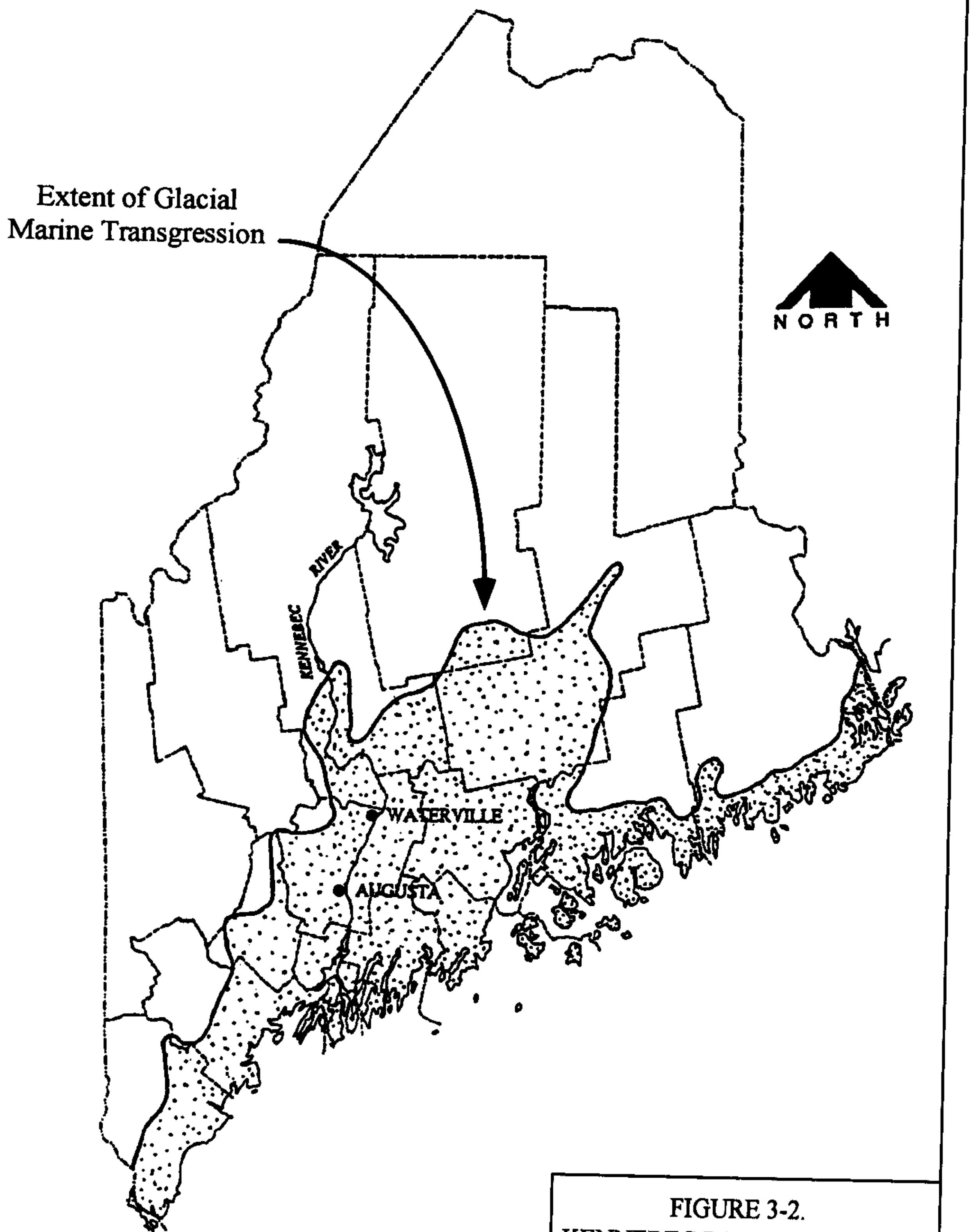


FIGURE 3-2.
KENNEBEC RIVER BASIN EIS

Inland Extent of the Late Glacial
Marine Transgression

Source: MSPO; Modified by Staff

time of year, snow pack, and long-term available storage. Target flows are also set to minimize flooding and maximize use of stored water. The annual storage target is to use 73 percent of the stored water in the headwater projects. The actual record, however, shows 63 percent use of stored water.

The storage in these upper Kennebec projects is usually sufficient to maintain a long-term average annual flow of 3,600 cfs at Madison. Flows deviate from this average based on time of year, snow pack, runoff, seasonal weather patterns, and available storage. In Table 3-3 and figures 3-3 and 3-4, we present monthly flow rates, which are exceeded 50 percent of the time, a parameter representing midrange flows, for the upper Kennebec River and a number of its key tributaries.

The headwater storage facilities are brought up to full pond elevations during spring runoff and snowmelt to minimize flood damage. The water stored in the reservoirs is used to provide relatively constant river flows through the drier summer and winter months. In general, high water levels are maintained in the headwater reservoirs during the summer to provide for recreation, and water levels are lowered in the winter to allow for storage of spring flows.

Nearly half of the basin's annual precipitation is returned to rivers through runoff, 40 percent of which occurs during the spring thaw. The basin's major floods occur during the spring, due to the combined effects of spring rains and snowmelt. There have been five major floods on the Kennebec River since 1973. The current record flood for the Kennebec River occurred during March/April 1987, reportedly causing $22 million in damage.

The uncontrolled Sandy and Carrabassett Rivers are major contributors to flooding on the Kennebec (CORPS, 1989). Owners of headwater storage facilities modify their operations to improve flood flow mitigation by attempting to maintain a 4- to 6-inch freeboard "cushion" below full pond level in Moosehead Lake until after the snow pack is largely depleted, and targeting a deeper drawdown level for the reservoirs before spring runoff.

Minimum river flows in the basin usually occur during September and October. The 7Q10 flow (the lowest flow occurring for 7 consecutive days over a 10 year period) for the Kennebec River in its current, flow-regulated state is calculated to be 2,064 cfs at the dam in Madison (MDEP, 1988). Environmental regulatory agencies use the 7Q10 flow to evaluate compliance with water quality standards under conservative conditions.

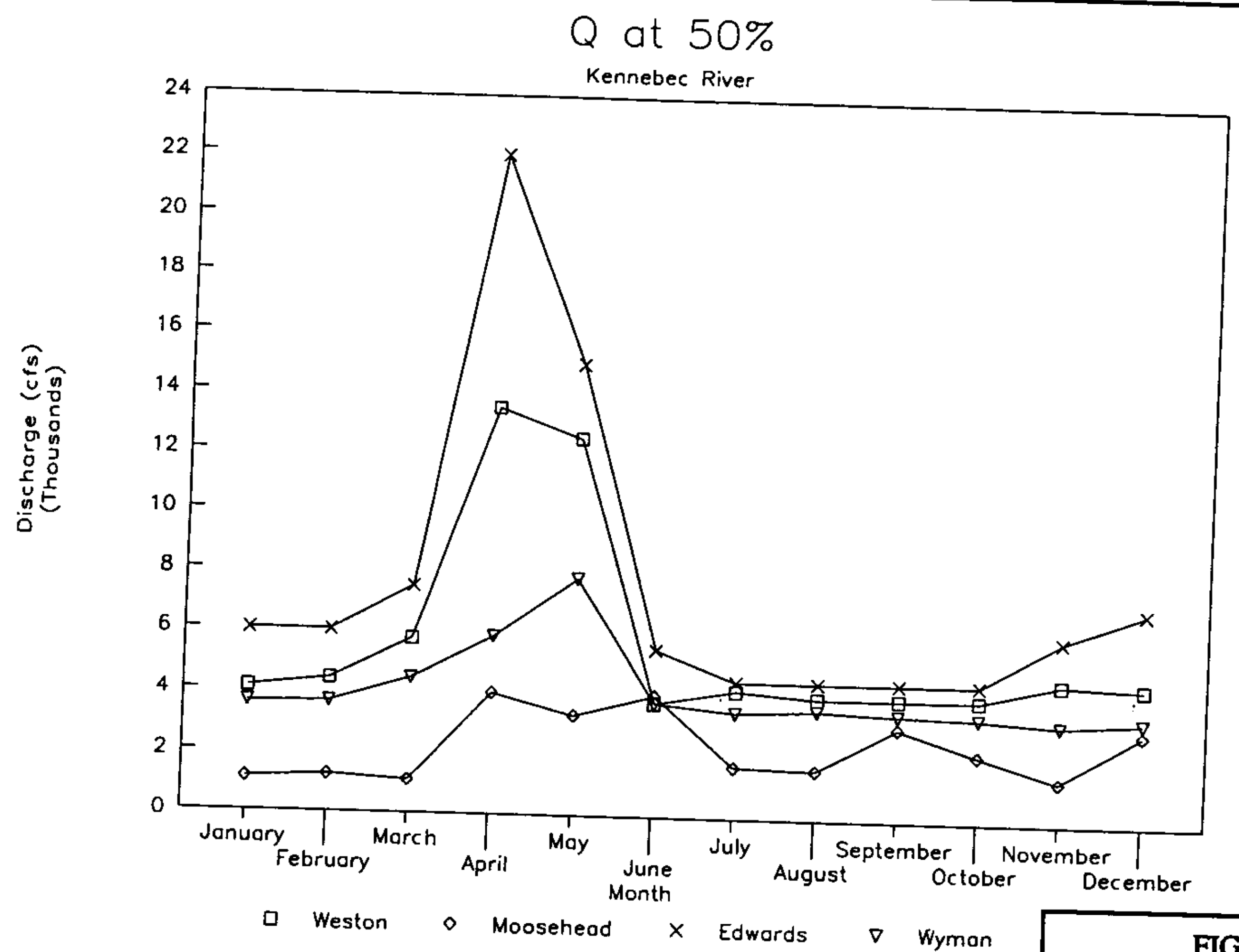


**FIGURE 3-3.**

KENNEBEC RIVER BASIN EIS

**Typical Monthly Flows at Main Stem Kennebec Projects**

Source: License Applications, modified by staff.

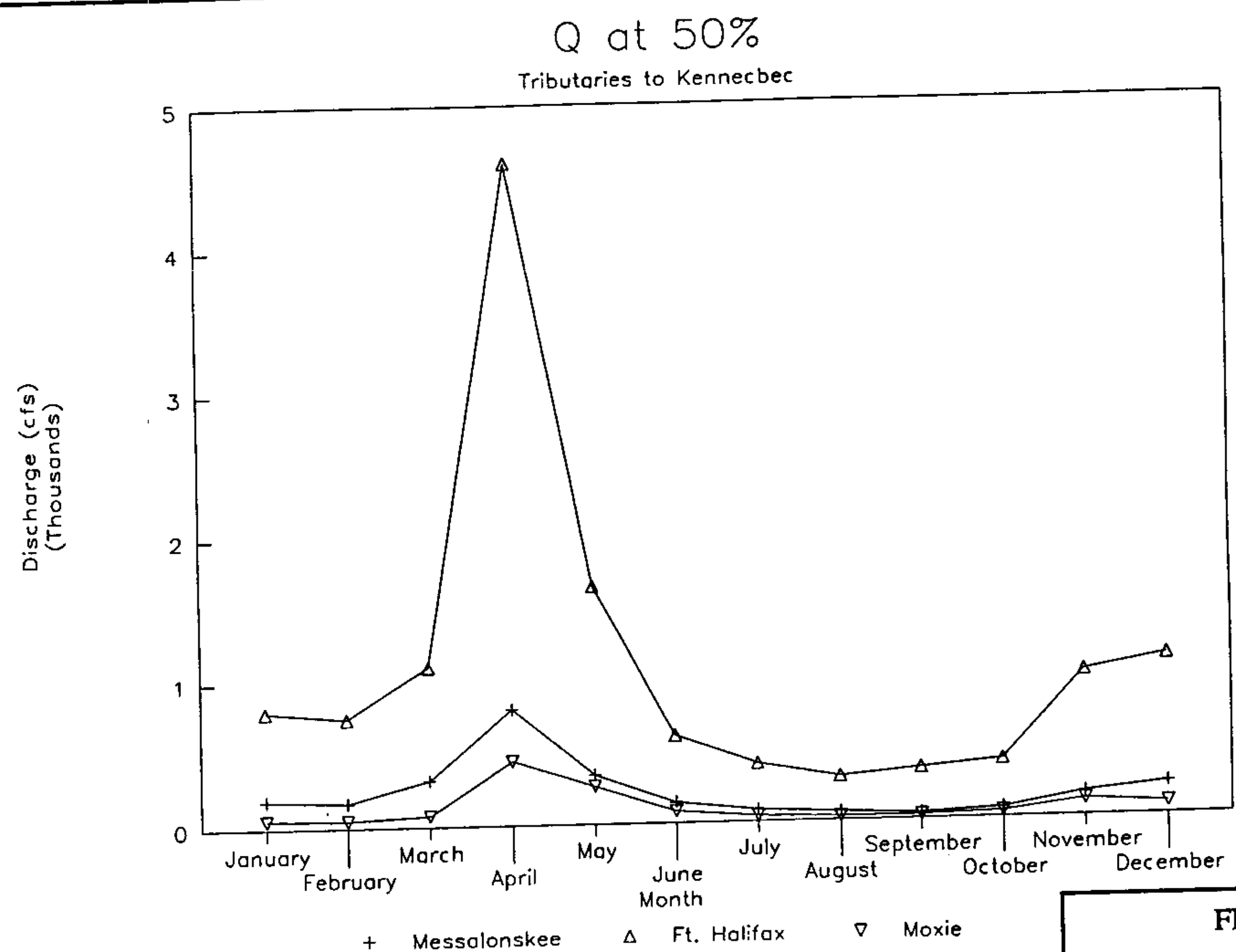


**FIGURE 3-4.**

KENNEBEC RIVER BASIN EIS

**Typical Monthly Flows at Tributary Kennebec Projects**

Source: License Applications, modified by staff.

Table 3-3. Fifty percent monthly flow duration values for the upper Kennebec River and select tributaries (cfs)[a]

| Project | Annual | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moosehead | 1,880 | 1,125 | 1,250 | 1,100 | 4,000 | 3,300 | 4,000 | 1,720 | 1,660 | 3,070 | 2,230 | 1,430 | 3,000 |
| Moxie | 70 | 55 | 50 | 75 | 445 | 260 | 80 | 40 | 25 | 25 | 40 | 110 | 80 |
| Wyman | 3,460 | 3,600 | 3,630 | 4,450 | 5,850 | 7,830 | 3,750 | 3,480 | 3,600 | 3,480 | 3,420 | 3,240 | 3,390 |
| Weston | 4,500 | 4,100 | 4,400 | 5,750 | 13,500 | 12,500 | 3,750 | 4,200 | 4,000 | 4,000 | 4,000 | 4,600 | 4,500 |
| Edwards | 6,000 | 6,000 | 6,000 | 7,500 | 22,000 | 15,000 | 5,500 | 4,500 | 4,500 | 4,500 | 4,500 | 6,000 | 7,000 |
| Fort Halifax | 700 | 800 | 750 | 1,100 | 4,600 | 1,650 | 600 | 400 | 300 | 350 | 400 | 1,000 | 1,100 |
| Messalonskee Lake[b] (unregulated inflow) | 150 | 190 | 170 | 320 | 800 | 340 | 140 | 80 | 55 | 40 | 65 | 160 | 220 |
| Sandy River[c] | 450 | | | | | | | | | | | | |

[a] Flow duration values based upon daily discharges.
[b] For Messalonskee Lake, inflow is the natural 50 percent monthly flow duration entering the lake.
[c] Monthly data not available for Sandy River.

### *3.1.3.2 Water Quality*

Consistent with the 1972 Federal Water Pollution Control Act, as amended by the Clean Water Act, MDEP designated surface water quality classifications for the upper Kennebec River Basin for a variety of uses (Table 3-4). In Table 3-5, we present MDEP's surface water quality standards for each of the classifications in the upper Kennebec River Basin.

According to the *State of Maine 1992 Water Quality Assessment* (as cited in MSPO, 1993), the surface water quality of the upper Kennebec River Basin achieves standards for assigned classifications in most areas. Notable exceptions include:

- Carrabassett River and certain tributaries - bacterial contamination;
- certain tributaries of the Sandy River - nonpoint sources;
- one tributary to Wilson Stream - dissolved oxygen (DO);
- Messalonskee Stream - trophic level, DO, and bacteria;
- certain tributaries to the Sebasticook River - nonpoint sources;
- West Branch Sebasticook River - dioxin and chromium;
- certain tributaries to the Kennebec River - combined sewer overflows and nonpoint sources;
- Kennebec River below Wyman dam - flow modification;
- Kennebec River, Fairfield to Sidney - DO and dioxin; and
- Kennebec River below Sidney - dioxin and bacteria.

MSPO (1993) expressed concern about the water quality of Messalonskee Stream related to discharges from a municipal treatment facility in Oakland and a combined sewer overflow in Waterville. It stated that these discharges could affect water quality in the impoundments downstream and that flow regulation in the upper Belgrade Lakes should be considered.

The Sebasticook River is eutrophic, primarily because of nonpoint source nutrient contamination and several municipal treatment facilities that discharge in the watershed. The residence time of the watershed allows for increased algae growth leading to low DO in the impoundments (e.g., at the Fort Halifax

Table 3-4. Classification of surface waters in Kennebec River Basin upstream of Edwards dam (MSPO, 1993)

| Drainage Area | Classification | Segment |
|---|---|---|
| Kennebec River Main Stem | Class A | From Moosehead Lake, including East and West Outlets, to point 1,000 feet below lake |
| | Class AA | From point 1,000 feet below Moosehead Lake to confluence with Indian Pond |
| | Class A | From Harris dam to point 1,000 feet downstream from Harris dam |
| | Class AA | From point 1,000 feet downstream from Harris dam to confluence with Dead River |
| | Class A | From confluence with Dead River to Route 201A bridge in Anson/Madison except for Wyman Lake |
| | Class B | From Route 201A bridge in Anson/Madison to Fairfield/Skowhegan boundary, including all impoundments |
| | Class C | From Fairfield/Skowhegan boundary to its confluence with Messalonskee Stream |
| | Class B | From its confluence with Messalonskee Stream to Sidney/Augusta boundary |
| | Class C | From Sidney/Augusta boundary to the Father John J. Curran Bridge in Augusta |
| | Class C | From the Father John J. Curran Bridge in Augusta to a line drawn across the tidal estuary of the Kennebec River due east of Abagadasset Point. The free-flowing habitat of this river segment provides irreplaceable social and economic benefits and this use shall be maintained |
| | Class B | From a line drawn across the tidal estuary of the Kennebec River due east of Abagadasset Point, to a line across the southwesterly area of Merrymeeting Bay formed by an extension of the Brunswick/Bath boundary across the bay in a northwesterly direction to the westerly shore of Merrymeeting Bay and to a line drawn from Chop Point in Woolwich to West Chop Point in Bath. Further, the Legislature finds that the free-flowing habitat of this river segment provides irreplaceable social and economic benefits and that this use shall be maintained |
| Dead River Drainage | Class A | From Long Falls dam to point 5,100 feet below the dam |
| | Class AA | From point 5,000 feet below Long Falls dam to confluence with the Kennebec River |
| Messalonskee Stream Drainage | Class C | From outlet of Messalonskee Lake to its confluence with the Kennebec River |
| Sandy River Drainage | Class AA | From outlet of Sandy River Ponds to Route 142 bridge in Phillips |
| | Class B | From Route 142 bridge in Phillips to confluence with the Kennebec River |
| | Class C | Wilson Stream, main stem, below the outlet of Wilson Pond |

Table 3-4. (cont.)

| Drainage Area | Classification | Segment |
|---|---|---|
| Sebasticook River Drainage | Class C | From confluence of the East Branch and the West Branch to confluence with the Kennebec River |
| | Class B | Sebasticook River, East Branch main stem, from outlet of Lake Wassookeag to confluence with Corundel Lake |
| | Class C | Sebasticook River, East Branch main stem, from outlet of Corundel Lake to confluence with West Branch |
| | Class C | Sebasticook River, West Branch main stem, from outlet of Great Moose Lake to confluence with East Branch, including all impoundments |
| Kennebec River, Minor Tributaries | Class AA | Moxie Stream, Moxie Gore, below point 1,000 feet downstream of Moxie Pond dam |

Table 3-5. Standards for water quality classification applicable to upper Kennebec River Basin (Source: MSPO, 1993)

| Classification | Water Uses | Standards |
|---|---|---|
| GPA | Drinking water supply after disinfection<br>Fishing<br>Recreation in and on water<br>Industrial process and cooling water supply<br>Hydroelectric power generation<br>Navigation<br>Natural habitat for fish and other aquatic life | - No numeral DO standards<br>- <2 MPN/100 mℓ (geometric mean) and <194 MPN/100 mℓ (instantaneous) E. coli bacteria<br>- No direct discharges after January 1, 1986 except existing licensed discharges where no reasonable alternatives exist<br>- No change in land use in watershed affecting characteristics or designated uses or increasing trophic state |
| AA | Drinking water supply after disinfection<br>Fishing<br>Recreation in and on water<br>Navigation<br>Natural, free-flowing habitat for fish and other aquatic life<br>No direct discharge of pollutants | - DO, bacteria and aquatic life as naturally occurs |
| A | Drinking water supply after disinfection<br>Fishing<br>Recreation in and on water<br>Hydroelectric power generation<br>Navigation<br>Natural habitat for fish and other aquatic life | - DO > 7 ppm or > 75% of saturation, whichever is greaer<br>- Aquatic life and bacteria as naturally occurs<br>- No direct discharges after January 1, 196 except existing licensed discharges where no reasonable alternatives exist<br>- No deposits of material on banks that transfer pollutants to waters |
| B | Drinking water supply after treatment<br>Fishing<br>Recreation in and on water<br>Industrial process and cooling water supply<br>Hydroelectric power generation<br>Navigation<br>Unimpaired habitat for fish and other aquatic life | - DO >7 ppm or >75% of saturation, whichever is greater, except October 1 to May 14<br>- DO >9.5 (7-day mean) and >8.0 (1-day minimum) in identified fish spawning waters from October 1 to May 14<br>- <64 MPN/100 mℓ (geometric mean) and <427 MPN/100 mℓ (instantaneous) E. coli bacteria from May 15 to September 30<br>- No adverse impact on indigenous, resident aquatic life due to discharges |
| C | Drinking water supply after treatment<br>Fishing<br>Recreation in and on water<br>Industrial process and cooling water supply<br>Hydroelectric power generation<br>Navigation<br>Unimpaired habitat for fish and other aquatic life | - DO >5 ppm or >60% of saturation, whichever is greater, except in identified salmonid spawning areas<br>- <142 MPN/100 mℓ (geometric mean) and <949 MPN/100 mℓ (instantaneous) E. coli bacteria from May 15 to September 30<br>- Water quality in salmonid spawning areas sufficient for spawning, egg incubation, and survival of early stages of life<br>- All indigenous fish species supported and structure and function of resident aquatic life maintained |

Notes: DO - dissolved oxygen
ppm - parts per million
MPN - most probable number
mℓ - milliliter
E. coli - Escherichia coli bacteria of human origin

Project). Currently there are several projects ongoing in the watershed to reduce nutrient loading (MSPO, 1993).

In Table 3-6, we identify major point source discharges of wastewater to the upper Kennebec River Basin.

In response to the dioxin water quality problems (see above list), the State of Maine issued a health advisory for the consumption of fish for a 56-mile stretch of the Kennebec River from Skowhegan to Merrymeeting Bay and a 13-mile segment of the Sebasticook River from Hartland to Pittsfield (MDHS, 1990). The state recommends that no fish from these stretches of surface water be consumed. It also issued a health advisory for fish in all ponds and lakes in Maine, including Moosehead Lake, due to elevated mercury concentrations (MDHS, 1994). The state recommends that children 7 years and younger, pregnant women, women who may get pregnant, and women breastfeeding not consume fish caught in any Maine lake or pond. Other people are advised to limit consumption of fish caught in ponds and lakes to between 6 and 22 meals per year, depending on the size and age of fish consumed.

Water quality in the project areas also could be influenced by removal of Edwards dam on the Kennebec River, which is being considered to improve water quality, restore anadromous fisheries, increase recreational opportunities, and provide economic benefits (SWETS, 1995a). DO concentrations would increase upstream of the current dam if it were removed, which would reduce the frequency of violations of the Class B DO standard upstream of the Augusta/Sidney town line. Enteric bacteria concentrations and the frequency of Class C coliform bacteria exceedances theoretically could increase, however, because of reduced residence time in the Kennebec River at Augusta if the dam were removed. The initial mobilization of arsenic and cadmium from shallow sediments currently behind Edwards dam probably would not result in violation of EPA's (1986) surface water quality criteria for these compounds if the dam were removed. The current concentration of arsenic and cadmium upstream and downstream of Edwards dam is similar. The state has no surface water quality standards for heavy metals.

### 3.1.4 Fishery Resources

The lower 44 miles of the Kennebec River, to the base of Edwards dam in Augusta, are tidally influenced. The upstream half of the tidal reach, including highly productive Merrymeeting Bay at the confluence of the Androscoggin River, is fresh water. Fish found here are typical of those found in freshwater and brackish water estuaries (Table 3-7).

Table 3-6. Summary of selected characteristics of point source discharges to Kennebec River (Source: MDEP, 1988)

| Licensee and Type of Effluent | Location | Flow (MGD) | Avg. BOD (mg/l) Permit Limits | Max. BOD (mg/l) Permit Limits | Monthly Avg. BOD (mg/l) | Monthly Max. BOD (mg/l) |
|---|---|---|---|---|---|---|
| Anson-Madison STD Sewage | Madison | 4.30 | 119 | 202 | 120 | 159 |
| Skowhegan STD Sewage | Skowhegan | 1.44 | 30.1 | 50.2 | - | - |
| S. D. Warren Industrial | Hinckley | 46.50 | 32.4 | 71.3 | 11.8 | 22.8 |
| Kennebec STD Sewage | Waterville | 12.70 | 30.1 | 50.2 | 9.4 | 31.1 |
| Scott Paper Industrial | Winslow | 11.00 | 59.6 | 113.6 | 21.6 | 47.0 |
| Statler Tissue Industrial | Augusta | 5.50 | 72.9 | 140.2 | 48.9 | 89.4 |

TABLE 3-7.

FISH SPECIES KNOWN OR LIKELY TO OCCUR IN PROJECT WATERS

| Family[1] | Scientific Name[2] | Common Name[1] | Moosehead | Moxie | Wyman | Williams | Sandy River | Weston | Ft. Halifax | Messalonskee Lake | Oakland | Rice Rips | Automatic | Union Gas | Edwards | Edwards Tailwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Petromyzontidae | *Petromyzon marinus* | sea lamprey | | | | | | | | | | | | | x | |
| Acipenseridae | *Acipenser brevirostrum* | shortnose sturgeon | | | | | | | | | | | | | | x |
| | *Acipenser oxyrynchus* | Atlantic sturgeon | | | | | | | | | | | | | | x |
| Anguillidae | *Anguilla rostrata* | American eel | | | x | | x | x | x | x | x | x | x | x | x | x |
| Clupeidae | *Alosa aestivalis* | blueback herring | | | | | | | | | | | | | | x |
| | *Alosa pseudoharengus* | alewife | | | | | | | x | | | | | | x | x |
| | *Alosa sapidissima* | American shad | | | | | | | | | | | | | x | x |
| Salmonidae | *Coregonus clupeaformis* | lake whitefish | x | | | | | | | | | | | | | |
| | *Oncorhynchus mykiss* | rainbow trout | | | x | x | x | x | | | | | | | | |
| | *Prosopium cylindraceum* | round whitefish | x | | x | | | | | | | | | | | |
| | *Salmo salar* | Atlantic salmon | x | x | x | x | x | x | | x | | | | | x | x |
| | *Salmo trutta* | brown trout | | | | x | x | x | x | x | x | x | x | x | x | x |
| | *Salvelinus fontinalis* | brook trout | x | x | | x | x | x | | x | x | x | x | x | x | x |
| | *Salvelinus namaycush* | lake trout | x | x | x | x | | | | | | | | | | |
| Osmeridae | *Osmerus mordax* | rainbow smelt | x | x | x | x | | x | | x | | | | | x | x |
| Esocidae | *Esox niger* | chain pickerel | | | x | x | x | x | x | x | x | x | x | x | x' | x |
| | *Esox lucius* | northern pike | | | | | | | | x | | | | | | |
| Cyprinidae | *Couesius plumbeus* | lake chub | x | . x | x | x | x[2] | x | x[2] | | | | | | | |
| | *Cyprinus carpio* | common carp | | | | | | | | | | | | | | x |
| | *Hybognathus regius* | eastern silvery minnow | | | | | | | | x | x | x | x | x | x | |
| | *Luxilus cornutus* | common shiner | x | x | x | x | | | | | | | | | | x |
| | *Notemigonus crysoleucas* | golden shiner | x | x | x | x | | x | | x | x | x | x | x | x | x |
| | *Notropis heterolepis* | blacknose shiner | | | x | | | | | | | | | | | |
| | *Notropis hudsonius* | spottail shiner | | | | | | | | | | | | | x | x |
| | *Phoxinus eos* | northern redbelly dace | x | x | x | | | x | | | x | x | x | x | | |
| | *Phoxinus neogaeus* | finescale dace | x | | x | x | | x | | | | | | | | |
| | *Pimephales promelas* | fathead minnow | | | x | x | | | x | | | | | | | |
| | *Rhinichthys atratulus* | blacknose dace | | | x | x | | x | | | x | x | x | x | x | x |
| | *Rhinichthys cataractae* | longnose dace | | | | | | x | | | | | | | | |
| | *Semotilus atromaculatus* | creek chub | x | x | x | x | | | | | x | x | x | x | x | x |
| | *Semotilus corporalis* | fall fish | x | | x | x | | | | x | x | x | x | x | x | |
| | *Semotilus margarita* | pearl dace | x | | x | | | | | | | | | | | |

**TABLE 3-7.**

**FISH SPECIES KNOWN OR LIKELY TO OCCUR IN PROJECT WATERS**

| Family[1] | Scientific Name[1] | Common Name[1] | Moosehead | Moxie | Wyman | Williams | Sandy River | Weston | Ft. Halifax | Messalonskee Lake | Oakland | Rice Rips | Automatic | Union Gas | Edwards | Edwards Tailwater |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Catostomidae | *Catostomus commersoni* | white sucker | x | x | x | x | x | x |  | x | x | x | x | x | x | x |
|  | *Catostomus catostomus* | longnose sucker | x |  | x | x |  |  |  |  |  |  |  |  |  |  |
| Ictaluridae | *Ameirus nebulosus* | brown bullhead | x |  | x |  | x | x | x | x | x | x | x | x | x |  |
| Gadidae | *Lota lota* | burbot | x |  | x |  |  | x |  |  |  |  |  |  |  |  |
| Cyprinodontidae | *Fundulus diaphanus* | banded killifish |  |  | x | x |  | x | x |  |  |  |  |  | x | x |
|  | *Fundulus heteroclitus* | mummichog |  |  |  |  |  |  |  |  |  |  |  |  |  | x |
| Gasterosteidae | *Apeltes quadracus* | fourspine stickleback |  |  |  |  |  |  |  |  | x | x | x | x | x | x |
|  | *Culaea inconstans* | brook stickleback |  | x |  |  |  |  |  |  |  |  |  |  | x | x |
|  | *Gasterosteus aculeatus* | threespine stickleback | x |  | x |  |  |  |  | x | x | x | x | x | x |  |
|  | *Pungitius pungitius* | ninespine stickleback |  |  |  |  |  |  |  |  |  |  |  |  |  | x |
| Cottidae | *Cottus cognatus* | slimy sculpin | x |  | x | x |  | x |  |  |  |  |  |  |  |  |
| Percichthyidae | *Morone americana* | white perch | x | x | x |  | x | x | x | x | x | x | x | x | x | x |
|  | *Morone saxatilis* | striped bass |  |  |  |  |  |  |  |  |  |  |  |  |  | x |
| Centrarchidae | *Lepomis auritus* | redbreast sunfish |  |  |  | x |  | x | (3) |  |  |  |  |  |  |  |
|  | *Lepomis gibbosus* | pumpkinseed | x | x | x | x |  |  | x | x | x | x | x | x | x | x |
|  | *Lepomis macrochirus* | bluegill |  |  |  |  |  |  |  |  |  |  |  |  | x |  |
|  | *Micropterus dolomieu* | smallmouth bass | x |  | x |  | x | x | x | x | x | x | x | x | x | x |
|  | *Micropterus salmoides* | largemouth bass |  |  |  |  |  | x | x | x | x | x | x | x | x | x |
|  | *Pomoxis nigromaculatus* | black crappie |  |  |  |  |  |  |  |  |  |  |  |  | x | x |
| Percidae | *Perca flavescens* | yellow perch | x |  | x | x | x | x | x | x | x | x | x | x | x | x |

Source: License applications and MSPO, 1993

1. Nomenclature consistent with Robins et al., 1991.
2. According to application, more than one species of minnows or shiners.
3. According to application, unidentified sunfish.

The habitat in the 120 miles of the Kennebec River upstream of Augusta alternates between hydroelectric impoundments and free-flowing river segments. About 79 miles (66 percent) of habitat are lacustrine (impounded), and about 41 miles (34 percent) are riverine. Much of the lacustrine habitat downstream of the Wyman Project is long, relatively narrow (typically 600 feet or less in width), shallow (generally less than 20 feet deep) impoundments with perceptible flow that resembles large rivers more than lakes. The most common fish in this portion of the river are those suited for coolwater and warmwater environments (e.g., smallmouth bass, brown trout, pickerel, and sunfish). There also may be some coldwater species, but they are probably dropdowns from upriver or smaller, coldwater tributaries. In contrast, the Wyman, Harris, and Moosehead impoundments are deepwater (maximum depth of 140 to 240 feet), lacustrine habitat, with thermal stratification that supports both coldwater (e.g., landlocked Atlantic salmon, lake trout, brook trout, and burbot) and warmwater species (Table 3-7).

The habitat in tributaries directly influenced by projects considered in this EIS (Sandy River, Sebasticook River, and Messalonskee Stream) also alternates between impoundments and free-flowing segments. The impoundments are generally riverine (long, narrow, with perceptible flow) except for Messalonskee Lake, the headwater reservoir for the four Messalonskee Stream projects.

*3.1.4.1 Resident Species*

Most species listed in Table 3-7 are considered resident species, although many make localized migrations for spawning and overwintering. Coldwater species are the most important game fish in the northern portion of the study area. For example, the Moosehead Lake fishery is managed to support self-sustaining populations of landlocked Atlantic salmon, lake trout, and brook trout. Production of wild landlocked salmon is supplemented by annual spring stocking of yearling landlocked salmon. Resource agencies and some angling advocacy groups consider smallmouth bass an undesirable competitor in this setting because they compete with and prey on young salmonids. Nevertheless, smallmouth bass were illegally stocked in the West Outlet of Moosehead Lake in 1974 and now support a fishery in this stream and downstream in Indian Pond (the Harris Project headpond) (letter from MDIFW, May 9, 1989).

Stocking of coldwater fish is used to supplement natural reproduction in the Wyman impoundment. There is no active stocking from Wyman to Williams, but the free-flowing segment upstream of the Williams impoundment supports a self-sustaining rainbow trout fishery that is regionally significant (MSPO, 1993). Rainbow trout are not commonly stocked in Maine (this reach was last stocked with rainbow trout in 1979), and anglers are attracted to the Wyman tailwaters by the unique nature of the fishery. Other coldwater species such as landlocked Atlantic salmon and brook trout and occasional lake trout and round whitefish (the latter two species reflect the influence of the Wyman Project's 50-foot-deep turbine intake) are caught in this segment.

The primary fishery for resident species from the Weston impoundment and downstream, including the lower reaches of Sandy River, Sebasticook River, and Messalonskee Stream, is for the coolwater species brown trout and smallmouth bass. Some coldwater fish are also caught in this portion of the river, primarily in free-flowing segments, as are species that prefer warmer water such as pickerel, yellow perch, white perch, brown bullhead, and largemouth bass. The Belgrade Lakes, which include Messalonskee Lake, support a fishery for northern pike. Because this voracious nonnative species does not occur elsewhere in Maine, this fishery is unique. MDIFW considers northern pike an undesirable species (McNeish, 1985).

Ongoing stocking of yearling brown trout occurs in the Sandy River and the main stem between the Weston impoundment and Edwards dam according to MDIFW brown trout management plans (McNeish, 1985). These plans support a catch rate of 0.2 trout per angler day. No significant natural reproduction of brown trout is expected on the main stem, but some is expected in Sandy River (MSPO, 1993). Experimental brown trout stockings are planned or ongoing in Messalonskee Stream and the Sebasticook River (MSPO, 1993).

#### *3.1.4.2 Anadromous and Catadromous Species*

Resource agencies consider the Kennebec River to be unique because it is the only river north of the Hudson River known to support reproducing populations of every anadromous fish species that is indigenous to the northeastern United States (Squiers, 1988; letter from Commerce dated April 8, 1996).

Active restoration efforts are ongoing to return alewives and American shad to their historical range on the Kennebec River. Both species ascended the Kennebec River in large numbers to Norridgewock Falls in Madison, 89 miles from the sea, before Edwards dam was built in 1837 (Squiers, 1988). Alewives historically ascended the Sandy River as far as Farmington and bred in Temple Pond, ascended the Sebasticook River at least as far as Stetson Pond on the East Branch and Great Moose Pond on the West Branch, and ascended Seven Mile Stream probably to Webber and Three Mile Ponds. Shad may have ascended Sandy River to Farmington (Squiers, 1988). Stocking of alewives began in 1985 and American shad in 1987 as part of the effort to establish spawning in historic spawning areas (Stahlnecker et al., 1994).

Adult alewives enter Maine rivers in May and June and spawn in lakes, ponds, and deadwater areas. Juveniles migrate downstream from mid-July through early December, but most have left the lakes that are their primary nursery habitat by October (Squiers et al., 1991). The Maine Department of Marine Resources (MDMR's) long-range goal is to restore a run of about 6 million alewives to the Kennebec River above Augusta. This would be accomplished by stocking and eventually providing fish passage to 21 lakes in the lower Kennebec River Basin (Figure 3-5). In Table 3-8, we show the estimated production in each of these lakes. Initial stocking would be accomplished by trapping adults at the most downstream fish barrier on the river and trucking them to targeted lakes. The feasibility of truck stocking alewives as a substitute for fish passage facilities will be evaluated during the initial phase of restoration, scheduled to be completed by 1999 (Squiers et al., 1986). The estimated potential alewife production in habitat below Edwards dam, much of it already accessible, is an additional 5.4 million adults (MSPO, 1993).

During 1993 and 1994, 34,482 and 58,701 alewives, respectively, were stocked in seven of the targeted lakes shown on Figure 3-5, all in the Sebasticook River subbasin. Agency alewife stocking goals were first achieved in 1994. Nearly all stocked alewives were collected immediately downstream of Edwards dam (Stahlnecker et al., 1994; 1995). In addition, Lake George, which is not targeted for restoration, was stocked with alewives between 1991 and 1993 as part of a 9-year study to explore the interactions of anadromous alewives and resident freshwater species (Stahlnecker et al., 1994). The impetus for the study is concern that resident game fish populations may be adversely influenced by competition with introduced alewives. The alewives' diet is primarily zooplankton which is also an important food for the young of most resident forage and game fish and adults of some species such as rainbow smelt. The results of the Lake George study, scheduled for completion by the end of 1995, may have an impact on future alewife restoration plans in the Kennebec River Basin and elsewhere in Maine (Stahlnecker et al., 1994).

Out-migrating juvenile alewives are currently monitored at several hydroelectric plants with downstream passage facilities. Recent monitoring reports at the Fort Halifax Project indicate successful juvenile alewife production in the lakes of the Sebasticook River subbasin. During 1993, large numbers of juvenile alewives were observed at Fort Halifax (FERC Order approving changes to downstream fish passage and study plan, Fort Halifax Project, September 29, 1994). During 1994, out-migrating adults were first observed on June 20 and juveniles on July 25, and MDMR staff observed a large number of juveniles (10,000+ estimated) in the forebay on September 19 (Stahlnecker et al., 1995). During our field work in September 1994, we observed

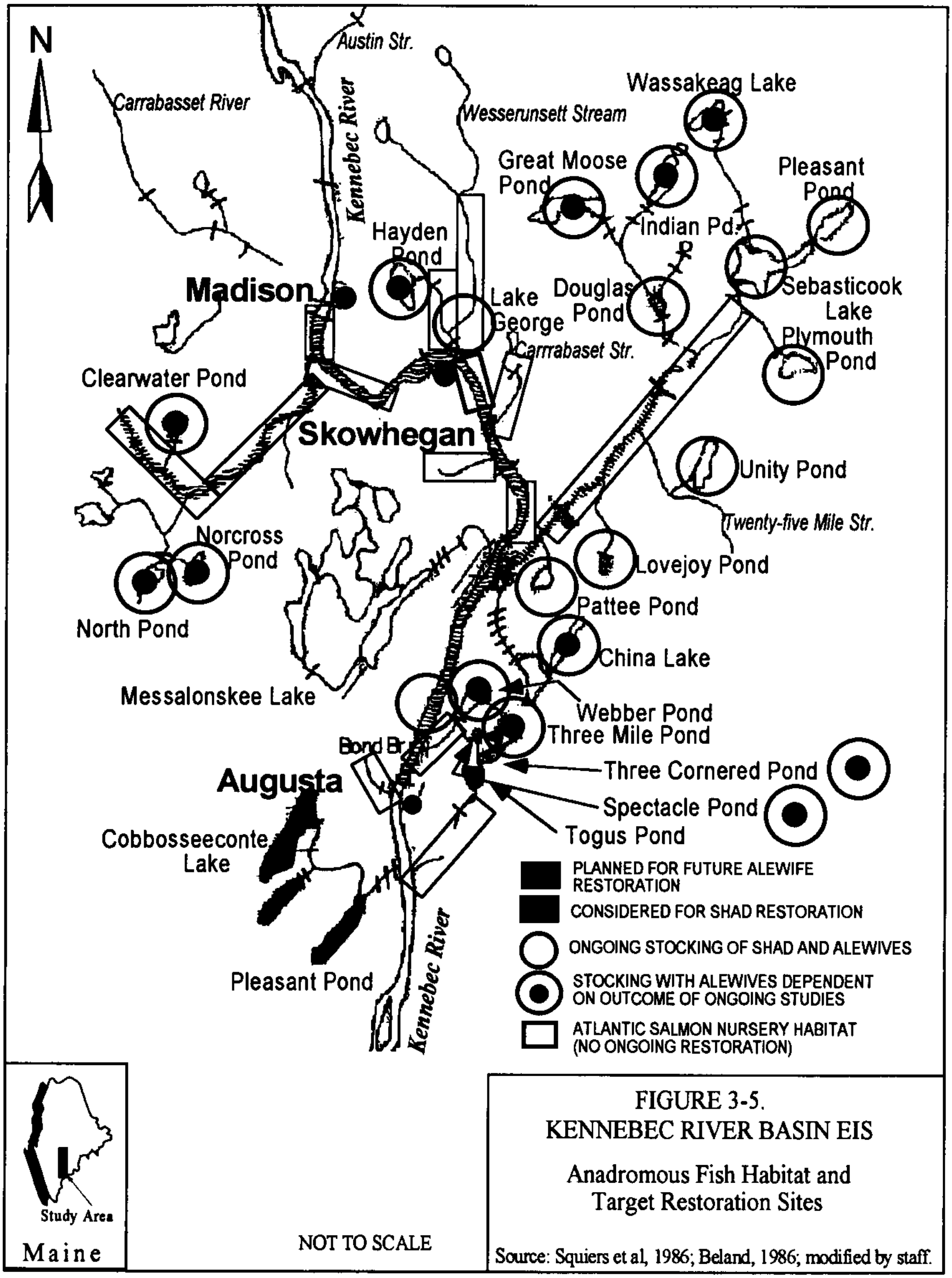


FIGURE 3-5.
KENNEBEC RIVER BASIN EIS

Anadromous Fish Habitat and Target Restoration Sites

Source: Squiers et al, 1986; Beland, 1986; modified by staff.

Table 3-8. Potential alewife production in the Kennebec River above Augusta

| Ponded Area | Surface Acreage | Total Fish[1] Production (235/Acre) | | Spawning[2] Escapement (35/Acre) | | Migration Barriers[3] |
|---|---|---|---|---|---|---|
| | | Without Downstream Passage Mortality | With Hydro[4] | Without Upstream Passage Inefficiencies | Passing 1st Dam (Edwards)[4] | |
| Sevenmile Stream | | | | | | |
| Webber Pond | 1,252 | 294,220 | 264,798 | 43,820 | 48,689 | 2(1) |
| Spectacle Pond | 139 | 32,665 | 29,398 | 4,865 | 4,865 | 1(1) |
| Three Mile Pond | 1,077 | 253,095 | 227,786 | 37,695 | 41,883 | 2(1) |
| Three Cornered Pond | 195 | 45,825 | 41,242 | 6,825 | 7,583 | 2(1) |
| Total | 2,663 | 625,805 | 563,224 | 93,205 | 103,020 | |
| Sebasticook River | | | | | | |
| Douglas Pond | 525 | 123,375 | 72,852 | 18,375 | 31,118 | 6(6)* |
| China Lake | 3,922 | 921,670 | 746,553 | 137,270 | 286,997 | 8(2) |
| Pattee Pond | 712 | 167,320 | 135,529 | 24,920 | 27,689 | 2(2)* |
| Lovejoy Pond | 324 | 76,140 | 55,506 | 11,340 | 15,556 | 4(3)* |
| Unity Pond | 2,528 | 594,080 | 433,084 | 88,480 | 109,235 | 3(3)* |
| Pleasant Lake | 768 | 180,480 | 118,413 | 26,880 | 50,579 | 7(4)* |
| Great Moose Lake | 3,584 | 842,240 | 497,334 | 125,440 | 262,264 | 8(6) |
| Big Indian Pond | 990 | 232,650 | 19,843 | 34,650 | 72,444 | 8(6) |
| Little Indian Pond | 143 | 33,605 | 137,377 | 5,005 | 10,462 | 8(6) |
| Sebasticook Lake | 4,288 | 1,007,680 | 661,139 | 150,080 | 254,162 | 6(4)* |
| Wassookeag Lake | 1,062 | 249,570 | 163,743 | 37,170 | 106,603 | 11(4) |
| Plymouth Pond | 480 | 112,800 | 74,008 | 16,800 | 25,606 | 5(4)* |
| Total | 19,326 | 4,541,610 | 3,115,381 | 676,410 | 1,252,715 | |
| Wesserunsett Stream | | | | | | 7(4) |
| Hayden Lake | 1,446 | 339,810 | 229,949 | 50,610 | 105,813 | |
| Sandy River | | | | | | |
| Norcross Pond | 122 | 28,670 | 15,236 | 4,270 | 8,034 | 7(6) |
| Clearwater Pond | 751 | 176,485 | 93,791 | 26,285 | 49,460 | 7(6) |
| North Pond | 170 | 39,950 | 21,231 | 5,950 | 11,196 | 7(6) |
| Parker Pond | 128 | 30,080 | 15,985 | 4,480 | 8,430 | 7(6) |
| Total | 1,171 | 275,185 | 146,243 | 40,985 | 77,120 | |
| Grand Total[5] | 24,606 | 5,782,410 | 4,047,797 | 861,210 | 1,538,668 | |

Source: Squiers et al., 1986; MSPO, 1996 (Attachment I).

1 Based on annual commercial yield of 100 pounds per surface acre and an escapement rate of 15%. Average weight of .5 pound/fish.

2 Escapement rate of 35 adult alewives/acre refers to escapement needed into pond or lake. Higher rates would be needed downriver depending on number of dams and fish passage efficiency.

3 Number in parentheses are number of barriers associated with hydroelectric facilities; an asterix indicates active stocking.

4 Production decreases assume 10% mortality at each hydroelectric project; spawning escapement passing first dam assumes a 90% upstream passage efficiency at each dam; estimates developed by MDMR.

5 Assumes 100% survival of downstream migrating juvenile alewives. A 10% mortality at each hydroelectric facility (with downstream passage) would reduce the potential total production to 4,047,800 alewives.

numerous large schools of out-migrating juvenile alewives in the Edwards impoundment and below Edwards dam.

Adult American shad migrate to the Kennebec River to spawn during May and June, and juveniles out-migrate from July to late fall. As with alewife, though, most juveniles leave the river by October (Squiers et al., 1991). Unlike alewives, shad most frequently spawn in riverine habitats. Squiers et al. (1994) report that the 20 miles of tidal freshwater below Augusta provided about 50 percent of the historical shad spawning and nursery habitat in the Kennebec River. MDMR surveys indicate that there is presently limited reproduction below Edwards dam and improving reproduction in the tributaries of Merrymeeting Bay (Squiers et al., 1994).

MDMR's original long-term goal was to achieve an annual production of about 725,000 shad upstream of Augusta (Squiers et al., 1986). After the completion of the restoration plan in 1986, however, field surveys on the main stem of the Kennebec River from Augusta to Waterville and on the Sebasticook River resulted in a revision of the projected annual production to about 690,000 shad (Squiers, 1988). Figure 3-5 shows areas targeted for shad restoration, and Table 3-9 shows estimated shad production by river segment. The first phase of restoration would be accomplished by introducing prespawning adults to the river between Edwards dam in Augusta and Lockwood dam in Waterville. Introduction would be via fish passage at Edwards or, if effective fish passage is not installed by 1986, stocking shad captured downstream of Edwards dam or from out-of-basin, if available (Squiers et al., 1986).

The original goal of Phase I stocking was to move 2,500 adults past Edwards dam. The number of adult shad stocked has not yet approached this goal, however, and MDMR subsequently revised the goal to 1,000 unless new sources for adults become available (Stahlnecker et al., 1993). Trucking shad from Edwards dam to upriver segments would begin 5 years before upstream fish passage is provided to that segment (Squiers et al., 1986).

During 1993 and 1994, 880 and 879 adult shad, respectively, were stocked in the Edwards impoundment at the Sidney boat launch. All of these shad were collected from the Connecticut River at Holyoke, Massachusetts (Stahlnecker et al., 1994; 1995). Shad stocks in the lower Kennebec River are presently at extremely low levels (Squiers et al., 1994). In addition, 186,000 American shad fry and 16,000 juveniles from an experimental shad culture program were released at the Sidney and Waterville boat launches in 1993 (Stahlnecker et al., 1994). About 56,000 fry and 15,600 juveniles were stocked between Waterville and Augusta in 1994 (Stahlnecker et al., 1995). Sampling during the fall at the Edwards interim downstream bypass by MDMR collected five out-migrating juvenile shad (Stahlnecker

Table 3-9. Potential shad production in the Kennebec River based on water surface area

| River Segment | Surface Area ($yd^2$) | Potential Shad Production[1] | | Spawning Escapement | | Barriers to Migration[2] |
|---|---|---|---|---|---|---|
| | | Without Downstream Passage Mortality | With Hydro[3] | Without Upstream Passage Inefficiencies | Passing 1st Dam (Edwards)[4] | |
| Mainstem Augusta dam (Edwards) to Milstar dam (Lockwood) Waterville | 6,264,635 | 144,086 | 129,677 | 72,526 | 48,168 | 1* |
| Sebasticook River Halifax dam to confluence of East and West Branches | 5,845,175 | 134,439 | 99,699 | 66,737 | 74,152 | 2-4 |
| Mainstem Kennebec River Scott Paper Company dam (Hydro-Kennebec), Waterville to Shawmut dam, Fairfield | 2,531,361 | 58,221 | 42,443 | 29,111 | 11,726 | 3 |
| Mainstem Kennebec River Shawmut dam, Fairfield to Central Maine Power dam (Weston), Skowhegan | 6,125,167 | 140,879 | 92,431 | 70,439 | 80,457 | 4 |
| Mainstem Kennebec River Skowhegan dam to Madison | 4,961,583 | 114,116 | 67,385 | 64,249 | 90,843 | 5 |
| Sandy River mouth to Route #4 Bridge in Farmington | 4,262,250 | 98,032 | 52,098 | 41,825 | 70,831 | 6 |
| Total | 29,989,985 | 689,773 | 483,773 | 344,887 | 371,360 | |

Source: Squiers et al., 1988b; MSPO, 1996 (Attachment I).

1 Assumes 2.3 shad/100 square yards and 100 percent survival of downstream migrating juvenile shad.

2 All barriers associated with hydroelectric facilities; an asterisk indicates active stocking.

3 Production decreases assume 10 percent mortality at each hydroelectric project; calculated by staff.

4 Spawning escapement passing first dam assumes a 90 percent upstream passage efficiency at each dam; fish not passed contribute to spawning in habitat below dam; estimates developed by MDMR.

et al., 1994). Sampling methods improved in 1994, resulting in collection of 194 juvenile shad in the Edwards forebays and interim downstream bypass (Stahlnecker et al., 1995).

Adult Atlantic salmon ascend rivers in New England throughout the spring, summer, and fall and spawn from late October through November. They spawn in coolwater streams on gravel substrate (0.5 to 4 inches in diameter) at the tail end of pools with sufficient flow to provide circulation to the eggs, which may be buried by up to 1 foot of gravel. Eggs usually hatch in late March and April, and fry emerge from the gravel several weeks later. Young salmon grow to 5 to 7 inches, usually in 1 to 3 years, before migrating as smolts to the sea in the spring (MSPO, 1993).

Atlantic salmon were historically known to have migrated in substantial numbers to Caratuuk Falls in Solon, and some apparently were able to leap the 16-foot-high falls and move into the Dead River. Historical spawning areas included the main stem of the Kennebec, and the Sandy, Carrabassett, and Dead Rivers (Foye et al., 1969).

The Maine Atlantic Sea-Run Salmon Commission's (ASRSC's) Strategic Plan for Atlantic Salmon Management considers the Kennebec River a priority "C" river. As such, active restoration of Atlantic salmon to the Kennebec River would occur when resources can be made available without detracting from existing management and restoration programs for priority "A" and "B" rivers (Beland, 1986).

ASRSC developed an interim plan for Atlantic salmon restoration above Edwards dam that depends on provision of fish passage at that dam. The plan presents a passive restoration strategy that would enable stray salmon that return to the Kennebec River to gain access to identified production habitat, most of which is upstream of hydroelectric dams (Figure 3-5, Table 3-10). Maximum production of salmon would probably require a spawning escapement (mature adults reaching suitable spawning and nursery habitat after harvesting and passage inefficiencies at dams) of 1,982 adults (Beland, 1986). When fully restored, United States Fish and Wildlife Service (FWS) projects that the annual salmon return to the Kennebec River would be 3,480 fish (FWS, 1989). The interim plan supplements existing plans prepared by MDMR and MDIFW (Beland, 1986). The most recent statewide Atlantic salmon restoration and management plan indicates that the current status of the Kennebec River salmon population is small and declining. Those salmon present are primarily of hatchery origin. The management goal between 1995 and 2000 is to maintain the current number of salmon and increase the population in the future (MASA, 1995).

Table 3-10. Atlantic salmon nursery habitat, Kennebec River and tributaries below Madison

| River Section | Nursery Habitat (100 $yd^2$ units) | Minimum Spawning Escapement Requirements[1] | | Barriers to Migration[2] |
|---|---|---|---|---|
| | | Without Upstream Passage Inefficiencies | Passing 1st Main Stem Dam[3] (Edwards) | |
| Below Augusta | | | | |
| Bond Brook | 176 | 12 | NA | 1 |
| Togus Stream | 958 | 56 | NA | 0-1 |
| Total | 1,134 | 68 | | |
| Augusta-Waterville | | | | |
| Sevenmile Brook | 141 | 8 | 9 | 1(1) |
| Sebasticook River | | | | |
| Winslow-Burnham | 3,300 | 196 | 262 | 2-3(2-3) |
| Above Burnham | 879 | 52 | 76 | 4(4) |
| Total | 4,320 | 256 | 338 | |
| Waterville-Skowhegan | | | | |
| Wesserunsett Stream | 4,576 | 272 | 438 | 5(4) |
| Martin Stream | 642 | 38 | 56 | 4(4) |
| Carrabassett Stream | 432 | 26 | 39 | 4(4) |
| Main stem Below Shawmut[4] | 840 | 174 | 231 | 3(3) |
| Main stem above Shawmut | 2,915 | 50 | 74 | 4(4) |
| Total | 9,405 | 560 | 838 | |
| Skowhegan-Madison | | | | |
| Sandy River | 17,304 | 1,028 | 1,821 | 5-6(5-6) |
| Main stem[4] | 1,170 | 70 | 112 | 5(5) |
| Total | 18,474 | 1,098 | 1,933 | |
| Total below Madison | 33,362 | 1,982 | 3,127 | |

Source: Beland, 1986; Squiers et al., 1986.

1 Spawning escapement requirements based upon 220 eggs per 100 $yd^2$ production unit, 50 percent females, 9 lbs. average, 7,400 eggs per female.

2 Numbers in parentheses represent number of barriers associated with hydroelectric facilities.

3 Assumes a 90 percent upstream passage efficiency at each dam (calculated by staff); assumed fish not passed at dams do not contribute to spawning in habitat below dam; NA - not applicable.

4 This figure underestimates the available habitat in this river reach.

MDMR currently has no interim plans for active salmon restoration on the Kennebec River. Future plans for salmon restoration on the Kennebec depend on this relicensing proceeding. Salmon passage through to Waterville is unlikely until after a ruling is made on whether or not to remove Edwards dam, which the state is requesting (Stahlnecker et al., 1994).

The Kennebec River currently has a small population of Atlantic salmon below Edwards dam, consisting mostly of hatchery strays from other rivers and some wild fish originating from streams below Augusta. The total run consists of less than 200 adults during most years, but there is a small salmon fishery below Edwards dam (Beland, 1986). Documented returns of Atlantic salmon to the Kennebec River (most by angler catch or other incidental capture) from 1975 to 1994 total 216 fish; only 9 were of wild origin (Table 3-11). The largest returns occurred in 1990 (46). In 1990, however, MDMR staff observations near the Edwards Project suggest that many more than 46 salmon returned to the base of the dam. MDMR staff observed as many as 60 salmon at one time in the tidal portion of Bond Brook during the summer and "dozens" near the base of the dam from the Edwards forebay wall (Stahlnecker et al., 1991). Several Atlantic salmon were seen in the Edwards tailwater and Bond Brook in 1994, and one Atlantic salmon was collected and released upstream of the dam during 1994 alewife collections in the Edwards tailwaters (Stahlnecker et al., 1995).

Owners of seven hydroelectric projects upstream of Edwards dam entered into a negotiated settlement agreement with Maine fishery agencies to facilitate the restoration of alewives, American shad, and Atlantic salmon in accordance with the existing management plans for all three species. The projects and associated owners are Fort Halifax, Shawmut, Weston (all owned by CMP), Lockwood (owned by Merimil Limited Partnership), Hydro-Kennebec (owned by Scott Paper Company), Benton Falls (owned by Benton Falls Associates), and Burnham (owned by Pittsfield Hydro Co. Inc.; now Consolidated Hydro Maine, Inc.). The owners collectively are known as the Kennebec Hydro Developers Group (KHDG), and the agreement is referred to as the KHDG agreement. This agreement is the basis for the installation of downstream passage measures at dams above which targeted species are stocked. Consequently, downstream passage measures are now in place at KHDG dams on the Sebasticook River. Upstream passage is scheduled to be in place by May 1, 1999, at Lockwood, Hydro-Kennebec, Fort Halifax, and Benton Falls; by May 1, 2000, at Shawmut and Burnham; and by May 1, 2001, at Weston according to the agreement.

Table 3-11. Historical Atlantic salmon returns to the Kennebec River from 1975 to 1994

| Year | Hatchery Origin | Wild Origin | Total |
|---|---|---|---|
| 1975 | 32 | 1 | 33 |
| 1976 | 4 | 0 | 4 |
| 1977 | 2 | 0 | 2 |
| 1978 | 2 | 0 | 2 |
| 1979 | 18 | 2 | 20 |
| 1980 | 4 | 0 | 4 |
| 1981 | 14 | 0 | 14 |
| 1982 | 24 | 0 | 24 |
| 1983 | 18 | 0 | 18 |
| 1984 | 1 | 0 | 1 |
| 1985 | 0 | 0 | 0 |
| 1986 | 0 | 0 | 0 |
| 1987 | 3 | 2 | 5 |
| 1988 | 20 | 0 | 20 |
| 1989 | 17 | 0 | 17 |
| 1990 | 42 | 4 | 46 |
| 1991 | 4 | 0 | 4 |
| 1992 | 0 | 0 | 0 |
| 1993 | 2 | 0 | 2 |
| 1994 | 0 | 0 | 0 |
| Total | 207 | 9 | 216 |

Source: USASRC, 1995.

FERC issued orders amending the licenses of six of the seven KHDG projects to incorporate the terms of the KHDG agreement (the Burnham Project was not considered jurisdictional at that time, although it is now). These orders, issued on January 25, 1989, indicated that amending the licenses for the subject projects to reflect the KHDG agreement would provide a definitive program and schedule for anadromous fish restoration in the Kennebec River Basin. The orders further stated that the amendments provide adequate provisions for FERC to require necessary changes that may be necessary for successful anadromous fish restoration. American Rivers intervened and filed a timely appeal of these orders, and state resource agencies intervened in support of the amendments.

FERC issued an EA of the amendments in March 1991 and issued an order denying rehearing, amending the licenses, and lifting the stays of the 1989 orders on October 22, 1992. The order stated that "(t)aking into account the analysis in the EA and the unknown resolution and timing of fish passage at Edwards dam, we conclude that the license amendments in this proceeding, incorporating the 1986 restoration plan, are a reasonable course of action and should be affirmed."

Anadromous sea lampreys (considered a nuisance species) are already present in the Edwards impoundment.

Catadromous American eels (which grow mostly in freshwater but spawn in saltwater) have been documented as far upriver as the Wyman Project. Most anglers consider American eels a nuisance species, but some people in this country and overseas (Europe and the Far East) consider them a delicacy and they are a favorite bait for striped bass in the United States. There is a seasonal, commercial American eel fishery in the Edwards impoundment and tailwaters. Our observations show that eel pots are used in this fishery. Eel pots are used in Maine to harvest "yellow eels," which are typically more than 2 or 3 years old but not yet mature. Adult eels ("silver eels") are harvested by weirs in late summer and fall during the migration to spawning grounds in the Sargasso Sea. The "glass eel" or "elver" fishery harvests small eels returning to mature in rivers with dip nets and fyke nets. The market for elvers is in the Far East where they are sold to eel farmers for grow-out to adult size. In 1995, 16,000 pounds of elvers were harvested. The eel fishery in Maine has grown dramatically in the past few years. In response, MDMR proposed legislation to manage the Maine eel fishery and the enacted legislation became effective in 1996 (MDMR, 1996). Given the increasing importance of this fishery, American eels are now a target species for enhancement by resource agencies in the Kennebec River (letter from Commerce to the Commission dated April 8, 1996).

Other anadromous fish that presently occur downstream of Edwards dam are targeted by resource agencies for restoration to the reach of the river between Augusta and Waterville. These species include Atlantic sturgeon, shortnose sturgeon, rainbow smelt, and striped bass. Because their restoration is related to proposed actions at Edwards dam, we discuss them in more detail in our discussion of project-specific resources (Section 3.3.3).

### 3.1.5 Terrestrial Resources

Within the 100 mile distance between the most upstream and downstream projects, there are several general physiographic regions. Kuchler designated two forest types in the project area: northern hardwoods and northern hardwoods-spruce forest (1964). Kuchler's map (Figure 3-6) identifies northern hardwood-spruce forest in the area of the upstream projects and the downstream projects, with a narrower band of northern hardwood forest dividing these two regions. More recently, MacMahon (1990) identifies six biophysical regions, including: Western Mountains, Saint John Uplands, Central Mountains, Western Foothills, Central Interior, and Midcoast Region (Figure 3-7). MacMahon's categories result from more detailed consideration of interaction of topography, soils, and climate on distribution and composition of vegetational communities.

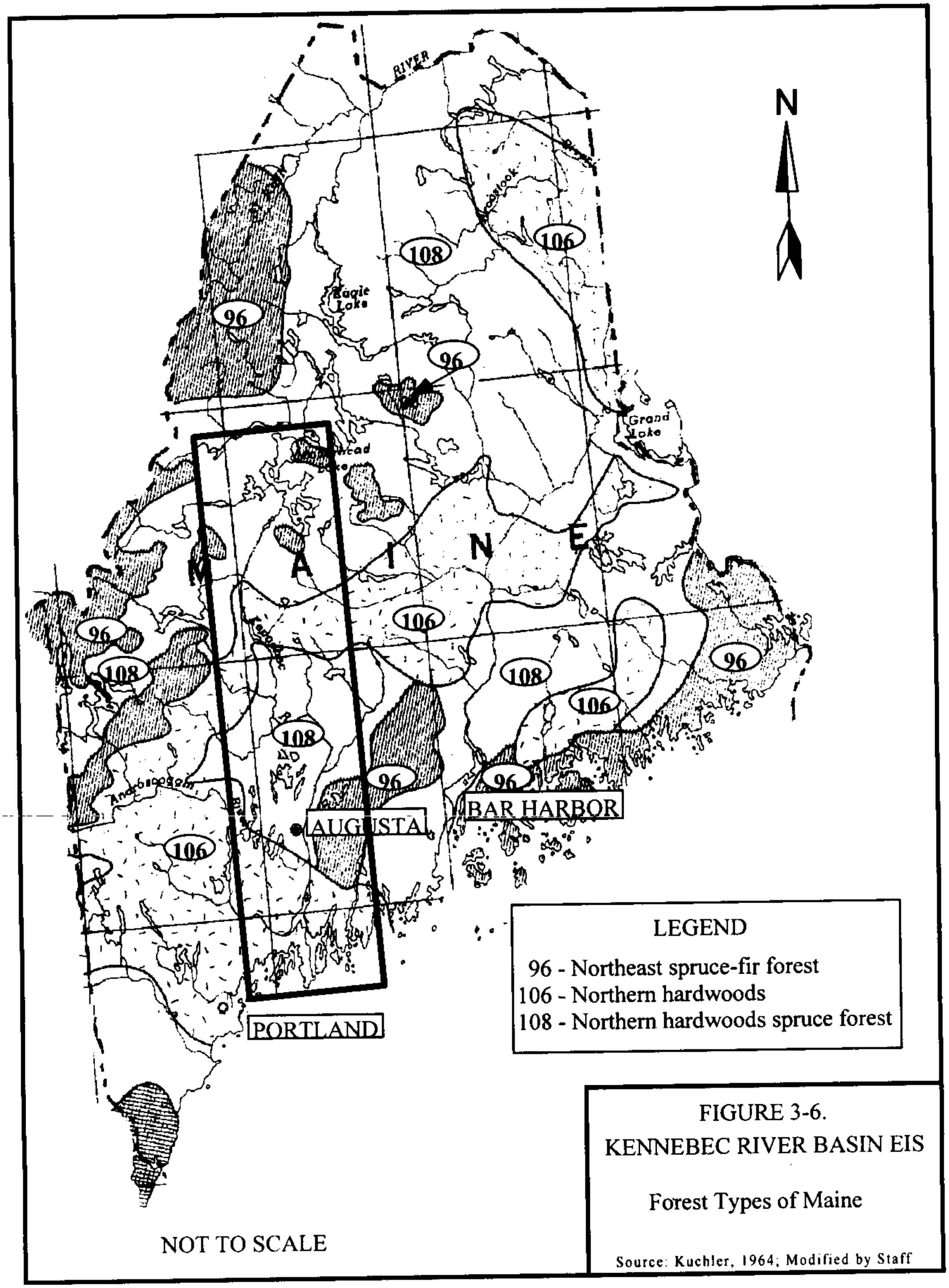


FIGURE 3-6.
KENNEBEC RIVER BASIN EIS

Forest Types of Maine

Source: Kuchler, 1964; Modified by Staff

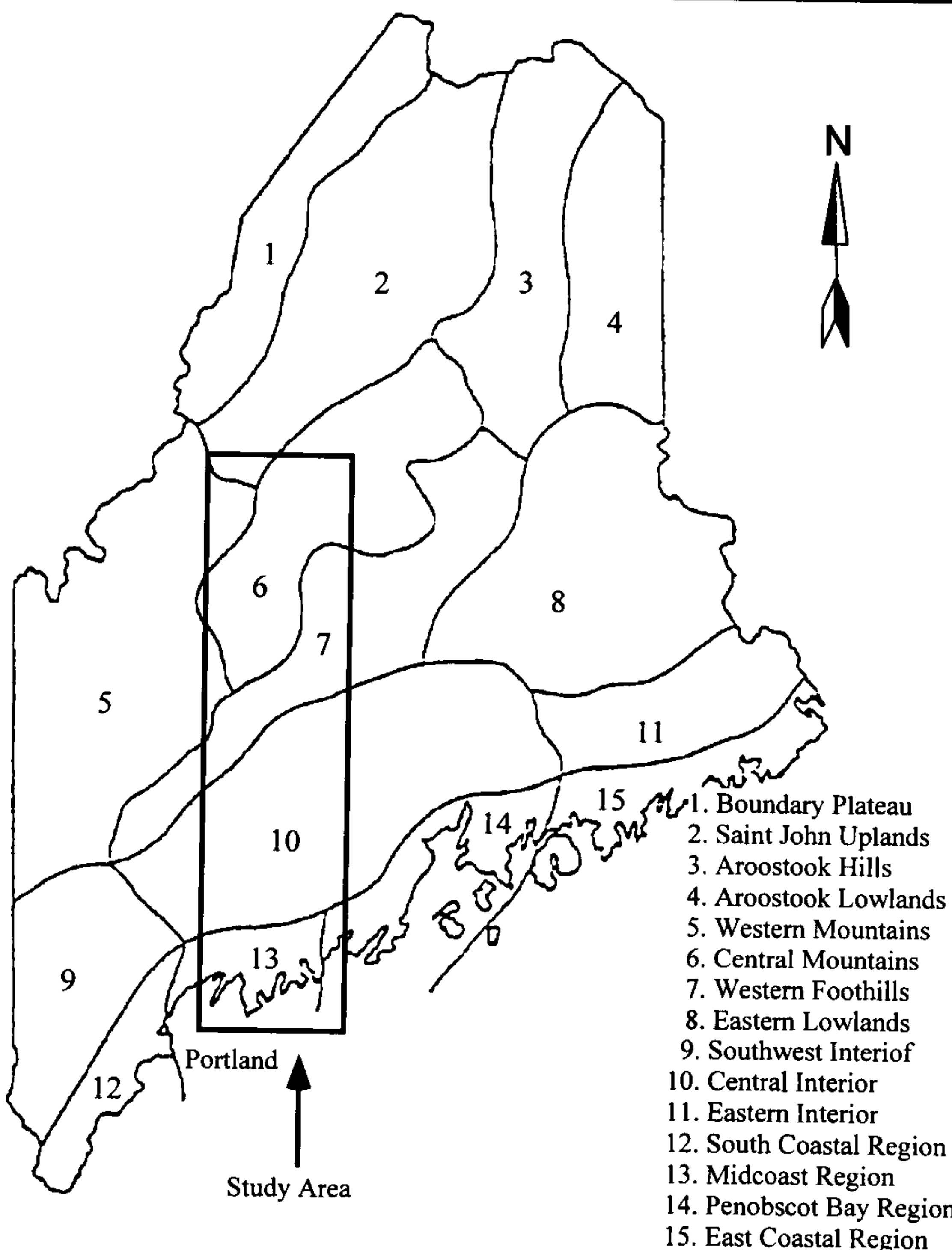


FIGURE 3-7.
KENNEBEC RIVER BASIN EIS

Biophysical Regions of Maine

Source: J. MacMahon, 1990 ; Modified by Staff

*3.1.5.1 Vegetation*

Between Moosehead Lake and the Edwards Project, forests dominate with increasing agriculture in southern areas. Northern hardwoods are dominated by sugar maple, yellow birch, and beech. Less abundant species include red maple, green ash, aspen, red oak, and American elm. Also less abundant are several species of conifers including hemlock and white pine.

The northern hardwoods-spruce forest include some of the same species as the northern hardwood forest with the addition of red spruce and balsam fir as dominants and paper birch, red pine, mountain maple, and American basswood as less frequent species.

In addition to the upland forested areas, a variety of wetland types are abundant. Climate, topography, and soil conditions combine to allow the development of numerous small wetlands and less frequent large wetland systems within and adjacent to the project areas. In general, project areas in parts of the river valley with steeper slopes tend to have smaller and fewer wetlands than project areas with low relief topography.

Because various methods were used to assess wetlands at the projects, there is no accurate and complete identification of all wetland types. It is clear, however, that a range of wetland types exist from open water to hardwood swamps, including freshwater tidal wetlands in the tailrace of the Edwards Project. A rough estimate based on the Cowardin et al.'s (1979) classification methodology reveals that there are at least nine major wetland types in the project areas, including, PFO1, PSS1, PEM, PUB, PAB, PML, PEMV, LUBH, and RUBH. Other modified types also exist depending on the ecological system (palustrine, lacustrine, or riverine) and water regimes that are encountered.

Agricultural crops include hay, corn, and fruit. Fields tend to be small and interspersed between wetlands and forested plots, creating a patchwork mosaic. Pastures are also common. Hedgerows and field borders often have a variety of shrubs and trees that provide a transition into forested areas. Boxelder, aspen, birch, white pine, and red oak are common tree species while raspberry, dogwood, barberry, and staghorn sumac are common shrubs. In Section 3.3.4, we present detailed information on project-specific vegetation.

*3.1.5.2 Wildlife*

There are about 170 species of mammals, birds, reptiles, and amphibians that could inhabit the northern project areas and about 280 species in the southern portion of the basin. This includes about 41 species of mammals, 100 species of birds, and 28 species of reptiles and amphibians to the north and 51, 197, and 33 species, respectively, to the south. The abundance, distribution, and diversity of wildlife in the basin is influenced largely by topography and human population patterns.

North from the Wyman Project, the basin is mountainous, largely forested, and rural. Common mammals in the Kennebec River Basin are white-tailed deer, moose, bear, fox, raccoon, porcupine, grey and red squirrel, snowshoe hare, and mink. Common bird species that may inhabit the project areas include black-capped chickadee, red-winged blackbird, cardinal, gray catbird, mallard duck, great blue heron, herring gull, song sparrow, purple finch, and downy woodpecker. Common reptiles and amphibians found in many of the project areas include green frog, bullfrog, leopard frog, spotted salamander, painted turtle, snapping turtle, and garter snake.

The southern portion of the basin, downstream of the Wyman Project, is less mountainous and more developed, particularly along the river, including more industrial and commercial development and increasing acreage of land used for agriculture. As a result, the southern areas tend to support fewer big game species and those species less tolerant of human disturbances. The increased diversity of land uses and vegetation community types in the southern portion of the basin, however, results in a greater diversity of wildlife species. A few species in the southern portion of the basin likely to benefit from the vegetation diversity include white-tailed deer, raccoon, snowshoe hare, wood turtle, garter snake, black duck, mallard, herring gull, crow, ring-necked pheasant, red-tailed hawk, and eastern bluebird.

#### *3.1.5.3 Threatened and Endangered Species*

There are a number of state listed and federally listed plant and animal species that could occur in the Kennebec River Basin. Table 3-12 shows federally listed species. Of these listed species, bald eagle and peregrine falcon have been identified at some or all of the projects, and shortnose sturgeon is potentially present in the tailwaters of Edwards dam. The occurrence of state listed species varies among projects. See Section 3.3.4 for project-specific information.

In general, federally listed species become listed due to reduced or declining population numbers throughout their geographic range. Depending on the life history and ecological requirements of a species, the range can be as small as within one state or as large as the entire United States. On the other hand, state listed species are listed as threatened or endangered based only on their population within the state boundaries, even if they are very common in other states. Quite often state listed species are at the edge of their geographic range where ecological conditions barely allow for reproduction and survival.

Table 3-12. Federally listed endangered and threatened species in Maine

| Common Name | Scientific Name | Status | Distribution |
|---|---|---|---|
| **FISHES:** | | | |
| Sturgeon, shortnose* | *Acipenser brevirostrum* | E | Kennebec River and Atlantic Coastal Waters |
| **REPTILES:** | | | |
| Turtle, leatherback* | *Dermochelys coriacea* | E | Oceanic summer resident |
| Turtle, loggerhead* | *Caretta caretta* | T | Oceanic summer resident |
| Turtle, Atlantic ridley* | *Lepidochelys kempii* | E | Oceanic summer resident |
| **BIRDS:** | | | |
| Eagle, bald | *Haliaeetus leucocephalus* | T | Entire state-nesting habitat |
| Falcon, American peregrine | *Falco peregrinus anatum* | E | Entire state-reestablishment to former breeding range in progress |
| Falcon, Arctic peregrine | *Falco peregrinus tundrius* | E | Entire state migratory-no nesting |
| Plover, piping | *Charadrius melodus* | T | Atlantic coast |
| Roseate tern | *Sterna dougallii dougallii* | E | Atlantic coast |
| **MAMMALS:** | | | |
| Cougar, eastern | *Felis concolor couguar* | E | Entire state-may be extinct |
| Whale, blue* | *Balaenoptera musculus* | E | Oceanic |
| Whale, finback* | *Balaenoptera physalus* | E | Oceanic |
| Whale, humpback* | *Megaptera novaeangliae* | E | Oceanic |
| Whale, right* | *Eubalaena spp. (all species)* | E | Oceanic |
| Whale, sei* | *Balaenoptera borealis* | E | Oceanic |
| Whale, sperm* | *Physeter catodon* | E | Oceanic |
| **MOLLUSKS:** | | | |
| None | | | |
| **PLANTS:** | | | |
| Small Whorled Pogonia | *Isotria medeoloides* | E | York, Kennebec, Cumberland, Oxford Counties |
| Lousewort, Furbish's | *Pedicularis furbishiae* | E | Aroostook County |
| Orchid, Eastern prairie fringed | *Platanthera leucopehaea* | T | Aroostook County |

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with NMFS.

There have been requests to list Atlantic salmon as threatened and to delist shortnose sturgeon in the Kennebec River Basin. Both species have historically inhabited and continue to inhabit the Kennebec River Basin. On March 10, 1995, FWS and the National Marine Fisheries Service (NMFS) published a finding that listing Atlantic salmon throughout its historic range in the United States is not warranted. They went on to state that further studies were needed to determine if Atlantic salmon in certain rivers, including the Kennebec River, meet the criteria for "species" under the Endangered Species Act (FWS and NMFS, 1995). Changes in the status of these species may affect the future operation of at least one of the projects.

### 3.1.6 Aesthetic Resources

The project areas extend from very scenic and natural settings in the upper river basin to densely settled industrial cities in the lower river basin at Waterville and Augusta. The headwater reservoirs include several wilderness-like lake scenes with some shorelines occupied by seasonal cabins. Permanent residences are located in the towns of Greenville and Rockwood. Moosehead Lake at 74,890 acres is the largest lake in Maine. Mt. Kineo rises more than 800 feet above Moosehead Lake. The Moosehead Lake Region lies at the southern end of the proposed Maine Woods National Park currently under consideration by the National Park Service, and it is recognized as one of the state's leading scenic areas.

From Moosehead Lake to the Wyman Project, the average river gradient is 17 fpm, and it includes the spectacular 240-foot-deep Kennebec River Gorge with Class IV-V whitewater rapids (MSPO, 1993). In the 12-mile stretch from the Harris Project to The Forks, just south of the confluence with the Dead River, the steep gradient drops 355 feet with fluctuating water flows. The 8-mile stretch downstream of The Forks to the Wyman Project is almost continuous riffle (MSPO, 1993). From The Forks downstream, adjacent roads afford numerous opportunities to view the river.

The average gradient is 6 fpm from the Wyman Project downstream to Augusta, and the river has alternating ponded and free-flowing segments. Along most of the river, riparian forest helps to visually define the river environment and separate it from adjacent agricultural lands. Below Augusta, 120 miles downstream of Moosehead, the Kennebec River becomes tidal.

In 1974, Maine established the State Register of Critical Areas which is an official inventory of sites and areas of significant natural, scientific, or historical value (MSPO, 1987). The Kennebec River Basin contains numerous sites listed on the Register of Critical Areas.

In 1982, MSPO published the Maine Rivers Study, which contains the results of a systematic evaluation of rivers. Rivers are classified as "A," "B," "C," or "D" depending on the number of resource values of greater than statewide, statewide, or regional significance (Figure 3-8). The resource values include river-related geologic/hydrologic features; critical/ecological resources; undeveloped river areas; scenic qualities; historic sites; rare vascular plants; significant bald eagle habitat; anadromous fish; inland fish; and suitability for whitewater boating, back-country excursions, and canoe touring (MSPO, 1985). In Table 3-13, we present segments of rivers and tributaries in the project areas that have unique or significant resource values according to MSPO's study.

### 3.1.7 Cultural Resources

The project area's cultural resources include prehistoric archeological sites and historic hydroelectric facilities. Cultural resource surveys have identified historic properties within the project areas of potential impact.

#### *3.1.7.1 Prehistoric*

The Kennebec River Basin yielded diagnostic artifacts indicative of habitation over the past 9,000 years. The earliest inhabitants of the upper Kennebec River drainage were big game hunting people of the Paleoindian period (9000 to 7000 BC). Evidence of subsequent Archaic period occupation (7000 to 1000 BC) is common in the Kennebec River Basin. Contact period sites (1000 BC to 1550 AD) are distributed throughout the basin (Peterson, 1993). Contact period sites are sites that post-date the first influence of European contact in Maine, whether from direct contact with Europeans or by Native middleman trade from the north or south (Spiess, 1991).

One or several ethnographic aboriginal populations occupied the basin into the 18th century. During this period, the Eastern Abenaki Indians controlled the entire river. They named the waterway for its serpentine channel through Merrymeeting Bay to the Atlantic Ocean. The Abenaki name is said to translate into English as "snakey monster" or "long, quiet water" (MSPO, 1993). There are many numerous archeological sites containing artifacts from the Paleoindian, Archaic, and Woodland periods along the shorelines. These sites contain quantities of fish remains providing ample evidence of the importance of anadromous fisheries to early inhabitants.

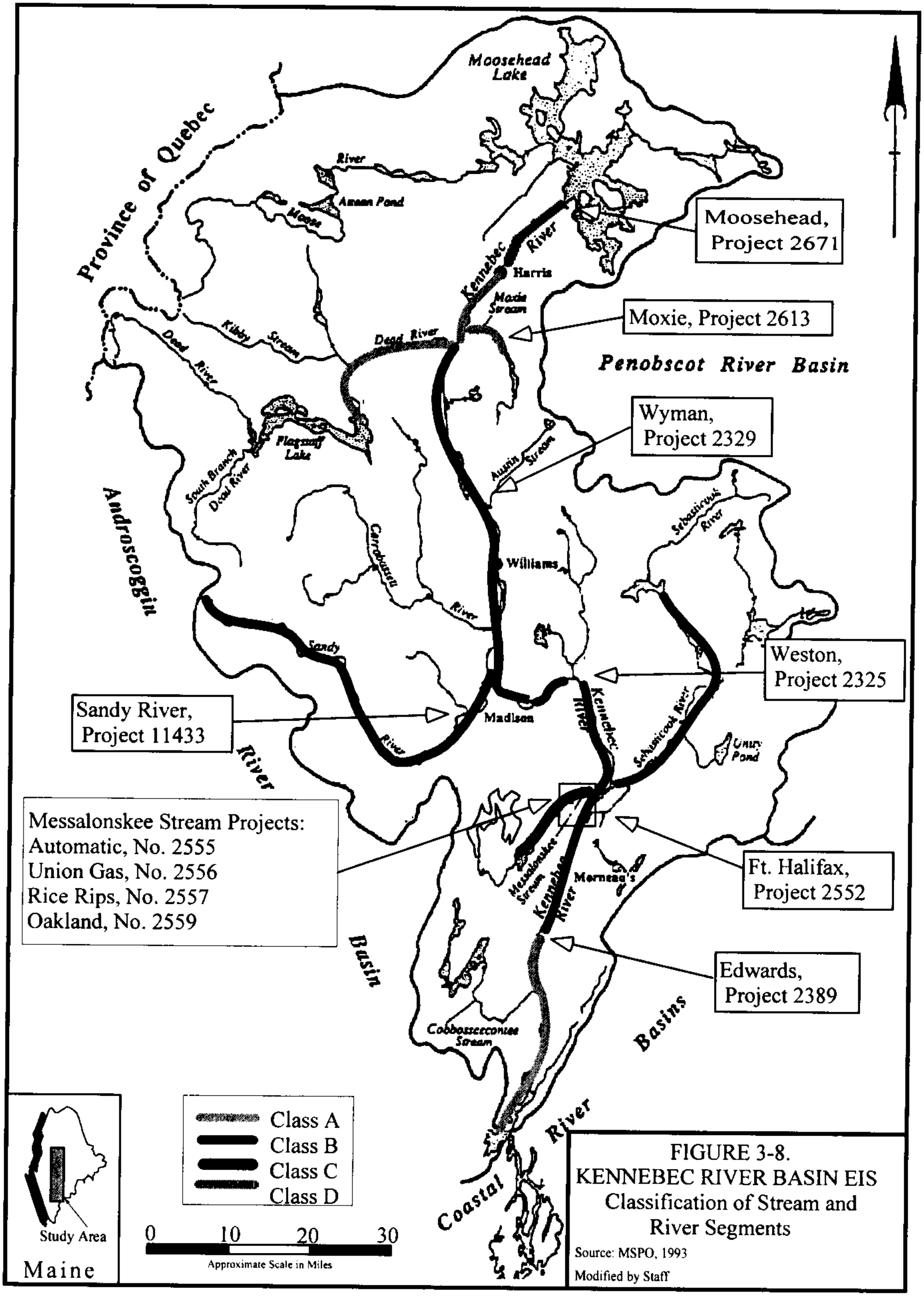


FIGURE 3-8.
KENNEBEC RIVER BASIN EIS
Classification of Stream and River Segments

Source: MSPO, 1993
Modified by Staff

Table 3-13. Unique or significant resource values of Kennebec River segments and selected tributaries classified A - D by Maine Rivers Study

| River segments | Length | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|---|
| "A" - River segments that possess a composite natural and recreational resource value with greater than state significance | | | | | | | | | | | |
| Dead River from Kennebec River to Flagstaff Lake | 24 | X | | X | X | | X | X* | | | X |
| Kennebec River from Bay Point to Augusta | 34 | X | X | | X* | X* | | | | | X* |
| Kennebec River from The Forks to Harris Dam | 12 | X* | | X | X | | X | X* | | | |
| Moxie Stream from Kennebec River to Moxie Pond | 12 | X | X | X | X | | | | | | |
| "B" - River segments that possess a composite natural and recreational resource value with outstanding statewide significance | | | | | | | | | | | |
| Kennebec River from Madison to The Forks | 45 | X | X | | X | | X | | | X | X |
| Sandy River from Kennebec River to headwaters | 66 | X | X | | X | | X | X | | X | |
| "C" - River segments that possess a composite natural and recreational resource value with statewide significance | | | | | | | | | | | |
| Kennebec River from Augusta to Madison | 42 | | X | | X | | X | | | X | X |
| Messalonskee Stream from Kennebec River to Messalonskee Lake | 5 | | X | | | | X | | | | |
| Sebasticook River from Kennebec River to headwaters | 48 | | X | | | | X | | | X | |
| Kennebec River from ocean to headwaters | 13 | | X | | | X | | | | X | X |
| "D" - River segments that possess natural and recreational resource values with reginal significance | | | | | | | | | | | |
| Kennebec River from East Outlet of Moosehead Lake to Indian Pond | 4 | | X | | | | | | | | |

Source: Maine Rivers Study, Volume 2, 1987.

1. Unique/significant river resource values are as follows: A = Geologic/Hydrologic; B = Critical/Ecologic; C = Undeveloped; D = Scenic; E = Anadromous fishery; F = Inland fishery; G = Whitewater boating; H = Backcountry Excursion; I = Canoe touring; J = Historic.
2. X = River or river segment with related resource values meeting a minimum standard of significance (which may be regional, statewide, or greater than statewide) in a given resource category.
3. X* = River or river segment with related resource values which are some of the state's most significant in a given resource category. These resources may have greater than statewide or national significance.

### *3.1.7.2 Historic*[4]

English colonization began in the 1600's along the lower Kennebec River. Popham colony was established in 1606 predating the first permanent settlement of Plymouth Colony in Massachusetts. Settlers abandoned Popham in 1608 when the colonial Governor was recalled to England.

Native Americans and early settlers depended on the Kennebec River for transportation and commerce. Small craft, often bearing furs or fish, could navigate as far upstream as Solon. The virgin forests provided ample raw materials for house and ship construction, fertile land sustained agriculture, and the river provided anadromous fish, an important food source. Early saw and grist mills were built along tributaries bypassing the stronger current of the Kennebec River.

As a transportation and communications corridor, the river itself gained strategic significance during the French and Indian Wars and the American Revolution when forts were built at Augusta and Waterville. Benedict Arnold journeyed up the river on his way to attacking Quebec.

After the revolution, industry grew and riverine settlement rapidly increased, spreading northward along the main stem and branching out along the southern tributaries. Commercial shipyards were built along the river from Gardiner to Waterville. Dams constructed on the lower Kennebec main stem and some of its tributaries accommodated log drivers and supplied power to the basin's timber and textile industries. The needs of these industries soon took precedence over other riverine uses. In 1837, a dam was built at Augusta, despite the fact that it blocked navigation and anadromous fish runs upstream of the city.

After Maine gained statehood in 1820, land was divided into townships that the state sold for revenue. The state retained 1,000-acre parcels of each township for settlement. Buyers of the townships established a system of "common ownership and undivided interest" whereby profits and losses were distributed in proportion to each owner's share. An outgrowth of this system was the formation of land management companies where groups of landowners formed corporations or delegated to one of the owners all responsibility for managing the land. When the expected migration of settlers to the 1,000-acre public parcels did not occur, Maine sold timber rights to these lands for state revenue.

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[4] We excerpted the historical overview from the economic characteristics and historical context in the Kennebec River Resource Management Plan (MSPO, 1993).

The northern half of the Kennebec River Basin above Madison is mostly unorganized territory (i.e., it lacks local government). Because of the harsh climate and rugged terrain of this remote area, it remained virtually unsettled and undeveloped. Land sales in the mid 1800's prompted new interest in harvesting this area's extensive spruce-fir forests, however, and boosted the basin's lumber and pulp and paper industries.

The present day character of the basin was established during the 19th century. Industrial development and the siting of the state capitol at Augusta brought people to the towns and cities clustered along the southern waterways below Skowhegan. Good agricultural land in the lower basin provided both subsistence and commercial enterprise. Abundant surface water offered the basin's residents recreational opportunities, and in the late 1800's resort development around some of the southern lakes drew vacationers from throughout New England. Dam construction continued to satisfy increasing power demands and facilitate log drives from the north. Because forest products companies owned large parcels of land in the upper basin, however, development in this area was minimal.

Today, the lower Kennebec River bisects the basin's only urbanized area. Industrial activity is located predominantly south of Madison, and pulp and paper manufacturing remains the mainstay of the basin's economy. Agriculture, while not a major land use in the basin, still holds an important place in the southern basin's rural economy. Recreational development continues along the shoreline of many southern lakes.

The upper basin, while remaining the raw materials base for the forest products industries, has evolved into a popular recreational area. Improved logging roads provide better access to the scenic north country, which draws tourists year-round.

### 3.1.8 Recreation Resources

The Kennebec River Basin is one of the most frequently used areas for river recreation in Maine. Participation in recreation activities such as fishing and whitewater boating increased on the Kennebec River as log drives were eliminated and water quality improved (MSPO, 1993). The Augusta area is a gateway to the Kennebec River Basin, and municipalities, utilities, and commercial operators have developed many day-use areas in the region to accommodate boat launching, fishing, whitewater boating, picnicking, and sightseeing.

The Kennebec River Basin offers many opportunities for whitewater rafting, canoeing, and kayaking. There also are opportunities for a variety of saltwater and freshwater fishing on the Kennebec River. Fishing for anadromous Atlantic salmon and striped bass, which occurs primarily in the Kennebec River downstream of Edwards dam, attracts people to the Augusta area. Anglers also fish the Kennebec River for landlocked salmon, trout, bass, perch, and pickerel. Waterfowl hunting from boats occurs on the Kennebec River, particularly for American goldeneyes, Canada geese, black ducks, and mallards. Most waterfowl hunting on the river is on Merrymeeting Bay (MSPO, 1993).

The Lily Bay State Park on Moosehead Lake offers camping facilities, access to salmon and trout fishing, a swimming area, boat launches and rentals, and snowmobiling. Baxter State Park, which is about an hour's drive from Moosehead Lake, is a vast, 200,000-acre wilderness preserve offering hiking, fishing, and camping. The Damariscotta Lake and Lake St. George State Parks are within an hour's drive of Augusta, and they provide camping facilities and access for fishing and swimming. The Popham Beach State Park, where the Kennebec River meets the Atlantic Ocean, offers access for striped bass fishing, swimming, and picnicking. The Maine Atlas and Gazetteer identifies 26 organized trailer boat access sites (10 on Moosehead Lake) and 10 carry-in boat access areas (two on Moosehead Lake) on the Kennebec River from Moosehead Lake to Popham Beach. There are also 41 campgrounds along the Kennebec River, 31 of which are located around Moosehead Lake (DeLorme Mapping Company, 1989).

The 1988 Maine State Comprehensive Outdoor Recreation Plan (SCORP) prepared by the Maine Department of Conservation (MDOC), Bureau of Parks and Recreation (BPR) analyzed the recreation needs of the Kennebec River Basin. In the SCORP, MDOC concludes that the recreational needs of the region are: horseback riding, camping, ski touring, picnicking, bicycling, inland swimming, nature interpretation, and boat access. Specifically, the Skowhegan/Madison urban area needs more park acreage, trails, and picnic facilities; the Waterville urban area needs more urban parks, swimming and picnicking facilities, and golfing and indoor skating opportunities; and the Augusta urban area does not have adequate day-use parks and boat launching and swimming facilities.

The Kennebec River Basin has a population of about 200,000 people, and within a 200-mile radius, there are about 2.5 million people. Interstate 95 leads to the Kennebec River Basin. Recreational use of the Kennebec River is expected to increase as population increases in southern Maine (MSPO, 1993).

No areas within or near the 11 project boundaries have been designated as Wilderness Areas, Wilderness Study Areas, or are included in the National Wild and Scenic River System. The National Park Service (NPS) (1992) identified a 28-mile segment of the Kennebec River from Harris dam to the Wyman impoundment as potentially possessing sufficient natural and cultural attributes to qualify for the National Wild and Scenic River System. The

Appalachian Trail, a federally designated National Scenic Trail, crosses the Kennebec River at the northern end of the Wyman Project near Caratunk and briefly follows the shore of Moxie Pond.

*3.1.8.1 Fishing*

The principal fisheries in Moosehead Lake; the Kennebec, Sandy, and Sebasticook Rivers; and Messalonskee Stream are warmwater species (e.g., bass and pickerel) and coldwater species (e.g., landlocked salmon and lake, brook, brown, and rainbow trout). The State of Maine plans to restore alewife, shad, and Atlantic salmon in the Kennebec River and its tributaries (see Section 3.1.4).

The most common game fish in the 120 miles of the Kennebec River upstream of Augusta are smallmouth bass, brown trout, pickerel, and sunfish. The Moosehead, Harris, and Wyman impoundments support landlocked Atlantic salmon and lake and brook trout. The free-flowing segment of the Kennebec River upstream of the Williams impoundment to the Wyman tailwaters supports a self-sustaining rainbow trout population that attracts anglers from throughout New England.

Anglers fish for Atlantic salmon, striped bass, and brown trout downstream of Edwards dam. Fishing for Atlantic salmon downstream of Edwards dam fluctuates depending on the annual run size. Atlantic salmon are not stocked in the Kennebec River, so the fishery has been accidentally created by stray fish from other rivers. The 1990 run brought anglers to the project area almost daily from May through October, and 106 adult salmon were reported caught. The 1991 run was considerably smaller than 1990, and only four fish were reported caught (NDT, 1992). The total Atlantic salmon run on the Kennebec River is believed to consist of 200 fish (Beland, 1986). Although the Atlantic salmon recovery plan for the Kennebec River is currently inactive, FWS (1989) projects that once the plan is activated the annual salmon returns could be 3,480 fish.

Fishing for striped bass occurs downstream of Edwards dam during May through October. The "hook and release only" season is from May 1 through June 30. The availability of striped bass in the Edwards Project area is linked to the presence of forage species such as alewife for the bass to feed on. Brown trout are caught occasionally from shore downstream of Edwards dam during the high spring flows and during the fall. Boat fishing for brown trout occurs during the summer immediately below the Edwards spillway. Availability of brown trout downstream of Edwards dam is probably due to the stocking of fish in upriver areas and subsequent downstream passage.

Angling opportunity for Atlantic salmon and striped bass within an hour's drive of the Kennebec River is available on the Androscoggin and the Sheepscot Rivers. Of the 14 rivers in Maine identified as Atlantic salmon rivers, more than 53 percent of the Atlantic salmon fishing in Maine during 1988 occurred on the Penobscot River. Only 10 percent of the Atlantic salmon fishing occurred on the Kennebec, Androscoggin, and Sheepscot Rivers (Boyle and Teisl, 1992). Angling opportunity for striped bass within an hour's drive of the Kennebec River varies greatly because it is tied directly to the availability of forage species in coastal rivers such as the Androscoggin and Sheepscot.

In general, fishing and boat access facilities in the Kennebec River Basin serve local and regional residents. FERC (1991) estimated that most Maine resident anglers are willing to commute only 40 to 45 miles to fish, because there are many exceptional fishing opportunities close to the anglers' homes. FERC (1991) also projected that the value of angling on the Kennebec River would increase gradually over an extended period of time through 2010, based primarily on anglers' historical preferences for fish species (e.g., brook, brown, or rainbow trout) and fishing locations. Resident anglers prefer to fish in lakes, ponds, or small tributaries rather than in the river. At the state level, only 3 percent of the residents and less than 2 percent of the nonresidents participate in river fishing (MDOC, BPR, 1988). Additionally, Maine anglers (residents and nonresidents) prefer to fish in remote ponds, whereas the areas of the Kennebec River where access is available are often adjacent to industrial land uses.

### *3.1.8.2 Whitewater Boating*

The Maine Rivers Access and Easement Plan (MDOC, 1985) identified the upper Kennebec River from Moosehead Lake to The Forks as an outstanding recreational resource for its whitewater boating. The plan also cited the Sandy River, Moxie Stream, and the main stem of the Kennebec River from Augusta to Harris dam for their unique and/or significant scenic values. There are a variety of commercial and noncommercial whitewater recreational opportunities along the Kennebec River (Figure 3-9).

The Kennebec Valley Tourism Council is promoting the creation of a canoe trail on the Kennebec River from Jackman on the Moose River, which feeds Moosehead Lake, to Popham Beach at the Atlantic Ocean. The 218-mile-long trail would take about 21 days to follow. The Council would publish a guide for the trail, including information on portages and campsites. Portages at several dams on the Kennebec River would be required to support a canoe trail (MSPO, 1993).

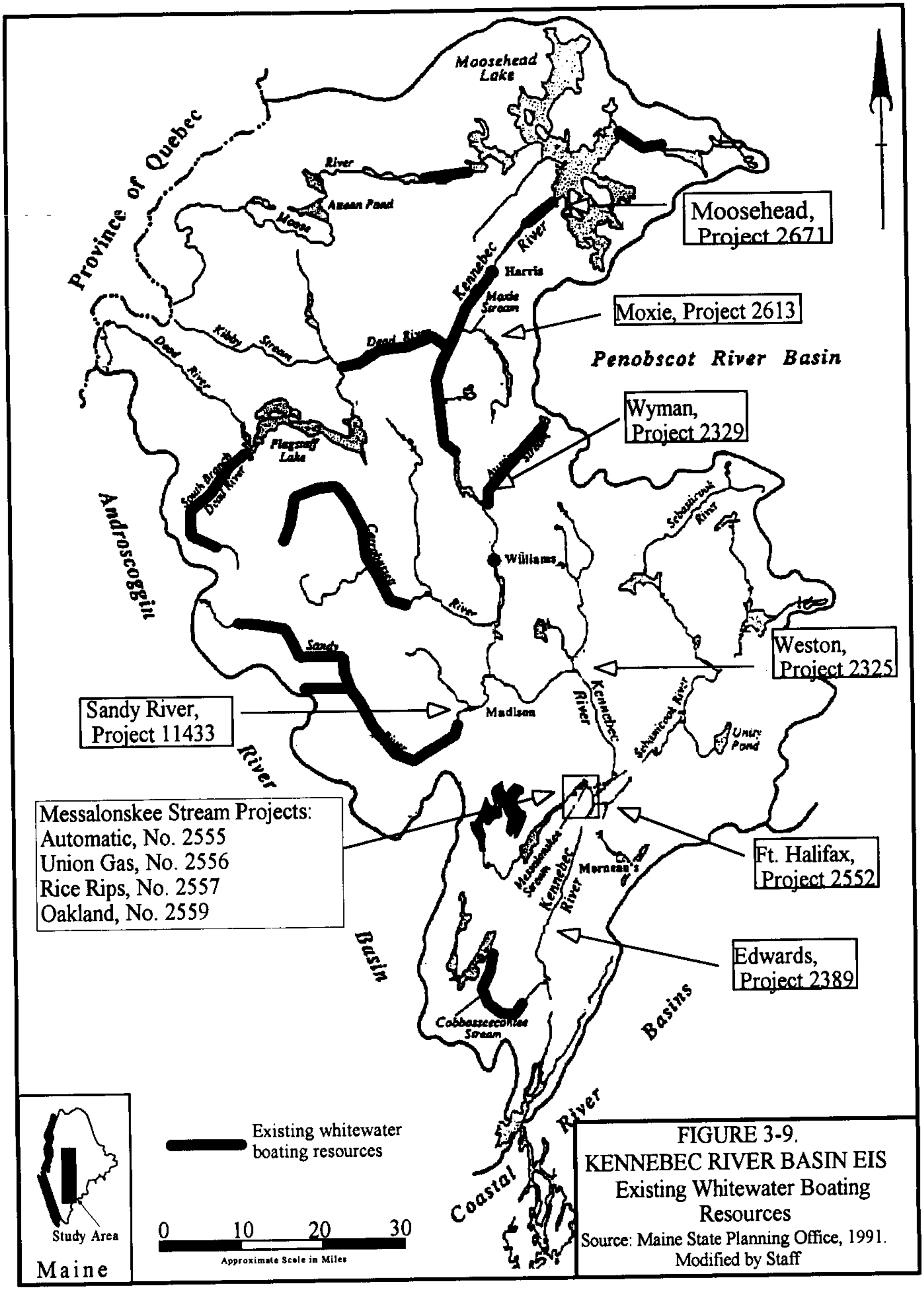

FIGURE 3-9.
KENNEBEC RIVER BASIN EIS
Existing Whitewater Boating Resources
Source: Maine State Planning Office, 1991.
Modified by Staff

*Upper Kennebec River*

Commercial rafting is the primary recreational activity on the upper Kennebec River. The number of commercial rafting passengers on the Kennebec River rose from about 7,300 to more than 30,000 between 1981 and 1991 (MSPO, 1993). MSPO (1993) estimated that the total economic activity due to rafting in Maine in 1989 was $35 million; the Kennebec River accounted for $20 million, the Penobscot River for $12 million, and the Dead River for $3 million of this total.

Use limits on commercial rafting on the Kennebec River are legislated based on number of days during the rafting season, duration of water releases, and carrying capacity of the river. Current limits are: 800 passengers per day on Saturdays, Sundays, Memorial Day, July 4th, and Labor Day, and 1,000 passengers per day on weekdays (MSPO, 1993). There are currently no restrictions on noncommercial rafting on the Kennebec River.

At the East Outlet of Moosehead Lake, there are 3.5 miles of Class II to III[5] rapids at flows from 1,200 cfs to 2,000 cfs, and Class III to IV rapids at flows above 2,000 cfs (AMC, 1991). There were about 1,500 user days of whitewater boating on the East Outlet in 1991 (Land and Water Associates, 1991). From Harris dam to Carry Brook, there are 3.75 miles of Class IV to V rapids that are used by commercial rafters, kayakers, and bold canoeists. In 1991, approximately 3,300 private rafters and 2,500 private kayakers and canoeists boated this stretch of the Kennebec River (MSPO, 1993). From Carry Brook to The Forks, there are 8.5 miles of Class I to IV rapids, and from The Forks to Caratunk, there are 9 miles of easy whitewater (Class I) and strong current good for paddling all season (April to October) (AMC, 1991).

On the Moose River between Long Pond and Brassua Lake, there are 2 miles of Class II to III rapids. On the Roach River from Kokadjo to Moosehead Lake, there are 6.5 miles of Class II rapids. On the Dead River from Spencer Stream to The Forks, there are 16 miles of Class II to III rapids at levels of 1,300

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[5] Class I stretches are clear passages with small, regular waves and riffles. Class II stretches have rapids of medium difficulty with clear and wide passages and possibly low ledges. Class III stretches have numerous high waves, irregular rocks, eddies, and rapids with passages that are clear but narrow, requiring expertise in maneuvering and usually inspection. Class IV stretches are difficult with long rapids, powerful, irregular waves, and dangerous rocks making inspection mandatory the first time. Class V stretches contain intense, powerful rapids with large unavoidable waves and holes or steep, congested chutes with complex, demanding routes requiring precise boat handling.

cfs and Class IV rapids at 3,500 cfs. The Dead River is one of the most popular runs in New England due to summertime releases. These releases attracted more than 1,800 private canoeists, kayakers, and rafters in 1991 (MSPO, 1993).

*Middle Kennebec River*

There are 7 miles of naturally flowing Class II to IV rapids on Austin Stream upstream of Bingham. On the south branch of the Dead River from Dallas School to Langtown Mill, there is a 6-mile natural flowing run of Class II to IV rapids. On the Carrabassett River, there are 6 miles of up to Class V rapids upstream of Carrabassett and 10 miles of Class I to III rapids between Carrabassett and Kingfield (AMC, 1991). There are two stretches of whitewater on the Sandy River. From Smalls Falls to Phillips, there are 11 miles of Class I to III rapids and 6 miles of Class I to III rapids between Farmington Falls and New Sharon. There are 8 miles of natural flowing Class I to III rapids on Temple Stream between Drury Pond and the Sandy River (MSPO, 1993). There is a 400-yard-long stretch of Class II rapids below Weston dam in Skowhegan.

*Lower Kennebec River*

Within an hour's drive of Augusta there are five noted river segments that offer whitewater canoeing and kayaking. On the Cobbosseecontee Stream, there is an 8-mile stretch from the Cobbosseecontee Lake outlet to Routes 126 and 9 that meanders through several small ponds and has Class I and II rapids. On the Little Androscoggin River, there is a 12-mile stretch above West Paris to South Paris that is run in the spring and has a short section of Class II to III whitewater. The Nezinscot River has a 12-mile stretch from Buckfield to Turner Center that is mostly flat water through meadows and woods with several rapids. The St. George River has a 6-mile stretch of river from Searsmont to North Appleton that is run in the spring and has some Class I to III rapids and a 26-mile stretch of river from North Appleton to Thomaston passing through several ponds with easy river sections punctuated with several sharp, Class III drops. The Sheepscot River has a 12-mile stretch from North Whitefield to Head Tide with good current and Class I to II rapids and a 13-mile stretch from Head Tide to Wiscasset.

#### *3.1.8.3 Recreation Use and Tourist Spending*

Although comprehensive visitation records of recreational use in the Kennebec River Basin are unavailable, the applicants estimated development-specific recreation use. At the 11 projects, applicants estimate that there were nearly 900,000 user-days[6] of recreation in 1991. About half of the recreational use was in the vicinity of Moosehead Lake and a quarter was on Messalonskee Lake. Fishing and boating have the highest estimated participation rates. Nearly all (92 percent) recreation was day use, and camping represented the night use in the project areas. Nearly 80 percent of the recreational activity occurred during the summer season. Snowmobiling and ice fishing were the primary winter recreational activities.

The Maine Tourism Coalition (1992) estimates that the economic impact of tourism statewide in 1991 was $2.75 billion. Tourist expenditures in 1991 in the Kennebec River Basin were $177 million and $55 million in the Katahdin/Moosehead Lake area.

### 3.1.9 Land Use

The principal land use features of the Kennebec River Basin include the scenic Moosehead Lake region; the small industrial towns of Madison and Skowhegan and city of Waterville along the forested river corridor; and the city of Augusta. The map in Figure 3-10 shows political subdivisions. There are concentrations of settlement along Route 201 between the highway and the river. Pulp and paper-related activities including timber harvesting dominate land use in the upper and middle segments of the river basin. Agricultural land use is common in the southern portion of the basin.

CMP owns in fee or holds flowage rights to approximately 6,200 acres of project lands at the Moosehead, Moxie, Wyman, Williams, Weston, Fort Halifax, and Messalonskee Projects (Table 3-14).

[6] A recreation user-day is defined as 12 person-hours, which may be one person for 12 hours, 12 persons for one hour each, or an equivalent combination of individual or group use, either continuous or intermittently (Walsh, 1986, pp. 68-69).

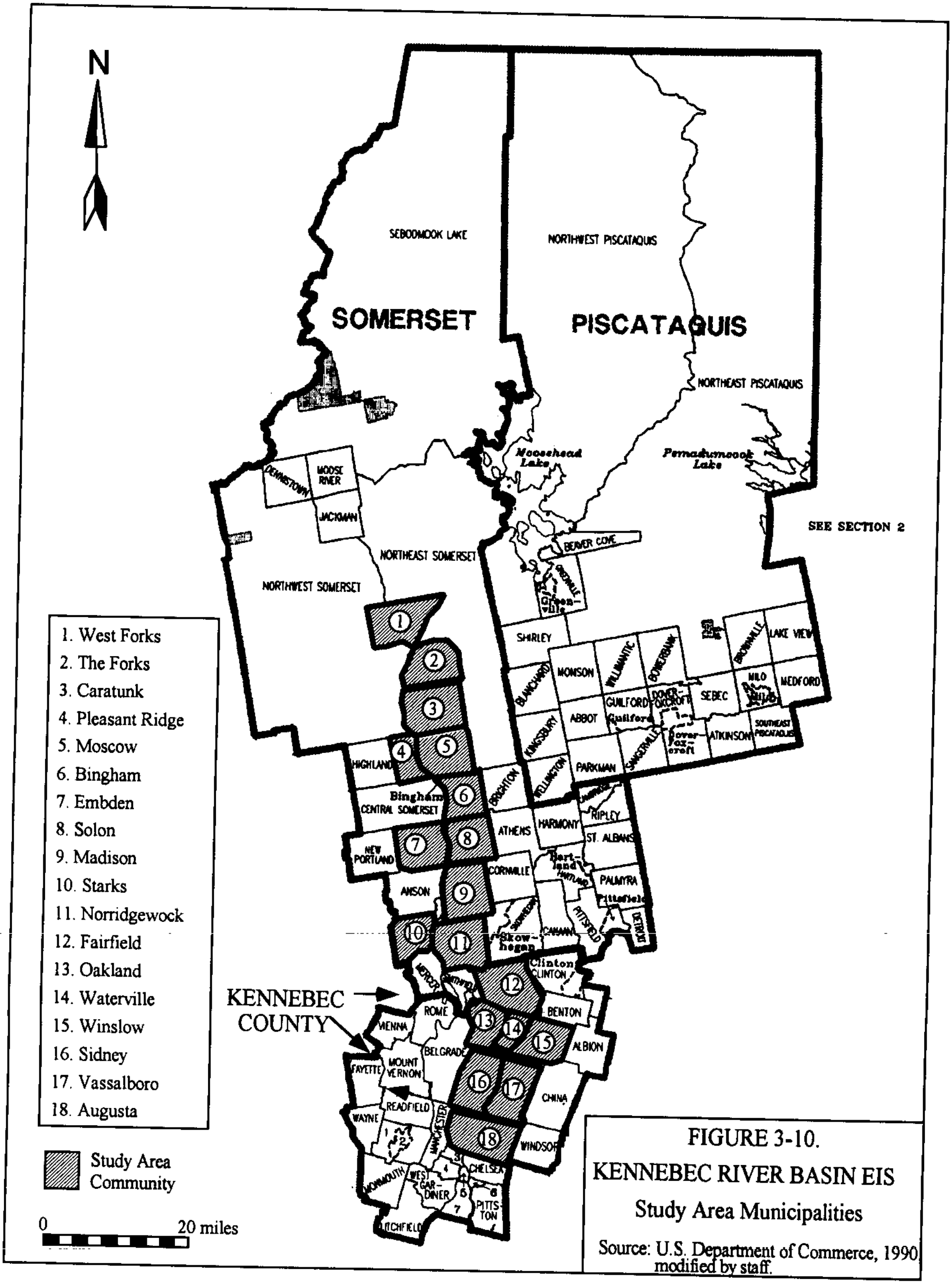


FIGURE 3-10.
KENNEBEC RIVER BASIN EIS
Study Area Municipalities

Source: U.S. Department of Commerce, 1990 modified by staff.

Table 3-14. Shorelands owned by CMP and KWP[1]

| Project | Project lands in acres | Nonproject lands[2] | Total acres |
|---|---|---|---|
| Moosehead Lake | 5.01 | 0 | 5.01 |
| Moxie Pond | 26.5 | | 26.5 |
| Wyman | 1,304.7 | 803.9 | 2,108.6 |
| Weston | 21.4 | 9.5 | 30.9 |
| Fort Halifax | 8 | 4.4 | 12.4 |
| Messalonskee Projects | 72.8 | 232.4 | 305.2 |
| Total | 1,438.41 | 1,050.2 | 2,488.61 |

1 This table does not include nonshoreline lands owned by CMP and affiliates within the Kennebec River Basin.

2 Land now owned by the licensee, acquired with and which abuts project land, as defined in Exhibit G of relicensing application and revised by CMP in its filing dated April 8, 1996.

*3.1.9.1 Maine Land Use Regulation Commission*

Land use is controlled by townships in the lower basin and by MLURC for the unincorporated areas in the upper basin. MLURC, created in 1969, established three resource-based zoning districts to ensure compatibility of future development with existing land use and natural resources. Zoning districts include protection, development, and general management:

- Protection Districts (P) are areas in which development would jeopardize unusual or fragile natural resources.
- Development Districts (D) are designated areas of existing residential, commercial, industrial, or recreational development where future compatible development is encouraged.
- General Management Districts (M) are existing and recommended areas of commercial forest-product or agricultural use (MLURC, 1991).

Most undeveloped land around Moosehead Lake and Moxie Pond is included in resource protection districts, which are used to regulate development and land use to protect recreation potential, fishery habitat, and scenic character.

MLURC requires a minimum setback of 100 feet from the shoreline of lakes and ponds and 75 feet from stream or river shorelines. Structures built within 500 feet of the normal high water mark can be no higher than existing screening vegetation or 25 feet high, whichever is greater. Vegetative buffers must be maintained within 75 feet of the high water mark of streams, and 100 feet of the high water mark of lakes and ponds (MLURC, 1991).

The Maine Wildland Lakes Assessment surveyed the resource values of 1,500 lakes with surface areas of 10 acres or more. Information was collected on fisheries, scenic quality, botanic features, physical resources, wildlife, shoreline character, and cultural resources. Based on the survey and subsequent lakes action program, MLURC adopted a general planning guideline to ensure that development on lakes remains below an average of one dwelling per 400 feet of shore frontage and one dwelling per 10 acres of lake surface area. More specifically, MLURC developed seven lake management classifications (Table 3-15).

MLURC initially classified Moosehead Lake as an MC3 lake. It recognized, however, that the MC3 criteria are not sufficiently refined for properly managing large lakes that are appropriate for a mix of conservation and development and that are likely to be under intensive development pressure. Moosehead Lake was considered a special case and was reclassified as an MC7 lake subject to further study. MLURC also placed Moxie Pond in MC7.

*3.1.9.2 Maine Shoreland Protection Act*

The Maine Shoreland Protection Act of 1971, as amended, requires all municipalities or MLURC to adopt, administer, and enforce ordinances that regulate land use activities within 250 feet of great ponds, rivers, freshwater and coastal wetlands, and tidal waters. Land use controls provided for in the Shoreland Zoning Act include a minimum lot area and minimum 100-foot shoreline frontage; structure setbacks of 75 feet; clearing limitations, including a minimum of 75 feet of vegetative buffer along the shoreline; timber harvesting limitations; erosion and sedimentation control; sewerage disposal; and provisions for nonconforming uses. The towns along the Kennebec River have adopted these provisions. Communities may adopt more restrictive ordinances. In addition, the city of Augusta adopted a Kennebec Greenway Plan as part of its Growth Management Plan.

Table 3-15. Lake management classifications

| Class | Characteristics |
|---|---|
| 1 | High value, least accessible, and undeveloped lakes. MLURC's goal is to preserve the best examples of these pristine lakes by prohibiting development within 0.25 mile of their shores and restricting permanent vehicular access. Existing timber harvesting standards are sufficient to protect resource values. Some lakes that meet MC1 criteria are not included because they are already protected by remote pond zoning. |
| 2 | High value, accessible, undeveloped lakes. Density restrictions are applied within 500 feet of the lakeshore. Variances on density may be allowed based on a lake concept plan. Existing timber harvesting standards are sufficient to protect resource values. |
| 3 | Potentially suitable for development based on available information on water quality, access, conflicting uses, shoreland availability, water level fluctuation, location, regional considerations, and special planning needs. Additional responsible development is allowed. MLURC will waive adjacency criterion for development proposals subject to water quality and soil suitability. |
| 4 | High value, developed. MLURC will allow a reasonable level of residential and recreational development while conserving natural resource values and maintaining undeveloped shoreland areas. Cluster development is required to protect natural values except where clearly inappropriate due to site characteristics. |
| 5 | Heavily developed lakes. MLURC will require cluster development to maintain natural qualities and scenic values and retain some undeveloped shoreline. |
| 6 | Remote ponds -- inaccessible, undeveloped lakes -- with coldwater game fisheries. MLURC prohibits development within 0.5 mile of ponds to protect the primitive recreational experience and coldwater lake fisheries in remote settings. |
| 7 | Not otherwise classified, including many lakes with multiple outstanding or significant resource values. MLURC will manage these lakes for multiple use including resource conservation, recreation, and timber production, giving specific consideration to identified resource values when evaluating the merits of lake-related rezoning and permit applications. |

Source: MLURC, June 7, 1990.

### 3.1.10 Socioeconomics

Our regional socioeconomic analysis includes eastern Maine and the Kennebec River Basin within Kennebec, Somerset, and Piscataquis Counties. The Kennebec River Basin encompasses four cities (Augusta, Waterville, Gardiner, and Hallowell), 96 towns, and some 60 unorganized townships. Except for an urban corridor along the lower main stem of the river, the Kennebec River Basin is predominantly rural. Of the 156 minor civil divisions in the basin, more than 70 are unpopulated and more than 20 sustain populations of less than 500. The northern areas primarily serve as a resource base for forest-related industries that originated in the basin during the 1800's, and these areas have remained less densely populated. The increase in recreational use of upper basin land and water resources has resulted in a peak seasonal population that is three to ten times greater than the permanent population of that region.

#### *3.1.10.1 Population Characteristics*

The state of Maine covers some 33,265 square miles, and its 1992 population of 1,236,300 ranked 39th in the nation (Commerce, 1994). Kennebec, Piscataquis, and Somerset are 3 of the 16 counties in Maine. None of these counties is part of a Metropolitan Area as defined by the U.S. Bureau of the Census. Kennebec County's 1992 population of 117,100 ranked 4th in the state. Piscataquis County's 1992 population of 18,800 ranked 16th in the state, and Somerset County's 1992 population of 50,800 ranked 8th. Population has increased by approximately 22 percent in Kennebec County, 15 percent in Piscataquis County, and 23 percent in Somerset County from 1970 to 1990 (Commerce, 1970, 1990, and 1994).

#### *3.1.10.2 Per Capita Personal Income*

In 1992, Maine had a per capita personal income (PCPI) of $18,163. This PCPI ranked 34th in the United States and was 90 percent of the national average ($20,105). In 1982, Maine's PCPI of $9,653 ranked 39th in the United States. The average annual growth rate of PCPI in Maine over the past 10 years was 6.5 percent; the national average annual growth rate was 5.7 percent.

In 1992, Kennebec County had a PCPI of $18,680. This PCPI ranked 5th in the state, and was 103 percent of the state average, and 93 percent of the national average. In 1982, Kennebec's PCPI of $9,852 also ranked 5th in the state. The average annual growth rate of PCPI in Kennebec County over the past 10 years was 6.6 percent.

In 1992, Piscataquis County had a PCPI of $14,138. This PCPI ranked 16th in the state, and was 78 percent of the state average and 70 percent of the national average. In 1982, Piscataquis' PCPI of $8,588 ranked 11th in the state. The average annual growth rate of PCPI in Piscataquis County over the past 10 years was 5.1 percent.

Somerset's 1992 PCPI was $15,090. This PCPI ranked 12th in the state, and was 83 percent of the state average and 75 percent of the national average. In 1982, Somerset's PCPI of $8,460 also ranked 12th in the state. The average annual growth rate of PCPI in Somerset County over the past 10 years was 6.0 percent.

*3.1.10.3 Labor Force*

There are three labor market areas (LMAs) that encompass the study area; Augusta, Skowhegan, and Waterville. LMAs include a central city or cities and the surrounding territory within commuting distance. It is an economically integrated geographical unit within which workers may readily change jobs without changing their place of residence (Maine Department of Labor, 1992).

Civilian labor force estimates for these Maine LMAs show a seasonal variation in employment. The 1992 labor statistics show a statewide seasonal variation in total nonfarm wage and salary employment from a peak of 528,160 jobs in October to a low of 490,960 jobs in February (about a 7 percent variation). The Augusta LMA peaked in June at 37,600 and was at a low of 35,270 in February (about a 6 percent variation). The Skowhegan LMA workforce peaked in December at 18,080 and was at a low of 15,580 in February (about a 14 percent variation). The Waterville LMA showed a peak workforce of 19,810 in September and was at a low of 18,650 in August (about a 6 percent variation) (Maine Department of Labor, 1992). The Waterville LMA's employment variation can be attributed in part to a seasonal population associated with Colby College, which is in Waterville.

The construction trades also showed some seasonal variation in the study area LMAs, with higher employment during the summer and fall months and lower numbers in the winter. Annual average construction employment for the 1992 period in the Augusta LMA was 1,440, 1,420 in the Skowhegan LMA, and 730 in the Waterville LMA.

The 1992 average monthly unemployment rate for the state of Maine was 7.1 percent. The three LMAs reported similar average monthly unemployment rates during the 1992 year; Augusta, 6.3 percent; Skowhegan, 9.7 percent; and Waterville, 7.4 percent. These figures also vary seasonally, showing decreased unemployment rates during the May through October period (Maine Department of Labor, 1992).

*Augusta LMA*

Reported employment in the Augusta LMA grew at a rate of 18 percent from 1981 through 1992. This is a modest rate of growth when compared to the state's increase of 23 percent for the same time period. Government has been and remains the dominant employer in the LMA, representing 39 percent of the total employment in the area in 1992. The trend in the Augusta LMA's employment base during the 1980's was away from the area's manufacturing sector and more toward employment in a variety of other sectors. Manufacturing employment actually decreased by 1,410 jobs during this period, and the percentage of jobs in manufacturing decreased from 15.8 percent of the area's base in 1981 to 9 percent of its base in 1992.

Even though the employment trend in the Augusta area was away from manufacturing, the types of growth in the retail and service sectors that were experienced in the state did not occur at the same rate in Augusta. In 1981, those two sectors accounted for 28 percent of the employment in the Augusta LMA. In 1992, this had increased to 33 percent. In the state as a whole, the employment base in these two sectors grew from 29.5 percent in 1981 to 46 percent in 1992.

Between 1981 and 1992, the total net gain of 6,550 in reported employment in the Augusta LMA took place in a number of sectors. The government sector reported a gain of 2,460; the services sector a gain of 2,580; the wholesale trade sector a gain of 870; the retail sector a gain of 1,200; and the finance/insurance/real estate sector an increase of 530.

A few employment sectors in the Augusta LMA that are worthy of additional mention are the health services sector, the banking sector, and the wholesale trade sector. These three sectors have all demonstrated healthy growth in the last decade as a result of significant investments by a number of businesses and organizations. Employment levels have increased in all of these sectors and have assisted in the transition away from the area's traditional manufacturing base.

*Skowhegan LMA*

Reported employment in the Skowhegan LMA grew at a rate of 18 percent from 1981 through 1992. The manufacturing sector remains the dominant employer in the LMA, representing 33 percent of the total employment in the area in 1992.

Manufacturing employment peaked in 1985 at 7,655 positions, up from 4,130 in 1975, and dropped to 5,660 in 1992. During the late 1980's, there was a small decline in durable manufacturing (0.5 percent) and the loss of 20 jobs in nondurable production.

Nondurable manufacturing activity currently provides 60 percent of the industrial production jobs in the Skowhegan LMA.

The Skowhegan LMA, like other areas of New England, experienced major overall job growth in the mid- to late-1980's, followed by stagnation over the past 2 years. Some industries, particularly construction, are more sensitive to short-term patterns than others (KVCOG, 1994).

*Waterville LMA*

Reported employment in the Waterville LMA grew at a rate of 13 percent from 1981 through 1992. The services sector remains the dominant employer in the LMA, representing 36 percent of the total employment in 1992. Manufacturing employment decreased by 1,430 jobs (minus 45 percent). During the period 1981 to 1992, the percentage of jobs in manufacturing decreased from 28 percent in 1981 to 17 percent.

Between 1981 and 1992, the total gain of 2,520 in reported employment in the Waterville LMA took place in a number of sectors. Total nonmanufacturing gained 25 percent (3,960 jobs). The services sector gained 36 percent (2,150 jobs), and the retail/wholesale sector gained 26 percent (1,340 jobs).

In the services sector, the big increases were in business, health care, and social services. In the retail sector, the largest increases occurred in general merchandise stores, food stores, car dealerships, service stations, and eating and drinking establishments.

## 3.2 RESOURCES THAT MAY BE CUMULATIVELY AFFECTED

Because operation of many of the hydroelectric projects on the Kennebec River Basin is so integrated, changing operations at one project to accommodate environmental and generation enhancements may have environmental or generation consequences at other projects. Affected projects may not be included in the 11 projects that we consider in this EIS. In the following section, we describe resource areas that may be cumulatively affected and the basis for our conclusions. We confine our analysis of cumulative environmental consequences to these specific resource areas.

Changes in flows at any project can affect the amount of water that is available at other projects and in other river reaches. As a result, flood storage capacity, ability to provide minimum or targeted flows for environmental purposes, and, in some cases, water quality may change. Recommended flow changes at the Moosehead Project could affect flows (and lake water surface elevation) from Flagstaff Lake, the other major storage reservoir in the upper Kennebec River Basin. If such changes occur, the water quantity in the Dead River could be affected, along with aquatic biota. We address these potential cumulative effects in sections 4.1.2.9 and 4.1.3.13 of this EIS.

Changes in flow also may influence the annual generation of downstream hydroelectric projects. We quantify these potential generation influences in Section 2.6 and Appendix D.

If existing or proposed changes in project flows alter downstream flows, resident aquatic biota beyond the river reach downstream of specific projects may be affected. Cumulative impacts also can accrue to anadromous fish when more than one dam is downstream of habitat identified for potential anadromous fish production. These impacts are associated with upstream and downstream fishway passage inefficiencies for both young and adult fish. We discuss these cumulative impacts in Section 4.1.3.13.

Creation of recreational facilities at specific hydroelectric projects may have a cumulative impact on regional recreational resources. We assess these potential regional impacts in Section 4.1.7.12.

## 3.3 SITE-SPECIFIC RESOURCES

### 3.3.1 Geology and Soils

#### *3.3.1.1 Moosehead*

Bedrock geology in the Moosehead Project area consists of igneous and metamorphosed sedimentary rocks of Cambrian to Devonian ages. Because the project area is large, there are many bedrock formations. Major formations include the Kennebec, the Lobster Mountain, and the Ronco Rock of the Ordovician age; the Dead River Formation of the Ordovician to Cambrian ages; and the Hurricane Man Formation of the Cambrian age. There also are many minor formations, several of which contain fossils. The Moxie Pluton, which is an underground intrusion of igneous rock, is also intruded into the bedrock in this area. This pluton has been exposed because overlying areas have eroded.

Surficial geology is dominated by glacial till, and there also are glacial stream deposits. There are no glacial marine deposits, however, because the postglacial inland sea that covered the southern portion of the state did not come this far north (see Figure 3-2). There are esker remnants in the Beaver Cove area.

Although there are no registered bedrock or surficial geologic critical areas in the project area, there are three bedrock outcrops of geologic interest. All three illustrate mineralogies and textures in the Moxie Pluton from fractional crystallization in a magma chamber. These sites are not affected by present operating water levels at the project.

Beck (1990) conducted mineral exploration around the Cambrian and Ordovician volcanics that bisect the Moosehead region. Results show that there are no known bedrock mineral deposits in the project area.

Photographs taken during recent site visits indicate that, in general, the banks of the Kennebec River at the Moosehead Project are either well armored with gravel and cobbles or well vegetated.

*3.3.1.2 Moxie*

Bedrock geology in this project area consists of sedimentary rocks of the Devonian age that have been minimally metamorphosed. They include the Carrabassett Formation (a massive, dark gray slate) and the Hildreths Formation (a thin, volcano-clastic and calcareous deposit). The project area has been intruded by two types of Devonian plutons. The Moxie Pluton is an elongated, sinuous pluton that is 75 kilometers long and 3 to 10 kilometers wide. It trends southwest to northeast across Moxie Pond and Moosehead Lake and contains minerals rich in iron and magnesium. The Bald Mountain Pluton is an ellipsoid that is 8 miles along its long axis. Moxie Pond traverses the northwest corner of this pluton.

Surficial geology is dominated by glacial till present as hills and hummocks often oriented parallel to the flow of the glacial ice movement. There are no glacial marine deposits because the postglacial inland sea that covered the southern portion of the state did not come this far north (Figure 3-2). There also are minor examples of other glacial deposits in the project area, including: end moraine deposits near the Mosquito Narrows (till and/or sand and gravel deposited at the margin of melting glaciers); glacial stream deposits at the Mosquito Narrows; and large, glacially transported boulder outliers between Caribou Narrows and Black Narrows that may be related to end moraine deposits.

Soils in the project area are a very poorly to somewhat excessively drained soil, shallow to deep, and developed in glacially deposited formations. Photographs from recent site visits indicate that, in general, the Kennebec River at the Moxie Project flows through bedrock outcrops and is unlikely to show erosion or slumping. The impoundment appears to be well vegetated along its banks.

There are no registered critical areas, bedrock or surficial, in the project area.

There is one known mineral occurrence in the project area. Nickel minerals have been found in association with the pyrrhotitic gabbro in the Moxie Pluton. This rock type crosses Moxie Pond near Black Narrows. It is unlikely, however, that this would be an economic source of nickel in the foreseeable future.

*3.3.1.3 Wyman*

Bedrock geology in this project area consists of metamorphosed sedimentary rocks of the Silurian and Devonian ages. They are referred to as the Perry, Smalls Falls, and Madrid Formations. The Lexington Batholith, formed in the Devonian age, occupies the western edge of Wyman Lake 7 miles north of Wyman dam.

Surficial geology consists of glacial tills, glacial stream deposits, and minor occurrences of glacial marine transgression sediments. The eastern side of Wyman Lake is composed of glacial tills and bedrock exposures, and the west bank is almost entirely till. Glacial streams have deposited extensive amounts of gravel in the project area because of meltwater that flowed off the glacial ice onto the land surface. These deposits are probably up to 250 feet thick. There are also numerous esker deposits on both sides of the river (Beck, 1987).

Soils within the project area belong to the Adams-Walpole-Buxton Association and occupy a band that is 1 to 3 miles along both sides of the Kennebec River within the impoundment. This association is characterized by "deep, poorly to excessively drained, nearly level to moderately steep loamy sands and fine sandy loams that formed in glacial outwashes and silt loams that formed in marine or lacustrine sediments, or both" (SCS, 1972). Photographs from recent site visits show that, in general, the river banks at the Wyman Project are either well armored against erosion with banks consisting of gravel and cobbles, well vegetated, or flows through bedrock.

There are no registered critical areas, bedrock or surficial, in the project area. There are no known bedrock mineral deposits, and it is not likely that any would be sought or discovered in the foreseeable future.

*3.3.1.4 Williams*

The Williams Project has already been issued a license. We include it in our evaluation, however, because of possible effects of upstream operating conditions. Bedrock in the area of this project is metamorphic, and it includes quartzite, meta-graywacke, meta-siltstone, slate, and meta-sandstone. Soils in the project area include loamy sands and fine sandy loams, formed in glacial outwash deposits, and silt loams formed in lacustrine sediments.

CMP identified several areas where wave action, ice, and reservoir fluctuations caused minor erosion of unconsolidated impoundment banks. Because the impoundment surface level would not be raised and operation of the project would not be changed, however, the rate of shoreline erosion would not increase. Photographs from recent site visits show that, in general, the river banks at the Williams Project are either well armored against erosion and banks consist of gravel and cobbles or are well vegetated, although there are deposits of silt and sand in the drawdown zone.

*3.3.1.5 Sandy River*

Bedrock geology in this project area consists of metamorphosed sedimentary rocks of the Silurian age. The most predominant is the Sangerville Formation, an interbedded pelite and limestone and/or dolostone (Crock, 1993).

The surficial geologic deposits in and near the project area include predominantly late Pleistocene glacial marine sediment with overlying glacial stream deposits. There are glacial till deposits at higher elevations. Modern alluvial sediments and structures have been and are being developed in the existing Kennebec flood plain (Crock, 1993). Photographs from recent site visits show that, in general, the river banks at the Sandy River Project are either well armored against erosion with banks consisting of gravel and cobbles, flow through bedrock outcrops, or are well vegetated. There also is evidence of minor bank slumping and erosion.

One such erosion site was identified in comments provided by a Norridgewock, Maine, landowner during public meetings on the Kennebec River Basin Draft EIS held in February 1996. The landowner's farmland on the floodplain of the Sandy River Project impoundment has experienced flooding events periodically from 1979 to 1996. A January 1996 ice jam induced flood-caused loss of a considerable quantity of soil from a 1,500-foot-long swale and a deeper, 100-foot-wide by 300-foot-long gully that formed across the cornfield.

There are no registered bedrock critical areas or lithic raw material sources in the project area (Crock, 1993).

*3.3.1.6 Weston*

The EA previously produced for this project identifies some erosion problems associated with its operation. Based on observations at the impoundment by GEI Consultants, Inc. (GEI) the project as it exists, however, contributes only minorly to existing erosion within the project boundary. Flood event river flows and nonproject impacts on shoreline vegetation are the controlling factors of erosion in the project area.

The upstream 4.5 miles of the reservoir are underlain by granite. Metamorphosed sediments underlie the remainder of the project area: the lower portion of the reservoir, the dams and powerhouse, and the river reach downstream to the Shawmut reservoir. The predominant unconsolidated deposits in the area are of glacial origin, including: tills, eskers, and glacial-marine silts and sands (commonly known as the Presumpscot Formation).

The river banks downstream of the dam consist primarily of steep, scoured bedrock outcrops. Most impoundment shoreline is moderately steep unconsolidated banks rising to a relatively flat flood terrace. The impoundment shoreline is generally stable. There are, however, some areas of shoreline erosion and slumping. Photographs from recent site visits show that, in general, the river banks are either well armored against erosion with banks that consist of gravel and cobbles, flow through bedrock outcrops, or are well vegetated.

While there are no registered critical areas, bedrock or surficial, in the project area, one bedrock outcrop showing the vertical bedding may be considered for registration. This outcrop, below Weston dam in Skowhegan, has educational value but it is not a vital part of interpretation of regional geology. This site is not affected by current operating water levels.

There are no known bedrock mineral deposits, and it is not likely that any would be sought or discovered in the foreseeable future.

*3.3.1.7 Fort Halifax*

Bedrock geology in this project area consists of metamorphosed sedimentary rocks of the Silurian age, which are referred to as the Waterville Formation (Beck, 1990).

Surficial geology consists of unconsolidated sediments including postglacial alluvial deposits and deposits directly related to glaciers and glacial movement. Specific sediments include: glacial-marine deposits (the Presumpscot Formation) and glacial till (a thin veneer of unsorted material covering the high lying areas of bedrock, and more modern alluvial structures related to the Sebasticook River and its tributaries). There are also some other minor glacial structures, including DeGreer moraines (short, arcuate ridges that are oriented parallel to the edge of the former ice sheet and exclusively below the marine limit) and drumlins (glacially streamlined hills composed of till and elongated in the direction of ice flow).

Photographs from recent site visits indicate that, in general, the river banks at the Fort Halifax Project are well vegetated and have small sections of naturally armored bank.

There are no registered critical areas in the project area. There is one area, an outcrop of the Waterville Formation below Fort Halifax dam, however, that may be considered because it is an important educational and interpretive outcrop.

There are no known bedrock mineral deposits, and it is not likely that any would be sought or discovered in the foreseeable future.

*3.3.1.8 Messalonskee*

The geologies of the Oakland, Rice Rips, Automatic, and Union Gas Projects are similar, and there are few geology and soils issues. Therefore, in the following section, we describe site-specific geology and soils resources for the Messalonskee projects as one.

Bedrock geology in this area consists of metamorphosed sedimentary rocks of the Silurian age. They are the Waterville Formation, the Sangerville Formation, and an unnamed pelitic rock unit between these two formations.

Surficial geology consists of postglacial alluvial and glacial deposits, which include glacial till, glacial stream, and glacial marine deposits. The southeastern boundary of Messalonskee Lake is formed by the Belgrade Esker/Delta Complex.

Soil types vary from silty loams in the Messalonskee and Belgrade Stream areas to sandy loams in the Messalonskee Lake area. Soil associations include the Scantic-Ridgebury-Buxton at Belgrade Stream, the Hollis-Paxton-Charlton-Woodbridge along Messalonskee Lake, and the Buxton-Scio-Scantic along Messalonskee Stream. Photographs from recent site visits show that, in general, the river banks in the area are either well armored against erosion with banks that consist of gravel and cobbles or are well vegetated.

There are no registered critical areas in the project area. Several sites within the Belgrade Esker/Delta Complex, however, have been recommended for inclusion. One site, the Pine Grove Cemetery Delta, either abuts or enters into the project area and provides documentation of past glacial history and processes.

There are no known bedrock mineral deposits, and it is not likely that any would be sought or discovered in the foreseeable future.

*3.3.1.9 Edwards*

Bedrock geology in this project area consists of meta-sediments of the Silurian and Ordovician ages. These sediments are referred to as the Waterville and Vassalboro Formations. There are no faults, but some minor earthquakes associated with movement several miles below the surface have been reported.

Although the general topography in this region was fairly well defined before the last ice age, present surficial geologic structures and deposits have been primarily defined by more recent glacial, glacial-marine, and postglacial alluvial processes. There are several deltas generated as a result of meltwater streams near Augusta but they appear derived from the Belgrade Esker Complex. A meltwater stream flowed along the course of the Kennebec River, as evidenced by esker deposits adjacent to the river. Glacial till is delineated as a surficial deposit over about 4 percent of the area, but it underlies other formations over a larger part of the area.

The Kennebec Esker, which runs adjacent to the west bank of the impoundment between Augusta and Waterville, is an active source of sand and gravel, and it may be a source of groundwater. The glacial-marine deposit referred to as the Presumpscot Formation may exist over the entire project area, or it may be intermixed with the above landforms. Modern alluvial processes related to river flow in the Kennebec River have reworked this project area into its current state.

There are two soil associations that developed on the glacially deposited surficial material within this project area (Faust, 1978). In the following section, we describe these associations, emphasizing physical origin and susceptibility to erosion.

The Buxton-Scio-Scantic Association is delineated over most of the area and comprises most of the impoundment banks. The soils in this association developed on lacustrine and marine sediments, are moderately well to poorly drained, and are typically silty or fine sandy soils. Wetness and permeability are the major limitations for use of this soil. Supplemental drainage and erosion controls are the major concerns for use management. The erosion hazard is defined as slight to moderate depending on the vegetation cover, slope steepness, and other site-specific conditions.

The Hinckley-Windsor-Deerfield Association is delineated over a small part of the area (a 0.75-mile stretch on the west bank just before the outlet of Sevenmile Stream and a 2-mile section on the east bank south of Waterville between about 14 and 16 miles from the dam). These soils developed on esker and glacial outwash deposits and tend to be coarse, deep, and excessive to moderately well drained. The erosion hazard of these soils is slight.

The soil types that make up the associations generally consist of silty loams and very fine to fine sandy loam and loamy sand, which are derived from the glacial till, glacial stream, glacio-marine, and alluvial surficial deposits that they overlie. Given that the topography along the river bank is relatively steep, and that the soils are generally slightly to moderately erodible, land use is limited largely to sand and gravel operations and an occasional industrial or residential property.

While there are no registered critical areas, the Kennebec Esker Complex and several fossil locations have been considered for inclusion in the register or described as valuable examples of geologic formations. The Kennebec Esker Complex is presently being affected by sand and gravel operations, which are leading to the partial or complete removal of sections of this resource.

There are no known bedrock mineral deposits in the project area, and it is not likely that any would be sought or discovered in the foreseeable future.

### 3.3.2 Water Quantity and Quality

In the following section, we summarize water quantity and quality issues specific to each project.

#### *3.3.2.1 Moosehead*

Moosehead Lake operates as a headwater reservoir supplying a relatively uniform and reliable flow to the downstream reaches of the Kennebec River. This project supplies approximately half of the total stored water on the river. The existing water level management of Moosehead Lake is governed, in part, by an informal agreement between KWP and MDIFW for the protection of lake trout spawning areas.

In accordance with this agreement, water level is controlled to maintain Moosehead Lake at or near (within 1 to 1.5 feet of) full pond elevation (1,029 feet above mean sea level [msl]) throughout the summer recreation season (MLURC, 1995). Drawdown of Moosehead Lake is initiated after Labor Day, with the maximum drawdown elevation of 1,024.5 feet msl targeted for October 10. If climatic conditions or circumstances beyond KWP's control do not allow the water level to reach the target elevation by October 10, the lake may be drawn down after October 10 as much as 2 feet, but no lower than the target elevation of 1,024.5 feet msl (MLURC, 1995).

The lake is allowed to partially refill during the late fall and early winter, and then it may be drawn down again in the winter to provide capacity to dampen flow from spring rains and snowmelt that begins in late March or early April. Maximum lake level is typically reached in mid May. The average annual fluctuation of the lake water level is 2.9 feet, but historically it can be as much as 7.5 feet (based on data from 1972 to 1988). Precipitation patterns and downstream water needs govern the degree of fluctuation in a particular year.

Inflows from one reservoir upstream of Moosehead, the Brassua Project on the Moose River, are regulated to help maintain flows to the Kennebec River while allowing Moosehead Lake to remain close to full during the summer. This upstream regulating reservoir also helps to partially refill Moosehead Lake after the fall drawdown. The other reservoir upstream of Moosehead is First Roach Pond on the Roach River. MDIFW owns and operates the dam and manages the flow to protect and enhance landlocked salmon and brook trout spawning and nursery areas in the Roach River. First Roach Pond is drawn down by mid-October (letter from MDIFW to the Commission dated April 4, 1996).

There are two outflow locations from Moosehead Lake: the East and West Outlets. The existing license for the Moosehead Project requires continuous minimum flows of 200 cfs from the East Outlet and 25 cfs from the West Outlet. This license also contains a ramping restriction that limits the rate of change in flow to no more than 350 cfs per minute at each outlet dam. The East and West Outlets join at Indian Pond, the next downstream impoundment, approximately 4 and 10 miles downstream of Moosehead Lake, respectively.

According to the U.S. Department of the Army, Corps of Engineers (Corps), the upstream Kennebec storage reservoirs, particularly Moosehead and Flagstaff, provide considerable flood control benefits by reducing the frequency and magnitude of flooding in the Kennebec River Basin, including the lower basin (Corps, 1989). Moosehead Lake provides 48 percent of the total reservoir storage available for flood control on the Kennebec River above Bingham (Corps, 1985). Moosehead Project operations have been refined to mitigate downstream flood flows by: (1) maintaining an additional 4- to 6-inch freeboard below full pond elevation until after the snowpack has been largely depleted, and (2) targeting a deeper drawdown level prior to the spring runoff to provide about 9 percent more available storage volume than the historic drawdown for the system. These measures help reduce or delay the discharge of high flows because they make use of the additional short-duration storage capacity.

KWP collected water quality data in 1989 that indicate seasonal stratification. Temperature in the lake varies during the year, from stratification during the summer to fall overturn and restratification in late spring. The DO content also changes seasonally on a percent saturation basis. Percent saturation values in the hypolimnion[7] tend to decrease with time during thermal stratification. DO concentrations in the lower depths of the lake decrease prior to fall overturn. MDEP concludes that the East and West Outlets downstream of the respective project dams meet applicable Maine DO standards (MLURC, 1995).

Color values measured in Moosehead Lake and its outlets in 1989 were low compared to other lakes in Maine, suggesting relatively low concentrations of dissolved organic compounds in the water column. Total phosphorus concentrations measured in Moosehead Lake and its outlets in 1989 ranged from 3 to 10 micrograms per liter ($\mu$g/l) well below 15 $\mu$g/l, which MDEP considers indicative of potential eutrophication problems. Secchi-disk transparency (a measure of water clarity) measured in 1989 was consistent with a trophic classification of oligotrophic[8] (versus eutrophic[9]). The chlorophyll-a concentrations (a measure of a water body's primary productivity attributable to phytoplankton[10]) measured in 1989 were two to five times higher than previously measured in Moosehead Lake by MDEP. The chlorophyll-a concentrations measured in 1989, however, may be inaccurate due to laboratory error. MDEP concluded that the Moosehead Lake impoundment meets applicable Maine standards for dissolved organic compounds, chlorophyll-a, and Secchi-disk transparency.

Values of pH, a measure of the relative acidity of water, were near neutral or slightly acidic (ranging from 5.9 to 6.9) in 1989. The total alkalinity, a measure of a water body's ability to buffer acid or resist further lowering of pH, suggest that Moosehead Lake has poorly to moderately buffered water that is typical of many lakes in the region (EPA, 1986).

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[7] A deep, cold, and relatively undisturbed region in a thermally stratified lake beneath the epilimnion.

[8] Condition of a water body lacking in plant nutrients with an abundance of DO throughout.

[9] Condition of a water body in which the increase in mineral and organic nutrients has reduced the concentration of DO, producing an environment that favors plants over animals.

[10] Minute, floating aquatic plants.

In 1989, KWP also conducted studies to evaluate the composition of aquatic macroinvertebrate[11] communities within the East and West Outlets and beyond 1,000 feet of each outlet dam, and within the periodically dewatered ("littoral") zone of each stream. The results of the study indicate that macroinvertebrate communities of the East and West Outlets of Moosehead Lake were typical of those found downstream of lakes and reservoirs with filter feeding insects dominating, and that these communities exist "as naturally occurs." The studies also showed that, although the densities of macroinvertebrates are reduced in periodically dewatered "littoral" zones relative to submerged zones, the reduction in density does not appear to place any food resource limitations on fish populations. MDEP has concluded that the Moosehead Project and the East and West Outlets meet the appropriate Maine water quality standards for the protection of aquatic life and habitat (MLURC, 1995).

Limited sampling of fish in Moosehead Lake conducted in 1987, 1992, and 1993 indicated the presence of mercury at concentrations exceeding both Maine and federal guidelines. The concentration of mercury was reported to be 0.47 milligrams per kilogram (mg/kg) in the single landlocked salmon filet analyzed, and 1.3 mg/kg in the single lake trout filet that was analyzed in 1987 (MDEP, 1987). The average concentration of mercury in young, small lake trout filets was 0.39 mg/kg in 1992, and 1.03 mg/kg in larger lake trout in 1993 (MDEP, 1995). These concentrations are within the range detected in numerous lakes and ponds sampled in 1993 and 1994 by MDEP (MDEP, 1994a).

As previously mentioned, Maine issued an advisory for the consumption of fish caught in all freshwater lakes and ponds in the state due to presence of mercury. EPA's fish consumption guideline for mercury is 0.6 mg/kg in edible fish tissue (EPA, 1993a). The U.S. Food and Drug Administration has established a 1.0 mg/kg mercury fish consumption guideline for edible fish tissue (FDA, 1984). The presence of mercury in fish at concentrations of concern for consumption is not unusual for poorly buffered (e.g., low alkalinity) impoundments, lakes, and ponds, particularly in the northern hemisphere. Mercury can originate from natural sources, such as weathering of bedrock or flooding and subsequent leaching from soil, and from industrial sources discharging to water bodies or via atmospheric deposition. There are no industrial discharges to Moosehead Lake.

*3.3.2.2 Moxie*

Since December 31, 1993, the Moxie Project has been operated in a run-of-river mode with a small winter drawdown to protect

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[11] Chiefly aquatic insects, plus mollusks, crustaceans, etc.

the shoreline and docks from ice damage. The project does not generate power, and there are no consumptive uses of project waters.

Moxie Pond is designated as a great pond, and MDEP classifies it as a Class GPA water body. The project to a point 1,000 feet downstream of the impoundment was reclassified in 1989 as Class A, and from this point to the confluence with the Kennebec River as Class AA.

The Owners of the Moxie Project (Owners) conducted water quality monitoring in Moxie Pond and Moxie Stream downstream of the dams during summer 1990. The deep, north basin of Moxie Pond exhibited a pronounced thermal stratification. Thermal stratification was evident in the shallower, south basin of Moxie Pond for only a short period of time during the monitoring program. DO concentrations measured also reflect the effects of stratification.

DO concentrations were found to be between 80 and 100 percent of saturation in the epilimnion[12] of both basins of Moxie Pond throughout summer 1990. The DO concentration in the hypolimnion of the north basin was significantly depressed, with concentrations recorded as low as 1 percent of saturation. DO concentrations decreased as the summer thermal stratification became more pronounced, limiting reaeration of the hypolimnetic waters. DO concentrations in the hypolimnion of the south basin were observed to decrease to 70 percent of saturation during summer 1990, but later became supersaturated to greater than 100 percent due to full circulation and the presence of a small algal bloom. The depletion of DO in the deep waters of Moxie Pond probably is associated with natural sources, including respiration[13] from phytoplankton and decomposition of natural organic matter in the water column.

Phosphorus concentrations averaged 0.0075 and 0.010 $\mu$g/l in the north and south basins, respectively, during summer 1990. Such concentrations indicate a borderline oligotrophic/mesotrophic, or unproductive to moderately productive, lake. Secchi-disk transparency and chlorophyll-a measured during this monitoring round are consistent with the characteristics of a borderline oligotrophic/mesotrophic lake. Color in Moxie Pond ranged from 9 to 35 standard color units, indicating the presence of dissolved organic matter in the water column. As previously

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[12] The upper region of a thermally stratified lake with more or less uniformly warm, circulating, and fairly turbulent water.

[13] The metabolic process by which an organism assimilates oxygen and releases carbon dioxide and other oxidation products.

mentioned, the decomposition of organic compounds can create an oxygen demand that results in decreased DO concentrations.

The pH and total alkalinity of Moxie Pond suggest that the impoundment is moderately acidic and is poorly to moderately buffered, typical of many lakes in the region (EPA, 1986). The concentration of other water quality parameters measured in 1990 was generally within the range reported for lakes in North America and consistent with values that would be expected in borderline oligotrophic/mesotrophic lakes.

Temperature and DO were measured at four locations in Moxie Stream twice during two consecutive days in summer 1990: directly below the dam in the northern outlet of the project, and below the dam and gated section of the southern outlet, above Moxie Falls, and just upstream of the confluence of Moxie Stream and the Kennebec River. In general, temperatures in Moxie Stream decreased with distance downstream from the project impoundment. DO concentrations exceeded 90 percent of saturation, compliant with assigned water quality classifications.

### *3.3.2.3 Wyman*

The Wyman Project is the second largest hydroelectric project in Maine, with an installed capacity of 72 MW. Normal operating flow releases cycle from approximately 6,240 cfs to a minimum of 490 cfs, depending on electric demand and river inflow. The minimum flow of 490 cfs is in accordance with an informal agreement with MDIFW. The maximum generating flow release is 8,500 cfs. When inflows are greater than 8,500 cfs and the impoundment is full, excess flows are released through the dam's gates.

The Wyman Project is a weekly cycling facility. The facility is operated in coordination with upstream hydroelectric projects so that the impoundment completes a drawdown cycle over a week. The Wyman impoundment is typically drawn down by an average of about 2 feet below full pond elevation during a weekend. The impoundment is gradually refilled during weekdays by peaking discharges from the Harris Project and releases from upstream storage projects. This refill is irregular due to the daily peaking releases at the Wyman Project. Peaking releases normally occur during the day. Historically, the Wyman Project impoundment was drawn down 8 to 12 feet during the late winter to reduce the frequency and magnitude of flooding in the Kennebec River Basin, including the lower basin. This drawdown ability has not been used as frequently since 1983 when upstream facilities were managed more intensively to help collect inflow from snowmelt and spring rains. The Wyman Project drawdown capability is still used to help reduce high flows and downstream flooding.

There are no major industrial or municipal wastewater discharges to the Kennebec River in the Wyman Project area.

The Wyman Project impoundment is considered a great pond, and has been designated a Class GPA water body. The Kennebec River below Wyman is free-flowing for nearly 4 miles to the Williams Project. This stretch was reclassified from Class B to Class A in 1989. The impoundment is considered a second-order dimictic lake.[14]

Only limited water quality data have been collected for the Wyman Project. MDEP reported a chlorophyll-a concentration of 1.2 $\mu$g/l in 1977. CMP generated DO and temperature profiles based on measurements made during summer 1984. The impoundment was found to be thermally stratified, with a thermocline[15] about 80 feet below the water surface. The deep thermocline is attributed in part to the Wyman Project intakes, which are about 50 feet below the normal water surface. DO concentrations below the thermocline measured that summer were sufficient to support salmonids. DO concentrations declined approaching the bottom of the impoundment, and were attributed to oxygen demand from organic sediments possibly associated with historical log drives.

CMP performed additional water quality sampling in the Wyman Project impoundment and tailrace in summer 1987. DO concentration and temperature profiles that were constructed from measurements made in the impoundment were substantially consistent with the 1984 results, except that the sediment oxygen demand observed was not as substantial as it was in 1984. The results of pH, Secchi-disk transparency, total phosphorus, chlorophyll-a, total alkalinity, and color measurements made in 1987 were also similar to the 1984 results. The mean summer chlorophyll-a concentration measured in 1987 was 0.8 $\mu$g/l, similar to that measured in 1977. These consistent results suggest that the trophic state of the impoundment may be stable under the current operating conditions. Available data do not indicate any buildup of nutrients or negative impact from water releases from the hypolimnion.

The temperature and DO concentration of the tailrace water measured on three days in 1987 were within Class A water quality standards.

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[14] A lake that circulates or turns over twice per year: during the spring after ice melt and during the late autumn/early winter before the freeze over.

[15] The region in a thermally stratified body of water in which the temperature decrease with depth is greater than that of the water above and below it, separating the epilimnion from the hypolimnion.

Several studies examined the diversity of aquatic macroinvertebrates in the free-flowing stretch of river downstream of the Wyman Project. A 1974 study provided a general indication that the fluctuating flows that result from peaking operations at Wyman may have an adverse impact on the downstream composition of macroinvertebrates, but drew no conclusion about the biological significance of this condition (Trotsky and Gregory, 1974). An aquatic macroinvertebrate study at the project commissioned by CMP during summer 1991 concluded that waters downstream of the Wyman Project may not be in attainment with the applicable Maine aquatic life standards (Eco-Analysts, Inc., 1991). The conclusions of the 1991 report suggest that a number of factors may contribute to the observed imbalance in the aquatic community, including project peaking operations, inappropriate sampling locations, inability to sample the existing macroinvertebrate community using the methods employed, and possible high flows from a hurricane during the study.

CMP commissioned a follow-up aquatic macroinvertebrate study in summer 1992. The follow-up studies showed that a larger, more stable invertebrate community is present in the deeper main channel of the river than in the shallow fringe areas where the 1991 study was conducted and which represent a minority of the habitat of the river. EPA expressed concern that the sampling locations used for the follow-up study did not represent areas affected by fluctuating current velocities as well as the sites used in the 1991 study, and indicated that "project operations....from the dam to at least 1,200 feet....may be causing violations of Maine's Class C water quality standards" (EPA, 1993b). EPA did acknowledge, however, that it is unclear if these impacts are caused by inadequate baseline flows, high peaking flows, or some other factor.

*3.3.2.4 Williams*

The Williams Project regulates the effects of the Wyman Project, 8 miles upstream, on Kennebec River flow. Project reregulation is targeted to meet KWP's set point flow of 3,600 cfs. It is operated continuously. Due to its limited storage capacity and the variable inflows from Wyman's peaking operations, Williams impoundment water levels fluctuate daily as much as 8 feet, but typically 6 feet or less.

The town of Bingham discharges about 80,000 gallons per day of treated, domestic wastewater to the Kennebec River at Jackson Brook. CMP monitored water quality in summer 1984 that indicated substantial compliance with water quality standards for DO, although concentrations decreased to 73 to 75 percent of saturation about 1.5 miles downstream of the Bingham discharge. The lower DO concentrations were attributed to biochemical oxygen demand from the wastewater (CMP, 1984). Monitoring showed that the impoundment did not stratify. Other water quality parameters measured were within the range typical of other lakes in Maine.

*3.3.2.5 Sandy River*

The Sandy River Project is operated as a daily pulsing facility when inflow to the project is less than the project hydraulic capacity (600 cfs). Such flows typically occur during July and August. During normal flows, MEW attempts to maintain the impoundment at the top of the flashboards 2.6 feet above the crest of the spillway (essentially run-of-river operation). During low-flow periods, the impoundment level is maintained between the top of the flashboards and the crest of the spillway.

MDEP classifies the Sandy River from the project area to its confluence with the Kennebec River as Class B. The project waters generally meet these standards, except in a shallow bypassed reach area at the base if the dam during times of low flow and little if any spillage at the dam. MDEP states that the Class B standard is generally attained (MDEP, 1990a). MEW conducted water quality monitoring during summer 1992 (Kleinschmidt Associates, 1993). DO concentrations ranged from 7.9 to 9.2 milligrams per liter (mg/l) above the impoundment and 7.5 to 9.8 mg/l in the impoundment. The DO content in the bypassed reach fell below the 7.0 mg/l Class B standard on two occasions, but varied between 7.4 to 9.4 mg/l during most of the 1992 monitoring round. MEW contends that both nonattainment events in the bypass are the result of maintenance work on the dam and stagnation from lack of water exchange during low flow cycling (MDEP, 1994b). Below the project tailrace, DO concentrations ranged from 8.3 to 9.6 mg/l. Water temperatures varied little; there was no stratification in the shallow impoundment or other areas monitored. Water temperature measured during July and August ranged from 66 to 73°F in the impoundment and 64 to 70°F upstream of the impoundment.

*3.3.2.6 Weston*

Reregulation of flows at the upstream Williams Project allows the Weston Project normally to be operated as a run-of-river facility. The Weston Project generating units are operated to maintain the normal full pond elevation to within 1 foot of the elevation of the spillway crest (156.0 feet msl). During infrequent (three times between 1981 and 1989), emergency energy demand periods, the usable storage capacity of the Weston impoundment may be temporarily used to provide additional generation, resulting in higher flow rates and greater water level fluctuation. During high river flow, the generating units are operated at 100 percent capacity 24 hours per day.

During the summer, when its spring-fed ponds are low, the Skowhegan Water Company draws 200 to 300 gallons of water per minute from a point below the project at the Great Eddy. There are two paper mills in this area: one about 15 miles upstream (Madison Paper Industries) and the other about 8 miles downstream (Scott Paper's Winslow Plant) of the Weston Project. Madison Paper Industries and the towns of Madison and Anson also discharge to the Kennebec River through the town of Madison's wastewater treatment facility, about 14 miles upstream of the Weston Project at the Abenaki Project.

The town of Norridgewock was scheduled to commence discharging about 225,000 gallons per day of treated wastewater to the Kennebec River near the village of Norridgewock in 1993. The town of Skowhegan's wastewater treatment plant discharges between 1.5 and 3.5 million gallons per day (mgd) of treated wastewater to the Kennebec River. Untreated wastewater overflows into the Kennebec River from combined sewers in Skowhegan during storm events. One of ten known combined sewer overflow points is adjacent to the Weston impoundment, and the remaining nine overflows are downstream of the project dam.

MDEP categorizes the Kennebec River from the Route 201A bridge in Anson-Madison to the Skowhegan/Fairfield town line, which includes the Weston Project area, as Class B waters. CMP monitored water quality in the area of the Weston Project in summer 1988. This monitoring included the headpond and tailrace of Madison Paper Industries dam 15 miles upstream from the project, the Weston Project impoundment immediately upstream of the North and South Channel dams, and the Weston Project tailwater at both the North and South Channel dams. Results indicated that DO concentrations, which ranged from 7.2 to 9.0 mg/l and 89.4 to 96.9 percent of saturation, exceeded the Class B standards of 7 mg/l and 75 percent of saturation.

CMP performed additional water quality monitoring during summer 1991 to address MDEP's concern about whether or not sufficient water existed in the project's North Channel to support a level of aquatic life consistent with Class B standards. DO concentrations measured under annual median and low flow scenarios were again above the Class B standard. The study also showed that substantial water depths remained during low flow conditions.

The Maine Department of Human Services (MDHS) issued a public health advisory concerning dioxin in fish in the Kennebec River below Skowhegan (MDHS, 1990). The advisory recommends that pregnant women and nursing mothers not consume fish caught in this river stretch, and that the general public limit themselves to eating 5, 8-ounce fish meals per year from this area. According to MDHS, the dioxin problem is associated with processes in the pulp, paper, and tanning industries (MSPO, 1993).

#### *3.3.2.7 Fort Halifax*

Fort Halifax Project operations depend on releases from upstream dams and generating facilities on the Sebasticook River. During normal project operation, CMP daily determines the flow release regime from the Fort Halifax Project. The project generating units are run to optimize operating efficiencies, electrical demand, and river flows. The usable storage capacity of the project impoundment is used to supplement inflow to optimize power generation when river flow is less than 1,700 cfs. During a typical weekday, the impoundment is cycled twice daily during peak electrical demand, once in the morning and once in the afternoon/evening. The impoundment is drawn down a maximum of about 2.5 feet during each cycle, and then allowed to refill.

The generating units are usually shut down on weekends during low flow periods to allow the impoundment to refill, and are operated only when spillage over the dam would otherwise occur. The river below the dam receives leakage flow during these periods. A flow of about 20 cfs is released from the project during downstream fish passage seasons. Flow regulation during typically high flow seasons of the year, along with the relatively flat topography of the Sebasticook River Basin, minimize the flooding potential near the Fort Halifax Project. The 1,400-foot riverine section of the Sebasticook River downstream of the project is backwatered by the Kennebec River, and it is influenced by the quantity of flow in the Kennebec. There are no known consumptive uses of water in the project area.

MDEP categorizes the segment of the Sebasticook River that includes the project impoundment as Class C waters. MDEP identified annual algae blooms in the project impoundment, and it showed that DO concentrations in deeper parts of the impoundment and the river immediately downstream of the project dam do not always meet the Class C standard (MDEP, 1986). During the summers of 1988, 1989, and 1990, CMP and MDEP performed additional water quality monitoring upstream and downstream of Fort Halifax dam that confirmed the 1986 results. DO concentrations occasionally did not meet the Class C standards (5 mg/l or greater than 60 percent of saturation, whichever is higher) in the project impoundment and tailwater during the 1988 monitoring. There were three instances of nonattainment of the DO standard in 1989, all measured at the bottom of the impoundment where low DO could be expected due to decaying organic matter (MDEP, 1994c). There were no instances of nonattainment of the DO standard during the 1990 monitoring. During 1992 water quality sampling at the Benton Falls impoundment, which is about 7 miles upstream of Fort Halifax dam, all DO levels measured exceeded Class C standards (CHMI, 1994).

Total phosphorus, chlorophyll-a, and Secchi-disk transparency measurements made concurrent with the 1988 DO monitoring indicated an algae bloom (MDEP, 1990a). Algae blooms are one source of oxygen demand.

MDEP attributes the DO problems to upstream point source discharges and nonpoint source pollution (MDEP, 1981). Eutrophication in Sebasticook Lake, upstream of the project, and other downstream water bodies creates a significant oxygen demand in the river. This eutrophication results from the historical accumulation of untreated sediments from former tanning, textile, and food processing facilities that once discharged to the river and from nonpoint sources from farmland. MDEP is currently attempting to rehabilitate Sebasticook Lake by flushing out nutrient-containing sediment. This restoration program cut phosphorus concentrations in the lake in half between 1979 and 1985, markedly improving the lake's water quality (MDEP, 1990a). According to MDEP (1990a), "the elimination of the Dexter sewage discharge in 1989 and continued annual drawdowns (which promotes sediment flushing) should further improve water quality in the future." In addition, the municipal wastewater treatment plant in the town of Newport, immediately downstream of Sebasticook Lake and about 50 miles upstream of the Fort Halifax Project, recently upgraded its wastewater treatment process and currently provides secondary treatment (CHMI, 1994).

The Benton Falls Project, directly upstream from the Fort Halifax Project, is required to flush a portion of its impoundment to attempt to limit algae blooms. Other nonpoint sources of nutrients include land bordering the Sebasticook River between Pittsfield and its confluence with the Kennebec River, which is primarily rural-agricultural, and cottage development around many of the headwaters of the lower tributaries of the Sebasticook River.

MDHS issued a public health advisory concerning dioxin in fish in the West Branch of the Sebasticook River below Hartland (MDHS, 1990). The advisory recommends that pregnant women and nursing mothers not consume fish caught in this stretch of the river. According to the state, the dioxin problem is associated with processes in the pulp and paper and tanning industries (MSPO, 1993).

#### *3.3.2.8 Oakland*

The four projects on Messalonskee Stream are generating facilities operated to use flows that are released from Messalonskee Lake dam. MDEP (1991) collected data that indicate that the free-flowing (i.e., unimpounded) segment of Messalonskee Stream below the Oakland powerhouse and the Rice Rips bypassed stream segment both meet or exceed biocriteria for Class C waters. MDEP (1991) also indicates that "similar conditions are expected to prevail throughout the stream from the Oakland dam to the Union Gas dam."

Messalonskee Lake dam, the storage development, is operated to provide water to downstream generating stations. CMP voluntarily limits amount and timing of drawdowns in Messalonskee Lake to enhance recreation and to provide flood control. Normal operation of the lake dam uses a drawdown of up to 0.5 foot, which provides enough water to generate electricity for about 1-1/2 days without inflow. A drawdown of 1.0 foot is implemented before high runoff periods, and 1.0 to 2.5 feet during the winter to help accommodate spring rains and runoff. Dams at the lakes upstream of Messalonskee Lake are operated to draw down water levels in the winter for flood control.

The maximum long-term flow available in the summer, using inflow and storage, is about 22 cfs. An operating flow of 570 cfs is released from Messalonskee Lake during periods of electric generation, providing sufficient flows to operate. When inflows to Messalonskee Lake are less than generation flows, the available storage of the lake is used to regulate flows on a 24-hour basis to permit generation during peak daytime electrical demand. During nongenerating periods, Messalonskee Stream receives a minimum flow of 12 to 15 cfs via leakage from Messalonskee Lake dam. The Oakland Project receives its inflow directly from water released at Messalonskee Lake dam, and it is operated to maintain a relatively constant headpond. There is negligible usable storage available.

Downstream flooding concerns on the Kennebec River are not directly related to Messalonskee Stream conditions. The storage capacity of Messalonskee Lake and upstream drainage dams is currently used during seasonal and extreme hydrologic conditions to reduce the potential for flooding along Messalonskee Stream. There were no reported serious flooding or damage problems associated with the Messalonskee drainage during the 1987 flood of record.

The two major water users in the Messalonskee drainage are near the Oakland Project. The Cascade Woolen Mill in Oakland uses about 250,000 gallons per day of water taken from Messalonskee Lake and supplied by the Oakland Water District (a division of the Rockland Water Company). The water district supplies its customers with a total of 600,000 gallons per day of water obtained from Messalonskee Lake. The Cascade Woolen Mill also obtains up to an additional 300,000 gallons per day of water from Messalonskee Stream below the Oakland Project where it maintains a 0.7-foot-high dam.

The mill discharges about 20,000 gallons per day of cooling water to the stream; its remaining wastewater is discharged to the Oakland municipal wastewater treatment plant.

Messalonskee Lake is considered a great pond, and MDEP categorizes it as a Class GPA water body. Water quality data in

MDEP files indicate that the mean total phosphorus concentration in Messalonskee Lake is less than 10 µg/l, which MDEP considers low to moderate. Chlorophyll-a concentrations (2.5 to 3.2 µg/l) were also low to moderate between 1977 and 1989. In general, MDEP considers the water quality of Messalonskee Lake "slightly above average for Maine lakes."

Messalonskee Stream water quality between Messalonskee Lake dam and the Rice Rips impoundment is similar to water quality in the lake. Some nonpoint source runoff from the town of Oakland enters this stretch of the river, but the 12 to 15 cfs leakage flow and limited size of the Oakland impoundment minimize residence time. DO concentrations measured in the Oakland impoundment between 1984 and 1986 ranged from 7.6 to 9.0 mg/l, with saturation values at 89 percent and above. These concentrations are in compliance with the Class C water quality standard.

*3.3.2.9 Rice Rips*

Outflow from the Oakland Project discharges directly into the Rice Rips headpond. The Rice Rips Project is operated to maintain a relatively constant headpond (within 1.0 foot of full pond elevation), and has negligible usable storage capacity.

The Oakland water treatment plant discharges about 500,000 gallons per day of treated wastewater, including the mill's process waters, to project waters at the Rice Rips impoundment.

The Rice Rips impoundment is a great pond and is classified as a Class GPA water. MDEP classifies the remaining sections of Messalonskee Stream as Class C waters.

The water quality of Messalonskee Stream declines because of the town of Oakland's discharge into the Rice Rips impoundment. The monthly average concentration of total phosphorus in the town's effluent ranged from 1,400 to 10,900 µg/l in 1984 (MDEP, 1990b). The total phosphorus concentration in the Rice Rips impoundment averaged from 46 to 280 µg/l during the 1984 to 1986 monitoring program. MDEP considers 15 µg/l total phosphorus to be a threshold concentration for the occurrence of algae blooms. As a result of the nutrient load added by the town of Oakland discharge, the Rice Rips impoundment is undergoing eutrophication as evidenced by heavy summer algae blooms. MDEP reports anaerobic conditions in the hypolimnion during thermal stratification (1990b), which are typically found in a eutrophic lake.

A follow-on study performed by MDEP in 1992 confirmed that the Rice Rips impoundment was failing to meet standards. There are several sources for this failure, including: algal blooms associated with the high phosphorus loading from the town of

Oakland's treatment plant, recycling of phosphorus from the bottom sediments within the impoundment, reduced flushing due to the presence of dams (and limited flows), and phosphorus loading from urban and agricultural sources in the vicinity of the impoundment.

MDEP (1990b) concluded that, given the limited availability of summer inflow, flow augmentation alone would not measurably improve water quality in the Rice Rips impoundment. As a result, the town of Oakland modified its operation to provide the equivalent of tertiary treatment (for phosphorus removal). Maine's Water Quality Classification Standards (MRSA Title 38, Article 4-A) require great ponds such as the Rice Rips impoundment to be free of culturally induced algae blooms. MDEP's report (1990b) recommends that "the town of Oakland....remove its discharge from the great pond unless no feasible alternative exists." The town of Oakland is currently operating under an interim discharge permit.

*3.3.2.10 Automatic*

The Automatic Project is operated to maintain a relatively constant headpond (within 1.0 foot of full pond elevation), and also has negligible usable storage capacity. The Automatic impoundment is a great pond and classified as Class GPA waters.

Messalonskee Stream water quality downstream from the Rice Rips impoundment is significantly affected by the quality of incoming waters. The Automatic Project impoundment receives nutrient loading from agricultural nonpoint sources and urban runoff from the city of Waterville. The impoundment has water quality problems that are similar to those in Rice Rips, and it is considered eutrophic. Mean total phosphorus concentrations ranged from 30.6 to 69.9 $\mu$g/l during water quality monitoring performed by MDEP from 1984 to 1986, and mean chlorophyll-a concentrations ranged from 6.8 to 201.1 $\mu$g/l during this period. Concentrations of total phosphorus exceeding 15 $\mu$g/l are conducive to algae blooms, and chlorophyll-a concentrations greater than 8 $\mu$g/l generally indicate algae blooms.

*3.3.2.11 Union Gas*

Union Gas, the most downstream of the Messalonskee projects, uses flow passed through the Messalonskee Stream system and runoff from a number of small intervening drainages. The Union Gas Project impoundment fluctuates up to 1.3 feet to provide generating capability when the three upstream generating developments are not operating.

Similar to the Automatic impoundment, the Union Gas Project impoundment also receives relatively poor quality water from upstream and urban runoff from the city of Waterville. DO concentrations measured by MDEP in 1984 to 1986 exceeded the Class C water quality standard of the greater of 5 mg/l or 60 percent of saturation. One measurement out of a total of 35 (4.4 mg/l, 53 percent of saturation) made by CMP in summer 1988 was noncompliant with the Class C DO standard.

#### *3.3.2.12 Edwards*

The Edwards Project, which extends upstream from the dam to approximately the mouth of Messalonskee Stream, is operated in run-of-river mode. Flows are significantly influenced by the operation of upstream projects. The Edwards Project includes an approximate 15-mile stretch of river. The impoundment is drawn down when inflows drop, and the tailwater is subject to a normal daily tidal fluctuation of about 1.0 foot.

According to Edwards, the "floodplain boundaries rarely extend for any distance from the normal water levels within the project area." Notable exceptions are some flatter lowland areas near the river's confluence with Messalonskee Stream and several areas associated with downstream backwaters and tributaries.

The Statler Tissue mill in Augusta is the only major user of the Kennebec River for water supply in the Edwards Project area. There are two point source dischargers to project waters, the Statler Tissue mill and the Kennebec Sanitary District (KSTD) wastewater treatment plant. The KSTD plant discharges approximately 12.7 mgd to the Kennebec River, including two combined sewer overflows that MDEP does not consider a significant threat to the water quality of the Kennebec River. The Statler Tissue mill is permitted to discharge up to 5.5 mgd of wastewater to the river.

MDEP classified the Edwards Project waters as Class C from the upstream limit of the project boundary to the confluence with Messalonskee Stream, and from the Sidney-Augusta town line to the downstream limit of the project boundary. Downstream of the project waters, the Kennebec River is also considered Class C to Abagadasset Point in Merrymeeting Bay. The stretch of river from its confluence with Messalonskee Stream to the Sidney-Augusta town line is classified as Class B waters. A study of the Kennebec River performed in 1978 indicated dramatic improvements in water quality for DO, biochemical oxygen demand, and pH between 1976 and 1978 (MDEP, 1979). That study also found fecal coliform bacteria, and recommended eliminating the discharge of untreated wastes from the Gardiner area (8 miles downstream from the project) and upgrading Augusta's wastewater treatment plant (about 1 mile downstream from the project) to improve water quality.

MDEP indicated that the mean enteric bacteria standards for Class B waters are not met at Sidney (MDEP, 1990c). This noncompliance is attributed to the discharge from the KSTD and combined sewer overflows in the Waterville-Winslow area and other nonpoint source contributions. Bacteria concentrations downstream of Edwards dam do not consistently achieve the Class C standard due to combined sewer overflows in Augusta (MDEP, 1990c).

MDEP performed water quality monitoring during summer 1983 at Lockwood dam (18 miles north of Edwards dam), and found that DO concentrations were greater than 90 percent of saturation, exceeding the state water quality standard. The results of water quality monitoring performed at Hydro-Kennebec's Winslow dam in 1984 (19 miles north of Edwards dam) were generally consistent with the 1983 results. MDEP's additional water quality monitoring during the summers of 1983, 1984, and 1985 indicated that DO concentrations in most of the drainage exceed 7 mg/l and 80 percent saturation during the hottest days of summer.

MDEP and S.D. Warren Co. conducted comprehensive water quality surveys during the summers of 1985 and 1987, and data from these efforts were used as input to a water quality model to predict water quality impacts of discharges from the S.D. Warren Co. mill in Hinckley (upstream of the Shawmut Project) and other significant discharges along the river under worst-case, low flow conditions (MDEP, 1988). Modeling results indicated that the minimum DO concentration under worst-case conditions would be no less than 6.57 mg/l, exceeding the Class C water quality standard. The modeling study also indicated that sediment oxygen demand does not significantly affect DO in the Kennebec River from Hinckley to Merrymeeting Bay.

USGS conducted seasonal water quality monitoring at North Sidney that indicate that Class B standards are met a substantial percentage of the time. Occasional violations of the Class B DO standards were observed in July and/or August during 1988 and 1990. Similar violations were also reported at North Sidney in September 1993 (USGS, 1994).

Edwards collected water quality data on the Kennebec River during summer 1990 and 1991. Data indicate little vertical stratification of temperature and DO in the impoundment. DO concentrations exceeded Class C standards during this effort, including samples collected below the dam during nonspillage conditions. The observed diurnal difference in DO concentrations (lower in the morning and higher in the afternoon) was attributed to the photosynthetic activity of aquatic plants (which produce oxygen during daylight hours). Chlorophyll-a concentrations were generally below the 10 $\mu$g/l concentration that MDEP considers to be a threshold value indicating algae blooms.

In October 1990, LOTIC, Inc. collected aquatic macroinvertebrates from locations along and below the impoundment

(LOTIC, 1990). That study concluded that the stretches of the project area downstream of Edwards dam meet the Class C MDEP aquatic life standard. LOTIC also concluded that the section of the river upstream of the Edwards impoundment achieves the Class C MDEP aquatic life standard. Although the evaluation technique used to determine compliance with the aquatic life classification standard is inappropriate for the Edwards impoundment (because the technique is based on unimpeded, free-flowing waters), types of organisms found in this stretch were similar to those found in the above-referenced upstream and downstream sections and are generally associated with good water quality (LOTIC, 1990). LOTIC concluded that "there were no data to support that the water quality in the impoundment has been degraded" for the river section between Waterville and Edwards dam (LOTIC, 1990).

MDEP reported the detection of polycyclic aromatic hydrocarbons in sediment samples collected from behind Edwards dam at concentrations typical of soil and sediment throughout the state (MDEP, 1990c). Laboratory analyses of sediment samples did not detect heavy metals at concentrations exceeding those in sediment samples collected from a remote northern Maine watershed (MDEP, 1990c). We detected higher concentrations of cadmium than those reported in 1990 by MDEP in the sediments sampled upstream of Edwards dam in 1994 and upstream and downstream of Edwards dam in 1995 (SWETS, 1995a, c). The range of cadmium detected in sediment during our 1994 and 1995 sampling events was 5.58 to 11.10 mg/kg. Cadmium was not detected in surface water samples or in elutriate[16] during the April 1995 supplemental sampling rounds (SWETS, 1995c).

### 3.3.3 Fishery Resources

*Threatened and Endangered Species*

There are no known federally listed threatened or endangered species of fish within the project boundaries of any of the 11 projects that are considered in this EIS. The endangered shortnose sturgeon is known to occur in the tidal portion of the Kennebec River, downstream of the Edwards Project. Shortnose sturgeon were collected by MDMR about 7 miles downstream of Edwards dam. It is likely that shortnose sturgeon are present immediately below the Edwards dam because, in 1995, small sturgeon were observed in the Edwards tailrace from May 10 to May 12 (MSPO, 1995). This is when shortnose sturgeon would be expected to spawn and Atlantic sturgeon would be expected to be much further downstream. Shortnose sturgeon are addressed in more detail in the site-specific discussion of the Edwards Project (Section 3.3.3.12) and in Appendix C.

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[16] Water decanted from a water-containing sediment sample.

The state considers several aquatic species rare in Maine. Atlantic sturgeon are present downstream of Edwards dam, and we discuss them in Section 3.3.3.12. Brook sticklebacks were collected in the Moxie and Edwards impoundments and downstream of Edwards dam. Existing project operations apparently do not adversely influence this species. The yellow lamp-mussel (*Lampsilis cariosa*), a rare bivalve, was found at the Benton bridge (upstream of Fort Halifax) and at the confluence of the Sebasticook River with the main stem of the Kennebec River. MNHP (1988) concluded that continued operation of the Fort Halifax Project would maintain suitable populations of this species and that the primary population probably occurs in the main stem of the Kennebec River.

*3.3.3.1 Moosehead*

Moosehead Lake supports a significant recreational fishery for landlocked Atlantic salmon, brook trout, and lake trout. The primary forage base for these resident sportfish is rainbow smelt, although yellow perch, slimy sculpins, and minnows are also a food source. In Section 3.1.4, Table 3-7, we list all fish species known in Moosehead Lake.

MDIFW monitored the lake trout population in the lake for more than 20 years in response to a decline in the population during the 1960's. It identified at least four spawning sites: Sandy Bay, Sugar Island, Center Island, and within Spencer Bay. These sites are shallow shoal areas with substrate of broken rock and rubble 6 to 12 inches in diameter. Based on these studies, MDIFW implemented an informal lake water level management agreement with KWP in 1971. The agreed-to minimum targeted drawdown limit of elevation 1,024.5 feet after October 10 ensures that known spawning sites are not dewatered and exposed.

After implementation of the lake level agreement, the lake trout population increased, and harvests increased significantly from a low of 2,554 fish in 1975 to a high of 10,359 fish in 1986. Because lake trout stocking stopped in 1975, the population increase was probably due, in part, to successful natural reproduction. Factors besides protection of spawning habitat that contributed to population increase include an increase in the minimum legal limit from 14 to 18 inches, which was instituted in 1972, and a decrease in the daily bag limit from 8 to 2 fish in 1977.

MDIFW also monitors the high quality landlocked Atlantic salmon population in Moosehead Lake. In recent years, the harvest of legal sized salmon remained stable and within the range of MDIFW's 12,000 salmon per year harvest goal. Salmon naturally reproduce in the lake's tributaries, and MDIFW estimates that, during the 1970's, total salmon parr production in these tributaries was more than 36,000 fish per year. In

1975, the annual salmon stocking rate was reduced from 50,000 to 25,000 salmon, which MDIFW considers to be an appropriate stocking rate to complement natural reproduction and maintain the fishery. The stocking rate was further reduced to 15,000 salmon in 1988 because of slower salmon growth related to low forage abundance (letter from MDIFW to the Commission dated April 4, 1996). The present management regime of reducing the water level before October 10 increases water velocity near the mouths of spawning tributaries and increases the amount of suitable spawning habitat available at the mouth of the tributaries.

Presently, the brook trout population in Moosehead Lake is entirely supported by wild fish spawned in the lake or its tributaries. MDIFW discontinued stocking in 1973. MDIFW gill netting data from 1973, 1978, and 1988 suggest that the brook trout population in the lake may have increased in the 1980's.

*East Outlet*

The recreational fishery in the East Outlet of Moosehead Lake includes landlocked salmon, brook trout, and lake trout. The lake trout originate from fish produced in the lake that drop down. Because the East Outlet is not stocked, salmon and brook trout originate from natural reproduction in this reach and from Moosehead Lake and Indian Pond (about 3.5 miles downstream of Moosehead Lake), into which the East Outlet flows.

MDIFW estimates that the annual salmon parr production is less than 1 percent of the total parr production of Moosehead Lake and that annual salmon smolt production in the East Outlet is about 500 to 1,000 fish. This relatively low production is probably due in part to the very limited supply of spawning gravel in this section of the river; MDIFW estimates that it is less than 0.2 percent of the total bottom substrate. Brook trout productivity is probably similarly limited by the small amount of spawning gravel. MDIFW indicates that high spring and early summer flows also contribute to limiting landlocked salmon and brook trout production in the East Outlet (letter from MDIFW to the Commission dated April 4, 1996).

Fish can pass upstream from the East Outlet to Moosehead Lake via a fishway, constructed in 1958, that is a series of eight pools, each with a submerged orifice. MDIFW periodically uses the fishway to trap fish to assess movements from or into the lake. Between May 29 and August 13, 1990, MDIFW collected 880 salmon of various sizes; 27 lake trout; 123 brook trout; and white sucker, longnose sucker, round whitefish, and lake chub.

*West Outlet*

The West Outlet of Moosehead Lake is a 9-mile-long stream characterized by a series of deadwater habitats and ponds connected by short sections of riffles. This stream supports a recreational fishery that is smaller than the East Outlet fishery. During May, there is a often a concentration of adult salmon and some brook trout in the pool immediately downstream of the West Outlet dam (MSPO, 1993). In 1974, smallmouth bass were illegally introduced to the West Outlet (MSPO, 1993), and they now contribute to the sport fishery. Smallmouth bass have since moved downstream to Indian Pond and proliferated. As with the East Outlet, lack of suitable spawning gravel limits salmonid reproduction. There is no fishway at the West Outlet dam.

*3.3.3.2 Moxie*

Moxie Pond primarily supports a coldwater fishery for brook trout and landlocked Atlantic salmon. The brook trout fishery is sustained by natural reproduction in several inlet tributaries including Bald Mountain Brook, Bear Brook, and Alder Stream, in addition to annual fall stockings of about 5,000, 4- to 8-inch long fish. The brook trout fishery is very good: angler harvest is 0.54 fish/angler/day, whereas the 1986 statewide management plan suggests a mean harvest goal of 0.5 fish/angler/day. Landlocked salmon populations are sustained by natural reproduction in tributaries, most notably Sandy Stream and Mosquito Brook, and about 1,000, 8- to 10-inch long salmon are stocked every 3 years. The landlocked salmon fishery is only fair. The average time to catch a legal salmon at Moxie Pond from 1976 through 1982 was 64.9 hours, and the statewide average was 38.5 hours.

Normandeau Associates, Inc. (NAI) and resource agencies conducted a field review of known salmonid spawning tributaries of Moxie Pond. They concluded that a drawdown of from 3 to 4 feet before spawning begins (October 15) could restrict salmonid access to these streams: Big and Little Sandy Stream, Alder Stream, Mosquito Stream, and Bald Mountain Brook (NAI, 1991a).

Although white perch were illegally introduced to Moxie Pond in 1985 and lake trout were unintentionally stocked, the pond is not managed for these species. An MDIFW lake inventory in 1984 recorded brook stickleback, a relatively rare species in Maine, in Moxie Pond. According to the Maine Natural Heritage Program (MNHP), the brook stickleback "...apparently has not been negatively impacted by current operating procedures of the Moxie Project." This species spawns from April to June when the pond is nearly full.

Shallow-water zones with aquatic vegetation are often nursery habitat for young fish because the plants offer cover. NAI surveyed nearshore aquatic vegetation in Moxie Pond and found that emergent plants such as bur-reed and arrowhead showed signs of stress. According to NAI, the present operating regime, which calls for an 8-foot winter drawdown that exposes aquatic plant tubers and roots to desiccation and freezing, is a likely cause of reduced overwintering success.

At a 1991 agency consultation meeting, an MDIFW representative indicated that the Moxie Pond fishery is a more important fishery resource than Moxie Stream. MDIFW would not support enhancement of Moxie Stream fishery habitat (i.e., through guaranteed minimum flows), therefore, at the expense of Moxie Pond water levels.

The upper half of Moxie Stream is large deadwater-type pools connected by short riffle sections. The lower half is largely runs and riffles and Moxie Falls, which has a total vertical drop of 111 feet. The falls prevent upstream movement of fish from the Kennebec River.

The Owners established 17 representative cross-sections to assess stream habitat characteristics for brook trout, the primary fish species of concern in Moxie Stream (NAI, 1991b). Moxie Stream substrate is primarily cobble and small boulders, typical of streams that provide high quality brook trout habitat. Only two transects had gravel suitable for brook trout spawning (in areas with sufficient flow to provide oxygen and remove metabolic wastes from incubating eggs). Channel width at low flows (about 25 cfs) ranged from 140 to 200 feet in deadwaters and runs and from 40 to 80 feet in riffles.

*3.3.3.3 Wyman*

MDIFW manages the Wyman impoundment for coldwater fisheries, specifically, landlocked Atlantic salmon, rainbow trout, and lake trout. These fisheries are supported by stocking, movement from upstream habitat, and natural reproduction in the impoundment and its tributaries. It is unclear what portion of salmonid reproduction originates from the impoundment.

MDIFW also manages the impoundment for a popular rainbow smelt fishery. These fish are primarily caught by ice fishing. They are also caught during the open water season and can be netted by hand at the upper end of the impoundment during the spring spawning run.

Warmwater species commonly caught in the impoundment include chain pickerel and yellow perch. White perch have not yet been identified in the impoundment, but are in upstream waters and probably will become established in the impoundment in the future. Field investigations conducted by CMP and MDIFW biologists in 1995 indicated that smallmouth bass are now well established in the Wyman impoundment (letter from CMP to the Commission dated April 5, 1996). The establishment of smallmouth bass and white perch could cause the coldwater fishery to be reduced by predation and competition (MSPO, 1993).

MDIFW manages the community downstream of Wyman dam for coldwater species, most notably rainbow trout, landlocked salmon, and brook trout. Each species makes up about a third of the sportfish catch in the Wyman tailwaters. Anglers report successful fishing from the retaining wall below the dam during the spring.

Rainbow trout is the priority species for management. Rainbow trout were first introduced to the Kennebec River above Solon in 1933, and they are now sustained by natural reproduction. Rainbow trout spawn in three tributaries between Bingham and Solon. Two tributaries, Austin Stream and Joe Foss Brook, drain into project waters downstream of the dam. The third tributary, Jackson Brook, joins the Kennebec less than 1 mile upstream of the head of the Williams impoundment. MDIFW biologists believe that most of the salmonid reproduction in this reach occurs in tributaries.

CMP characterized the amount of existing rainbow trout habitat seasonally available during an average, dry, and wet year using habitat time-series analysis of IFIM data. For this analysis, it assumed a minimum flow release of 490 cfs. Median flow duration values (exceeded 50 percent of the time) indicate central tendency, and 90 percent flow exceedance values represent extreme conditions of limited habitat. In Table 3-16, we present a summary of the results.

The relatively low habitat availability during the spring and during a wet year is caused by high flows that frequently exceed the hydraulic capacity of the Wyman Project. Flows in excess of the project hydraulic capacity must be spilled over the dam and are beyond CMP's control. Diminished suitable habitat is created by excessive water velocity.

Table 3-16. Summary of habitat time-series analysis with existing operations at the Wyman Project under median and extreme conditions for adult rainbow trout

| Year | Season | Percent Peak WUA - Median Conditions | Percent Peak WUA - Extreme Conditions |
|---|---|---|---|
| Average | Winter | 65 | 37 |
| | Spring | 36 | 29 |
| | Summer | 65 | 37 |
| | Fall | 66 | 36 |
| Dry | Winter | 91 | 40 |
| | Spring | 48 | 35 |
| | Summer | 83 | 37 |
| | Fall | 83 | 39 |
| Wet | Winter | 34 | 23 |
| | Spring | 22 | 21 |
| | Summer | 45 | 33 |
| | Fall | 55 | 26 |

Representatives of CMP and state and federal resource agencies provided a qualitative assessment of existing Wyman tailwater habitat during a review of this reach (CMP, AIR response, September 10, 1992). The objective of the review was to determine the most appropriate location for instream habitat enhancement devices.

MDIFW indicated that the river from Wyman dam to the Route 16 bridge probably is deep enough to provide cover for rainbow trout. It stated that placing additional structures in this reach, however, could interfere with navigation of the small motorized boats used to fish in the tailwaters (Figure 3-11). There are several large eddies along the side of the channel that presently serve as velocity refuges during high flows.

The main channel of the river from the bridge to the airfield runs on the east side of Whipple Island along Route 201. This reach, which is about 3 feet deep, is fast riffle and run habitat. The bottom is flat and contains very little cover. It used to be a side channel until the flood of 1987 redirected the main channel from the west to the east side of Whipple Island.

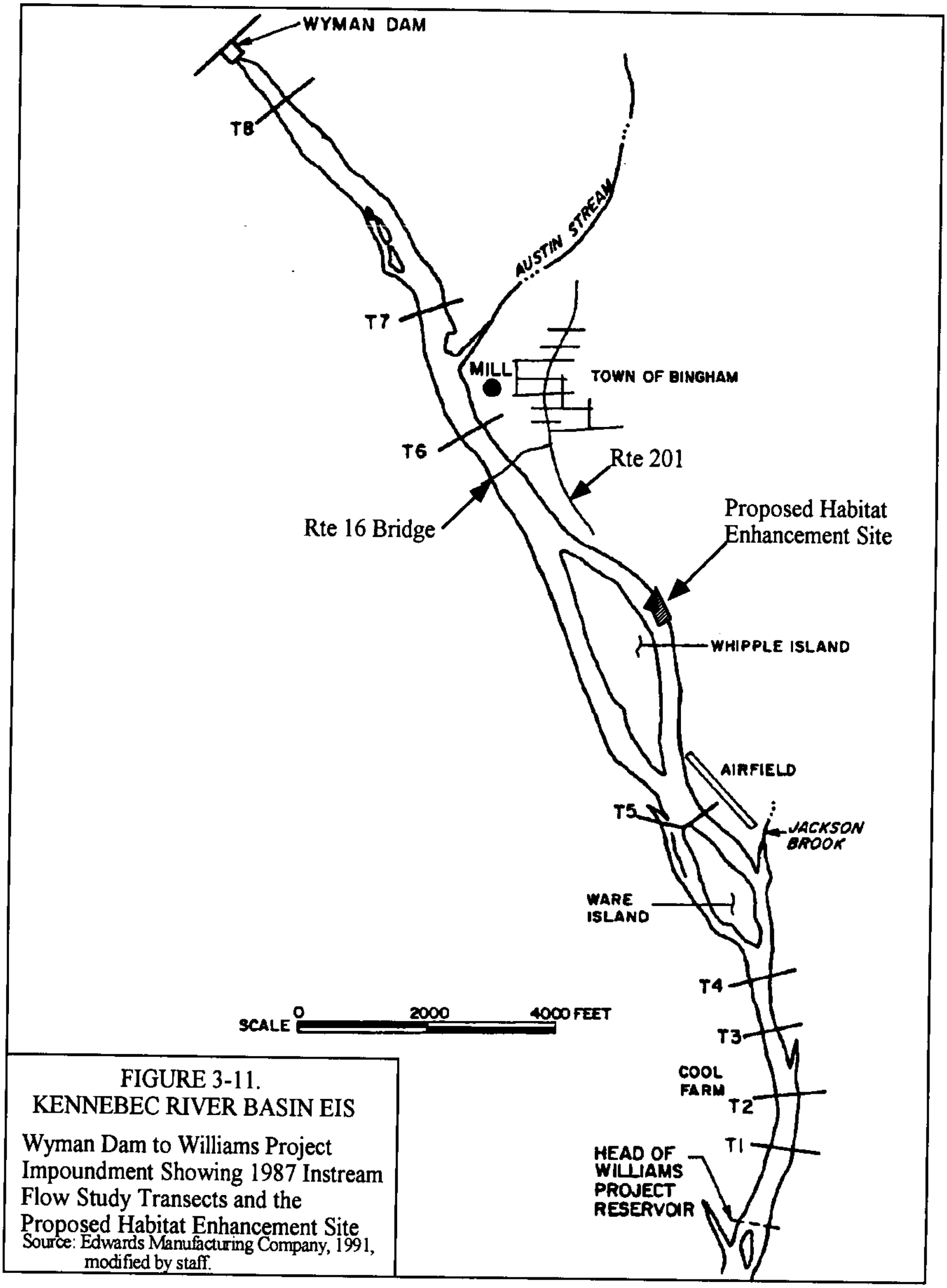


FIGURE 3-11.
KENNEBEC RIVER BASIN EIS

Wyman Dam to Williams Project Impoundment Showing 1987 Instream Flow Study Transects and the Proposed Habitat Enhancement Site

Source: Edwards Manufacturing Company, 1991, modified by staff.

From the airfield to the head of the Williams impoundment, the banks are very steep, and existing depth, velocity, and cover are generally good, according to the minutes of the site meeting (CMP, AIR response, September 10, 1992).

*3.3.3.4 Williams*

There are a variety of warmwater and coldwater resident fish in the Williams Project area (Table 3-7). Creel census data from anglers fishing in the Williams impoundment show that yellow perch and white suckers are the most commonly caught species. Chain pickerel are also caught in this area.

The upper reach of the Williams impoundment is a shallow to moderately deep river characterized by moderate current velocities. Constant releases at Williams dam provide current velocities throughout the impoundment that are greater than what is typically found in a true lentic (lake) environment, especially at the upstream end. Fallen trees, stumps, and sunken logs provide some instream cover. Instream cover, however, including aquatic vegetation, is scarce throughout the impoundment (TES, 1984).

CMP used the Habitat Evaluation Procedure (HEP) to assess the suitability of the Williams impoundment for yellow perch, smallmouth bass,[17] rainbow trout, and landlocked salmon (TES, 1984). The study concluded that there was little possibility that self-sustaining populations of these species exist in the Williams impoundment. Impoundment fluctuations dewater the few potential smallmouth bass spawning sites. Low winter temperatures and lack of aquatic vegetation throughout the study area limit the suitability of this area for yellow perch. Lack of instream cover makes even the riverine portions of the impoundment marginal for adult rainbow trout and landlocked salmon. CMP concluded that a large portion of the existing fish populations, particularly game fish, probably originate from the Wyman impoundment and enter the downstream Kennebec River through turbine passage and spillage.

We evaluated the impoundment in July 1994 and confirmed the lack of suitable fish habitat that TES reported (TES, 1984). Daily drawdowns have virtually eliminated emergent vegetation, and we observed little submergent vegetation (there was some *Elodea* sp. but not enough to offer much cover). Few juvenile fish were observed in the shallow water habitat along the shore during a time when we normally would expect minnows and young centrarchids (sunfish and black bass) to readily be observed.

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[17] This species has not been identified in the Williams impoundment. We expect, however, that it will eventually become established.

### 3.3.3.5 *Sandy River*

Game fish in the Sandy River Project area include smallmouth bass, brown trout, and brook trout. Landlocked Atlantic salmon and rainbow trout are also reported, but few are caught by anglers. Other fish species that contribute to the angler catch are chain pickerel, yellow perch, white perch, brown bullhead, American eel, and suckers. The same species are present above and below the dam. Historically, anadromous Atlantic salmon, American shad, and alewives were present in this part of the Sandy River. Smallmouth bass are the most abundant game fish in the impoundment, and they appear to be self-sustaining. A 1992 survey of the smallmouth bass population conducted by MDIFW indicated that few smallmouth bass near the dam are more than 12 inches long.

Upstream of the Sandy River impoundment, habitat is predominantly boulder-rubble riffles and shallow pools. There are extensive gravel riffle areas in the 3 miles immediately upstream of the impoundment. Brown trout are stocked to supplement natural reproduction between Strong and New Sharon (DeSandre, 1985), well upstream of the Sandy River Project. Brown trout of both wild and hatchery origin caught by anglers fishing in the Sandy River are an average of 12.3 inches long (MSPO, 1993); this is smaller than the mean length of 14 inches specified in the Sandy River Brown Trout Management Plan (DeSandre, 1985). Brook trout naturally reproduce upstream of Strong and in many of the Sandy River's tributaries (MSPO, 1993).

At the base of Sandy River dam, there is a narrow plunge pool separated from the tailwater by a ledge, boulder, and rubble peninsula (Figure 2-6). Due to its small size and other physical characteristics, this 100-foot-long pool offers little fisheries habitat.

The free-flowing river downstream of the project to its confluence with the Kennebec River is dominated by finer grained substrate than upstream, with almost no boulder riffles. The 1.5 miles of river downstream of the dam are characterized by deep riffles or runs not more than 2 feet deep with a rubble and gravel substrate. There are occasional shallow riffles with excellent gravel deposits that appear suitable for salmonid spawning. Closer to the Kennebec River, the Sandy River deepens with 200- to 400-foot-wide, 4- to 6-foot-deep runs. Substrate in this downstream reach is a mixture of rubble, gravel, and sand with some ledge outcrops.

The 2.5-mile-long, 150-acre impoundment is relatively shallow; the deepest point measured during an MEW bathymetric survey was about 12 feet. The substrate is predominantly sand, although cobbles and boulders are increasingly common towards the upper end of the impoundment. During our site visit (July 1994), we observed abundant emergent and submergent plant growth along the impoundment edges. This growth would provide ideal spawning and nursery habitat for centrarchids and forage fish. The maximum temperature measured in the impoundment during July and August was 73°F. Temperature should not prevent salmonid migration through the impoundment. Considerably warmer temperatures occur downstream of the Sandy River Project.

#### *3.3.3.6 Weston*

The Kennebec River in the Weston Project area supports both a coldwater and warmwater fishery that includes brown trout, brook trout, smallmouth bass, pickerel, and yellow perch. MDIFW manages the impoundment primarily for brown trout. Since 1987, MDIFW has annually stocked about 2,000 yearling brown trout in the impoundment at Oosoola Park. Additional brown trout may originate from wild and stocked fish in the Sandy River, which joins the Kennebec in the upper part of the Weston impoundment. Landlocked Atlantic salmon and rainbow trout may also reside in the impoundment, most likely coming from upstream areas. Most coldwater fish species between Madison and Skowhegan are caught in the 1.5 miles of flowing water immediately upstream of the head of the Weston impoundment (MSPO, 1993). In winter, there is an ice fishery for chain pickerel and salmonids on the impoundment. The focal point of the winter fishery is Weston Island in Skowhegan (MSPO, 1993).

This part of the Kennebec River historically supported anadromous Atlantic salmon, American shad, and alewives. State and federal resource agencies plan to restore these species to their historical range in the Kennebec River Basin.

The Weston impoundment is about 12 miles long with a surface area of about 930 acres and an average depth of about 20 feet. Habitat varies from the shallower, higher velocity water found in the upper third of the impoundment to the deeper, slower water of the lower impoundment. Substrate in the impoundment varies from sand and silt to gravel shoals and boulders. The physical characteristics of the upper third of the impoundment appear favorable for adult smallmouth bass and resident coldwater species.

Periodic warmwater temperatures throughout the impoundment during the summer, however, may be suboptimal for coldwater species. It exceeded 24C immediately upstream of the south dam and 23°C upstream of the Weston impoundment during CMP's early August sampling in 1988. Except for water depth and some fallen trees, cover in the lower two-thirds of the impoundment is minimal because the steep river banks rise almost immediately from the water surface. Aquatic vegetation at the mouths of several intermittent brooks (the only tributaries in the lower impoundment), would provide limited nursery habitat for resident warmwater species.

Below Weston dam, there is a 3,000-foot-long reach of free-flowing river before the backwater effects from the downstream Shawmut Project impoundment. Generally, the habitat consists of relatively high velocity riffles with small pools and ledge outcrops bordered by steep-sided gorge walls. Brown trout stocked in the Shawmut impoundment use this reach when the water temperatures are favorable. According to Scarola (1987), brown trout prefer temperatures that range from 18 to 24°C but seek the coldest water available during the summer. Resident smallmouth bass from the Shawmut impoundment and fish originating from above Weston dam, including landlocked salmon and rainbow trout, probably also use this reach.

*3.3.3.7 Fort Halifax*

The Fort Halifax impoundment supports primarily a warmwater fishery, and fishing for smallmouth bass and white perch is especially productive. Other game fish include chain pickerel, yellow perch, several species of sunfish, brown bullhead, and American eel. There also probably are largemouth bass. Brown trout may seasonally move to and from the impoundment from tributary streams or wash down from upstream areas of the Sebasticook River. Most angling occurs in the upstream portion of the impoundment near Pattee Pond (Figure 3-5). MDIFW passively manages the impoundment for indigenous resident species.

Ambient summer water temperature suggest that the impoundment is best suited for warmwater fish species. The mean water temperature during July and August in 1988 and 1989 was 23.5°C, and the maximum was 28.4°C. Such temperatures are at or above the thermal limits of most coldwater salmonids.

CMP conducted a reconnaissance-level survey, as requested by resource agencies, to assess the potential impact on fish resources from daily impoundment drawdowns of up to 2.5 feet. The survey focused on potential impacts on smallmouth bass, because this species uses shallow-water habitats for spawning and nursery functions. CMP found that, of the estimated 7.3 acres of littoral zone that were dewatered during the survey, about half of the exposed substrate consisted of gravel, cobbles, and boulders, the preferred substrate for smallmouth bass spawning and incubation. Two major areas of quality smallmouth bass spawning habitat were the lower reach of Outlet Stream (average depth of 6 to 10 feet) and the upper end of the impoundment immediately below Benton Falls dam. The banks of about 90 percent of the impoundment are relatively steep-sided (greater than a 30 degree slope), which substantially reduces the value of these areas for smallmouth nesting.

The Fort Halifax Project tailwaters extend about 1,400 feet to the confluence of the Sebasticook River with the Kennebec River. MDIFW manages this reach for a coldwater brown trout fishery. About 10,000 yearling brown trout are stocked in the Kennebec River from Augusta to Waterville. One stocking site is at the confluence of the Sebasticook and Kennebec Rivers. There are also smallmouth bass in the Fort Halifax tailwaters.

Most of the 1,400-foot tailwater reach (about 1,200 feet) is pool habitat backwatered by the Kennebec River, even at low Kennebec River flows and no discharge from the project. Substrate in this lower portion is predominantly gravel and cobble. The uppermost portion of this reach is influenced more by flow releases from the project, particularly during low flow periods in the Kennebec River. This 200-foot-long reach is normally riffle habitat (although at high flows, water is backed up to the base of Fort Halifax dam) with a predominantly bedrock substrate along with cobbles and small boulders. There is a profuse growth of aquatic vegetation attached to the coarse substrate in much of this riffle area (Acres, 1990; CRA, 1991).

Historically, American shad, alewives, and Atlantic salmon migrated through the Fort Halifax Project area. Adult alewives are presently stocked in seven lakes in the Sebasticook River subbasin (Section 3.1.4). CMP provided interim downstream fish passage for alewives at the Fort Halifax Project beginning in 1987. Permanent downstream fish passage facilities were installed in accordance with the KHDG agreement (Section 3.1.4) and have been operational since 1993. Out-migrating juveniles and some postspawning adult alewives pass through the project area from June through November. Based on studies conducted during 1995, CMP concluded that modifications to the downstream fishway (including 12-foot deep aluminum screens of 3/16-inch punched sheet) and plant operating modifications would ensure safe passage for virtually all down-migrant adult and juveniles passing the Fort Halifax Project. CMP considers it appropriate to curtail further downstream passage studies (ECS et al., 1996).

*3.3.3.8 Oakland* (including Messalonskee Lake)

Messalonskee Lake supports a high quality warm- and coldwater fishery. MDIFW estimates that the winter fishing effort in 1988 was 3,346 angler days, and that the summer fishing effort in 1989 was 7,845 angler days. The lake is 9.1 miles long, about 3,510 acres, and its maximum depth is 113 feet.

The warmwater fishery in Messalonskee Lake is dominated by smallmouth bass, white perch, yellow perch, and chain pickerel. Largemouth bass are relatively uncommon in the lake, but are more frequently caught in the primary inlet stream to the lake, Belgrade Stream. The Belgrade Stream channel is heavily vegetated with submergent and emergent aquatic plants and numerous shallow shoals and coves that are preferred spawning habitat for largemouth bass (NDT, 1990). In addition, northern pike were introduced to an upstream lake and spread downstream to Messalonskee Lake. Although pike are infrequently caught, the lake population probably will increase because the large marsh at the lake's southern end should provide good habitat for this species at all life stages.

The primary coldwater fishery of Messalonskee Lake is landlocked Atlantic salmon. Natural reproduction of salmonids is limited, and the fishery depends almost entirely on stocking. MDIFW annually stocks between 3,250 and 3,500 yearling salmon in the lake. Brook trout were stocked irregularly in recent years, and brown trout are occasionally caught, although none were recently stocked. Salmon and trout from Messalonskee Lake move in to and out of Belgrade Stream depending on water temperatures and seasonal conditions. The pool immediately below Wings Mills dam, which blocks further upstream movement of fish in Belgrade Stream, is a popular spring fishing location for salmon. During low flow, high temperature summer conditions, salmon and trout move downstream into Messalonskee Lake's cooler waters.

There are no agency plans to restore anadromous fish to Messalonskee Stream, and upstream passage of fish is not an issue at any of the Messalonskee projects. To prevent out-migration of stocked fish (mainly landlocked salmon and, to a lesser degree, brook trout), however, the Messalonskee Fish and Game Club (now inactive) installed a 3/4-inch clear spaced fish screen adjacent to Messalonskee Lake.

Releases from Messalonskee Lake dam are designed to provide generation flows to the four hydroelectric projects on Messalonskee Stream and are pulsed unless inflow to Messalonskee Lake is greater than 570 cfs. The free-flowing stream reaches below Messalonskee dam (about 1,900 feet long) and Oakland dam (about 1,600 feet long) are dominated by coarse substrate (cobbles, boulders, and bedrock) and high gradient cascades. The banks along most of the reach below Oakland dam are nearly vertical and inaccessible. MDIFW (personal communication, D. McNeish, October 12, 1989, prefiling consultation meeting) indicates that there are no coldwater fish management plans for the stream reach between Messalonskee Lake dam and Oakland dam and that this reach does not require study. The Cascade Woolen Mill weir (0.7-foot high) and the prevailing steep gradient block upstream movement of fish from the Rice Rips impoundment into the Oakland tailwaters.

The Oakland impoundment is the smallest of the four Messalonskee projects: it is 1,900 feet long and covers only 10 acres. Its maximum depth is 10 feet, and the substrate is predominantly cobble, gravel, and sand. There probably are smallmouth bass in this impoundment, although there are no fisheries data available. At the impoundment's upper end, there is a large, shallow gravel and cobble riffle where the stream enters the impoundment. This is a popular and productive area for crayfish collecting (NDT, 1990).

*3.3.3.9 Rice Rips*

The Rice Rips impoundment is about 1.6 miles long, and it covers an area of about 87 acres. Open water areas are generally 15 to 20 feet deep with several isolated areas that are up to 32 feet deep. The upper end of the impoundment narrows and becomes shallow just above the Oakland water treatment plant. Near the Cascade Woolen Mill, the habitat is more riverine (2 to 4 feet deep), and substrate is dominated by cobble and ledge.

The impoundment's east shore is relatively linear. The substrate in the nearshore area (less than 2 feet deep) is mostly cobbles. Further offshore, to a depth of at least 5 feet, there are numerous, dense beds of submerged aquatic vegetation.

The west shore of the impoundment is characterized by numerous deep embayments fed by small tributaries. The largest of these, Red Brook, enters the impoundment midway along the west shore. This brook supports a reproducing brook trout population. The substrate of the nearshore habitat is hard-packed, silty sand and clay with occasional patches of cobble and gravel. Emergent vegetation is abundant in the shallow water, and dense beds of submergent vegetation are prevalent in the deeper water, especially downstream of the water treatment plant outfall.

There is a healthy warmwater fishery in the impoundment. Common species include chain pickerel, yellow perch, white perch, and smallmouth bass (even though smallmouth bass spawning habitat is limited). Largemouth bass habitat is optimal and even though none were collected during MDIFW sampling, this species probably is in the impoundment.

The impoundment is the upstream limit of MDIFW's experimental brown trout fishery program, and it is stocked to support MDIFW management objectives. The impoundment thermally stratifies in the summer, but the deeper, cooler water is very low in DO during the summer and thus not suitable as a thermal refuge for brown trout. Both Red Brook and the well oxygenated water at the upstream end of the impoundment, however, may provide summer refugia for brown trout.

A key area of the experimental Messalonskee brown trout stocking program is the 2,400-foot-long Rice Rips bypassed reach. MDIFW began stocking this reach with brown trout in 1986 to establish a "put and take" fishery (i.e., it does not depend on natural reproduction), but if year-to-year survival and growth cannot be shown, this stocking program would be discontinued.

MDIFW considers it likely that there are brown trout in the bypassed reach from May to mid June and from mid September through October (although current regulations specify September 30 as the end of the fishing season). Low flow and high stream temperatures would cause trout to move downstream to the Automatic impoundment during the summer.

Presently, the bypassed reach receives flows of about 12 to 15 cfs during nongenerating periods. During generation, flows greater than the Rice Rips Project hydraulic capacity (630 cfs) are spilled into the bypassed reach. This reach has a relatively high gradient, dominated by shallow riffle habitat and substrate of cobble and small boulder. Five pools comprise about 23 percent of the total habitat of this reach.

MDIFW sampled the bypassed reach during the spring of 1988 and identified only American eels, blacknose dace, white suckers, and threespine sticklebacks. NDT (1990) reports that it observed juvenile smallmouth bass and pumpkinseeds and two dead brown trout in this reach during the summer. Both MDIFW and NDT observed very high numbers of crayfish.

*3.3.3.10 Automatic*

The 68-acre Automatic impoundment is about 4.5 miles long and relatively narrow (average width of about 160 feet) with typical depths of 5 to 10 feet. The substrate in the lower and middle impoundment is mostly silty sand with some clay, mud, and organic debris. The upper impoundment substrate is more a mixture of sand and gravel with a short (500-foot) cobble and boulder run at the upper end just below the Rice Rips powerhouse. This short reach has the best brown trout habitat in the impoundment (NDT, 1990).

The impoundment shoreline is vegetated with lush communities of emergent and submergent plants. Additional shoreline cover is provided by overhanging trees, logs, and branches, especially in the area that begins about 0.5 mile upstream of the dam, which is not heavily developed with commercial and residential structures. Several small streams enter the impoundment, the largest of which is Fish Brook. These small streams may offer some thermal refugia from high summer temperatures in the impoundment (25 to 27°C) that approach upper tolerance limits for brown trout.

Although the impoundment is targeted as an area for development of the experimental brown trout fishery, limited angler reports (covering 6 days in 1989) indicate that no brown trout were caught in the impoundment. The warmwater fish community in the impoundment, however, appears robust. There is ample spawning, nursery, and adult habitat for smallmouth bass, largemouth bass, chain pickerel, and panfish. Limited angler reports indicate that smallmouth bass, largemouth bass, chain pickerel, and yellow perch were caught. MDIFW collected primarily brown bullheads, yellow perch, and white suckers in trap nets with a few American eels and pumpkinseeds. MDIFW seine collections indicate that the impoundment supports exceptionally high densities of golden shiners and silvery minnows. Besides providing a good forage base for resident game fish, these minnows support a commercial bait fishery (NDT, 1990).

There is a 300-foot-long, deep pool immediately below the Automatic powerhouse. Downstream of this pool, there is a 200-foot-long riffle section that joins the Union Gas impoundment at an oxbow. The Automatic tailwaters offer good brown trout habitat, and one angler reported catching three brown trout in this reach on June 14, 1990 (NDT, 1990).

#### *3.3.3.11 Union Gas*

The Union Gas impoundment covers about 25 acres and extends about 1.5 miles upstream of the dam. The upper 3,000 feet of the impoundment form a large oxbow that is 3 to 8 feet deep with gravel and cobble substrate. Between the oxbow and the Silver Street bridge, the impoundment has a relatively straight channel that is 60 to 90 feet wide and 2 to 5 feet deep. Near the center of this reach, a ledge outcrop creates a shallow area (0.5 to 1.5 feet deep) that partially isolates the upper and lower impoundment. Downstream of the Silver Street bridge, the impoundment widens to 350 feet with a maximum depth of 22 feet. The predominant substrate in the lower impoundment is mud and silty sand.

Largemouth bass, smallmouth bass, chain pickerel, white perch, yellow perch, and brown bullhead probably are present in the impoundment because they are widely distributed upstream and downstream. There is, however, no direct information on the impoundment's warmwater fish community. Upstream of the Silver Street bridge, there is suitable habitat for all life stages of smallmouth bass. Downstream of the bridge, there is suitable adult smallmouth bass habitat. Yellow perch, white perch, and brown bullhead habitat is common throughout the impoundment. Largemouth bass and pickerel prefer shallows with aquatic vegetation, and there are only a few areas with these characteristics. These two species are not expected to be abundant in the impoundment (NDT, 1990).

MDIFW annually stocks the impoundment with yearling brown trout as part of its previously discussed experimental brown trout program. NDT did not observe any anglers on the impoundment on any of its visits to this site (NDT, 1990).

The Union Gas tailwaters extend about 5,000 feet to the confluence with the Kennebec River. The lowermost 3,000 feet is backwatered by the Kennebec River. This reach is generally 2- to

8-feet deep with predominant substrate of gravel, cobble, and silty sand. Above this, there is a 700-foot split channel around an island with shallow and swift moving riffles. The substrate is predominantly gravel and small cobbles. The uppermost 1,300 feet is free-flowing stream that is predominantly riffle and run habitat with two pools. The substrate in this reach is mostly cobble and shale fragments.

The primary MDIFW management goal for the Union Gas tailwater is to maximize fishing opportunity for brown trout from May 1 to June 15 and from mid September to the end of the fishing season (September 30). MDIFW presently manages a successful brown trout fishery in the main stem of the Kennebec River, and under favorable flow and temperature conditions, brown trout probably would move into the Union Gas tailwaters. Limited angler reports indicate that brown trout are caught below Union Gas dam in the spring. The brown trout fishery is maintained by stocking.

The tailwaters support smallmouth bass, and NDT observed large numbers of juveniles and adults in the pools and backwater reach during site visits (1990). Golden shiners, silvery minnows, and crayfish, which are ideal prey for smallmouth bass, were also often observed. A 1988 MDIFW fishery survey collected an adult sea lamprey below the dam, and NDT observed seven adults preparing spawning sites in the upper portion of this reach in 1990 during IFIM studies (NDT, 1990). This parasitic species is considered a nuisance fish.

Because of recent introductions of American shad in the main stem of the Kennebec River between Augusta and Waterville, young and adult shad could be present in portions of the Union Gas tailwaters. There also may be out-migrating juvenile alewives in the lower backwatered reach on occasion. Neither shad nor alewives, however, have been collected or observed in the tailwaters.

When the Union Gas Project stops generating, flow reductions caused by reducing the wicket gates from 70 percent open to totally closed cause an abrupt decline in water levels below the project. The most notable effect of this is evident immediately downstream of the dam where about 1/3 of an acre of stream channel are rapidly dewatered. During a downramping study, four stranded fish were observed in this area: a 4-inch-long golden shiner, a 6-inch-long white perch, and two smaller fish that could not be captured for positive identification. All but the golden shiner were stranded in isolated pools (NDT, 1991).

#### *3.3.3.12 Edwards*

Most existing aquatic habitat in the Edwards impoundment is lacustrine. There is a transitional zone between lacustrine and riverine habitat near the USGS gauging station (11 miles upstream of the dam) that ends at the foot of the rapids downstream of the confluence of Messalonskee Stream, about 15 miles upstream of the dam. Upstream of the influence of Edwards dam, there are about 2 miles of free-flowing river before Lockwood dam in Waterville again impounds the river.

Several wetlands and submerged aquatic vegetation along much of the shoreline offer spawning and nursery habitat for many fish in the impoundment. Species in the impoundment include resident sportfish such as brown trout, smallmouth bass, largemouth bass, chain pickerel, yellow perch, white perch, several species of sunfish, and brown bullhead. Resident forage fish include white sucker, banded killifish, spottail shiner, and blacknose dace. Anadromous sea lampreys, considered a nuisance species, and catadromous American eels also exist in the impoundment. There is a seasonal commercial eel fishery in the impoundment and downstream of the dam. Our observations show that eel pots are used in this fishery. SWETS (1995a,b) contain detailed descriptions of existing habitat in the Edwards impoundment.

NDT (1992) characterized existing habitat downstream of Edwards dam (Figure 3-12). The downstream reach is tidally influenced, especially during low flow (less than 4,000 cfs). During low flows, the range of water surface varied by 1.3 feet within 265 feet of the dam, but increased to 4.8 feet near the Father Curran bridge. Tidal fluctuations are less at moderate and higher flows. The pool at the base of the dam is about 30 feet deep downstream of the angle on the west portion of the dam and 20 feet deep upstream of a small island near the eastern shore (NDT, 1992). There is little current in this pool during periods of little or no spillage at the dam. Downstream of this pool, the water is relatively shallow (typically about 5 feet deep) until near the Father Curran bridge, where a more uniform, bowl-shaped, 10- to 12-foot-deep channel forms.

Although the tidal project tailwaters are freshwater, there are some resident and anadromous fish species that use low salinity or freshwater portions of estuaries below Edwards dam (Table 3-7). The predominant resident game fish in the tailwaters are brown trout and smallmouth bass. Brown trout up to 6 pounds or more are reported by anglers fishing in the tailwaters. These fish may originate upstream of the dam. Although the migratory patterns of brown trout below the dam are unknown, there may be some sea-run brown trout. MDIFW plans to establish an estuarine brown trout management plan for the tidal Kennebec River from the "Chops" to Edwards dam, but several issues must be resolved first (McNeish, 1985). There is suitable habitat for all life stages of smallmouth bass downstream of the dam, and anglers report periodic catches of adult smallmouth bass in the tailwaters.

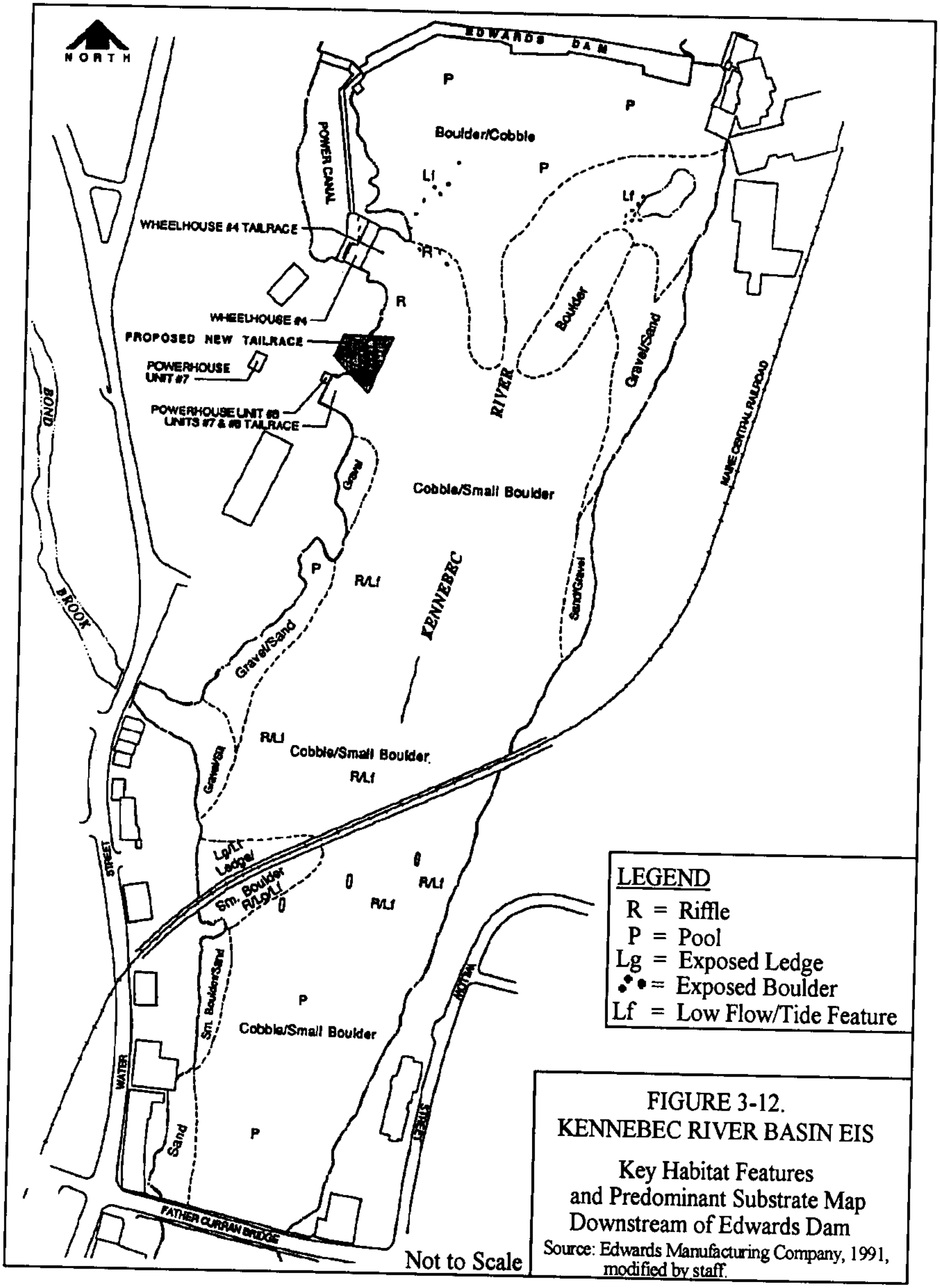



FIGURE 3-12.
KENNEBEC RIVER BASIN EIS

Key Habitat Features
and Predominant Substrate Map
Downstream of Edwards Dam

Source: Edwards Manufacturing Company, 1991, modified by staff.

Other resident game fish in the tailwaters include Atlantic salmon, brook trout, chain pickerel, yellow perch, white perch, and several species of sunfish. Resident forage species include white sucker, fallfish, creek chub, and several stickleback and minnow species. There are common carp, a nuisance species, in the tailwaters, and MDIFW and others are concerned about preventing this species from moving upstream of the dam.

We discuss the existing environment in terms of anadromous alewife, American shad, and Atlantic salmon restoration efforts in Section 3.1.4 because multiple projects influence use of available habitat. Restoration of anadromous populations of Atlantic sturgeon, shortnose sturgeon, rainbow smelt, and striped bass, however, relate specifically to proposed actions at Edwards dam. In the following section, we discuss existing habitat for these species above and below the dam and habitat usage below the dam. SWETS (1995a, b) provide additional information on these species.

*Atlantic Sturgeon*

There are considerably fewer Atlantic sturgeon in the lower Kennebec River than shortnose sturgeon. Between 1979 and 1981, MDMR collected 49 Atlantic sturgeon compared to 668 shortnose sturgeon. MDMR captured most Atlantic sturgeon in Merrymeeting Bay or further downriver in saline waters (Squiers and Smith, 1979). The ratio of juvenile Atlantic sturgeon to adult shortnose sturgeon in two other estuaries with significant populations of both species, the Saint John and Hudson Rivers, is 10 Atlantic sturgeon to 1 shortnose sturgeon; in the Kennebec estuarial complex, this ratio is 1 Atlantic sturgeon to 22 shortnose sturgeon (letter from E. Richert, Director, MSPO, June 2, 1995). Historical records indicate that the major spawning area for Atlantic sturgeon in the Kennebec River was between Augusta and Waterville (Squires, 1988).

Until recently, South Gardiner was the farthest upriver point at which Atlantic sturgeon were collected. One of two adults that MDMR collected in July 1980 was extruding milt, which suggests that there may be some spawning near the project tailwaters. In addition to the MDMR collections, 31 adult Atlantic sturgeon were collected between mid June and the end of July 1980 in a commercial fishery in South Gardiner. Many adults collected in July were ripe. On June 2, 1995 (letter from E. Richert, Director, MSPO, June 2, 1995), FERC was informed that, in 1994, MDMR collected seven adult sturgeon just below Edwards dam. Five of the seven were ripe males, confirming that the project tailwaters are most likely now used for Atlantic sturgeon spawning. After July, when most spawning occurs, young Atlantic sturgeon and postspawned adults probably move downstream and out of the influence of the Edwards Project.

SWETS (1995) evaluated Atlantic sturgeon habitat in the impoundment and indicated that some spawning and incubation habitat exists upstream of the dam (SWETS, 1995a). However, Dadswell (1996) states that Atlantic sturgeon would not spawn in the impoundment and the value of the 2 miles of lotic habitat upstream of the impoundment is unknown. Additionally, Dadswell (1996) states that low flows through the impoundment could delay downstream movements of larval Atlantic sturgeon and a lack of preferred food items in the impoundment could reduce juvenile Atlantic sturgeon survival. Currently, there is no upstream passage provided for Atlantic sturgeon at Edwards dam. Because Atlantic sturgeon cannot access areas upstream of Edwards dam the impoundment habitat use by this species has not been studied and the value of this habitat is unknown.

*Shortnose Sturgeon*

The tidal reaches of the Kennebec River are significant habitat for the endangered shortnose sturgeon. MDMR estimates that the Kennebec River population was about 7,000 fish based on tagging studies from 1977 to 1981 (Squiers et al., 1982). Shortnose sturgeon spawning sites on the tidal portion of the Androscoggin River, which like the Kennebec flows into Merrymeeting Bay, are characterized by gravel, rubble, and large boulder substrate next to deep, turbulent areas (Squiers, 1988).

No mention of the shortnose sturgeon is made in the historical accounts of the Kennebec River sturgeon fishery, but it was probably present and went unidentified because of the difficulty in distinguishing shortnose sturgeon from young Atlantic sturgeon (KRC, undated).

MDMR conducted an intensive effort in the late 1970's to determine the distribution and abundance of shortnose and Atlantic sturgeon in the Kennebec River estuary. The location farthest upriver where shortnose sturgeon were collected was Gardiner, about 7 miles downstream of Augusta (Squiers and Smith, 1979). The relatively large number collected (33 in July and 3 in August 1977) suggests that shortnose sturgeon concentrate in the waters downstream of Edwards dam. There is reason to believe that they are at least occasionally found in the project tailwaters. The deep hole below the dam on the west side of the channel seems like an appropriate spawning site during periods of substantial spillage at the dam.

MDMR indicates that, although sampling for sturgeon was not conducted upstream of Gardiner because river conditions were unsuitable for setting gill nets, shortnose sturgeon may migrate and potentially spawn in the project area (letter dated August 29, 1991). During 1995, MDMR biologists observed small sturgeon about 3 feet long in the tailrace of wheelhouse number 4 near Edwards dam from May 10 through 12. River flows were very low in early May, and the small sturgeon observed in the tailrace were probably shortnose sturgeon that may have spawned below the spillway under higher flow conditions (MSPO, 1995).

SWETS (1995) evaluated shortnose sturgeon habitat in the impoundment and indicated that spawning, incubation, and adult habitat are abundant upstream of Edwards dam but that there is relatively little larval and juvenile shortnose sturgeon habitat in the impoundment. Dadswell (1996) states that there is little shortnose sturgeon spawning habitat in the impoundment and only the 2 miles of lotic habitat upstream of the impoundment may be viable for spawning. Dadswell (1996) also states that the impoundment would be poor egg and larval habitat and these life stages would be confined to the 2 miles of lotic habitat upstream of the impoundment which would allow predators to locate and concentrate on deposited eggs and larvae. MDMR states that it is unlikely that juvenile and nonspawning adults would use the habitat upstream of Edwards dam to any great extent (MSPO, 1995). Currently, there is no upstream passage provided for shortnose sturgeon at Edwards dam. Because shortnose sturgeon cannot access areas upstream of Edwards dam, the impoundment habitat use by this species has not been studied and the value of this habitat is unknown.

We present life history and habitat of shortnose sturgeon in the Kennebec River more thoroughly in Appendix C to this EIS.

*Rainbow Smelt*

Anadromous rainbow smelt spend the summer in the saline nearshore water of bays and estuaries but move into freshwater during winter months. The lower Kennebec River supports the largest winter recreational smelt fishery in Maine. Smelt fishing focuses near Hallowell and Gardiner, within 7 miles of Augusta. MDMR estimates that the population size below Edwards dam is between 6 to 90 million (Squiers, 1988). MDMR considers it likely that there are smelt in the Edwards tailwaters (letters dated August 29, 1991). Spawning occurs during spring high-flow periods. When flows increase, smelt congregate near tributaries and other suitable spawning sites. Spawning occurs primarily at night (McKenzie, 1964). Smelt cannot negotiate a vertical drop of more than 6 to 8 inches (McKenzie, 1964), therefore, historically, smelt probably only ascended the Kennebec River as far as Waterville to Ticonic Falls (Squiers, 1988).

SWETS (1995a) indicates that much of the impoundment is suitable habitat for all life stages of rainbow smelt and that smelt spawning habitat is abundant in the upstream portions of the reservoir. MDMR states that is highly unlikely that smelt would use the deeper waters of the impoundment for spawning (MSPO, 1995). Dadswell (1996) indicates that the only sites where smelt spawning would occur upstream of Edwards dam would be in the 2 miles of lotic habitat upstream of the impoundment and any of the accessible tributaries to the impoundment. SWETS (1995a) concluded that the tributaries to the impoundment would have little value because there is little spawning habitat available and the tributaries have high gradients and are inaccessible to smelt. Currently, there is no upstream passage provided for rainbow smelt at Edwards dam. Because rainbow smelt cannot access areas upstream of Edwards dam, the impoundment habitat use by this species has not been studied and the value of this habitat is unknown.

*Striped Bass*

Historically, striped bass ascended the Kennebec River as far as Waterville and the Sebasticook River a short distance above its mouth (Squiers, 1988). Currently there is a significant recreational fishery for striped bass along the coast of Maine, including in many estuaries. Most striped bass caught in Maine originate in either the Hudson River or the Chesapeake Bay (Flagg and Squiers, 1992). In 1982, MDMR began a program to restore striped bass of Maine origin by stocking juvenile striped bass in the lower Kennebec River. Between 1982 and 1991, more than 260,000 juvenile striped bass were stocked. Small numbers of juvenile striped bass (1 to 26) were collected since 1987 in the lower Kennebec River before the annual late summer stocking of hatchery fish, indicating at least limited striped bass spawning in the estuary (Flagg and Squiers, 1992).

A relatively recent press account reports that, in November 1993, a local smelt fisherman netted 398 juvenile striped bass in the lower portion of the Kennebec River near Bath, Maine (Canfield, 1993). This strongly suggests recent improvements in local spawning success, because MDMR has not stocked juvenile striped bass since 1991 (MSPO, 1995). MDMR collected 268 wild young-of-the-year striped bass during 1994, mostly downriver of Bath (MSPO, 1995), suggesting that at least some local production is continuing. Limited ichthyoplankton sampling by MDMR resulted in the collection of only three larval striped bass (comments from L. Flagg, MDMR, July 14, 1994, scoping meeting [p. 61 of transcript]), which indicates that the location of spawning in the lower Kennebec River is unknown.

The dominant nutrient pathway in the lower Kennebec River is most likely from the extensive marsh systems, especially those in the Merrymeeting Bay region. The food web is therefore probably mainly based on organic detritus from the nonpersistent emergent vegetation from the fresh- and saltwater marshes. The estuarine complex is an important nursery area for the anadromous fish species produced in the riverine sections of the Kennebec and Androscoggin Rivers (Squiers, 1986). Merrymeeting Bay is the most likely nursery habitat for young striped bass. Larval striped bass consume zooplankton, which should be much more abundant in Merrymeeting Bay than in the riverine habitat downstream of the dam or in the impoundment.

MDMR staff noted adult striped bass in the Edwards tailwaters from May to September. MDMR considers it the predominant anadromous game fish in project waters (letter dated August 29, 1991). Stone & Webster staff observed schools of large striped bass (according to anglers, some exceeded 30 inches) in project tailwaters during September 1994 field studies supporting dam removal studies (SWETS, 1995). They appeared to be feeding on large schools of out-migrating juvenile alewives.

SWETS (1995) and Dadswell (1996) indicated that only the 2 miles of lotic habitat upstream of the impoundment would provide potentially viable striped bass spawning habitat upstream of Edwards dam. Additionally, they suggested that velocities through the reservoir would be too low to keep the semibuoyant eggs suspended and that egg mortality from settling on the bottom would be high. Dadswell (1996) suggests that some overwintering habitat may occur in the impoundment. Currently, there is no upstream passage provided for striped bass at Edwards dam. Because striped bass cannot access areas upstream of Edwards dam, the impoundment habitat use by this species has not been studied and the value of this habitat is unknown.

### 3.3.4 Terrestrial Resources

In this section, we present information on terrestrial resources by specific projects, except for threatened and endangered species. Because project reviews by federal and state natural resource agencies and the applicants' specific studies were similar for most projects, we consolidate our discussion of threatened and endangered species and present it first.

*Threatened and Endangered Species*

At all projects, no federally listed plant, invertebrate, reptile/amphibian, or mammal species or their habitats were identified within project boundaries or within areas that would be influenced by proposed project operations. At all projects, transient bald eagles (federally and state listed) were identified, while only Moosehead had nesting pairs within the project vicinity (at the head of Indian Pond and Spencer Pond). Additionally, a peregrine falcon (federally and state listed) nesting location is present on the cliffs of Mount Kineo Island in Moosehead Lake.

At Moosehead Lake, two state-listed plant species, *Agrostis mertensii* and *Draba arabisans* were observed (at previously documented locations) on a slope well above the water level where they are unaffected by existing and proposed water level fluctuations.

Several state-listed rare plant species (*Woodsia alpina*, *W. glabella*, and *Erigeron hyssopifolius*) are known to occur along the rock faces of Moxie Falls, but these areas are not likely to be influenced by project operations. No other state or federally listed plants are known to exist or were observed in the project area.

MNHP's (1986) rare biotic element surveys identified an extensive population of the rare Long-leaved Bluet in flood-washed gravel about 1/8 mile below Wyman dam. This is perhaps the largest population of this species in the state, and it is apparently thriving. The peaking flows that result from generation may be responsible for the health of this community because it would create conditions that would be similar to (but at much greater frequency) more natural, periodic flood flows. Resource agencies have not requested protection or enhancement of this habitat because, although the species is rare, it is not state-listed as threatened or endangered, and it is healthy at this location.

MEW's consultant, Kleinschmidt Associates (KA) performed specific studies to document the occurrence of wood (state species of special concern) and spotted (state listed as threatened) turtles within the Sandy River Project area. No wood or spotted turtles were identified. Although MNHP identified six rare plant species in the region surrounding the Sandy River Project, KA did not identify any during its surveys.

MNHP identified three Critical Areas at the Weston Project (April 30, 1990). Area No. 49 provides habitat for Canada buffaloberry and long-leaved bluet; Area No. 56 for Ram's head lady slipper and spotted wintergreen; and Area No. 393 for snowy orchid. MNHP staff surveys indicated, however, that these areas are not affected by existing project operations.

At Messalonskee Lake, black tern nest in the large southern wetland, and although the species is not threatened or endangered, MDIFW considers this a species of special concern. This wetland is a state-listed critical area. It provides habitat for the largest nesting colony in the state.

*3.3.4.1 Moosehead*

*Vegetation*

Vegetative cover within and surrounding the project area is predominantly forestland. Somerset and Piscataquis Counties, in which the lake is located, are 91 and 83 percent forestland, respectively. Compared to the rest of Maine, these two counties have a higher proportion of spruce/fir forests and proportionally lower cover of white/red pine and aspen/birch forests. KWP indicates that the shoreline vegetation of Moosehead Lake is about 6 percent hardwoods, 27 percent softwoods, 35 percent mixed woods, 12 percent residential uses, and 20 percent other.

Hardwood communities are dominated by sugar maple, beech, and yellow birch with associated species including red maple, white ash, black cherry, basswood, black birch, northern red oak, elm, hophornbeam, hemlock, white pine, balsam fir, and spruce. Shrub species frequently occurring in hardwood forests are striped maple, vibernums, pin cherry, and beaked hazelnut. Groundcover species include Canada mayflower, starflower, sarsaparilla, wood sorrel, spinulose woodferns, and veronica.

The spruce/fir forest is composed primarily of red spruce and balsam fir. Common associates include white and black spruce, hemlock, white pine, northern white cedar, and birch. Although they are less common in softwood forests, shrub species include saplings of overstory species and highbush blueberry with raspberry wherever there are openings in the canopy. Herbaceous species include bunchberry, goldthread, and Canada mayflower.

KWP identified 13 cover types within the 500-foot-wide study area around the perimeter of the lake. Roughly 91 percent of the areal coverage is provided by 9 upland cover types, and 4 wetland cover types make up the remaining 9 percent. Upland cover types include: softwood, hardwood, and mixed forest (plus three more for cut areas of these forests), shrubland, old field, and residential. Residential areas are most common in the towns of Greenville and Rockwood and along the southwest shoreline, although there are small clusters and isolated seasonal camps around most of the lake.

Although agriculture is essentially nonexistent around Moosehead Lake, silviculture is active and timber harvesting has occurred in the past and will continue in the future. Harvesting has occurred up to the shores of the lake, and most stands of trees along the shoreline are second or third growth. Current MLURC zoning regulations require maintenance of a 250-foot buffer that has restrictions on the type and nature of timber harvesting and other development around the shores of water bodies more than 10 acres in size.

In response to our additional information request, KWP performed additional wetland studies, which resulted in the identification of, in addition to the four wetland types identified in the license application, a fifth wetland type, open water. This additional effort refined the wetland acreage estimate, identifying 365 mapped wetland areas totalling 1,641 acres of wetlands (an increase from the 1,307 acres listed in the license application) located within a 500-foot band of the shoreline. The five wetland cover types include 13 open water (17 acres), 48 emergent (110 acres), 222 shrub-scrub (900 acres), 81 forested bogs (613 acres), and 1 hardwood swamp (1 acre) wetlands. In addition, aquatic bed and drawdown zones are identified as wetland types and briefly discussed but are not mapped "because they represent little or no cover in the project area" (Eco-Analysts, 1993). However, Eco-Analysts estimated that at the annual average drawdown of 2.9 feet, 1,000 acres are in the drawdown zone.

The sparse vegetation that occurs in the drawdown zone includes arrowhead, water lobelia, white button, quillwort, creeping spike rush, bladderwort, and possibly bog rush. Aquatic bed species, typically found in the littoral zone at the mouths of tributary streams include *Elodea*, bur-reed, spatterdock, and bladderwort.

Open water wetlands, which are located behind gravel or cobble berms that hold back water even during drawdown conditions, are the second smallest component of the Moosehead wetland system. Sweet gale and leather leaf are common atop old tree stumps.

Emergent wetlands are a relatively minor component of Moosehead wetlands, although their high plant species diversity makes them ecologically significant. There are two subgroups of emergent wetland, depending on the degree of inundation under full pond conditions. Plant species inundated at full pond include three-way-sedge, spikerush, mannagrass, woolgrass, softrush, blueflag, and sedges. Some of these species and marsh cinquefoil, swamp candles, bluejoint, meadowsweet, horsetail, bog aster, bugleweed, and cotton grass occur in saturated but not inundated emergent wetlands.

Scrub-shrub wetlands, which also consist of two subgroups, are the most abundant wetland type at Moosehead. Scrub-shrub wetlands dominated by deciduous species are commonly associated with streams. Vegetation includes speckled alder; northern winterberry; mountain holly; red maple; grey birch; silky dogwood; sensitive, interrupted, and cinnamon ferns; tall meadow rue; and bluejoint. Scrub-shrub wetlands dominated by ericaceous plants are most often associated with large wetland systems. Dominant woody species include leatherleaf, sweetgale, northern white cedar, and black spruce. Sheep laurel, rhodora, pale laurel, Labrador tea, marsh St. Johnswort, marsh cinquefoil, and swamp candles are also found in this habitat.

Forested bogs are the second most abundant wetland type at Moosehead and are typically found landward of scrub-shrub and emergent wetlands, often extending for some distance beyond the study area boundary. Species diversity is low, with northern white cedar and black spruce dominant and black/red spruce hybrids and balsam fir also present. The sparse groundcover layer consists of sphagnum moss, creeping snowberry, twinflower, goldthread, wood sorrel, and bunchberry along with seedlings of overstory species.

There is only one small hardwood forest wetland within the project study area. It consists of red maple with lower abundances of northern white cedar, yellow birch, green ash, and balsam fir. The shrub layer also contains speckled alder, wild raisin, meadowsweet, and mountain holly. Abundant groundcover includes sphagnum moss and sensitive fern.

*Wildlife*

KWP identified 12 major vegetation community types in the project area that support an abundance of wildlife. There is a large degree of overlap for many wildlife species potentially found in these vegetation community types. Species such as white-tailed deer, black bear, ruffed grouse, snowshoe hare, red fox, raccoon, striped skunk, fisher, and moose can occur in a variety of habitats, depending on the particular activity being pursued. Many bird species, such as hairy woodpeckers, chickadees, yellow-rumped warblers, and ruffed grouse, also forage across several vegetation community types. Typically, amphibians and reptiles have more specific and thus restricted habitat requirements. There are also many animal species that have a preferred habitat and are seldom found outside of that habitat. Typical limited ranging species include pine warblers, many waterfowl, swamp sparrow, black-backed woodpecker, beaver, snapping turtle, and water shrew.

KWP's consultant, NAI, surveyed the project area in August 1989, and observed more than 34 wildlife species, including 6 mammal species, 2 amphibians, and 26 birds. At least seven of these species were found in three or more cover types (vegetation communities) and 22 in two or more.

Due to concerns about negative impacts of impoundment fluctuations and other operational features raised by MDIFW (letter dated August 19, 1991) and FWS (letter dated August 13, 1991), KWP contracted with NAI to perform additional studies of potential project operation impacts on fish and wildlife habitats. Study results were submitted as Appendix E-V of the license application. The NAI report identified 242 wildlife species potentially occurring in the project area, including 26 herpetofauna, 176 birds, and 40 mammals.

KWP conducted a study of loon nesting success to assess if project operations are having an adverse impact on loons. Study results reported in 1991 indicated that, of the six nesting pairs, one pair was successful, one pair was unsuccessful because of a water level decrease, and the other three losses were probably due to predatory or human disturbances.

### *3.3.4.2 Moxie*

*Vegetation*

The Moxie Project is within a region with two general forest types: northern hardwood and spruce-fir (Section 3.1.5). Timber harvesting, past and present, has a major influence on the composition and development of cover types within the project area. Selective cutting releases shade-intolerant species and can improve growth of preferred tree species, ultimately altering the species composition. The Owners' consultant, NAI, performed reconnaissance surveys and identified 10 vegetated cover types within a 250-foot-wide zone around Moxie Pond and along the length of Moxie Stream.

Of the cover types assessed, 1,246 acres are upland habitat and 103 acres are wetlands around Moxie Pond. There are an additional 254 upland acres and 181 wetland acres along Moxie Stream downstream of the dam. Six cover types are considered upland (softwood forest, hardwood forest, mixed forest, recently cut forest, and shrubland/old field, and residential area) and four are wetland (softwood forest, shrub, emergent, and aquatic vegetation).

Typical hardwood canopy species around Moxie include beech, sugar maple, yellow and paper birch, bigtooth aspen, and red maple. Softwood species include balsam fir, red spruce, northern white cedar, white pine, and tamarack. Understory species typical of dryer areas include striped maple, viburnums, mountain holly, raspberry and pin cherry, and under wetter conditions red-osier dogwood, beaked hazelnut, speckled alder, leatherleaf, and sweet gale are common. A similar moisture gradient for groundcover species results in bellwort, starflower, sarsaparilla, bracken fern, hay-scented fern, spinulose shieldferns, Prince's pine, and wintergreen in dryer sites and bluejoint grass, cinnamon, interrupted and sensitive ferns, sphagnum moss, three-way sedge, rattlesnake grass, and woolgrass in wetter sites.

The 103 wetland acres around Moxie Pond include 70 acres of softwood-forested, 20 acres of scrub-shrub, and 13 acres of emergent wetlands. There also are 59 softwood forested acres, 115 scrub-shrub acres, and 7 emergent acres of wetlands associated with Moxie Stream. An assessment of the area of the impoundment bottom exposed during a 6-foot drawdown revealed that 418 acres (19 percent) of the 2,230-acre pond are exposed. Extrapolation of shoreline conditions to encompass an 8-foot drawdown revealed that about 553 acres (25 percent) of the impoundment is exposed at this level of drawdown.

*Wildlife*

Wildlife species observed by the Owners' biologists during field work in June to August 1990 include 2 species of amphibians and reptiles, 56 bird species, and 6 species of mammals, for a total of 64 species. The biologists observed 29 of these species in both Moxie Pond and Moxie Stream habitats, 21 species only in Moxie Pond, and 11 species only along Moxie Stream.

Because of concerns about impoundment fluctuations, increased recreation, minimum flows, and other aspects of project operations, raised by MDIFW (letter dated April 8, 1986) and FWS (letter dated May 9, 1986), the Owners contracted with NAI to perform additional studies of potential project operation impacts on fish and wildlife habitat. Study results were submitted as Appendix E-IV of the license application. NAI identified 26 amphibian and reptile species, 167 bird species, and 52 mammal species as potentially using the Moxie Project area.

The NAI report indicates that the relatively stable summer pond level minimizes impacts on wildlife habitats during the growing season and protects nesting waterfowl. Potential impacts from the 8-foot drawdown on furbearers and other wildlife, however, were acknowledged. Types of drawdown impacts include changes to water-cover ratios, interspersion, water depth, amount and type of vegetation, sediment depth of freezing, ice-scoured sediment removal/resuspension, and distances to other habitats. In addition, winter drawdowns affect furbearers by restricting access to food resources, increasing exposure to predation and adverse weather for longer periods while travelling greater distances for forage. All of these affect habitat suitability and can reduce or alter wildlife use, which ultimately may lower survival rates or reduce reproduction, causing population declines.

There is a range in habitat use by different animals (Section 3.3.4.1), and some wildlife are found in a variety of habitats while others remain in a preferred habitat. In Section 3.3.4.1, we present species that would be typical in the project area.

There is a great blue heron rookery, a fairly uncommon occurrence, about 1.5 miles east of Moxie Pond near Alder Stream (Figure 3-19). Adults that nest at this site may forage around the shores of Moxie Pond, as would juveniles later in the summer and fall.

A MDIFW-mapped deer wintering area, which is considered critical wildlife habitat, is also within the project area along Alder Stream. We do not expect project operations to influence this habitat. There are no other state-listed critical habitats or rare biotic elements in the project area.

### *3.3.4.3 Wyman*

*Vegetation*

The land around the Wyman Project impoundment and in the tailrace is almost entirely forested, with a mixture of hardwood, softwood, and mixed forest. The cover type is generally northern hardwood-spruce forest. Typical canopy species include beech, aspen, birch, oak, cherry, spruce, fir, pine, and hemlock. Red maple, silver maple, and green ash also are found closer to the water. Alders, sweet gale, ferns, asters, goldenrods, sedges, and grasses are common midstory and groundcover species.

Wetlands are limited because of the steep-sided shoreline and predominantly rock, cobble, and gravel substrates. There are only 5 wetlands that are 1 acre or greater in size, which total about 12 acres altogether. Four wetlands are at the upstream end of the impoundment, and the fifth is at the mouth of Whitcomb Brook Cove, 1.7 miles upstream of the dam. These wetlands tend to have sedges and grasses near the water's edge and transition to shrub (alder) wetlands further from the water, which are then abutted by upland forested areas.

Most of the 2-foot drawdown zone is unvegetated except in some shallow mud-bottom coves, which are mostly at the upstream end of the impoundment. Submerged vegetation includes *Potomageton*, *Valisneria*, and *Elodea*. The greatest density of submerged vegetation occurs in the 5-acre wetland at the outlet of Pleasant Pond Stream. The 2-foot drawdown exposes an estimated 1 to 2 acres of mud flats in shallow water coves.

There are several small floodplain forests below the dam that are dominated by silver maple and ash with ferns and sedges dominant as groundcover. Much of the tailwater shoreline is dominated by alder and shrub thickets.

*Wildlife*

Given the predominantly upland forested habitat around the impoundment, wildlife populations are primarily upland species, including white-tailed deer, moose, bear, fox, raccoon, porcupine, mink, and a variety of raptors and songbirds. CMP identified 28 amphibian and reptile species, 49 bird species, and 41 mammal species as potentially occurring in the project area.

The Kennebec River watershed is within the North Atlantic flyway, and it supports a variety of transient waterfowl and shorebird species. Nesting, however, is limited. Bald eagles are regularly observed in the area but there are no known nesting sites. There is a historic nesting site for peregrine falcons on Henhawk Ledge, about 0.2 mile from the western shore of the Wyman impoundment. No recent nesting activity has been observed.

MDIFW indicated (letter dated August 28, 1990) that there are several historic deer wintering areas on tributaries to the Wyman impoundment, but none are adjacent to the impoundment. There would not, therefore, be any potential impacts on these areas from project operations.

In response to MDIFW (letter dated April 9, 1986) and FWS (letter dated May 9, 1986) concerns over potential project impacts on nesting waterfowl and loons, CMP assessed potential impacts and evaluated management options. Study results indicate that, largely because of lack of suitable nesting habitat, project operation impacts on waterfowl and wildlife are negligible except for possible reduction of loon nesting success (only 1 pair out of 10 successfully nested in 1987). As a result, CMP developed a Loon Management Plan (Section 4.1.4).

#### *3.3.4.4 Williams*

*Vegetation*

Vegetation in the Williams Project vicinity is generally characterized as northern hardwoods-spruce forest. Compared with the more northern projects, there is greater interspersion of other cover types. On the west side of the 4-mile-long impoundment, the shoreline is steeply sloping and forested with little development. There is one low-lying scrub-shrub and emergent wetland area along the west shore about 2 miles upstream of the dam.

The east shore is more heterogeneous, with an abandoned railroad bed immediately abutting much of the eastern shoreline, vegetated primarily with grasses, shrubs, and weed species. There is an open water/emergent wetland just east of the railroad bed about 0.75 mile above the dam that is connected through a culvert to the impoundment. North of the wetland is old field for about 0.4 mile. About 1.5 miles up from the dam along the eastern shore is a 5-acre emergent/scrub-shrub wetland with a small perennial stream. The rest of the eastern shoreline is largely wooded.

CMP identified four forested cover types within the project area that are either hardwood or softwood dominated or some combination. Hardwood canopy species in upland areas include red oak, paper birch, gray birch, beech, aspen, and sugar maple, and common shrubs are beaked hazelnut, honeysuckle, and hobblebush. Groundcover includes wild sarsaparilla, wood asters, teaberry, bracken fern, club moss, starflower, partridgeberry, and trailing arbutus. Conifers found intermingled in hardwood or softwood stands include white pine, balsam fir, hemlock, and white spruce.

In wetland areas, green ash, red maple, silver maple, willows, northern white cedar, and American elm are common canopy species, and speckled alder, highbush blueberry, red-osier and silky dogwood, elderberry, and willows are common shrubs. Sensitive and cinnamon fern, Joe-pye-weed, soft rush, grasses, and sedges are common wetland groundcover.

Wetlands are limited in the impoundment, and most of the acreage is concentrated in only a few places. The westerly bend in the river about halfway up the impoundment has scattered communities of forested, scrub-shrub, emergent, and aquatic-bed wetlands. The other location is the 5-acre site mentioned above. Otherwise, there are small pockets (<5 acres) along the shoreline in coves or where the few tributary streams enter the impoundment. CMP acknowledges that, because of the fluctuating pond levels, aquatic-bed wetlands are uncommon and the main body of the river is essentially devoid of aquatic vascular plants. Our observations during our site visit in July 1994 are consistent with CMP's conclusions.

*Wildlife*

The west bank provides habitat for woodland wildlife, and the east bank has a greater variety of habitats, including open fields, ponds, young conifer stands, and the railroad bed along with forested areas. While a limited amount of wetland habitat is available scattered along the impoundment shores, wetlands are subject to daily water level fluctuations and "as a result the habitat value is greatly reduced" and "waterfowl use is probably restricted to the migration period." Although some were observed during field surveys, because of water level fluctuations, the suitability of the river as a habitat component for beaver, mink, muskrat, and river otters is limited.

There is a diversity of habitat types in the project area that reflects the changing land-use patterns from large uninhabited forestlands to the north of the Williams Project to more rural mixed forestland and small farms with increasing human settlement to the south. CMP identified 28 amphibians and reptiles whose range includes this portion of the Kennebec River. Additionally, at least 109 birds and 28 mammals may occur in habitats within the project area, for a total of 165 species. CMP performed field surveys in October 1984 that identified 49 wildlife species.

*3.3.4.5 Sandy River*

*Vegetation*

Vegetation within the Sandy River Basin is predominantly agricultural within the flood plain and second and third growth northern hardwood and softwood forest at slightly higher elevations or where soils are not conducive to agricultural development. Crops include a rotation of corn, alfalfa, and hay.

Banks along the project impoundment are 10 to 20 feet high and steeply sloped eroding sand and clay. Vegetation cover is variably dense and includes St. Johnswort, dogbane, Virginia creeper, boneset, milkweed, purple loosestrife, and reed canary grass. Locations in the lower impoundment where forest abuts the banks have white pine, quaking aspen, silver maple, and American linden as overstory species and raspberry, virgin's bower, riverbank grape, ground nut, water parsnip, Canada lilly, acrimony, and wild cucumber as shrub and groundcover species.

The upper end of the impoundment, including Yeaton Island, is more heavily forested. Common species include American linden, butternut, American elm, green ash, and black willow in the overstory and ostrich and sensitive fern, tiger lilly, false nettle, blue vervain, riverbank grape, goldenrod, and raspberry in the undergrowth.

The bypass and tailrace areas are short and similarly vegetated with alder, willow, steeplebush, raspberry, goldenrod, grasses, and silver maple. High flows scour portions of these areas and commonly result in pioneering species near the normal water level.

Wetlands are limited along the 2.5-mile length of the impoundment, primarily because of the steep banks. MEW's consultant, KA, identified three wetland areas. The first, an emergent and aquatic bed wetland about 1,000 feet upstream of the dam on the west shore, is associated with the mouth of an intermittent tributary stream. Common emergent vegetation includes cattail, sweet flag, wool grass, bulrush, Joe-pye-weed, and monkey flower, and more aquatic species include arrowhead, pickerel weed, and *Elodea*.

There is another emergent wetland about 3,000 feet upstream of the dam at the mouth of a tributary stream along the east shore that is dominated by *Eleocharis* sp., wool grass, arrowhead, reed canary grass, pickerel weed, and pond lilly. In addition, based on our site visit in July 1994, it appears that landward of the emergent wetland and extending up the tributary there is scrub-shrub wetland, dominated by speckled alder, silky and red-osier dogwood, and willow.

The third wetland area is the largest and most complex. Situated along an intermittent stream on the western shore, there are 1.5 acres of emergent, 3 acres of scrub-shrub, and 2 acres of forested wetland. Species are similar to those described for the other two wetlands with the addition of mature silver maple and black willow in the forested area.

*Wildlife*

Wildlife species adapted to mixed agricultural, forested woodlot in rural areas (relatively low human density) are typical of the project area. Common mammals include moose, white tailed deer, raccoon, skunk, red and gray squirrels, beaver, and muskrat. Red fox, coyote, black bear, and river otter are probably less abundant in the project area. During wildlife surveys of the project area and observations during other work at the site in summer 1992, KA observed painted and snapping turtles, great blue and black crowned night herons, killdeer, bank swallows, sandpipers, belted kingfisher, red-wing blackbird, mallard, merganser, black duck, and Canada geese. A variety of warblers and smaller songbirds and blue-wing teal and wood duck in flight also were observed. Breeding waterfowl included mallards and American black duck.

*3.3.4.6 Weston*

*Vegetation*

The Weston Project facilities are within the business district of Skowhegan, so there is minimal vegetation cover. Much of the impoundment upstream of Skowhegan is bordered by land cleared for residential and agricultural land uses. Vegetation cover types at the Weston Project include open fields; forested uplands; and scrub-shrub, emergent, and forested wetlands. Most bank vegetation is upland woods. Extending away from the impoundment, there is a mosaic of farm parcels, forested gullies, and wood lots that appear to be overgrown fields. Dominant deciduous canopy species include gray birch, black ash, silver maple, red maple, and red oak. Dominant coniferous canopy species include white pine, eastern hemlock, and red spruce. Understory species include striped maple, mountain maple, and shadbush.

The impoundment has about 25 small (>1/8 acre) wetland areas located mostly at the outlets of small tributary streams. The largest wetland is about 3 acres, and is located at the outlet of Mill Stream in Norridgewock. The small wetlands are either scrub-shrub areas, which contain meadowsweet, Joe-pye-weed, meadow rue, and a variety of willows and ferns; or emergent areas, with a border dominated by alders, and water lilies, pickerelweed, and arrowhead in areas of standing water.

*Wildlife*

Wildlife habitat within the Weston Project area is typical of the moderately developed segments of the Kennebec River. The 25 miles of project shoreline and riparian areas provide habitat for a variety of wildlife. Species identified during CMP's field work in July of 1989 and 1990 include 3 mammals, 21 birds, and 1 reptile. Mammal species that probably inhabit project lands include: white-tailed deer, moose, fox, beaver, coyote, mink, raccoon, skunk, woodchuck, squirrel, muskrat, and chipmunk.

The Kennebec River watershed is within the North Atlantic flyway, and it supports a variety of transient waterfowl and some local nesting populations. Common bird species that could occur include: pintail (with brood), mallard (with brood), red-breasted merganser (with brood), killdeer, spotted sandpiper, belted kingfisher, bank swallows, and green herons. Raptors that may occur in the project area include bald eagle, osprey, broadwing hawk, red-tail hawk, and several species of owls. Songbirds potentially include black and white warbler, yellow warbler, song sparrow, cedar waxwing, and American robin.

No bald eagle nest sites are known to exist in the project area. There also are no significant wildlife habitat units such as deer wintering areas.

#### *3.3.4.7 Fort Halifax*

*Vegetation*

In general, the 5.2-mile-long impoundment is bordered by low rolling hills to relatively flat terrain that contains land farmed extensively in the past with a narrow band of forest along much of impoundment. There are narrow bordering bands of wetland along certain stretches of the impoundment. Vegetation identified along the impoundment margin by CMP's consultant, Acres International (Acres), during field work in August 1989 includes sugar maple, red maple, green ash, and more upland forested areas with white pine, eastern hemlock, white ash, white oak, and red oak. Along much of the northern portion of the impoundment, old fields extend down to the water's edge, which probably represents formerly farmed land that is now rural residential.

Acres identified four wetland cover types, including deciduous swamp, shrub swamp, emergent marsh/wet meadow, and submerged aquatic vegetation (SAV), although it combined data for deciduous and shrub swamp because species are similar. About 13 acres of deciduous swamp are distributed along the impoundment, primarily along downstream shores. Tree species include sugar and red maple, American elm, swamp white oak, green ash, and black willow. Shrub swamps often contain saplings of canopy species and speckled alder, mapleleaf viburnum, elderberry, and silky dogwood. Virginia creeper, poison ivy, grape, wild cucumber, and raspberry are also common.

Emergent marsh/wet meadow often occurs between the trees and the open water. The emergent marsh/wet meadow include herbaceous plants over a transitional zone from more water tolerant or obligate species to less tolerant, wet meadow, species. A total of 15 acres in the project area occurs primarily in four locations. Common vegetation includes purple loosestrife, reed canary grass, stinging nettle, barnyard grass, woolgrass, cattail, jewelweed, sensitive fern, arrowhead, soft rush, pickerel weed, and swamp smartweed. In the drawdown zone, swamp smartweed is dominant, but most of the estimated 7.3-acre drawdown zone is unvegetated.

SAV is scattered throughout the impoundment in waters less than 8 feet deep, although it is nearly continuous along the north shore of the mid and upper impoundment. There are an estimated 62 acres of SAV throughout the impoundment. SAV species include pondweed, common *Elodea*, duckweed, and fragrant water lilly.

Banks of the tailrace shoreline are dominated by deciduous saplings and shrubs in a narrow band with developed lands beyond the banks. Black locust, green ash, silky dogwood, viburnum, riverbank grape, sensitive fern, and purple loosestrife are common species.

MNHP conducted surveys, at CMP's request, of the impoundment and tailrace areas. No Registered Critical Areas or any rare or unusual plant species were reported. MNHP concluded that, because the area is developed and disturbed, there is currently no habitat likely to support four plant species with a historical record of occurrence near the mouth of the river.

*Wildlife*

The interspersed forest, agricultural land, and wetlands along the impoundment provide habitat for certain wildlife species, while other species are limited because of the lack of large forested tracts. Acres observed 39 wildlife species during field work in August 1989, including 4 amphibian/reptile, 5 mammal, and 30 bird species. Other potentially occurring furbearers in the area include bobcat, coyote, fisher, mink, red and gray fox, and white-tailed deer.

Of the bird species noted, many are common throughout the region as permanent or summer breeding residents. There are few documented waterfowl observations from the impoundment, although migratory species are common as indicated by avid duck hunting during fall months. Bald eagles and osprey are commonly seen foraging, particularly around the confluence of the Sebasticook and Kennebec Rivers, but there are no known nest sites in the project area. There are no Registered Critical Areas of habitat as designated by the MNHP, nor occurrences of rare, threatened, or endangered wildlife species within the project area.

### *3.3.4.8 Oakland*

*Vegetation*

The topography within the Messalonskee Lake area, the Oakland Development, and downstream reaches of Messalonskee Stream is low rolling hills. Land-use patterns change from rural seasonal and year-round residences and agriculture around Messalonskee Lake to urban residential, commercial, and light industrial in Waterville. Undeveloped areas adjacent to the project waters consist of forested and agricultural lands. Forested shoreline buffers are present in most locations around Messalonskee Lake and the Oakland impoundment and along Messalonskee Stream. Forestlands range from lowland areas dominated by black and green ash, red maple, and willows, to uplands of mixed species that include red oak, white pine, paper birch, hemlock, and sugar maple. Other species that occur with less frequency include silver maple, northern white cedar, black spruce, alder, gray and yellow birch, beech, aspen, and black locust. Agricultural lands include pasture, hay, corn, and alfalfa.

Messalonskee Lake is a large body of water with about 20 miles of shoreline habitat, of which nearly 12 miles are developed for houses and summer cottages. The other 8 miles are relatively undisturbed mixed forest down to the water's edge. In general, the littoral zone is narrow with very little wetland development, except for emergent wetlands north of Bangs Beach (Figure 3-19) and along the west shore opposite Midway Island.

The exception and most significant ecological feature within all four Messalonskee project areas is the large wetland complex at the southern end of Messalonskee Lake. This wetland has about 700 acres of deepwater marsh and another 500 acres of bog that are essentially bisected by Belgrade Stream, the inflow to the lake. The plant community in the marsh consists of abundant rushes, sedges, grasses, wild rice, and bur-reed. In shallow water areas between emergent plants, floating leaved plants include water-shield, pondweed, water lilly, and cow pond-lily, and submergent species include water milfoil, wild celery, and common bladderwort. Monotypic stands of cattail occur around Mill Brook.

The bog portion of the wetland has typical acidophile species. A sparse overstory of black spruce and larch covers much of the bog, particularly towards the older, shoreward side. Although the shrub layer is predominantly leatherleaf and rhodora, Labrador tea, bog laurel, and large cranberry are also present. Cottongrass, pitcher plant, and other smaller herbs that form the usual bog flora of the northeast also occur throughout the bog.

In contrast to Messalonskee Lake, the Oakland impoundment is the smallest impoundment of the four Messalonskee projects. It is in an urban setting with residences and industry along the west shore. The east shore is undeveloped, steeply sloping, and partially covered with typical deciduous trees and balsam fir. Between the Oakland impoundment and Messalonskee Lake dam, the shoreline only has a narrow deciduous wooded buffer strip between the water and heavy residential development. There is only one important area of emergent wetland around the impoundment on the western shore including the area up to Messalonskee Lake dam. While some small protected coves along the shore have emergent vegetation, wetland plant communities are not well developed.

*Wildlife*

The undeveloped Messalonskee Lake shoreline and 1,200-acre wetland system provide valuable habitat for a large number of important game and nongame wildlife species. Excellent interspersion of open water and emergent vegetation and the abundance of valuable plant foods result in optimum breeding and migratory resting and staging area habitat conditions for waterfowl. The large wetland area also is important nesting habitat for the uncommon black tern; it is the largest and only continuously used nesting site in Maine. As such, the wetland is a Maine Registered Critical Area. Other wildlife benefit from the large expanses of emergent vegetation interspersed with open water, including muskrat, mink, otter, and the prey species that support these populations.

On the other hand, the developed nature of much of the land around the Oakland Development and upstream to Messalonskee Lake dam reduces the likelihood that project operations would disturb sensitive species in this area. In general, the abundance and diversity of wildlife is reduced over more northerly areas of the Kennebec River Basin, and species such as black bear, red fox, and bobcat are probably not present. The forested buffer and the interface of aquatic and terrestrial habitats, however, does provide valuable resources for wildlife species in the area.

The presence of agricultural lands also enhances the habitat values for "edge" associated wildlife such as white-tailed deer, pheasant, and ruffed grouse. Semiaquatic mammal species such as mink, otter, and raccoon probably occur in the river stretch between the dams, and upland species would include skunk, gray squirrel, woodchuck, snowshoe hare, and rodents. A variety of songbirds, occasional shore and wading birds, and a limited number of waterfowl (mallard) also probably occur.

### *3.3.4.9 Rice Rips*

*Vegetation*

The eastern shoreline of the Rice Rips impoundment has steep, forested slopes with upland mixed forest extending to the banks. Red maple, red oak, and yellow birch are the common hardwoods; white pine and hemlock are the common conifers. There is a very narrow fringe of wetland shrubs, including silky dogwood, alder, river bank grape, arrowwood, willow, and highbush cranberry, and small trees, including red maple and northern white cedar, along the bank where impoundment hydrology influences soil characteristics.

The western shore is more gradually sloped with numerous shallow water wetlands along the water's edge. The Rice Rips impoundment has the second greatest wetland acreage of the four Messalonskee impoundments (excluding Messalonskee Lake). The western shoreline is convoluted, and many of the coves support forested, scrub-shrub, and emergent wetlands. CMP identified 12 discreet wetland areas from the project tailrace, throughout the impoundment, up to the Oakland Development tailrace. Along the deep water fringe, there are large populations of water lily and dense beds of waterweed downstream of the Oakland wastewater treatment plant discharge. The nutrient loading from the discharge may be responsible for the development of these dense beds. Emergent wetlands contain cattail, arrowhead, three-way sedge, and great bulrush with submergent aquatic species, including waterweed, waterwort, needle spike rush, and arrowhead. Additional shrub species include sweet gale, winterberry, and witch-hobble.

The river reach below the dam (most of which is associated with the Rice Rips bypassed reach) has a moderately steep streambed with a rocky substrate. Riparian vegetation along the bank is restricted to a narrow band of mixed hardwood canopy species and thick growth of shrubs and ferns with limited development of other wetlands.

*Wildlife*

Wildlife usage of the Rice Rips impoundment is enhanced by the diversity of open water, wetland, and upland habitats along the western shore. Beaver are active, and there also are probably muskrat, mink, and other water-dependent animals. As with Oakland, the rural residential and agricultural land uses surrounding the Rice Rips Project area provide conditions conducive to certain species while inhibiting disturbance-intolerant species. In general, the diversity of species present at the Rice Rips and Oakland Projects are probably similar. The carrying capacity of more aquatic-oriented species, however, would be higher at Rice Rips because of its larger impoundment and greater wetland acreage. Periodic poor water quality conditions in the Rice Rips impoundment may adversely affect the food web, precluding use by certain species.

*3.3.4.10 Automatic*

*Vegetation*

The Automatic Project impoundment has two different habitat areas. From the dam to just downstream of I-95, the banks are steep and the urban setting results in many buildings situated adjacent to the water and very little wetland or woody vegetation habitats. CMP identified 5 wetland areas in this stretch of the impoundment and 11 additional ones further upstream. From just downstream of I-95 to the tailrace of the Rice Rips Project, there are larger wetland areas, including forested, scrub-shrub, and emergent vegetation. The Automatic impoundment has the greatest wetland acreage of the Messalonskee impoundments (excluding Messalonskee Lake). Submerged and emergent species include pickerelweed, bur-reed, arrowhead, rice cutgrass, wild rice, manna-grass, and various rushes and sedges, including the rather uncommon Torrey's three-square. Forest and shrub species are similar to those described at the two upstream Messalonskee projects.

*Wildlife*

The various wetland and upland cover types in and around the Automatic Project, particularly in the upper two-thirds of the impoundment, provide good habitat for a variety of wildlife species. The mixture of cover types provide foraging and nesting habitat for "edge" species, those that make frequent movements between cover types or stay near the edge of cover types to take advantage of species that move between cover types. Many plant species are of high value to wildlife for food and cover. Mallards, pintails, flycatchers, kingbirds, red-winged black birds, yellow-rumped warblers, common yellowthroats, great blue herons, black-crowned night herons, and bitterns are present in the project area. Other wildlife species, including mammals and herpetofauna, are probably similar to those reported from other Messalonskee projects.

*3.3.4.11 Union Gas*

*Vegetation*

The river valley in the immediate project area is largely undeveloped. It is steep and narrow and the site of Pine Grove Cemetery and a city park. Land beyond the valley slopes is cleared and developed as residential properties. The slopes of the valley are heavily forested. Wetlands are limited to several small seepages and a narrow fringe along the banks. CMP identified eight discreet wetland areas within the project area. There are several emergent and scrub-shrub wetlands near where the stream makes a looping meander. Plant species in wetlands and bordering upland forested areas are similar to those described for the other projects on the Messalonskee River, except several bur oak were noted in the floodplain forest within the large bend of the stream.

Downstream of Union Gas dam to the confluence with the Kennebec River, conditions are similar to above the dam, and the narrow, steep-sided valley limits development of extensive wetlands. Messalonskee Stream backwaters from the Kennebec River to within 3,000 feet of the dam.

*Wildlife*

Minimal acreage of wetlands, floodplain forests, and other habitat diversity and discontinuity with larger undeveloped areas probably limit wildlife opportunities. Although it is within an urban setting, the natural state of the large bend in the stream has preserved some high value wildlife habitat. CMP noted beaver activity and many mallards, other ducks, and a great blue heron. Occasionally, species that predominantly inhabit or use the Kennebec River valley may move into the tailrace of the project to forage.

### *3.3.4.12 Edwards*

*Vegetation*

Information on vegetation within the project area comes from cover-type mapping described in Edwards' application, a December 1994 AIR response about potential impacts of drawdowns, and SWETS (1995a,b). Vegetation along the length of the project area is predominantly forest within the slopes of the valley, and agriculture and rural residential lands dominate the relatively flat to gently rolling plain beyond the valley. The second largest land use within the valley adjacent to the Edwards impoundment (especially along the west shore) is sand and gravel excavations. The railroad along the east shore has limited the development of land within the valley slopes, and the forest is more continuous along the length of the impoundment.

Edwards identified 10 cover types from aerial photograph interpretation, and hardwood forest, mixed forest shrubland, disturbed areas, and agricultural and open land are common or fairly common. Softwood forest, bottomland forest, plantation forest, shrub swamp, and shallow marsh are more limited in occurrence and areal coverage. Common canopy species found in the various forest cover types include red oak, green ash, white birch, aspen, red maple, white pine, eastern hemlock, spruce, and balsam fir. Less common species include silver maple, sugar maple, yellow birch, American beech, hophornbeam, black cherry, willow, and American elm.

Upland shrub species, which occur in reverting fields, transmission line right-of-ways, and disturbed gravel excavations, include willow, Virginia creeper, poison ivy, staghorn sumac, honeysuckle, witch hazel, raspberry, meadowsweet, and sweet fern. More hydric shrub species include red-osier and silky dogwood, speckled alder, willow, highbush blueberry, and several viburnums. More than 100 herbaceous species were identified from upland and wetland habitats, most of which are typical for Maine. Upland species include sarsaparilla, burdock, asters, thistle, wood ferns, club moss, partridgeberry, starflower, bracken fern, and grasses. More hydric species include cinnamon, interrupted, and sensitive ferns; sedges; rushes; purple loosestrife; tearthumb; smartweeds; bulrushes; woolgrass; pickerelweed; arrowhead; and cattail.

Narrow bordering wetlands along the shore of the impoundment tend to be either shallow marsh or bottomland forest on low terraces. Either as independent or grouped wetland types, Edwards identified 29 bottomland forest (PFO1) wetland areas, 4 shrub swamp (PSS1) wetlands, 8 shallow marsh (PEM), and 3 open water (PUBH) areas; a total of 42. In comparison, we identified 33 forested, 6 shrub swamp, 14 shallow marsh, and 3 open water wetlands, for a total of 56. As described in SWETS (1995a), although there were discrepancies in the areal coverage, wetland types, and boundary positions, ultimately estimates of our total area (approximately 40 acres) versus Edwards' were within 0.45 acre of each other. Descriptions of each wetland are provided in Appendix E of SWETS (1995b).

There are no Maine Registered Critical Areas within the project area, although wild ginger (state-listed threatened) is found on land near Sevenmile Brook. This area is beyond the influence of project operations.

*Wildlife*

Edwards surveyed the project area for wildlife resources, focussing on the impoundment perimeter and adjacent lands because these areas are most likely affected by project operations. Surveys performed in 1990 and 1991 identified a variety of wildlife species, noting that the available habitat is largely upland forest riparian zone with steep banks limiting the development of high quality littoral zone habitat along most of the impoundment's 30 miles of shoreline. Edwards identified 33 herpetofauna, 196 avifauna, and 50 mammal species whose ranges overlap the study area.

The extensive, largely undisturbed riparian habitat provides a valuable travel corridor for white-tailed deer, otter, raccoon, and other species. The woody vegetation provides perches for kingfisher, flycatchers, osprey, and bald eagles. Wading and shorebirds are frequently present along the shore and amidst the rocky ledges near the outlet of Messalonskee Stream. The variety of cover types (densely wooded ravines and slopes, scrub-shrub bordering gravel excavations, emergent marshes, and agricultural land) provide habitat heterogeneity that supports a diversity of animal species.

The upper and lower ends of the impoundment are more developed with more frequent human disturbances associated with Waterville and Augusta, limiting the value of these areas for species that are more sensitive to disturbance. The Edwards impoundment shoreline, in terms of habitat value, may be more similar to the Williams Project impoundment than the nearby Fort Halifax or Messalonskee projects in terms of the size and nature of forested areas with minimal human development (particularly the eastern shore of the Edwards impoundment). Also the greater impoundment fluctuations (4 foot or greater) and the resultant shallow water shoreline communities are more similar between Edwards and Williams than the nearby Fort Halifax and Messalonskee projects (which have less than 2 foot fluctuations).

There are no Maine Critical Areas (such as deer wintering areas) within the project area, although bald eagles forage along the river.

### 3.3.5 Aesthetic Resources

#### *3.3.5.1 Moosehead*

Moosehead Lake is the largest lake in Maine, and it is the primary headwater of the Kennebec River. The irregular and rugged shoreline, vegetative diversity, islands, and high relief provide a highly scenic setting. A survey of more than 1,500 lakes larger than 10 acres in Maine rated Moosehead as outstanding in every resource category (MSPO, 1989).

Part of the White Mountain physical region, Moosehead Lake is surrounded by mountainous terrain with numerous peaks at elevations reaching 3,200 feet. Big and Little Squaw Mountains rise to the south of the lake. Squaw Mountain is operated as a ski resort and contains several chair lifts to the summit. The chair lifts are operated irregularly during the fall for foliage viewing by tourists. The summit of Mt. Kineo (owned by the state), rises 800 feet from the lake and offers spectacular views of the region from an abandoned Maine Forest Service tower. Easily accessible on the Kineo peninsula, Mt. Kineo is a favorite venue for mountain climbers and hikers. Moosehead Lake has 78 recorded islands, the largest of which are Sugar (4,200 acres), Deer (2,300 acres), Kineo (1,400 acres), Farm (1,000 acres), and Moose (350 acres).

Views of dams at the East and West Outlets are readily available to tourists and residents from Route 15/6 and from a public access road. The East Outlet dam offers views of broad sections of the lake and of Mt. Katahdin, Maine's highest peak, to the east and of Big and Little Spencer Mountains. Indian Hill in Greenville offers especially scenic views of the region. The Maine Department of Transportation maintains a scenic turnout and picnic area at Indian Hill. Numerous wetlands (37 areas are greater than 10 acres) and shallow water areas add to the area's attractiveness. Whitewater rapids just downstream of the East Outlet dam are considered one of the eight most significant rapids in the Kennebec River Basin (MDOC, BPR, 1988) and are included on the Register of Critical Areas.

#### 3.3.5.2 *Moxie*

The rugged, forested shoreline; rocky islands; and surrounding hills give high scenic value to the Moxie impoundment. Moxie Pond lies in the transition zone between the White Mountains and the New England Uplands. Low, rolling mountains rise to elevations in excess of 2,000 feet msl and include the Mosquito, Pleasant, Dimmick, and Bald Mountains. The highest peak in the immediate vicinity is Bald Mountain (el. 2,629 feet msl) near the southeast end of the impoundment. A public road immediately north of the dam structures offers a sweeping view to tourists and residents of the impoundment, boat launch, parking area, concrete dam and sluice gates, several seasonal cottages, and outlet streams. A transmission line, not associated with the project, parallels the western shore of the impoundment for its entire length.

Hikers and nature-oriented recreationists enjoy excellent views of the impoundment from the Appalachian Trail at Pleasant Pond Mountain and Bald Mountain. Moxie Falls and Baker Pond Falls, located 1 mile and 3.5 miles downstream of the reservoir, respectively, are on the Register of Critical Areas (No. 292 and No. 235). Moxie Falls has a single vertical drop of 52 feet and a total drop of 111 feet; it is one of highest falls in Maine and one of 10 significant falls in the Kennebec River Basin. Baker Pond Falls drops 40 feet. Moxie Stream is rated "A" by the Maine Rivers Study in part for its falls and scenic qualities.

#### 3.3.5.3 *Wyman*

The overall character of the impoundment at the Wyman Project is that of a deep, steep-sided lake with a heavy gravel/cobble/boulder shoreline substrate. The impoundment is 0.5-mile wide at the southern end and narrows to 0.25 mile at the northern end. There are four major islands with steep cobble/gravel shorelines in the impoundment. The small community of Caratunk is situated on the relatively flat east bank of the river at the northern end of the impoundment. Near the village, the Appalachian Trail crosses the impoundment.

U.S. Highway Route 201 follows the sparsely populated eastern edge, in some places coming quite close to the shore. The highway is generally at an elevation sufficient to give travelers an excellent view of the impoundment and the unpopulated mountains of Pleasant Ridge to the west, rising some 1,000 feet above the lake. Route 201 from Solon (9 miles downstream) to The Forks (5 miles downstream) is a designated State Scenic Highway. This segment has a unique and diverse range of views related to a variety of spatial enclosures and topographic diversity. The Houston Brook Falls and eskers along the eastern shore of the impoundment in Caratunk are several of the scenic features along this stretch of the Kennebec River.

#### 3.3.5.4 *Sandy River*

The Sandy River in the vicinity of the project flows through lands bordered by farms and wooded areas. Land on the shores of the clear and meandering river is basically undeveloped and creates an idyllic pastoral setting. Five small wetland areas add to the scenic quality of the views. The architecturally important powerhouse and dam dominate the scene. Above the dam, the impoundment extends 2.5 miles and generally has steep sparely vegetated banks of sand and clay. A bypassed reach extends 100 feet from the base of the dam and consists of a narrow pool with islands of ledge, boulder, and rubble. Tourists and residents are afforded views of the river and the project from Sandy River Road.

#### 3.3.5.5 *Weston*

The Weston Project is in the center of the small, densely settled industrial town of Skowhegan. Norridgewock village center is nestled on the south side of the impoundment, about 6 miles upstream of the dam. Along the upper impoundment, between Norridgewock and Skowhegan, the Kennebec River user can appreciate moderately steep banks, approaching 40 feet in elevation upstream, with some flood plains along the southern bank. Narrow strips of forested land, open fields, and wetlands at the outlets of small tributaries characterize the riverbanks. There are three areas on the Register of Critical Areas in the vicinity (Nos. 49, 393, and 56), which contain rare plant species that add to the beauty and diversity of the area.

A picturesque foot bridge connects the western bank of the south channel with the island between the project dams. West Front and Alder Streets provide wide open views of the south channel impoundment and footbridge to the traveller. Route 201 affords a view of the powerhouse and lower impoundment. Most of Elm Street offers views of the headpond and its setting.

Norridgewock Avenue provides intermittent views of the upper impoundment with a foreground and background of widely separated residences and farms amid woods and fields. Users of the Route 201 bridge can see rushing whitewater in the tailrace and, when there is spillage at the north dam, the deep north channel, which is cut through bedrock. Route 2 in the vicinity of the Great Eddy area affords the finest view of the tailwaters and the Weston powerhouse to tourists and residents.

*3.3.5.6 Fort Halifax*

The Fort Halifax impoundment along the Sebasticook River is 5.2 miles long, and it has a riverine character with an average width of 660 feet. The drainage area upstream and adjacent to the project is dominated by low, rolling, forested hills to the south and east, rising several hundred feet about the river. Large tracts of open fields and rural areas parallel the river and are generally screened from viewing from the impoundment by a narrow stand of mixed forest at the margin of the impoundment. The slope of the hills and the setback of most of the roads provide a pleasing pastoral setting.

Within the project area, more than 90 acres of wetlands scattered throughout the impoundment enhance the scenic quality of the area. Public views of the impoundment available to motorists are limited to the Route 201 bridge, Route 100A in Benton, and from Garland Road to the south where it crosses the Benton town line. The dam structure and architecturally important powerhouse are in an urban area in Winslow.

*3.3.5.7 Messalonskee*

Messalonskee Stream is a 10.2-mile tributary that drains 177 square miles. The scenes and settings of the projects vary from the highly industrial landscape of Waterville to the rural vistas that include Messalonskee Lake in Oakland, Sidney, and Belgrade. Between the two extremes, most project shoreline and adjoining lands exhibit forested buffers and limited public views of the river with only a handful of clearings extending to the waters' edge. While upland areas can be relatively steep, perennial streams are generally low gradient, meandering drainages with numerous adjoining wetlands. CMP's transmission line corridors and MCRR rights-of-way travel through the project areas, frequently parallel to the shoreline, crossing Messalonskee Stream in several locations.

The applicants completed an aesthetic assessment of the project areas. Messalonskee Lake (Snow Pond) is a large lake with long stretches of heavily wooded, relatively undeveloped shoreline. Routes 27/11/8 in Belgrade afford expansive views of the lake marsh and bog in the foreground, the lake itself, and forested shore in the background. Views from Route 8/11 include fields and woods leading down a long gradual slope to the lake and are very picturesque. In Oakland, the dam and the narrow northern terminus of the lake are visible from the Routes 11/23 bridge. A particularly scenic narrow whitewater stretch of the tailrace is also visible from this bridge.

The fortress-like Oakland powerhouse is a dominant architectural feature in the small community. Along Route 23, the Rice Rips impoundment is occasionally visible through trees and beyond a long slope of pasture leading to the water. Rice Rips Road affords wide open views of the bypassed reach upstream and the powerhouse downstream. County Road offers views of whitewater and forested shorelines of the Rice Rips tailrace. The gently sloping wooded shorelines of the Automatic impoundment can be seen from Center Street in Waterville. Further downstream, the Union Gas Development is visible from Cool Street and Route 104, but the powerhouse is below grade and not readily visible.

#### *3.3.5.8 Edwards*

The area in the immediate vicinity of Edwards dam is highly urbanized with mixed industrial and commercial development. Washington Street and Buena Vista Drive parallel the river along the ridge of the steep west bank immediately upstream of the dam and afford clear views of the eastern shore of the impoundment. Along the impoundment, both banks are predominantly wooded with about three dozen clearings. On the east bank, an MCRR line runs the full length of the impoundment along a natural terrace and has effectively inhibited development on much of the east bank, except for about six sand and gravel operations. There are about 20 sand and gravel operations along the west bank.

The river corridor between Augusta and Waterville (Lockwood dam) is virtually inaccessible to view by motorists. Travelling around the impoundment by car along Route 201 on the east and Route 104 on the west, there are few opportunities to view the river. The roads are set back 500 to 1,000 feet from the river banks, and the relative steepness of the banks on both sides obscures the actual shoreline from view in all but a few places. Along the impoundment, the only developed public access to view the impoundment is the public boat launch on the west bank in the town of Sidney, and a car-top boat launch area on the west bank on Edwards' property at the dam in Augusta.

Once on the river, the steep banks and minor development along the shoreline combine to provide a "near-wilderness experience" along this stretch of the Kennebec River (MSPO, 1991). Views from the river consist of dense forest canopy on moderately steep to steep river banks. Agricultural uses and the residences along the roads that parallel the river are screened by trees and shrubs, occasionally only a single row, along the river's edge. Views of forests and agricultural lands are broken only by the railroad spur and the sand and gravel operations.

### 3.3.6 Cultural Resources

#### *3.3.6.1 Moosehead*

At the Moosehead Project, historic properties include a currently undetermined number of potentially eligible archeological sites. A Phase I archeological survey and subsequent investigations revealed more than 270 potentially eligible sites. Subsequently, an ongoing Phase II investigation has significantly reduced the number of potentially eligible sites.

There are no project facilities that qualify as historic properties (PA, September 1993).

#### *3.3.6.2 Moxie*

At the Moxie Project, there are no archeological sites or project facilities that qualify as historic properties (PA, September 1993).

#### *3.3.6.3 Wyman*

Historic properties at the Wyman Project include the project powerhouse and seven archeological sites.

The Wyman Project facilities are eligible for listing in the National Register of Historic Places (NRHP). Specific notable features include the art deco style detailing of the main entrance including lamps and Gothic door, multipane steel framed windows with tilt-out sashes, and decorative concrete pilasters and paneling on the downstream side (PA, September 1993.)

Phase I and Phase II archeological investigations and subsequent field visits by MHPC staff identified five sites eligible for listing in the NRHP. Eligible sites are ME 86-12, ME 86-3A, ME 86-3B, ME 86-11, and ME 86-13 (PA, September 1993).

#### *3.3.6.4 Williams*

Historic properties at the Williams Project include three prehistoric archeological sites and three potentially eligible archeological sites. Phase II archeological investigations identified three sites eligible for listing in the NRHP: ME 69.4, ME 69.5, and ME 69.6. Phase I archeological investigations identified three sites that may be eligible for listing in the NRHP: ME 69-13, ME 69- 14, and ME 69-15 (CMP, 1984).

There are no project facilities that qualify as historic properties.

*3.3.6.5 Sandy River*

Historic properties at the Sandy River Project include the project facilities and one prehistoric archeological site.

The Sandy River powerhouse, intake canal, and dam are eligible for listing in the NRHP (SHPO opinion, March 25, 1993). Specific notable features of the powerhouse include the brick superstructure, windows with steel mullions resting on granite lintel in bays separated by pilasters, shallow asymmetrical gables, an original horizontal belt-driven generator, and the massive granite block foundation housing the turbine. The dam features a full length, 331-foot-long ogee spillway.

Phase I and II archeological investigations identified one prehistoric site eligible for listing in the NRHP. The eligible site is ME 52-34 (PA, September 1993).

*3.3.6.6 Weston*

Historic properties at the Weston Project include the project facilities and 11 archeological sites.

The significant features of the neoclassical Weston powerhouse are its green-tiled hip roof, tan brick veneer with a variety of ornamental string courses and stone blocks; stone trim around the multipart windows and in the bracketed overdoors, and quoins, water table, and base; original entryway highlighted by a pair of tall stacks that project through the roof and are connected by a low parapet; and original light fixtures (letter from K. Mohney, Architectural Historian, Maine Historic Preservation Commission, Augusta, Maine, July 27, 1990).

Phase I and II investigations, and subsequent MHPC staff field visits resulted in identification of 11 archeological sites eligible for listing in the NRHP. Eligible sites include ME 52-10, ME 52-16, ME 69-11, ME 52-9, ME 69-2, ME 69-8, ME 69-24, ME 69-27, ME 69-31, ME 69-40, and ME 69-34 (PA, September 1993).

*3.3.6.7 Fort Halifax*

Historic properties at the Fort Halifax Project include the existing project structures and a currently undetermined number (about 29) archeological sites recommended for further study. Fort Halifax Park is 300 yards from the powerhouse, and the Maine BPR maintains it as a historic site.

The Fort Halifax Project powerhouse is eligible for listing in the NRHP. A two-story brick building covered by a gable roof, its significant features include its parapet wall at the gable peak; original multipane steel frame windows with tilt-out sash; pronounced, elongated voussoirs above the first story openings; and granite window sills and concrete copings on pilasters and parapet (letter from K. Mohney, Architectural Historian, Maine Historic Preservation Commission, Augusta, Maine, July 27, 1990).

A Phase I archeological survey and subsequent field visits by MHPC staff identified 29 potentially eligible sites. These sites are ME 53-15, ME 53-16, ME 53-29, ME 53-30, ME 53-59, ME 53-64, ME 53-66, ME 53-69, ME 53-75, ME 53-5, ME 53-6, ME 53-11, ME 53-19, ME 53-21, ME 53-22, ME 53-23, ME 53-31, ME 53-55, ME 53-56, ME 53-57, ME 53-58, ME 53-60, ME 53-61, ME 53-62, ME 53-63, ME 53-65, ME 53-67, ME 53-68, and ME 53-70 (PA, September 1993).

*3.3.6.8 Oakland*

Historic properties include the powerhouse and nine archeological sites eligible for listing in the NRHP.

The Oakland powerhouse is eligible for listing in the NRHP. The significant historic features of the Oakland powerhouse include its fortress-like stone structure with Gothic style arched window, projecting course of granite blocks, and crenelated roof; random ashlar masonry walls over a steel frame; granite voussoirs above the window and door openings; original multipane tilt-out and double hung windows; and original two-leaf front doors with cross-bracing over the vertical board construction (letter from K. Mohney, Architectural Historian, Maine Historic Preservation Commission, Augusta, Maine, July 27, 1990).

Phase I and Phase II archeological investigations and subsequent field visits at all four Messalonskee projects by MHPC staff identified nine prehistoric sites eligible for listing in the NRHP, including ME 37-1, ME 37-16, ME 37-18, ME 37-19, ME 52-26, ME 52-30, ME 53-41, ME 53-42 and ME 53-48 (PA, September, 1993).

*3.3.6.9 Rice Rips*

There are no historic project facilities associated with the Rice Rips Project. We describe archeological sites identified during Phase I and Phase II surveys in Section 3.3.6.8 under the Oakland Project.

*3.3.6.10 Automatic*

The Automatic powerhouse is eligible for listing in the NRHP. The significant historic features include its one-story hipped roof, neoclassical building with exterior veneer of tan brick; decorative stone trimmings at the base, water table, corner quoins, windows, doorway, and the cornice; green tile roof; and original multipane windows with tilt-out sash and front doors (letter from K. Mohney, Architectural Historian, Maine Historic Preservation Commission, Augusta, Maine, July 27, 1990).

We describe archeological sites identified during Phase I and Phase II surveys under the Oakland Project in Section 3.3.6.8.

*3.3.6.11 Union Gas*

The Union Gas powerhouse is eligible for listing in the NRHP. The significant historic features of the Union Gas powerhouse include its rectangular building constructed of random ashlar masonry with broad gable roof and centrally placed narrower cross gable; round, arched covered windows and board-and-batten doors on the facade; granite quoins and trim around door and window openings; and a chimney at one end (letter from K. Mohney, Architectural Historian, Maine Historic Preservation Commission, Augusta, Maine, July 27, 1990).

We describe archeological sites identified during Phase I and Phase II surveys in Section 3.3.6.8.

*3.3.6.12 Edwards*

Historic properties at the Edwards Project include a currently undetermined number of potentially eligible archeological sites. There are no project facilities that qualify as historic properties (SHPO opinion, October 12, 1994).

A Phase I archeological survey resulted in identification of eight potentially eligible sites. These sites are ME 37-40, ME 37-42, ME 37-47, ME 37-50, ME 38-53, ME 38-55, ME 38-63, and ME 38-83. Phase II investigations are planned for sites subject to active erosion.

### 3.3.7 Recreation Resources

*3.3.7.1 Moosehead*

The Moosehead Project is a two-dam (East and West Outlets), storage facility impounding the 74,200-acre Moosehead Lake (Figure 3-13). Moosehead Lake is about 30 miles long and up to 15 miles wide, with more than 173 miles of shoreline. The Moosehead Lake area provides opportunities for lake water sports, including fishing, boating, waterskiing, and swimming. Moosehead is one of Maine's most highly prized lake fishing areas, and principal species include wild and stocked land-locked salmon, wild lake trout, and wild brook trout. People hunt for deer, moose, bear, and waterfowl on land adjacent to the lake and its

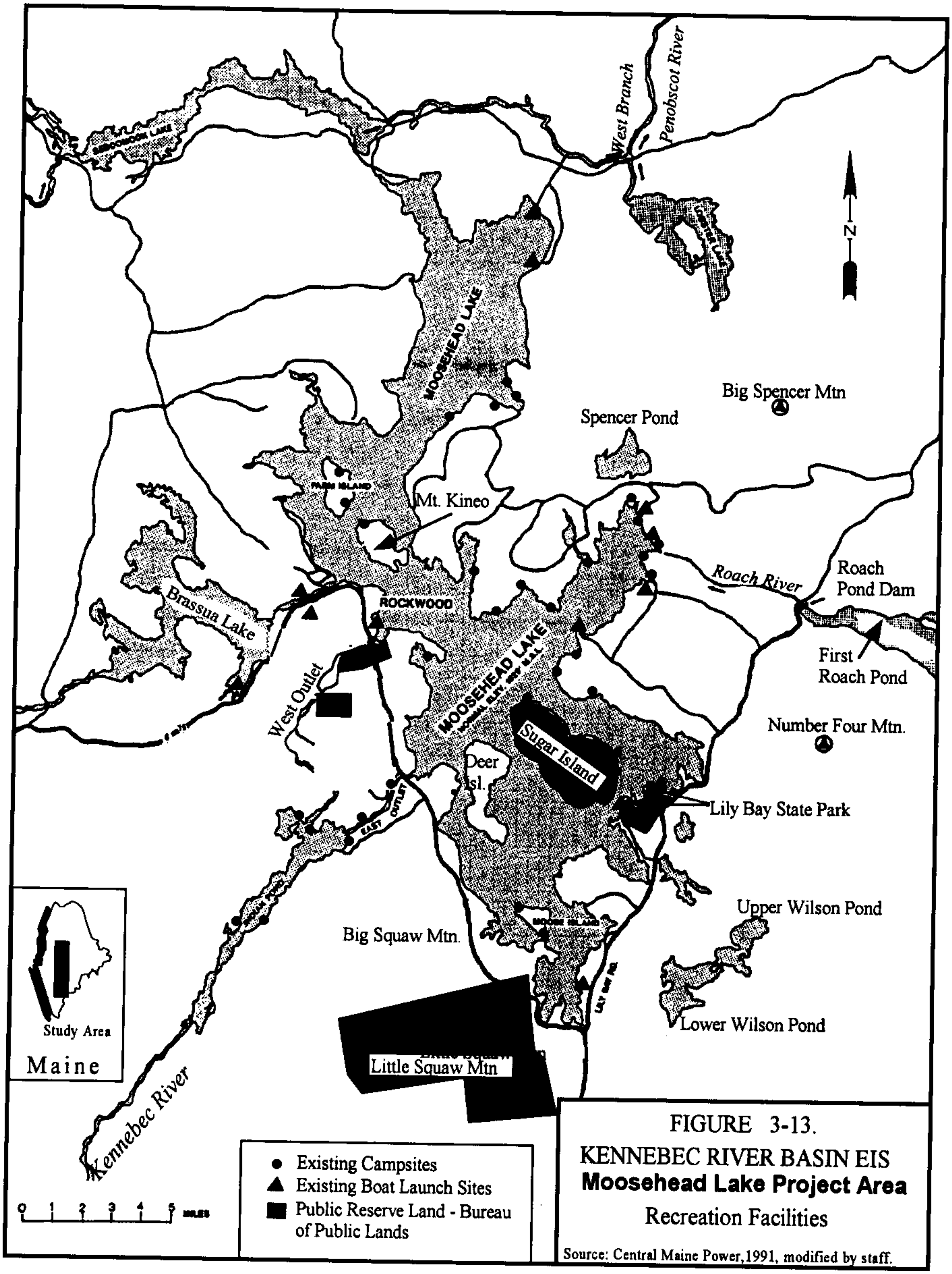



FIGURE 3-13.
KENNEBEC RIVER BASIN EIS
**Moosehead Lake Project Area**
Recreation Facilities

Source: Central Maine Power, 1991, modified by staff.

two outlets. Hiking, mountain bicycling, ice fishing, and snowmobiling are also popular activities in this region.

Moosehead Lake hosts a wide variety of publicly available recreation facilities and sites. The vast majority of these are provided by public agencies or are operated as private businesses. There are at least 72 recreational facilities along the shores of Moosehead Lake and the East and West Outlets, including: docks, wharfs, campsites, hiking trails, beaches, boat launches, resorts and hotels, marinas, picnic areas, restaurants, and float plane bases. Moosehead Lake also has 2,000 private cottages and 400 camping sites along its shores.

Recreation facilities and opportunities directly related to the Moosehead Project include:

- a boat launch and parking area for 50 vehicles on the west shore of Moosehead Lake near Rockwood;
- a boat put-in site and parking area on the north side of the East Outlet;
- a 3.5-mile stretch of Class II and III whitewater below the East Outlet;
- foot access from Route 15 to the East Outlet dam (primarily used by anglers); and
- foot access from Route 15 to the West Outlet dam used by canoeists and anglers for access above and below the dam.

KWP estimates that there are more than 410,000 annual user-days of recreation on Moosehead Lake. About 95 percent of the recreation activity occurs during the day, and the peak weekend use is over 11,000 user-days. One-fifth of the recreational activity is fishing, two-thirds of which occurs in the summer and one-third in the winter.

The following recreational resources are also within an hour of the Moosehead Project area: the Squam Mountain Ski Area, the Indian Pond boating and camping area, the west branch of the Penobscot River, the Kennebec River Gorge, and Baxter State Park. These areas combined with Moosehead Lake make the area one of Maine's most significant recreational resource areas.

*East Outlet*

The East Outlet offers 3.5 miles of challenging Class II and Class III whitewater for canoeists, kayakers, and rafters. Anglers on the East Outlet fly fish for landlocked salmon by wading or using drift boats. In 1990, the total East Outlet recreation use for the summer (May through September) was estimated at 7,000 user-days. Sixty-four percent (4,300 user-days) of the activity was fishing, and 18 percent (1,260 user-days) was boating.

For the East Outlet, the optimum range of flows is 600 to 1,200 cfs for fishing and 1,400 to 1,800 cfs for boating. The acceptable range of flows is 600 cfs to 1,600 cfs for fishing and 1,200 to 2,000 cfs for boating (CMP, 1991a). Fishing and boating use on the East Outlet occurs at different times of the day. During July and August, flows are typically in the 1,200 to 2,000 cfs range 60 percent of the time. During June and September, flows are typically over 2,000 cfs 75 percent of the time, which is ideal for whitewater boating, but less than optimal for fishing. Access to the southern end of the East Outlet is via Burnham Road, which is a logging road passable only with a four-wheel drive vehicle.

*West Outlet*

The most popular recreational use of the West Outlet is fishing, and canoeing is the next most popular. The West Outlet, which offers 10 miles of shallow water boating down to Indian Pond, is popular with canoeists looking for a mixture of flatwater and easy whitewater. The West Outlet is the designated route of the Kennebec Valley River Trail with a meandering approach to Indian Pond and very good smallmouth bass fishing. The minimum flow for canoeing is 120 cfs. Total West Outlet recreation use for summer (May through September) 1990 was estimated at 5,000 user-days. Seventy-five percent (3,750 user-days) of the activity was fishing, and 25 percent (1,250 user-days) was boating.

Recreational demand in the Moosehead area is heavy now, and we expect that it will increase substantially in the future. All types of boating, day-use activities such as picnicking and snowmobiling, and cottage development probably will increase.

*3.3.7.2 Moxie*

Moxie Pond is about 7.5 miles long with a surface area of about 2,231 acres. It is surrounded by commercial woodland, and there are 170 seasonal cottages spread along the shore of the pond. The cottages are all outside the project boundary, however, and not on the Owners' land. Primary recreational activities are fishing, boating, and swimming. The land surrounding Moxie Pond is frequently used by hunters. Anglers catch wild brook trout and wild and stocked landlocked salmon on Moxie Pond and primarily wild brook trout from Moxie Stream. Levels of boat use and water skiing are moderate on Moxie Pond because there are many shoals, islands, and ledges.

Existing recreational facilities (Figure 3-14) both on and near Moxie Pond and Moxie Stream include:

- a public boat launch/picnic area with associated parking facility and bank fishing access along the northwest shore of the impoundment;
- a scenic overlook and access trail at Moxie Falls, which provides access to the 111-foot-high falls designated by the Maine Registered Critical Areas Program as one of the 11 most significant waterfalls in Maine;
- five primitive campsites near Little Sandy Stream on private land;
- six primitive campsites near Joe's Hole at the south end of the lake on private land;
- the Appalachian Trail, a federally designated National Scenic Trail, running east to west at the south end of Moxie Pond; and
- numerous undeveloped sites on the pond that provide opportunities for carry-in boat access, day use, or camping, many of which are accessible via an old railbed that provides public access along most of the west shore of the impoundment.

The Owners estimate that there are more than 57,000 annual user-days of recreation on Moxie Pond. Most use is boat fishing, and nearly 90 percent of recreation occurs during the day.

The Appalachian Trail, which extends from Mount Katahdin in Maine to Springer Mountain in Georgia, is a trail of national significance that traverses the area just beyond the southern end of the Moxie Project. The Owners granted an easement to NPS for use of the trail corridor where it crosses a transmission line near Joe's Hole. This part of the trail also receives considerable day use because it provides access to Bald Mountain about 4 miles east of the southern end of the pond. Bald Mountain offers panoramic views of the entire area. Annual use of this section of the Appalachian Trail is estimated at 1,000 to 1,500 hikers per year.

Expert whitewater boaters benefit from the fall drawdown flows and boat Moxie Stream in September and October. At flows of 350 cfs, Moxie Stream has several stretches of Class III to Class V rapids. We estimate (based on flow duration curves), that under existing conditions, flows exceed 350 cfs during at least part of each month of the recreation season (May through October). In a typical May, flows in Moxie Stream are 350 cfs or greater 35 percent of the time. Flows of 350 cfs occur 5 percent

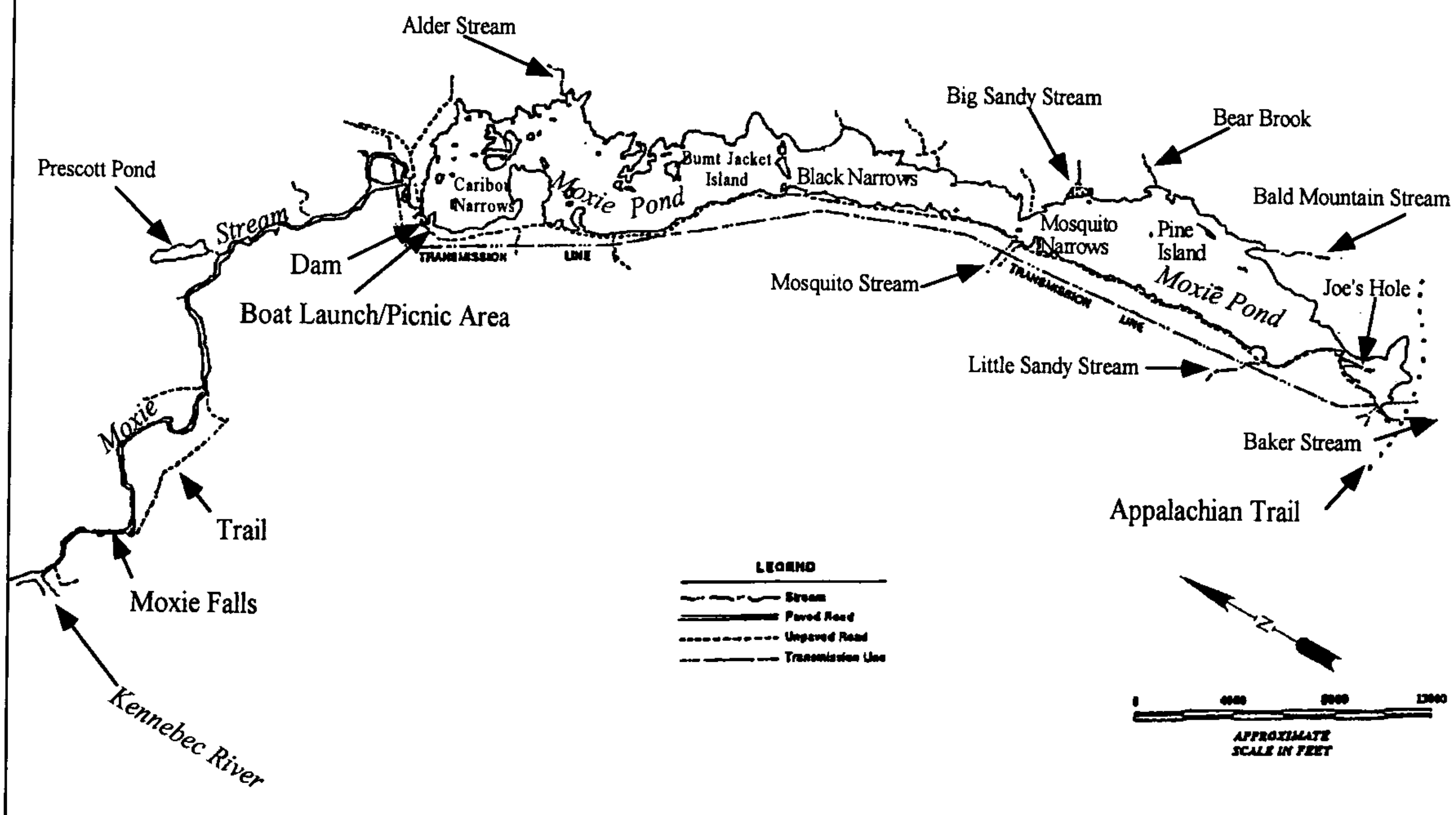



FIGURE 3-14.
KENNEBEC RIVER BASIN EIS
**Moxie Project**
Recreation Facilities
Source: Central Maine Power, 1991, modified by staff.

of the time or less during typical months of June through October.

The following recreational resources are within an hour of the Moxie Project area: the Indian Pond boating and camping area, the Kennebec River Gorge, and the Dead River. In Section 3.1.8.2, we describe whitewater boating resources in the vicinity of Moxie Stream.

Lake and river recreation demand in the Moxie area is heavy now, and it probably will increase substantially in the future. According to the SCORP (MDOC, 1988), unmet needs in the north Kennebec district, which includes the Moxie Pond area, are horseback riding, camping, ski touring, picnicking, bicycling, inland swimming, nature interpretation, and boat access.

Moxie Pond is likely to receive additional development pressure in the future because the lake is attractive and easily accessible. Large commercial paper companies, which historically have owned and leased the lots around Moxie Pond, have begun to sell these lots outright. The popularity of Moxie Falls also is likely to continue to grow as more people become aware of its scenic beauty and look for recreational activities that are relatively easily accessible.

Demand for additional summer day-use activities on Moxie Pond is not likely to grow as fast as on some other lakes in the area, however, such as Moosehead Lake. Moxie currently receives moderate boat use, which will probably increase somewhat. Fishing use is likely to also increase, and use of the Appalachian Trail and winter use are likely to increase as participation in hiking and snowmobiling increase.

#### 3.3.7.3 *Wyman*

The Wyman Project impoundment extends upstream from the dam for about 14.4 miles, and it is mostly between 0.25- and 0.5-mile wide. The impoundment has an approximate surface area of 3,240 acres, and it is surrounded by primarily commercial woodland. Most recreation in the Wyman Project area is fishing, boating, camping, hunting, swimming, picnicking, and snowmobiling. Impoundment users tend to fish, swim, and picnic, while tailrace users fish for landlocked salmon, brook trout, and rainbow trout. Route 201, designated as a scenic highway, follows the east shore of the impoundment and provides access to the length of the project. Access to the west bank of the upper 8 miles of Wyman Lake is by jeep trails and logging roads.

Fishing below Wyman dam is extremely popular. This stretch of river supports landlocked salmon, brook trout, and rainbow trout. Fishing on Wyman Lake is less popular; there is limited ice fishing for smelt on the lake near Carney and Decker Brooks.

There are very few seasonal or year-round cottages around Wyman Lake, and overall use of the impoundment for recreational boating is low. The highest recreational use in the project vicinity is by anglers fishing downstream of the dam and travelers on Route 201 who use the day-use sites along Route 201.

CMP estimates that there are 40,000 annual user-days of recreation at the Wyman Project. Most use is fishing downstream of the dam and on the Wyman impoundment. About 80 percent of the recreational activity occurs during the day.

CMP estimates that swimming and picnicking areas in the project area are at 100 percent capacity on weekends during the recreation season (May through September), and parks in the project area are at 75 percent capacity. Fishing areas, boat launching facilities, trails, and interpretive displays in the Wyman Project area are at 50 percent capacity or less on weekends during the recreation season.

The Wyman Project has the following recreational facilities (Figure 3-15):

- a public swimming and picnic area, boat launch, and 10-vehicle parking area on the west bank on a small cove about 1 mile above the dam maintained by the Moscow/Bingham Chamber of Commerce and the Maine BPR;
- the Houston Brook Falls foot trails and parking area, 2 miles above Wyman dam;
- a picnic and parking area, 7 miles upstream of Wyman dam;
- a day-use access area at Carrying Place Stream with carry-in boat facilities and access for swimming and bank fishing, 8 miles upstream of Wyman dam;
- fishing access and carry-in boat access owned and operated by CMP below Wyman dam;
- a canoe portage trail on the east side of the river;
- a public boat landing used for shore fishing, swimming and boat launching, and parking along the east shore, 5 miles above Wyman dam;
- two roadside pull-off areas along Route 201 used for picnicking and sightseeing;
- a boat launch and parking area for 25 vehicles, 12 miles above Wyman dam in the town of Caratunk; and
- several overnight, primitive campsites along the shore of the Wyman impoundment.

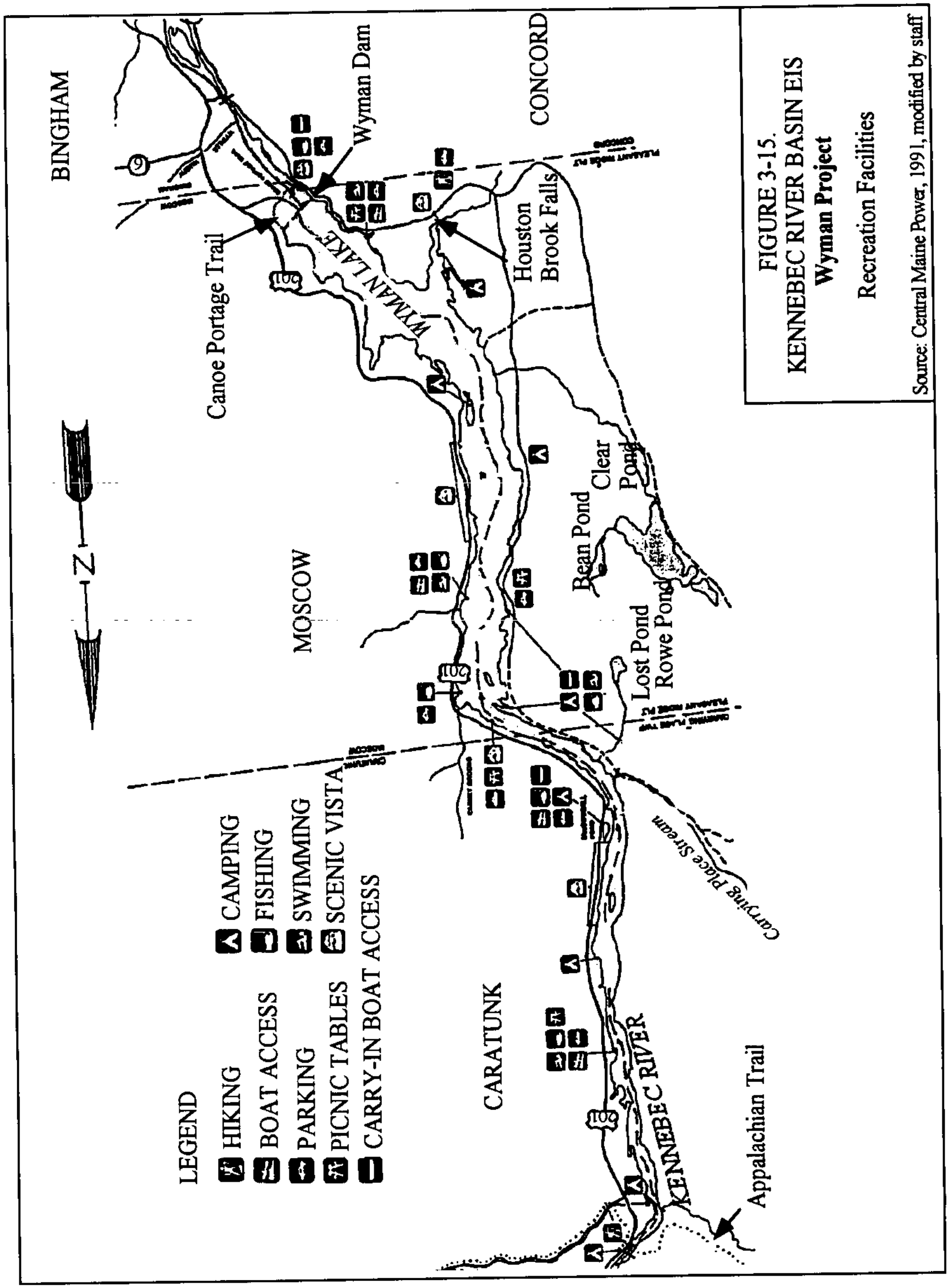



FIGURE 3-15.
KENNEBEC RIVER BASIN EIS
**Wyman Project**
Recreation Facilities

Source: Central Maine Power, 1991, modified by staff

There are no whitewater runs within the limits of this project. Whitewater users, however, take advantage of Wyman's camping, picnicking, and swimming areas both before and after whitewater trips to other parts of Maine.

In addition to the Wyman Project lands, CMP owns large tracts of land that abut the project. These lands are open to the public for activities such as hunting, trapping, snowmobiling, hiking, and camping. Public use of these lands is expected to increase in the future.

*Appalachian Trail*

The Appalachian Trail, a federally designated National Scenic Trail, crosses the Kennebec River at the northernmost end of the project. CMP sold NPS a 3,000-foot-wide corridor along the west side of the Kennebec River and granted NPS an easement on the east side of the river. A private outfitter provides a canoe shuttle across the river for hikers. In 1985, a hiker drowned attempting to ford the Kennebec River at the trail crossing.

The flow rate in the Kennebec River at the ferry crossing varies between 1,000 and 10,000 cfs during the summer months with a typical flow of about 2,000 to 3,000 cfs. At 10,000 cfs, the river is likely to be at its deepest point, and the water at the ferry crossing is between 8 and 9 feet deep. Here the river enters waters that are affected by Wyman Lake. The river slows markedly to less than 1 fps at the observed flow rate of 6,000 cfs, and the width of the river is just under 100 yards. The difficulty in crossing the Kennebec River at the Appalachian Trail (AT) varies with, among other things, the river flows, water depths, and the physical ability of the person attempting to cross the river. The riverbed at the ferry crossing consists of round stones with an estimated average stone size of 6 inches in diameter. The bottom slopes down at approximately 10 percent and becomes steeper toward the middle of the river. At 6,000 cfs, the middle 50 yards at the ferry crossing are more than 6 feet deep.

Two hundred yards north of the ferry crossing, the river widens and becomes shallow to create slight rips. The width at this gravel bar section is about 175 yards. The gravel bar is much shallower than the ferry crossing, with a maximum depth of 4 feet (at 6,000 cfs). This section has a large rock bottom similar to that at the ferry crossing.

Since 1986, the Maine Appalachian Trail Club and the Appalachian Trail Conference have jointly funded and provided a ferry service for most of the hiking season (June through October). This service was offered for 2 hours each day. In 1995, the ferry service was expanded to 4 hours per day (from 10 am to 12 pm and from 3 pm to 5 pm) from early August through early October in addition to the 2-hour service between late May and early August. This ferry is offered at no cost to AT hikers.

On the east side of the Kennebec River at the trail crossing, there are currently four campsites. On the west side of the river, there is an area that is used for camping. However, MATC and ATC discourage camping along the Kennebec River near the AT crossing.

In 1995, nearly 1,000 people used the free ferry service, and nearly 200 people were observed fording the river during the hours the ferry service was operating. From 1992 to 1995, ferry use more than doubled from 462 to 982 (ATC comment letter dated April 5, 1996).

*3.3.7.4 Sandy River*

The Sandy River Project creates an impoundment that is about 2.5 miles long and covers 150 acres. Most land abutting the impoundment is privately owned farm land and forest. The most popular recreational activities in the project area are fishing downstream of the dam for trout and bass; fishing on the impoundment for bass; and waterfowl hunting, swimming, and picnicking on the impoundment.

There is currently no public access to the project area. Private access is from fields along the impoundment or from a farm field off the River Road in Starks from which anglers walk to fish downstream of the dam. There is also a private dirt road on the south side of the river that anglers follow for access to the project area (Figure 3-16).

Whitewater canoeing occurs upstream of the Sandy River impoundment. In Section 3.1.8.2, we describe the whitewater boating upstream on the Sandy River.

MEW performed a recreation use study in 1992 using spot counts and interviews with local people. Based on the recreation use spot checks conducted in 1992, we estimate that there are 2,000 user-days of recreation in the Sandy River Project area per year. About half of the use is fishing in the tailrace and half is fishing, picnicking, and swimming on the impoundment. The most common comment from people interviewed was that the lack of access to the tailrace and impoundment at the Sandy River Project limits their recreational activity in the project area.

*3.3.7.5 Weston*

The primary recreational activities in the Weston Project area include fishing, boating, and picnicking. CMP estimates that there are nearly 36,000 annual user-days of recreation at

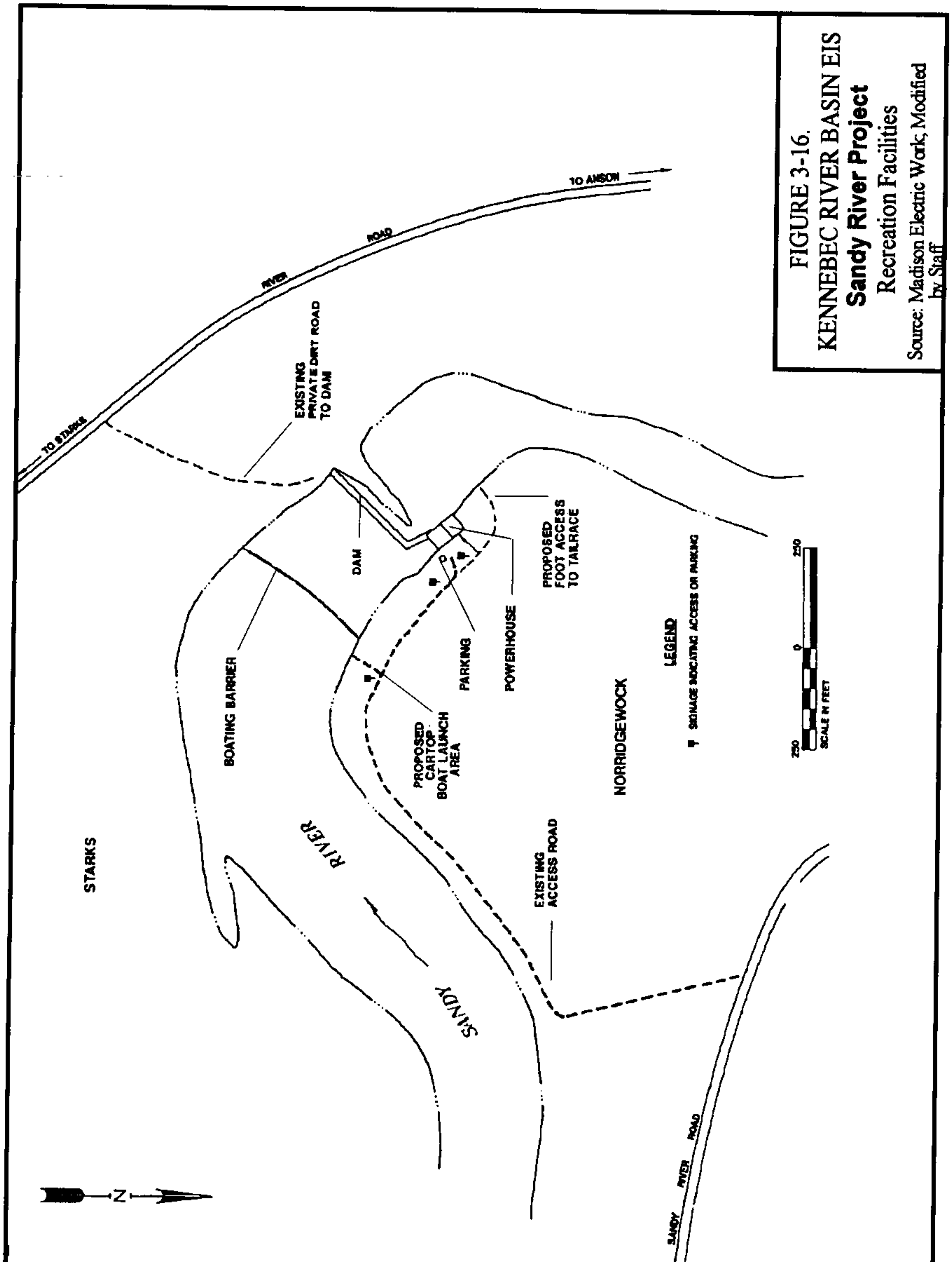



FIGURE 3-16.
KENNEBEC RIVER BASIN EIS
**Sandy River Project**
Recreation Facilities
Source: Madison Electric Work, Modified by Staff

the Weston Project. The highest concentration of anglers is normally along the tailrace shoreline, but fishing is also popular on the impoundment. While boating on the impoundment is typically day use and associated with fishing, a few canoeists traverse the area on extended trips down the river. Boating immediately below the dam is limited to experienced whitewater boaters. Most picnicking use in the project area occurs at Oosoola Park, which is owned by the town of Norridgewock (Figure 3-17).

Within the project boundary, access to the impoundment is provided about 5 miles upstream of the dam in the town of Norridgewock. These access sites include Oosoola Park, a multi-use municipal park providing parking, a boat launch, and a picnic area. CMP purchased land adjacent to this park in 1990 to accommodate any increased use. Along the opposite shoreline, the Maine Department of Transportation owns an informal access area that provides parking, carry-in boat access, and fishing.

Additional access to the impoundment is provided about 12.5 miles upstream of the project dam at the Abenaki Project. The site is owned by the Madison Paper Industries and provides carry-in boat access, fishing, and a picnic area.

Below the dam, CMP owns a parking lot and land near the town of Skowhegan's pedestrian bridge. From this parking lot, anglers and whitewater boaters walk along rugged, steep paths to access the south side of the river shoreline. Because of the steep slopes and whitewater rapids, CMP discourages use in this area. Fishing in the tailrace is likely to eventually increase, however, since CMP plans to provide upstream and downstream fish passage facilities.

The stretch of whitewater below the dam is about 400-yards long, and it is rated as Class II whitewater. Recreational use of the rapids is currently limited and of local significance. Future whitewater boating activity at the project is unlikely to increase because the rapids are short, and there are abundant regional whitewater recreational opportunities.

Canoe portage around Weston dam would help extended boat trips on the Kennebec River. CMP suggested two possible take-out locations on opposite sides of the river, both with corresponding portage trails leading through the town of Skowhegan. The trails for both portages would cross Route 201 (a heavily traveled, urban thoroughfare) and follow a residential street for about 0.5 mile with a put-in directly upstream of the town sewage treatment plant.

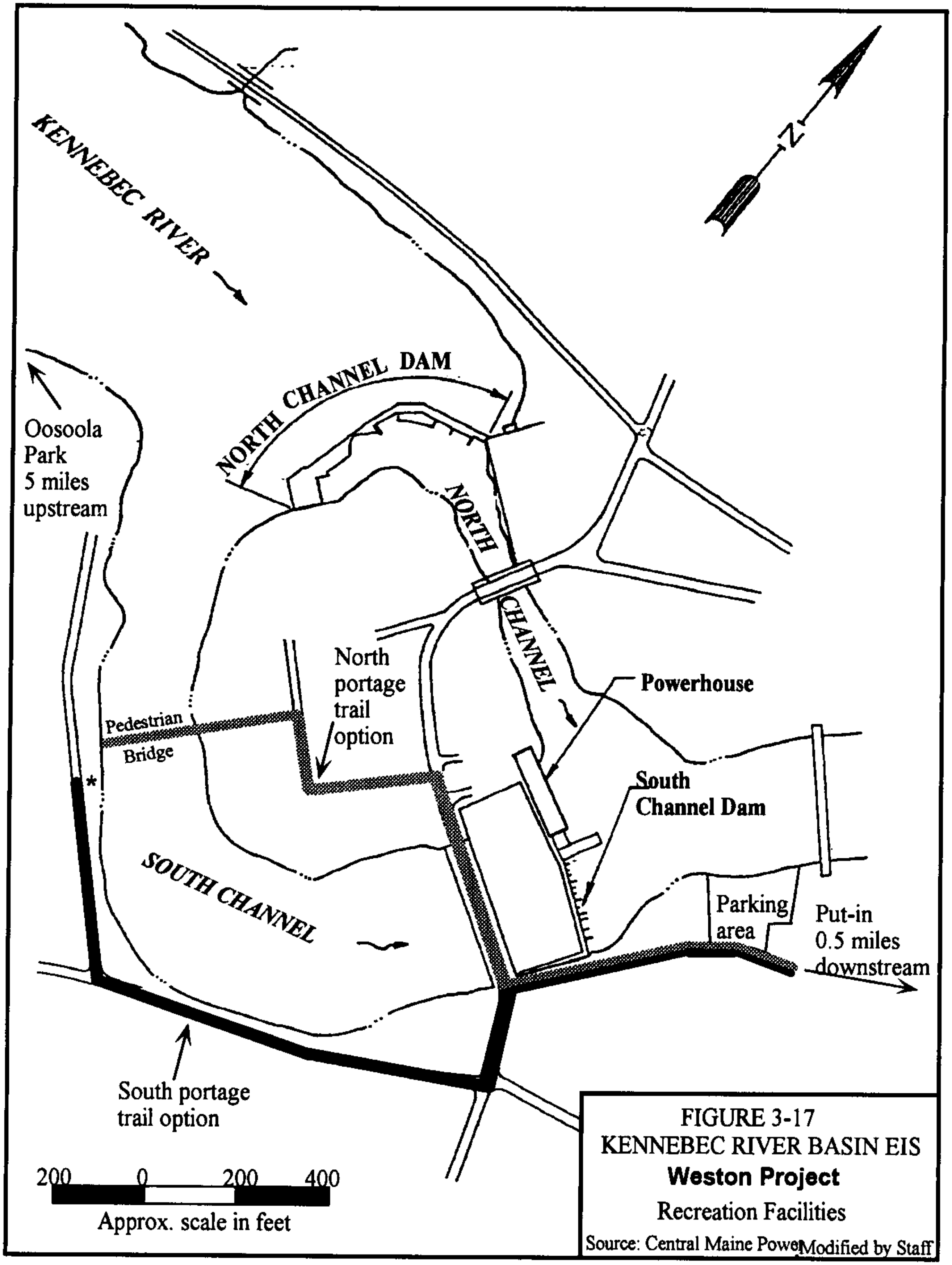



FIGURE 3-17
KENNEBEC RIVER BASIN EIS
**Weston Project**
Recreation Facilities
Source: Central Maine Power Modified by Staff

### *3.3.7.6 Fort Halifax*

Recreational activities occurring in the Fort Halifax Project area include fishing downstream of the dam and fishing, boating, and duck hunting on the impoundment. Anglers fish for brown trout and smallmouth bass downstream of Fort Halifax dam and on the impoundment. Most fishing below the dam takes place during the spring from the bank, or by wading during low flow periods. Fishing on the impoundment is concentrated near the Garland Road access site 4 miles upstream of the dam.

Fishing activity is light to moderate in the project area depending on the season. Heaviest use is in the spring and early summer. Some boating with canoes and small skiffs occurs on the impoundment, but boating use is not heavy and most activity is fishing-related. The river in the project area has not been popular for swimming because of historically poor water quality.

CMP estimates that there are nearly 20,000 annual user-days of recreational participation in the Fort Halifax Project area. Most of this use is fishing, particularly below the dam.

The existing recreation facilities and access at the project (Figure 3-18) include:

- a primitive carry-in boat launch facility about 350 feet upstream of the dam with off-road gravel parking on the shoulders of the access road;
- a primitive foot trail to tailrace fishing sites on the south shore of the river that can be reached via the gravel access road;
- a canoe portage trail around the south side of the dam;
- the Garland Road carry-in access and fishing site, 4 miles upstream of the dam, which provides informal access for people with car-top boats and a small area for bank and wading anglers;
- the Fort Halifax Park, which is 900 feet from the powerhouse, is maintained by the Maine BPR as a historic site, provides fishing access to the north shore of the project tailwaters, and has parking for as many as 50 vehicles; and
- a walk-in access site for anglers several hundred feet upstream of the dam.

Recreation in the Fort Halifax Project area is limited to local use because of the proximity of superior substitute locations for fishing, boating, and duck hunting and the overall

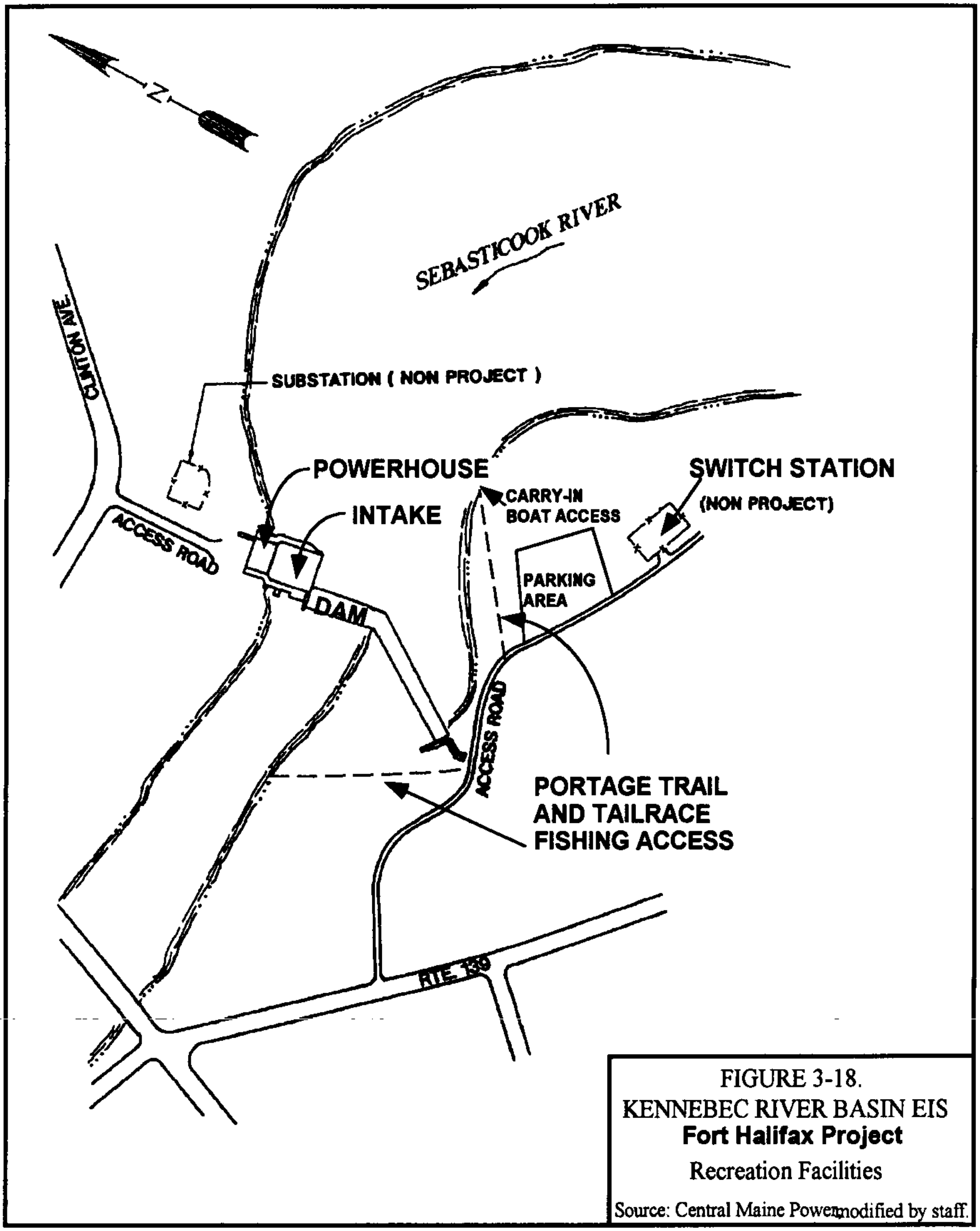



FIGURE 3-18.
KENNEBEC RIVER BASIN EIS
**Fort Halifax Project**
Recreation Facilities
Source: Central Maine Power modified by staff.

lack of access to the Sebasticook River in the project area. The new boat ramp CMP constructed in Waterville, which provides access to the Kennebec and Sebasticook Rivers below the project dam, continued improvement in water quality, and improving fisheries should increase angling in the project area.

*3.3.7.7 Oakland*

The Oakland Project area includes Messalonskee Lake and dam and Oakland dam and impoundment. Messalonskee Lake (also known as Snow Pond), which extends 15 miles upstream and covers 3,600 acres, is the farthest downstream of the Belgrade Lakes, which also include Great Pond, Long Pond, the McGrath Lakes, East Pond, and North Pond. The Belgrade Lakes are renowned for their fishing and pleasant rural setting, and are a popular summer resort area. The shoreline of Messalonskee Lake has been heavily developed with seasonal cottages and, more recently, year-round homes.

There are public recreation access areas at the north and south ends and near the middle of Messalonskee Lake. This lake is one of the most heavily used of the Belgrade chain-of-lakes, and it is a regionally significant recreation resource for shoreline cottages, camps, and homes and recreational activities. Recreational activities on the lake include: boat and bank fishing, swimming, water skiing, windsurfing, duck hunting, ice fishing, and snowmobiling. Fishing is the primary activity supporting bass, perch, pickerel, northern pike, landlocked salmon, and brook trout. The southern end of Messalonskee Lake is a large wetland, which provides opportunity for duck hunting and bird watching.

Existing recreation facilities on or near Messalonskee Lake (Figure 3-19) include:

- a boat ramp at the southern end of the lake, which is maintained by the Maine BPR and has parking for 25 to 30 vehicles;
- a commercial day-use area with a hard surface boat ramp at Bangs Point on the lake in Sidney, Maine;
- a gravel boat launch with limited parking also in Sidney;
- a hard surface boat launch with parking for 10-12 vehicles on the northwest shore of the lake in the town of Oakland; and
- a parking and informal day-use area at the outlet of the lake with roadside parking for three vehicles.

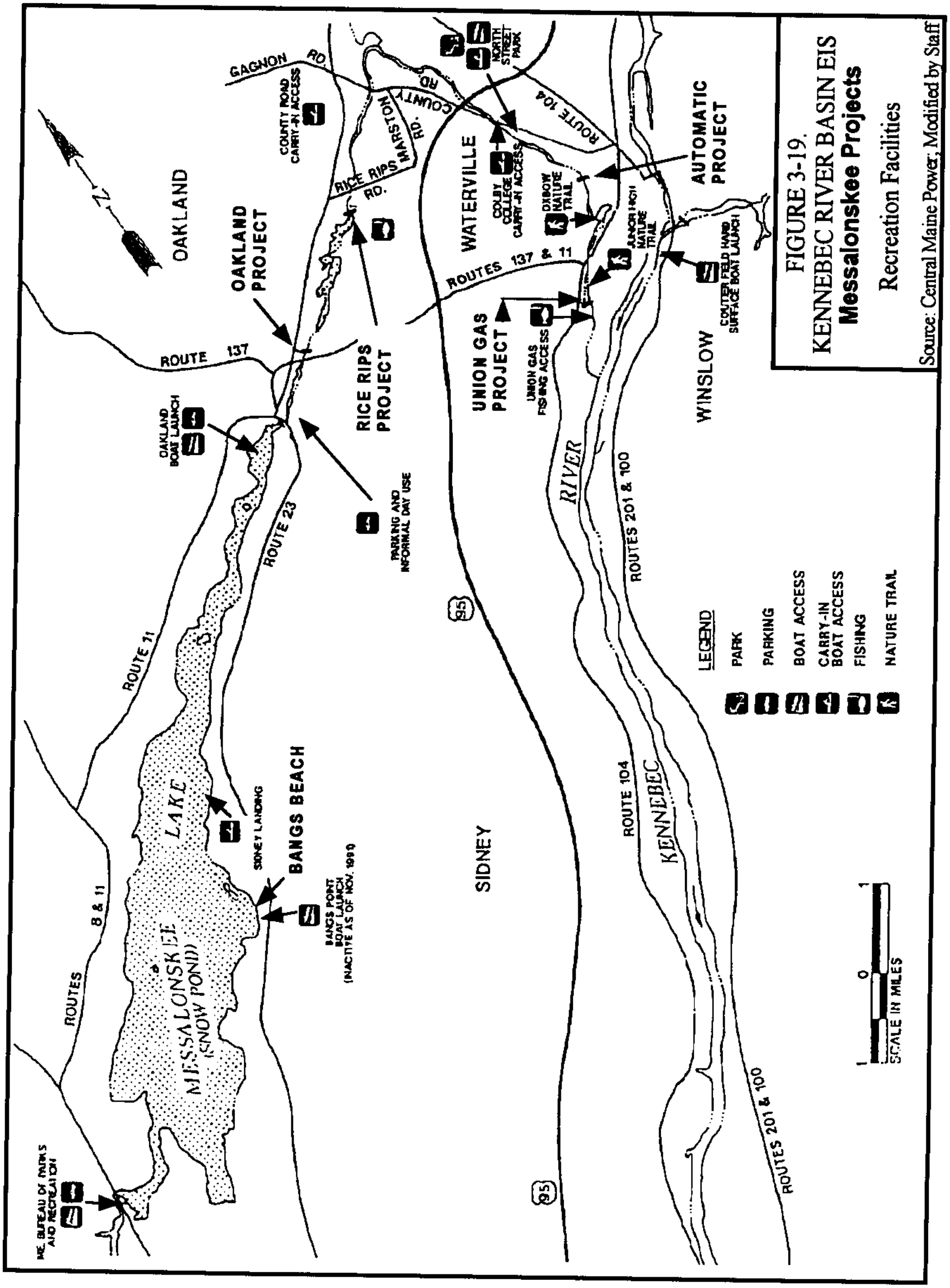



FIGURE 3-19.
KENNEBEC RIVER BASIN EIS
**Messalonskee Projects**
Recreation Facilities
Source: Central Maine Power; Modified by Staff

Recreation at Oakland dam and impoundment is limited to fishing and swimming above and below the dam. There are no improved recreational facilities at the Oakland Development because of the nature and inaccessibility of the river gorge below the powerhouse.

CMP estimates that there are more than 250,000 annual user-days of recreation on Messalonskee Lake and 5,000 annual user-days of recreation at the Oakland dam and impoundment. Most use on Messalonskee Lake is boat fishing, and most recreation at the Oakland Development is fishing below the dam. About 85 percent of recreation activity occurs during the day, and 70 percent of recreation use originates from public access sites.

CMP estimates that weekend use during the recreation season is at 75 percent or less capacity at all of the public recreational access facilities in the Oakland Project area.

CMP reports that the North Kennebec Regional Planning Commission recommends location of a day-use park in the northern part of the Belgrade Lakes, and a 1977 Maine BPR study also recommends a day-use park for the northern part of the Belgrade Lakes. Population growth near Messalonskee Lake and Stream and improvements in water quality are likely to encourage increased recreation use in the area.

Use of Messalonskee Lake is expected to increase due to continued development of year-round and seasonal homes, continuance of MDIFW's trout stocking program, and increasing popularity of the Belgrade Lakes with tourists and recreationists. Fishing, boating, picnicking, swimming, and snowmobiling are expected to increase, and other uses should remain stable. CMP does not encourage increased recreation activity at the Oakland Development because of safety concerns related to the steepness of the gorge, the moderate stream gradient, and substantial flows in periods of high water. CMP expects recreational use at Oakland to remain stable and limited to local people familiar with the area.

*3.3.7.8 Rice Rips*

The Rice Rips Project area is 2 miles downstream of the Oakland Project (Figure 3-19). The area around the Rice Rips Project is predominantly forest and rural/residential land. The project impoundment extends 1.6 miles upstream from the dam, and it has a surface area of 87 acres at normal surface elevation.

There are no developed recreation areas in the Rice Rips Project area. There is fishing, however, along the shores of the impoundment, below the powerhouse, and in the Rice Rips bypass area. In the bypass area, MDIFW has instituted an experimental brown trout stocking program, and a few wild brook trout are also present. Some boating and swimming occurs on the Rice Rips impoundment, and people hunt ducks in the project area. An informal roadside parking area between the dam and the powerhouse provides parking for six vehicles along Rice Rips Road.

CMP owns property along the east shore of Messalonskee Stream from Oakland dam along the Rice Rips impoundment to Rice Rips dam. The terrain along this stretch is steep with forest cover. An informal trail exists along the top of the gorge at Oakland and along the Rice Rips impoundment shore. CMP owns adjacent nonproject land that is managed for timber production. Currently, local people use the property for hunting and fishing.

CMP estimates that there are more than 17,000 annual user-days of recreation at the Rice Rips Project. The unimproved sites are all at less than 25 percent capacity on weekends during the recreation season.

The 1988 Maine SCORP (MDOC, 1988) concludes that the Waterville urban area needs more parks and swimming and picnicking facilities. Fishing is expected to increase as MDIFW's stocking programs upstream become better established.

Fishing use is expected to increase if efforts to enhance the stream's coldwater fishery succeed. Other uses, such as swimming and boating, may increase somewhat in the project area as a result of proposed measures to improve water quality in the Rice Rips impoundment.

*3.3.7.9 Automatic*

The Automatic Project is in a residential area of Waterville (Figure 3-19). The impoundment extends 4.5 miles upstream from the dam, and it has a surface area of approximately 68 acres. There is some fishing on the Automatic impoundment, the tailrace section below the powerhouse, and the section of stream abutting the Union Gas impoundment downstream. Anglers catch warmwater species and some brown trout. Duck hunting and canoeing also occur on the Automatic impoundment.

North Street Park in Waterville is along the east bank of Messalonskee Stream and provides a picnic area, playground, athletic fields, and carry-in boat access for public use. An annual canoe race is held along this section of the Messalonskee Stream, and students and faculty recreate along the stretch of the stream adjacent to the campus of Colby College. Winter uses of the Automatic Project include snowmobiling, ice skating, and cross-country skiing.

Existing recreation facilities at the Automatic Project include: an upstream boat access site that is part of the larger North Street Park and is owned and operated by the city of

Waterville, a boat launch for carry-in boats, and parking for 10 vehicles at Colby College. There are also several informal boat access sites around the impoundment.

CMP estimates that there are more than 18,000 annual user-days of recreation at the Automatic Project. Most use is boat and bank fishing on the impoundment, and about 85 percent of the recreation activity occurs during the day. About 90 percent of the recreation use originates from private access sites. The public access sites are all at less than 25 percent capacity on weekends during the recreation season.

*3.3.7.10 Union Gas*

The Union Gas Project is on the lower Messalonskee Stream at the edge of the residential/business area of Waterville. The impoundment extends over 1 mile upstream from the dam, and it has a surface area of 25 acres. Recreation use in the Union Gas Project area includes fishing, walking the area's formal and informal trails, all-terrain-vehicle (ATV) use, and boating on the impoundment. MDIFW operates a brown trout management program in the Kennebec River that provides fish up to the Union Gas tailrace. Spring brown trout fishing is popular in the project area.

Existing recreation facilities at the Union Gas Project include (Figure 3-19): (a) the Oxbow Nature Trail, which includes open space areas, a walking trail, and a carry-in boat access to the tailrace area; and (b) the Junior High School Nature Trail, which offers walking access to Messalonskee Stream below the dam. In 1989, CMP constructed the Couture Field boat launch on the Kennebec River in Waterville, upstream of the Messalonskee Stream confluence. This facility enables boaters to launch and motor to the Union Gas tailrace. The facility has a hard-surface boat launch, 9 picnic tables and grills, and parking capacity for 20 vehicles with trailers.

Several unimproved fishing sites above and below the dam and powerhouse on the west side of Messalonskee Stream are used by anglers, and several old logging roads are used by ATV riders.

CMP estimates that there are 3,700 annual user-days of recreation at the Union Gas Project. Most use is bank fishing downstream of the powerhouse. Nearly all recreation activity occurs during the day. Eighty percent of the recreation in the project area originates from public recreation access points. The access sites are all at 25 percent or less capacity on weekends during the recreation season.

### *3.3.7.11 Edwards*

Recreation opportunity in the Edwards Project area is primarily limited to fishing downstream of the dam and on the 1,143-acre impoundment. Motor boating, water skiing, canoeing, and swimming on the Edwards impoundment occur infrequently because there are numerous other lakes, ponds, and rivers near the project. The physical characteristics of the impoundment, such as the narrowness of the river, the presence of rock outcrops, and the shallow water depths, also are limiting. There are a limited number of public and private access facilities.

Anglers fish for Atlantic salmon, striped bass, brown trout, and smelt downstream of Edwards dam. Fishing for Atlantic salmon downstream of Edwards dam fluctuates in response to the annual run size. Fishing for striped bass occurs downstream of Edwards dam primarily from August through October. The availability of striped bass in the project area is linked to the presence of forage species such as alewife. Brown trout are caught occasionally from shore during the high spring flows and during the fall. Boat fishing for brown trout occurs during the summer immediately below the spillway. Availability of brown trout downstream of Edwards dam is probably due to the stocking of fish in upriver areas and subsequent downstream passage.

Smallmouth bass and brown trout are the primary species pursued by anglers on the Edwards impoundment. Fishing on the impoundment is concentrated near the Sidney boat launch and the confluences of several small streams feeding the Kennebec River. Wading anglers in the project area are limited by steep banks and a lack of shallow, cobbled areas, even near the confluences of tributary streams. Wading anglers fish near Fort Halifax in Waterville and below Edwards dam near the confluence with Bond Brook. Both areas are outside of the Edwards Project area.

Recreation use in the Edwards Project area was about 5,000 user days in 1994 (SWETS, 1995). Sixty percent of the recreation use was fishing for Atlantic salmon, striped bass, and brown trout downstream of Edwards dam. Other recreation use in the project area was boat fishing for smallmouth bass and motor boating on the Edwards impoundment.

There are four public recreation facilities that offer access to the Edwards Project area (Figure 3-20). CMP owns and operates a boat launch, picnic facilities, and parking area on the west bank of the Kennebec River in Waterville less than 1 mile upstream of the confluence of Messalonskee Stream and the Kennebec River. The CMP facility provides angler and boating access to the Kennebec River in the Edwards Project area. The facility offers a hard-surface boat ramp, 9 picnic tables, and parking for 20 vehicles with trailers.

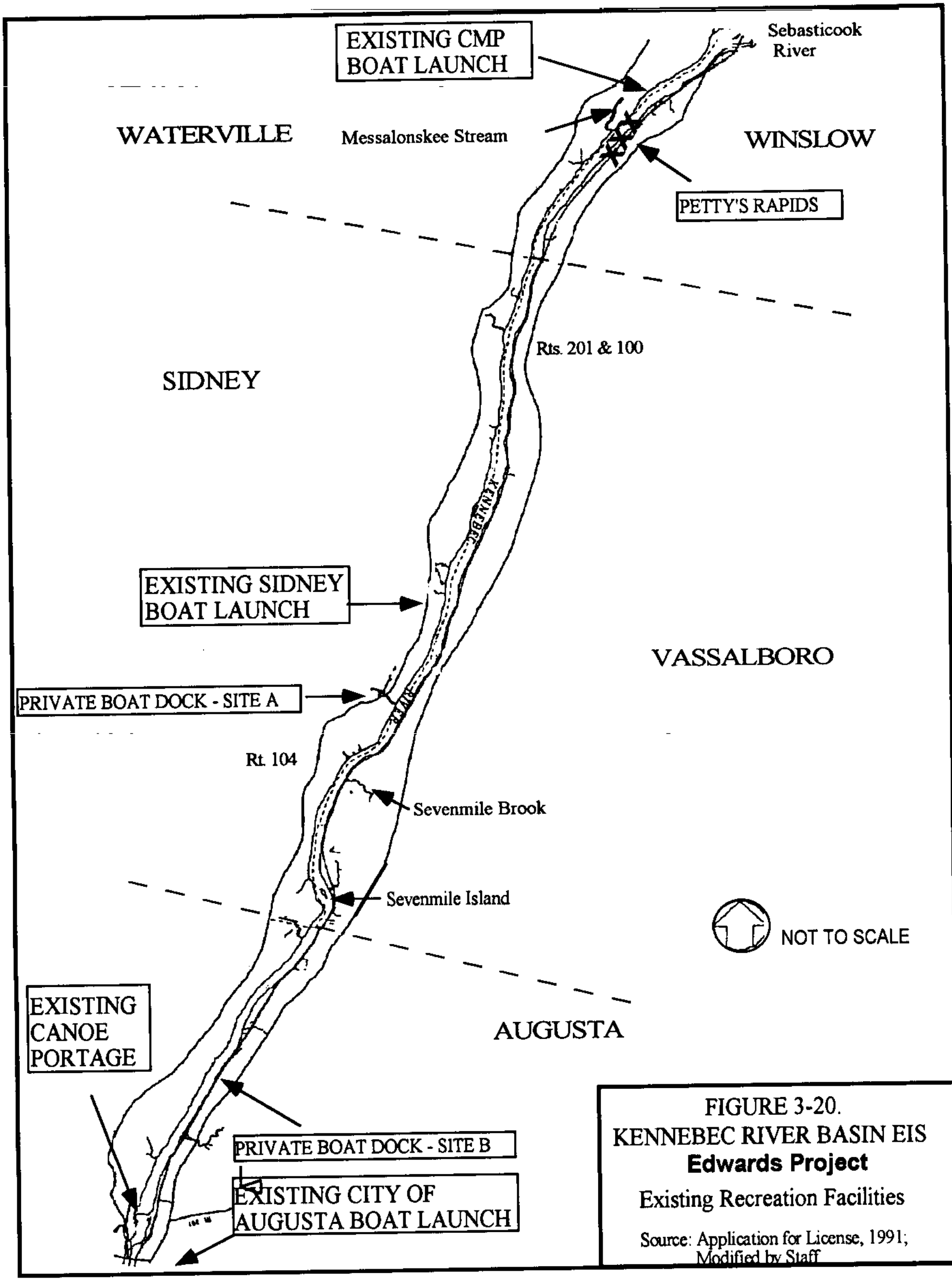



FIGURE 3-20.
KENNEBEC RIVER BASIN EIS
**Edwards Project**
Existing Recreation Facilities

Source: Application for License, 1991; Modified by Staff

The town of Sidney owns and operates a park with boat access on the west bank of the Kennebec River about 8 river miles upstream of Edwards dam. The park has an unmarked, gravel parking area with room for about 25 vehicles. The boat access is a single-lane ramp suitable for launching medium sized (up to 16 foot) and smaller boats. The park has two athletic fields several hundred feet from the river bank and a single-lane dirt road extending several hundred feet south from the parking area into a wooded area along the riverfront.

Edwards maintains a canoe portage trail, two parking areas, and a stairway down to the tailrace of the project. The 3,300-foot-long portage trail on the west side of the Kennebec River begins at a take-out point about 750 feet upstream of Edwards dam and travels south through a wooded area for 200 feet. The next 2,000 feet extends south through a 20-vehicle, gravel parking area, down Edwards dam access road, and to Water Street in Augusta. The portage route then crosses a large clearing, which is used as a parking area, covering 900 feet to a set of stairs, then down the stairs and 200 feet to the Kennebec River shoreline. The stairs are primarily used by anglers fishing the Edwards dam tailwaters for Atlantic salmon, striped bass, and brown trout. The parking area adjacent to the stairs can accommodate at least 50 vehicles.

The city of Augusta owns and maintains a park with a boat launch, picnic facilities, and parking area about 1 mile downstream of Edwards dam, adjacent to Fort Western, on the east bank of the Kennebec River. This park is outside of the Edwards Project area, but anglers launch their boats here and motor upstream to the base of Edwards dam to fish for Atlantic salmon, striped bass, and brown trout. The park has one boat ramp, a boat pier, and parking for 20 vehicles.

In addition to these public access facilities, there are two small, private boat docks used to moor small (about 14-foot) boats on the impoundment. The lack of private recreation facilities on the Edwards impoundment is due primarily to the steep banks along the length of the impoundment that restrict easy access to the water.

There are 24 lakes and ponds with public boat launches in Kennebec County, all of which are within an hour's drive from the Edwards impoundment. At a minimum, all of these water bodies offer largemouth bass, smallmouth bass, and white perch fishing, and most offer brown and brook trout fishing. These two dozen lakes and ponds combine for more than 40,000 acres of surface water for public flatwater fishing within an hour of the Edwards impoundment. There are also 84 other lakes and ponds in Kennebec County with private access for flatwater fishing (DeLorme, 1989).

In Section 3.1.8.1, we discuss angling opportunity for Atlantic salmon and striped bass within an hour's drive of the Edwards Project. Within an hour's drive of Edwards impoundment, there are five noted river segments that offer whitewater canoeing and kayaking. The following rivers offer Class I to Class III boating: Cobbosseecontee Stream, Little Androscoggin River, Nezinscot River, St. George River, and Sheepscot River (Section 3.1.8.2 describes whitewater boating on these rivers).

### 3.3.8 Land Use

#### *3.3.8.1 Moosehead*

The normal full pond elevation and project boundary of the Moosehead Project is 1,029 feet msl. About 74 percent of the land surrounding the Moosehead reservoir is undeveloped forest land. The remaining 26 percent of the land immediately adjacent to the project is residential with limited commercial and industrial uses. The most dense residential development extends along the southwest shoreline from Greenville to the unincorporated territory of Rockwood (population 375) with 900 dwellings; 75 percent of these dwellings are seasonal. About 1,500 small lots and camps exist elsewhere along the southern shoreline. Overall, about 2,600 seasonal and year-round homes are within 1,000 feet of the shoreline.

The remaining shoreline consists of large lots held by paper companies and private owners. KWP owns 5.03 acres of land near the East Outlet and the West Outlet dams.

MLURC and the town of Greenville control land use within 250 feet of the shore and require permits for all but minor changes. Most undeveloped shoreline is included in a MLURC Resource Protection District or municipal Shoreland Zoning Ordinance. The Maine Wildland Lakes Assessment attributed outstanding values to all resources surveyed around Moosehead Lake in 1986. Subsequently, MLURC classified Moosehead as a Management Class 7 lake (Table 3-15) subject to further study (MLURC Comprehensive Land Use Plan as amended July 7, 1990).

#### *3.3.8.2 Moxie*

Commercial forest land management is the predominant land use in the Moxie Stream watershed. Much of the land is under MLURC jurisdiction, and it is designated for forestry and agricultural activities. There are 170 seasonal dwellings and camps within 1,000 feet of the shoreline primarily along the western side of the impoundment, consistent with the Residential Development subdistrict zoning. MLURC designated a 500-foot Recreation Protection Subdivision along the southwestern quarter of the shoreline where the Appalachian Trail corridor approaches the impoundment shore at Joe's Hole.

The eastern shoreline of the impoundment is less developed, and MLURC regulates it as a Great Pond Protection Subdivision with limited residential development. At the northern end of Mosquito Narrow, about 1.5 miles are zoned residential and less than 1 mile is within a General Management Plan zone. Most land is privately owned. The Owners control 26.5 acres in the immediate vicinity of the dam.

*3.3.8.3 Wyman*

Timber harvesting and recreation constitute the major land and water uses on the largely undeveloped lands around the Wyman Project. U.S. 201 runs parallel along the east side of the river and provides the primary north/south access in the region. The small towns of Bingham, Caratunk, and Moscow are on the east side of the impoundment. The west side is primarily undeveloped with limited access and half a dozen seasonal cottages within the project boundaries. There is no access along the western shore of the impoundment north of Carrying Place Stream. CMP owns 2,108.6 acres of land abutting the perimeter of the entire impoundment, which extends 14.4 miles upstream of the dam. CMP-owned land generally extends several hundred feet from the shoreline upstream of the dam and 1,000 feet from the shoreline at the dam. Downstream, below Austin Stream, CMP owns a strip of land 10 feet wide on the eastern side and no land on the western side.

Within Caratunk, NPS owns a total of 191.54 acres in fee and 13.06 acres in easement for the AT, including approximately 27 acres in the area between the east bank and U.S. 201. On the west bank of the river, NPS owns a total of 737.86 acres in fee and 112.74 acres in easement, including a 32-acre easement for the Appalachian Trail at the northern end of the impoundment. A small saw mill operates just south of Caratunk between the river and Route 201. In 1989, FERC approved the development of a salmon hatchery in a small area just downstream of the confluence with Austin Stream. All land uses within 250 feet of the shoreline are regulated by MLURC or by municipal shoreland ordinances, consistent with the Maine Shoreland Zoning Act.

*3.3.8.4 Sandy River*

Agricultural uses dominate the land near the Sandy River Project, which is in the towns of Norridgewock and Starks. Cleared land along the flood plain is cultivated, and dwellings tend to be associated with the farms. Most land along the impoundment is in private ownership, and there are no state or publicly owned recreational areas. Water uses include fishing above and below the dam and swimming in the impoundment. Access to the project area is limited. MEW owns 5 acres necessary to access the powerhouse on the east side and 6.5 acres on the west bank adjacent to the dam. Forested uplands surround the low lying flood plains. Norridgewock and Starks have adopted shoreland protection zoning for land uses within 250 feet of the shoreline, consistent with the Maine Shoreland Zoning Act.

#### *3.3.8.5 Weston*

Land uses adjacent to the Weston Project include agricultural fields, residential development, undeveloped woodlots, and transportation routes. A narrow strip of forested land and open fields forms the border of the impoundment. An area of dense, mixed development in Skowhegan provides the setting for the dam. Woolen and shoe industries drive the Skowhegan economy.

The second area of residential development is the village of Norridgewock on the south side of the impoundment 6 miles up-stream of the dam. Within Norridgewock, Oosoola Park is on the impoundment, immediately downstream of Mill Stream. Route 2/201A parallels the south shore from Skowhegan to Norridgewock where it crosses the river and then runs parallel on the north side to Madison. The Maine Central Railroad (MCRR) also parallels the river from Norridgewock to Madison, between the highway and the river. Skowhegan and Norridgewock have adopted shoreland protection zones for land uses within 250 feet of the shoreline consistent with the Maine Shoreland Zoning Act. CMP owns about 21.4 acres of project land in Skowhegan near the powerhouse and dam.

#### *3.3.8.6 Fort Halifax*

Land use near the Fort Halifax Development is primarily agriculture and rural residential development. Riparian forests typically exist in a narrow stand between the impoundment margin and large tracts of old field and agricultural land. The dam is in the densely settled town of Winslow. Rural lands extend along the length of the impoundment with small farms within site of the shore. Winslow and Benton have adopted shoreland protection zoning for land uses within 250 feet of the shoreline and within the 100-year flood plain consistent with the Maine Shoreland Zoning Act. CMP owns 8 acres of project land in Winslow in the immediate vicinity of the dam and powerhouse and in Benton at the upstream end of the impoundment.

#### *3.3.8.7 Messalonskee Projects*

Land use along Messalonskee Stream varies from dense industrial and commercial use in Waterville and Oakland to agricultural and forestry use in Belgrade and Sidney. There is a sizable park and natural area along the stream oxbow in the Union Gas impoundment adjacent to downtown Waterville. CMP's transmission line corridors and MCRR rights-of-way travel through the project area, frequently parallel to the shorelines and crossing Messalonskee Stream at several locations. Oakland, Sidney, and Belgrade have adopted shoreland zoning ordinances. Waterville has adopted comprehensive land use zoning, which includes a Waterways Conservation Ordinance consistent with the Maine Shoreland Zoning Act.

CMP owns 72.8 acres of project land at the Messalonskee Project. This land is generally in the vicinity of the Oakland powerhouse and dam in Oakland, Sidney, and Belgrade; near the Rice Rips dam and powerhouse in Oakland; and in the immediate vicinity of the Union Gas Project dam and powerhouse. In addition, CMP owns 234.4 acres of nonproject land including approximately 237 acres along the east side of Messalonskee Stream between the Oakland and Rice Rips Projects, which has been recommended for study as a greenbelt managed for timber (Section 4.1.8.9).

#### *3.3.8.8 Edwards*

There are five municipalities on the Kennebec River along the Edwards Project impoundment. The city of Augusta occupies land on both banks of the river; Sidney and Waterville are on the west bank; and Vassalboro and Winslow occupy the east bank. Sidney, Vassalboro, and Winslow are large bedroom communities for government and industry jobs in Augusta to the south and Waterville to the north.

Development along the impoundment is concentrated in Augusta and Waterville, and large tracts of undeveloped forest lands and agricultural parcels border the Kennebec River on both banks. Municipal planning efforts in these communities have resulted in adoption of shoreland and municipal zoning ordinances that include criteria for protection of natural resources along the river corridor and within the towns' boundaries consistent with the Maine Shoreland Zoning Act.

### 3.3.9 Socioeconomics

#### *3.3.9.1 Moosehead*

The Moosehead Project is in Somerset and Piscataquis Counties on Moosehead Lake. These areas are unincorporated territories and have no major population centers. The largest town is Greenville, with a population of approximately 1,884 (according to the 1990 census). Rockwood, with a year-round population of about 350 (personal communication, D. Moreland, Total Quality Maine, and J.H. Rumpp, Jr., SWETS, September 11, 1995) is the only other population center on the lake.

Employment and industry in this region are limited. Jobs in the area are found in forest products, tourism, local and state government, and local sources. Much of the economy is supported by seasonal recreation spending and hunting, fishing, boating, and seasonal residences. Winter recreation including skiing and snowmobiling also plays a role in the local economy.

Development in the region is limited by people and natural resources. Regional economic development groups have created plans, including plans for a hardwood paneling plant, for attracting businesses and industry to the region. The local economy is fairly fragile, however, and it depends largely on external economies (personal communication, D. Moreland, Total Quality Maine, and J.H. Rumpp, Jr., SWETS, September 11, 1995).

*3.3.9.2 Moxie*

Both total population and overall density are low in the general vicinity of the Moxie Project. The Forks Plantation, about 5 miles west of Moxie Pond, had a population of 30 in 1990. The adjoining community to the west, West Forks, had a year-round population of 63 that same year (Commerce, 1990).

In addition to the year-round residents residing in the community noted by the Census, the Moxie Pond area has about 170 small cottages and camps used primarily as seasonal vacation retreats and hunting and fishing camps. The Owners hold title to 26.5 acres of land in the immediate vicinity of the dam. Four individual lots on the Owners' land are leased to camp owners on the lake.

*3.3.9.3 Wyman*

The Wyman Project is bounded on the east by the towns of Bingham, Moscow, and Caratunk Plantation, and on the west by the unorganized townships of Concord, Pleasant Ridge, and Carrying Place Township. These municipalities had the following populations as reported by the 1990 census of population: Bingham - 1,230, Moscow - 608, Caratunk Plantation - 98, and Pleasant Ridge - 91. No population data are available for Carrying Place Township or Concord (Commerce, 1990). Development and population have remained fairly stable in the region in the recent past.

The forest products industry is the major business in the area, and there are several lumber mills in the Bingham area. Recreation-related business also creates employment opportunities for residents, providing services for whitewater boating, fishing, and other related uses (personal communication, F. Higgins, Kennebec Valley Tourism Committee, and J.H. Rumpp, Jr., SWETS, August 22, 1995).

*3.3.9.4 Sandy River*

The Sandy River Project is on the Sandy River in the towns of Starks and Norridgewock. According to the 1990 census, the population of Starks was 508 and Norridgewock was 3,105.

The town of Starks is a rural community that serves as a bedroom community for businesses in Madison, Farmington, and Skowhegan. There is no commercial center in Starks; however, the town does contain several municipal buildings, and it is the residential center. There is only limited economic activity in the town, consisting of agriculture (corn, hay, dairy), small private forestry concerns, and home-based businesses (personal communication between G. Hilton, Starks Planning Board, and J.H. Rumpp, Jr., SWETS, March 28, 1995).

The town of Norridgewock is a rural community with some commercial establishments along its Main Street area. The community had a 1980 population of 2,552, which was an increase of about 29 percent since 1970. The 1990 population was 3,105, which is a 22 percent increase from 1980 figures (Census, 1990).

Norridgewock's major industries are the New Balance footwear manufacturing facility and the Central Maine Christmas Tree and Wreath Company. Agriculture (corn, hay, dairy) and small timber harvesting operations also contribute to the town's economy. Norridgewock also has a general aviation airport, which is the fourth busiest facility in the state, largely providing service for paper company business in the area (personal communication between F. Marshal, Norridgewock Planning Board, and J.H. Rumpp, Jr., SWETS, March 30, 1995).

*3.3.9.5 Weston*

The Weston Project is located in the towns of Skowhegan, Norridgewock, Starks, and Madison. The project dams are in Skowhegan's town center, and most of the impoundment is within the town of Norridgewock. The village of Norridgewock is adjacent to both the south and north sides of the impoundment about 6 miles upstream of the dam.

The village of Norridgewock and downtown Skowhegan are the population centers in the project area. Much of the project impoundment shoreline is undeveloped. The 1990 population of Skowhegan was reported to be 8,725, which is about an 8 percent increase from 1980 figures (8,098). The town of Norridgewock had a 1990 population of 3,105, which is a 22 percent increase from the 1980 figures (2,552).

Skowhegan's economy is largely based on the pulp and paper industry; S.D. Warren Company is the largest employer in town. Other employment is in shoe manufacturing, health services, and local government. Skowhegan has also experienced a recent growth in retail trade with the construction of a Walmart store and a new shopping center (personal communication between R. Grey, Skowhegan code enforcement officer, and J.H. Rumpp, Jr., SWETS, August 22, 1995).

#### *3.3.9.6 Fort Halifax*

The Fort Halifax dam and powerhouse are in a commercial/residential area in the town of Winslow. The small town of Benton is at the upstream end of the project impoundment. The town of Winslow reported a population of 7,997 in the 1990 census. This represents a decrease of 0.7 percent from the 1980 population of 8,057.

The Scott Paper Company is the major employer in Winslow, however, other employment opportunities occur in a major business area, the Winslow Economic Development Park, on Route 201 south of the town of Winslow. The site is zoned for mixed use, and it is currently occupied by Mid-State Machine Products, Sukee Ice Arena, Gibbs and Sons Pole Construction, and Waterville Window Company (MSDEC, 1994).

#### *3.3.9.7 Messalonskee Projects*

Physical attributes of Messalonskee Stream, such as its high gradient, steep banks, and several constrictions, encouraged its early development as a mill stream. Use of water resources played a key role in the industrial development that exists in both the Oakland and Waterville areas. Waterville is the major industrialized center in the project area. The Keyes Fibre Company, Hathaway Shirt, and MCRR, which are all along the Kennebec River, are the major employers in Waterville. The Cascade Woolen Mill on Messalonskee Stream just below the Oakland Development powerhouse, is the only significant industrial development in the town of Oakland.

The city of Waterville, with intensive development along both sides of lower Messalonskee Stream, is the area's major population center. Oakland, at the head of the stream and along the northern third of Messalonskee Lake, is the only other relatively populous area. Sidney and Belgrade, bordering the southern two-thirds of Messalonskee Lake, are significantly less developed towns.

According to the 1990 census, Waterville had a 1990 population of 17,173. The population for Oakland was 5,595, Belgrade was 2,375, and Sidney was 2,593 (Census, 1990). Seasonal population increases, however, can be significant in these areas.

### *3.3.9.8 Edwards*

Project facilities are in the city of Augusta, and the project impoundment stretches upstream through the town of Sidney, the city of Waterville, and the towns of Winslow, and Vassalboro. The city of Augusta is on the southern end of the study area on both the east and west banks of the Kennebec River. Augusta encompasses about 57 square miles and supports a population of about 21,300 (Census, 1990).

Because Edwards dam is within the city of Augusta, Edwards pays property taxes on the project to the city. The current assessed value of real estate (land and buildings) at the Edwards facility is $901,600. In addition, the city of Augusta levies a personal property tax on plant machinery (turbines, generators, transformers, etc.) valued at $3.2 million. The total tax bill for property associated with the facility was $89,004.72 in 1994 (using the 1994-95 tax rate of 0.02170 mills) (Augusta, 1994).

Information from the Commission's July 13, 1994 Scoping Meeting indicates that, as a result of an agreement between the city of Augusta and Edwards on December 13, 1992, additional fiscal benefits have accrued to the city. This agreement provides that, during the period 1991 through 1998, if Edwards operates the existing project, Edwards shall provide to the city 3 percent annually of the gross revenues through 1993 and 4 percent annually of the gross revenues for the years 1994 through 1998, in addition to any property tax payments that may be due. After December 31, 1998, until the license being applied for terminates or until the city purchases the project, the city shall continue to receive 3 percent of the gross revenues of the "New Project" (as developed under the current license application) (Augusta, 1992).

Based on the formula outlined in this agreement, the city received about $75,000 in above-tax revenues from Edwards in 1991 (Roundy, 1991). Using this figure, the gross annual revenues from the project were about $2.5 million in 1991. CMP reports indicate that the value of power at the Edwards Project was $2,915,679.85 in 1994, resulting in approximately $116,600 in above-tax revenue for the city of Augusta (Brook, 1995). During 1994 through 1998, the city could expect to receive similar sums annually, above property tax revenues, from Edwards for the Edwards Project if current rates remained in effect.

Vassalboro is on the east bank of the Kennebec River bordered by Augusta to the south and Winslow to the north. It is about 52 square miles in area and supported a population of about 3,700 in 1990.

The town of Sidney is on the west bank of the Kennebec River bordered by Augusta to the south and Waterville to the north.

Sidney is about 41 square miles in area and supported a population of about 2,600 in 1990.

Winslow is on the east bank of the Kennebec River north of Vassalboro at the northeastern end of the project's impact area. In 1990, the town's population was 8,000. Winslow is about 38 square miles in area.

The city of Waterville is on the west bank of the Kennebec River north of Sidney at the northwestern end of the project area. The population of the town was estimated at 17,200 in 1990. Waterville is about 15 square miles in area.

# 4.0 ENVIRONMENTAL CONSEQUENCES

## 4.1 PROPOSED PROJECTS WITH ADDITIONAL STAFF RECOMMENDATIONS

In this section, we describe the potential environmental consequences of the projects as proposed by the applicants and establish the basis for our recommended additional enhancements to the applicants' proposals, as appropriate. In Section 4.1, we describe the applicant's proposal; describe alternative enhancements suggested by resource agencies or other interested parties; present our analysis of the options available as well as staff alternatives, as appropriate; and present our conclusions and recommendations. We identify any unavoidable adverse impacts associated with the projects with our recommended additional enhancements in Section 4.4 and irreversible and irretrievable commitment of resources associated with the projects with our recommended additional enhancements in Section 4.5.

Within each specific resource discussion in Section 4.1, we also discuss the potential effects if Edwards dam is removed. We include this as a separate discussion because it is a project alternative espoused by a number of parties. In contrast, agencies and interested parties offered numerous enhancement alternatives for the other 10 projects but no project alternatives.

### 4.1.1 Geology and Soils

Resource agencies have not expressed concern about erosion and sedimentation problems that could be caused by proposed or recommended construction and modifications in the project areas. The staff concludes that construction of fish passage facilities, fish habitat enhancements, recreation-related enhancements, and substantive project upgrades may affect soil and geology resources in the Kennebec River Basin.

We recommend that erosion and sedimentation control measures or plans be developed with resource agency consultation prior to submittal to FERC for approval. When plans for specific environmental enhancements have already received resource agency comments, just the erosion and sedimentation control plan should be submitted for resource agency comments. In Table 4-1, we indicate which projects with our recommended additional enhancements would require development of erosion and sedimentation control plans.

Nonroutine erosion and sedimentation control issues were raised at the Moxie, Sandy River, Weston, and Edwards Projects. In the following sections, we discuss these issues.

Table 4-1. Erosion and sedimentation control plan needs at each project (Source: Staff)

| Project | New Recreation Facilities | New Fishways | Other Environmental Enhancements | Substantive Plant Upgrade |
|---|---|---|---|---|
| Moosehead | X | -- | X | -- |
| Moxie | -- | -- | -- | -- |
| Wyman | -- | -- | X | -- |
| Williams | -- | -- | X | -- |
| Sandy River | X | X | -- | -- |
| Weston | X | X | -- | X |
| Fort Halifax | X | X | -- | -- |
| Oakland | X | -- | -- | -- |
| Rice Rips | X | -- | X | -- |
| Automatic | X | -- | -- | -- |
| Union Gas | X | -- | -- | -- |
| Edwards | X | X | -- | -- |

#### *4.1.1.1 Moxie*

Past Moxie operations have established reservoir equilibrium with an 8-foot drawdown. We agree with the "consensus scenario" (developed during or post-application settlement discussions) (sections 4.1.3.2 and 4.1.4.2), and recommend that annual drawdowns be reduced to 1.5 feet. With less drawdown during the winter, the interface between the ice and the shoreline would be altered. This new interface zone could be subject to increased erosion under certain circumstances (e.g., if the substrate were predominantly silt and organic matter).

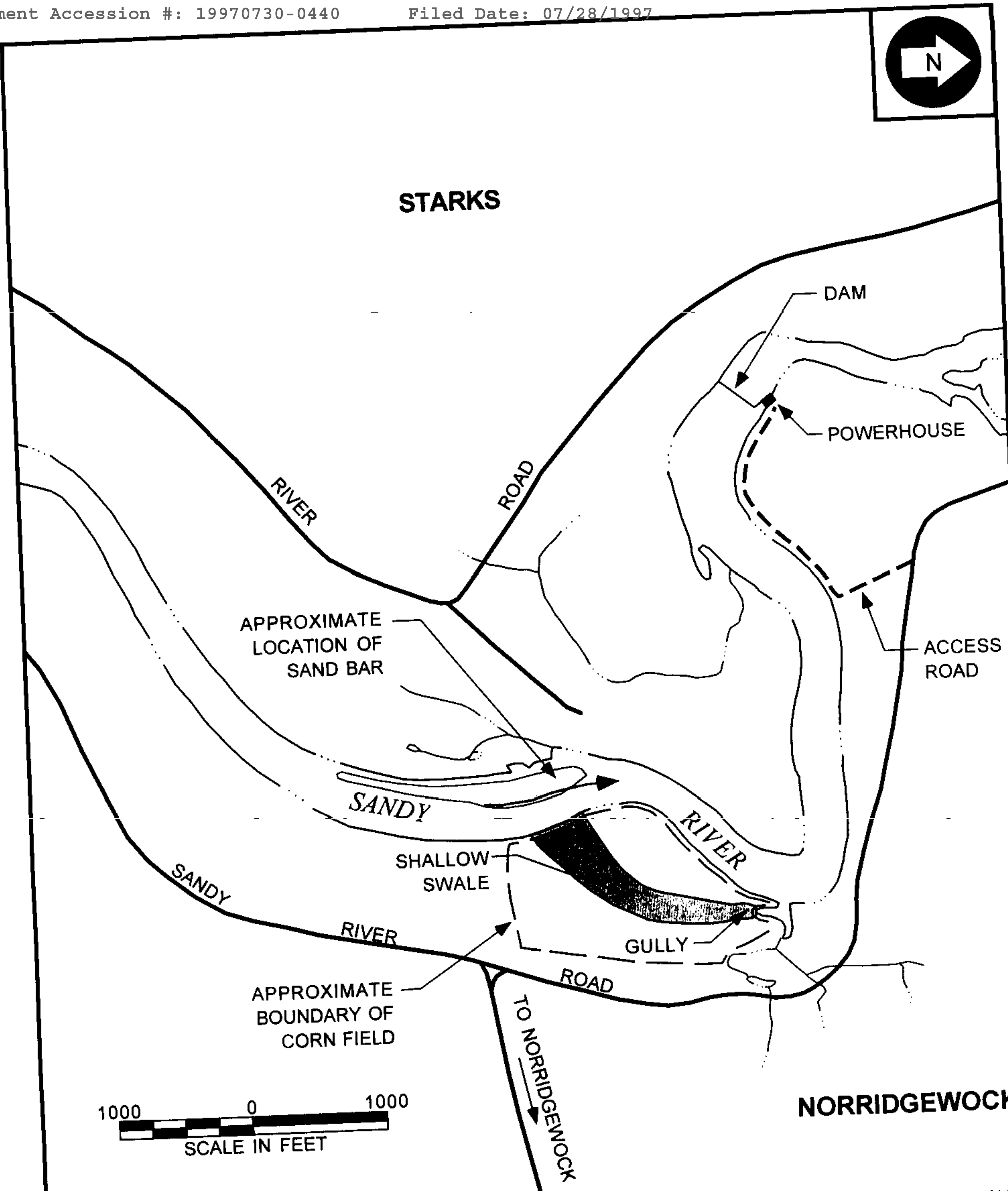
Photographic documentation and our observations during our November 16, 1993, site visit suggest that much of this new interface zone would be armored by boulders, cobbles, and gravel. Shoreline erosion from ice, however, could result from this water level regime because the Owners did not review the entire shoreline to locate sites that would be susceptible to erosion with a limited winter drawdown (areas dominated by silt and organic matter). We therefore recommend that the Owners (or The Forks) conduct a qualitative assessment of shoreline areas that could be susceptible to ice erosion in consultation with MLURC and the Natural Resources Conservation Service (NRCS). This shoreline assessment should be included as part of our recommended review of potential ice damage to permanent docks on Moxie Pond (Section 4.1.7.2). This qualitative assessment would establish a baseline to which future conditions could be compared, and appropriate stabilization techniques could be implemented if substantial shoreline erosion is evident with the revised water level regime.

#### *4.1.1.2 Sandy River*

In oral testimony on February 13, 1996, and in written correspondence, a landowner on the project impoundment claims the operation of the hydroelectric project was responsible for damage to his farmland during flood events in 1979, 1987, and 1996. He claims project operation caused a sandbar to form in the Sandy River channel (about 6,000 to 7,000 feet upstream of the dam) adjacent to his cornfield located in the floodplain of the Sandy River (Figure 4-1). The landowner claims the sandbar contributed to the ice jam that flooded his field. The landowner claims that removal of the sandbar materials from this impounded reach of the river adjacent to his property would resolve the flooding-induced erosion of his land. The landowner proposes that MEW remove about 4,300 cubic yards of material per year for 10 years along with any additional sediments that continue to be deposited on the sand bar.

MEW, in a letter dated April 5, 1996, responded to the landowner's comments and claims of damage to his field from operation of the Sandy River hydroelectric project. MEW used three points to dispute the effect the impoundment had on flooding. MEW states that gravel and sand deposition adjacent to the land in question is a result of a natural river bend that reduces water velocities. It further states that anchor ice may form on this bar to rechannel the river flows more to the landowner's side of the river. MEW also claims that the lack of vegetative buffer on the landowner's cornfield probably contributed to the rate of erosion during the 1996 flood event. Finally, MEW claims that erosion in the floodplain is a natural process and supplies photos from an unimpounded reach of the Sandy River 18 miles upstream where similar erosion recently occurred.

For our analysis, we examined impoundment bathymetric data, soil maps, surface hydrology, impoundment operating levels, and sediment transport potential in the project impoundment. Impoundment transect data compiled by MEW (Figure 4-2) show a relatively narrow and deeper channel at transect 4, compared to transects 5 and 6 and a shoaling near mid-channel of transect 5 that could correspond to the sandbar. U.S. Soil Conservation Service Maps (1972) created from a 1965 aerial photo also show a mid-channel bar in the vicinity of transect 5. The Surficial Geologic Map of Maine (Department of Conservation, 1985) shows

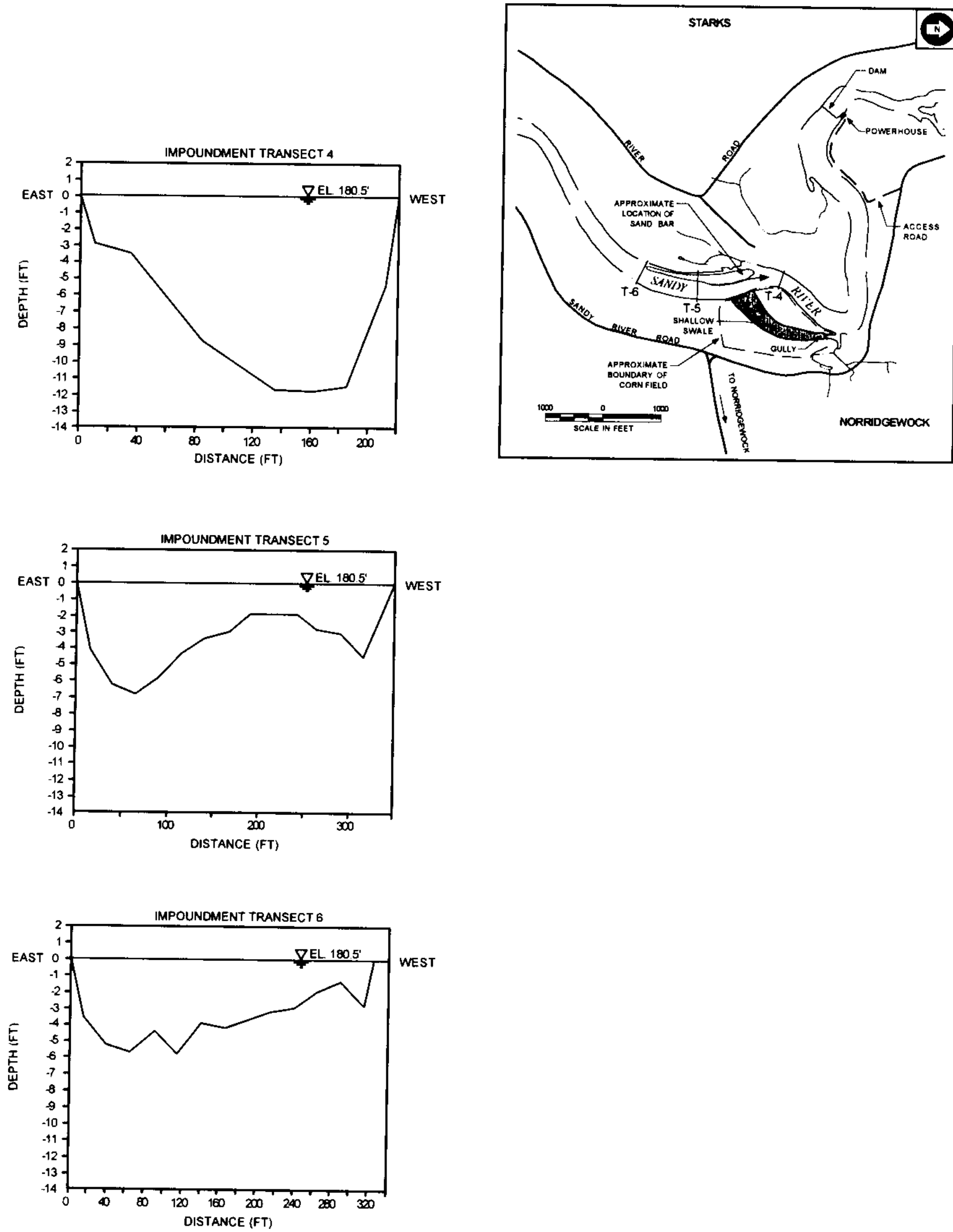



SOURCE: MEW, 1993; HILTON, 1996; AS MODIFIED BY STAFF

**FIGURE 4-1 LOCATION OF CROPLAND EROSION ADJACENT TO SANDY RIVER IMPOUNDMENT**
SANDY RIVER PROJECT, MADISON ELECTRIC WORKS
8/20/96

**KENNEBEC RIVER BASIN EIS**

**FIGURE 4-1**




SOURCE: MEW, 1993; AS MODIFIED BY STAFF

**FIGURE 4-2 IMPOUNDMENT TRANSECTS**
SANDY RIVER PROJECT
MADISON ELECTRIC WORKS
8/20/96

**KENNEBEC RIVER BASIN EIS**

**FIGURE 4-2**

that alluvial sediment structures are being developed in the Sandy River floodplains. River flows during the 1996 ice jam were approximately 24,000 to 27,000 cfs (personal communication between J.C. Shiau, Stone & Webster, and J. Nielson, USGS, June 17, 1996), and this corresponds to about the 10-year flood event (FEMA, 1996). We have no information to determine if the flashboards were retained during the flood, but the impoundment level during the high flow period should have been at or above the top of the flashboards. At this level, the impounded reach of the river extends about 2.5 miles upstream of the dam. The impoundment substrates are predominantly sand, although the upper end of the impoundment has some cobble and boulders.

Stream bedload deposition is affected by the size and angularity of the materials, water velocity and turbulence conditions, and the stream gradient, as well as changes in depth, width, and gradient of the stream. This last factor, a reduction in gradient and increase in width and depth of the stream channel, is an empirically observed law of sediment transport (Leliavsky, 1955). Generally, we would expect deposition of stream bedload sediments to occur in the backwater reach of the project impoundment at a water surface elevation equal to or somewhat higher than the elevation of the crest of the dam. We would also expect finer suspended materials to be deposited downstream in the impoundment. The bathymetry of the channel would also dictate the patterns of erosion and deposition. The sand bar adjacent to the cornfield appears to occur on the inner bank of a turn in the river channel. This is an expected location for deposition regardless of the presence of the dam because it is a lower energy, more shallow portion of the channel. Deposition at this location most likely occurs during high flow events. The location of the gully erosion that occurred in 1996 on the cornfield was on the outer bank of a turn in the natural river channel. There is nothing notable, based on conventional river hydrology, about the location of the bar or erosion area that indicates project operation is the primary cause of deposition or erosion. If the project contributes to the deposition of materials to form the sandbar, its effect is likely minor.

The landowner's claim that project operation contributed to formation of an ice dam in the river channel adjacent to his cornfield is not well supported. Anchor ice, snow ice, and surface ice can all contribute to ice jam-induced floods. However, ice jams can occur at any constriction of river flow and have been known to increase local river stage by as much as 0.5 meter (FERC, 1992). There is no reason to expect that the impoundment contributed to the formation of an ice dam or the January 1996 ice jam. Anchor ice generally forms when water velocities exceed 0.6 meters per second (FERC, 1992). This reach of river is generally deeper and slower moving as an impounded water body than in the absence of the dam and thus not as likely to contribute to anchor ice.

We conclude from the Soil Conservation Service maps that the sand bar has been in place since at least 1965. There is no reason to believe that removing it would prevent the recurrence of flooding of the adjacent field or prevent the natural reformation of the bar in future years. Removal may have a minor reduction on the water level that would be reached during an overtopping of the bank because the cross section of the river channel would be larger. This minor effect may not be sustained due to natural accretion of alluvial sediments in this location.

The condition of the cornfield likely had a greater effect on the degree of erosion than the presence of the sand bar. The cornfield that was eroded by the 1996 flood was more susceptible to damage because all riparian vegetation was cleared to the water's edge, and there was no protection of the banks from erosive forces. With riparian vegetation in place, a natural levee often forms, reducing the occurrence of flood waters leaving the channel. Corn farming up to the edge of the bank at this location on the Sandy River may be inconsistent with measures to limit erosion-induced soil losses.

We do not concur with the landowner's recommendation to dredge the river as a method to reduce the impact of flood effects on the cornfield. Dredging in the impounded project waters would also have potential impacts on water turbidity and aquatic resources. If 10 years of annual maintenance dredging is required to maintain the channel, as suggested by the landowner, long-term impacts on aquatic and water resources can be expected. The degree of impact would depend on the specific dredging methods, access, and disposal locations for the sediments.

The landowner has offered access for dredging through his field road that is accessible from Sandy River Road. However, the river is more than 100 feet wide at this point of access and the materials proposed to be removed are near the opposite bank, across a river more than 9 feet deep. A reasonable access to the opposite bank is not available through the landowner's field and would likely require the permission of the landowner on the opposite bank of the river. Furthermore, this ongoing dredging would likely require a Section 404 permit from the U.S. Army Corps of Engineers and a Section 401 WQC from MDEP. The landowner's proposed plan would be difficult to accomplish given the need for adjacent landowner permission and permitting.

The proposed long-term dredging methods, access issues, and likely permitting process leads the staff to question the suitability of the landowner's proposed plan to have MEW dredge the river channel. Any minor flood impact reduction benefits provided by the dredging that may also be attained by other methods, do not justify maintenance dredging and its attendant impacts on water quality and aquatic resources.

An erosion and sedimentation control plan designed to stabilize erodible soils on the floodplain adjacent to the impoundment could do more than annual dredging to ensure that additional erosion in the area of the project is minimized. We recommend that MEW develop an erosion and sedimentation plan for land abutting the impoundment. The plan should include measures to establish mature riparian vegetation around the impoundment and to reduce the potential for erosion on the impoundment banks. The plan should be consistent with current land use, but in the event the plan identifies some current land uses that are not consistent with the goal of minimizing erosion, the plan should identify methods and costs to limit, contain, or eliminate the inconsistent current land use practice. The plan should be prepared in consultation with NRCS and MDEP. The plan should be submitted to the Commission for approval. Once approved, MEW should provide the plan free of charge to all property owners abutting the impoundment.

#### *4.1.1.3 Weston*

CMP normally maintains the Weston impoundment level within 1 foot of full pond elevation. CMP proposes to continue to operate the project in a run-of-river mode.

Although no commenters raised concerns about the banks in response to the Public Notice, a private citizen raised the question of project effects on the reservoir shoreline near a residence during the prefiling consultation for CMP'S Wyman Project (transcript from September 7, 1989 Public Meeting, G. Buller, pp. 8-18).

After observing impoundment shoreline conditions for CMP, GEI Consultants, Inc. (GEI) reported that the primary erosion along the banks was not caused by project operation (GEI, 1992). While impoundment fluctuations may play a very minor role, GEI reports that most bank erosion occurs during yearly flooding. High water flow velocities remove some sediment and soil at constrictions or along the outside of bends in the river during normal flows, as would be expected along an unrestricted stream. During flood events, high flow velocities can remove sediment and soil from all areas; the situation is intensified at the constrictions and bends. In addition, the banks are also undercut during flood events.

Although not specifically included in GEI's report or videotape narrative, the videotape survey of the impoundment shoreline that accompanied GEI's report revealed that sizable shoreline erosion and instability (i.e., slumping) were usually along areas where nonproject-related shoreline practices and uses had left the banks unprotected by trees (and their protective root systems).

The highways and railroad right-of-ways in project areas usually needed bank riprap to stabilize banks, and residential areas sometimes required riprap. Shoreline erosion also occurred when a line of trees had been left along the top edge of the bank, but the area behind the trees (e.g., field, yard) had been cleared. In "natural" areas that were well protected by trees yet were eroded, the streambank deposits appeared to be coarse sand, gravel, and cobbles (e.g., eskers) which, lacking cohesive components (i.e., clay and fine silt), were naturally loose and vulnerable.

We conclude that continued project operation, as proposed, would have no severe adverse effects on geology and soils resources at Weston Project. We agree with CMP that any locally severe shoreline erosion and instability has not been caused by project operation, but by factors beyond CMP's control. We therefore conclude that it would be inappropriate to require CMP to initiate protective measures along the impoundment shoreline.

*4.1.1.4 Edwards*

*Applicant's Proposal*

If the originally proposed project expansion was developed, the staff would recommend that Edwards finalize its existing soil erosion and sedimentation control measures prior to submittal to agencies and FERC for approval. We do not anticipate that Edwards' revised proposal to upgrade existing turbines and generators would result in potential erosion or sedimentation.

*Staff's Licensing Alternative*

Licensing the Edwards Project with staff-recommended enhancements would not cause erosion or sedimentation in the project area.

*Dam Removal*

Oak Ridge National Laboratory (ORNL) analyzed the potential effects on soils and geology if the dam is removed (ORNL, 1997). In the following section, we summarize its analysis.

ORNL (1997) found that slope stability is not a major concern: "The river currently undergoes rapid pool elevation changes due to natural storms and upstream hydropower peaking operations without serious erosion problems. Gerber (1996) assessed slope stability and also dismissed rim slope failure as a concern. Moreover, analysis of sediment conditions upstream of the dam and likely breach discharge rates suggest that even rapid drawdown would release only modest quantities of material downstream. Relaxation of this slow drawdown constraint allows the project [dam removal] to be undertaken in essentially one season."

Based on the results of ORNL's analysis (1997), if the dam is removed, we recommend the development of a site-specific erosion and sedimentation control plan that is consistent with best management practices (Smith, 1991) and provides for the following:

- bank stabilization of erodible areas within the drawdown zone;
- monitoring of slope stability and bank surface erosion on the reaches above Edwards dam (the current impoundment); and
- revegetation of steep slopes (greater than 20 degrees) susceptible to surface erosion in the drawdown zone.

The plan should contain a baseline survey and include regular inspections during the impoundment drawdown. The plan should also include provisions for future maintenance, emergencies, remedial action, and abutting landowner communication and assistance.

We recommend that the river banks downstream of the dam be allowed to naturally revegetate.

Dam removal would also create an unavoidable short-term increase in downstream turbidity and sedimentation.

### 4.1.2 Water Quantity and Quality

In the following section, we summarize the proposed and recommended operational and monitoring strategies and plans for each project as they relate to water quantity and quality, including our recommendations for each operation and monitoring issue. Since water quantity and lake water level management are often more directly related to fishery, terrestrial, and recreation resources for many projects, in those cases, we address these issues in sections 4.1.3, 4.1.4, and 4.1.7.

#### *4.1.2.1 Moosehead*

Flows released from Moosehead Lake depend on lake water level management. Potential project effects pertain primarily to fish, wildlife, and wetlands and are further discussed in sections 4.1.3.1 and 4.1.4.1.

*Water Quality*

Under proposed operations at the Moosehead Project, classification standards for dissolved oxygen (DO) in the affected waters would be attained (MLURC, 1995). Increased flow in the East and West Outlets should enhance existing water quality in the West Outlet and downstream reaches of the Kennebec River, particularly for DO concentrations and water temperature during the warm and low-flow summer months. KWP's proposed operations should result in attainment of Class GPA standards for aquatic life and habitat within the impoundment waters (MLURC, 1995). MLURC (1995) has also concluded that the flow releases proposed by KWP from the East and West Outlets should enable those outlets to meet applicable water quality standards.

We evaluated the potential disruption of typical seasonal stratification patterns, and therefore water quality conditions, in Moosehead Lake. We calculated water residence times in Moosehead Lake, based on flow duration curves provided by KWP. Residence times, for all alternatives considered, ranged from 131 days for average releases of 2,000 cfs to 472 days for average releases of 5,800 cfs. The residence times are substantial because of the lake's large size and water storage capacity, indicating that significant changes in the seasonal stratification patterns of Moosehead Lake are unlikely.

*Mercury*

Mercury can accumulate in living tissue and cause toxic effects on the nervous systems of fish, humans, and wildlife that consume mercury-contaminated fish. Mercury has been reported in fish collected from Moosehead Lake and in numerous other ponds and lakes in Maine at concentrations of concern from a public health standpoint. Maine has issued an advisory for the consumption of fish caught in all freshwater lakes and ponds in the state due to the presence of mercury (Section 3.3.2.1). There are no known local man-made sources of mercury in the watershed of Moosehead Lake.

CLF et al. (letter from CLF, October 8, 1993) have expressed concern about potential contribution of project operations to mercury levels and suggested that a study be performed to further evaluate the distribution and significance of mercury in game fish and in bald eagles and common loons that feed on game fish in the reservoir and riverine stretches of the Kennebec River. In the same letter, CLF et al. also have suggested that FERC require license reopening for possible modification of reservoir operations if the mercury study "verifies a mercury contamination problem," and that KWP implement a fish consumption advisory program if results show that operating the hydropower system contributes to the mercury problem.

The staff considered project-specific information, and we thoroughly reviewed the available literature on the occurrence and causes of elevated concentrations of mercury in fish. In the following section, we present our findings and recommendations.

Literature review. Elevated levels of mercury in fish have been reported from two types of freshwater ecosystems not affected by local industrial mercury sources: (1) acidic lakes (Wiener et al., 1990; Wren et al., 1991; Hakanson et al., 1988); and (2) reservoirs (Brouard et al., 1990; Canada-Manitoba Governments, 1987; Jackson, 1988). Most investigations (Mierle, 1990; Mierle and Ingram, 1991; Glass et al., 1991; Fitzgerald et al., 1991; Aastrup et al., 1991), however, concluded that atmospheric deposition is the predominant source of mercury in such systems.

Studies also suggest an apparent link between increased concentration of mercury in fish and the creation of new reservoirs (Bodaly et al., 1984; Brouard et al., 1990; Stokes and Wren, 1987). Increased fish mercury concentrations in newly created reservoirs is time-dependent, initially rising and then generally declining to levels measured in natural water bodies (Brouard et al., 1989).

Sorensen et al. (1989) first raised the issue of a possible link between reservoir water level fluctuations and fish mercury concentrations. Tetra Tech, Inc. (1995) evaluated the results of numerous studies conducted to date and concluded that there is no definitive evidence of a cause and effect relationship between annual drawdown cycles in reservoirs and elevated fish mercury concentration. Several studies suggest such a link, but several others suggest a relationship between drawdown and lower fish mercury concentrations. All hypotheses regarding the potential link between impoundment fluctuations and bioaccumulation of mercury are as yet unproven.

Project-specific data. Given the age of the Moosehead Project, limited data relevant to fish mercury concentrations in Moosehead Lake, and the lack of other than unproven hypotheses that link fish mercury concentrations to drawdown in older reservoirs, it is not currently possible to determine to what extent operation of the Moosehead Project may adversely affect game fish mercury concentrations, if at all. We note that recent limited data on mercury in fish tissues was obtained from Flagstaff Lake, where fluctuations are considerably greater (up to 25 feet) than at Moosehead Lake, the concentration of mercury was considerably lower in fish from Flagstaff Lake compared to fish from Moosehead Lake (letter from T. Haines, Professor of Zoology, University of Maine, to W. Hanson, CMP, December 20, 1994). Given these facts, it is not appropriate to require KWP to implement the suggestions made by CLF et al.

Staff conclusions. Game fish mercury concentrations in Moosehead Lake have been documented to exceed public health standards, and it is possible that water level drawdowns and variable flow releases could influence mercury concentrations in game fish. We are unaware of a definitive link between impoundment fluctuations or variable flow regimes associated with hydroelectric project operations and increased bioavailability of mercury. If there is such a link, project operations could cause localized impoundment cumulative impacts on downstream ecosystems. We recommend that the licenses for projects with variable impoundment levels and flow regimes (Moosehead Lake, Wyman, and Fort Halifax) be amended at a later date, so that localized and cumulative impacts may be addressed if a definitive link between project operations and bioavailability of mercury is established during the term of the project licenses.

*4.1.2.2 Moxie*

*Pond Water Level*

Issues of flow and water level management at the Moxie Project pertain primarily to fisheries and recreational uses. We discuss these issues in detail in sections 4.1.3.2 and 4.1.7.2.

*Water Quality*

MDEP classified Moxie Pond's waters as Class AA in 1992. Measurements taken by the Owners from spring to fall 1990 demonstrated that the pond did not meet water quality standards for DO in the bottom waters of the north basin. Releases from closure dams B or C (Figure 2-4) are the only project operations that could affect water quality in the north basin. Because both of these dams are fixed, any releases would only entail surface water. We conclude that modifying the project facilities or operations would most likely not improve the existing DO regime in the north basin. Therefore, we make no recommendations specifically related to water quality for the Moxie Project.

*4.1.2.3 Wyman*

Issues of flow and water level management at the Wyman Project pertain primarily to fisheries and terrestrial resources. We discuss these issues in detail in sections 4.1.3.3 and 4.1.4.3.

*Water Quality*

CMP monitored DO in Wyman Lake during the summers of 1984 and 1987, and found that the water in the tailrace met Class A standards. MDEP, in its WQC dated August 18, 1995, has agreed that with conditions that are specified in the WQC (which are similar to our recommendations), water quality standards would be met. MDEP has recommended that CMP conduct a macroinvertebrate survey to confirm that the 1,000-foot reach downstream of the dam meets aquatic life standards. We address aquatic life issues in Section 4.1.3.3.

*Mercury*

We recommend that the license issued for this project be amended at a later date so that localized and cumulative impacts may be addressed if a definitive link is established between project operations and mercury bioaccumulation. We discuss why in Section 4.1.2.1.

*4.1.2.4 Sandy River*

Pond water levels and flow regulation issues for the Sandy River Project pertain primarily to fish and wildlife resources, and we address them in sections 4.1.3.5 and 4.1.4.5.

MEW proposes to monitor water quality in the bypassed reach for DO and temperature during worst-case conditions for 2 years following the license issuance. MDEP has stated in text supporting the WQC (February 24, 1994), that MEW's proposed measures should be adequate to ensure compliance with water quality standards.

We agree with MEW's proposal and recommend that MEW monitor water quality during worst-case conditions consistent with MDEP sampling protocol for a 2-year period. The results of this monitoring, along with MDEP comments, should be reported to FERC. If water quality standards are not met, MEW should also develop proposed corrective actions in consultation with MDEP and include such measures in its submittal to FERC for approval.

*4.1.2.5 Weston*

Pond water level management and flow regulation issues pertain primarily to fish and wildlife resources at the Weston Project, and we discuss them in sections 4.1.3.6 and 4.1.4.6. CMP has satisfactorily addressed the water quality issues we raised at this project. MDEP issued a WQC on November 17, 1992, stating that, as long as conditions specified in the WQC were implemented, continued operation of the project would not violate applicable standards. We agree with MDEP and therefore make no recommendations specific to water quality for the Weston Project.

*4.1.2.6 Fort Halifax*

*Pond Water Level*

CMP proposes to operate the reservoir in a peaking mode all year with a normal drawdown limit of 2.5 feet below full pond level (full pond elevation is 51.5 feet mean sea level [msl]), unless DO concentrations in the project impoundment and downstream of the project dam fall below the Class C standards. When DO standards are violated, CMP would increase the number of additional releases and draw down the impoundment to flush it out, increasing (i.e., improving) DO concentrations.

Flushing out the impoundment is intended to mitigate the effects of algal blooms, which are caused by high temperatures and the eutrophic condition of the Sebasticook River. CMP proposes to monitor water quality every summer to support this effort. CMP will also consider operating the impoundment in a run-of-river mode during periods when DO concentrations fall below standards, provided all upstream hydroelectric projects operate in the same manner (MDEP, 1994c).

Interior (letter from W. Patterson, Interior, March 3, 1993) and Commerce (letter from R. Roe, Commerce, March 26, 1993) have suggested that CMP operate the project in a run-of-river mode in May and June to maintain stable water levels in the impoundment and improve aquatic life and fisheries (Section 4.1.3.7) as well as conditions for nesting waterfowl and other wildlife (Section 4.1.4.7).

MDEP, in its WQC, has concluded that CMP's proposal to limit water-level fluctuations in the impoundment would not adversely affect fish and fish habitat, and the proposal appears to adequately protect and maintain wildlife surrounding the impoundment. MDEP has also concluded that CMP's proposal appears to adequately achieve and maintain suitable use of the waters that are affected by the project as habitat for aquatic life (1994c). The WQC required that CMP develop and implement a water quality monitoring plan (1994c). The monitoring plan is to include provisions for operating the project in a run-of-river mode when water quality approaches unacceptable levels, and implementing an impoundment drawdown and flushing regime if run-of-river operations do not mitigate the water quality problem. MDEP has also required CMP to monitor water levels in the project impoundment.

We agree with CMP's proposals and MDEP's conditions. Therefore, we recommend that CMP develop and implement a plan to monitor DO levels in the Fort Halifax impoundment and modify the operation of the project to run-of-river mode when DO approaches unacceptable levels (5 ppm). When run-of-river operation fails to improve low DO levels, CMP should implement an impoundment draw-down and flush. If after 5 years, water quality problems persist, scenarios that would trigger an additional cooperative effort to solve the water quality problems should be included in the plan. If additional cooperative efforts are necessary, a second plan defining the measures to be implemented should be developed in consultation with MDEP and upstream hydroelectric projects. The second plan should include the cost and entity responsible for implementing any measures proposed. The first plan should be developed in consultation with MDEP and submitted to the Commission for approval. If determined to be necessary, the second plan would also require Commission approval prior to implementation.

*Flow Regulation*

Flow regulation issues are largely related to fisheries resources and are discussed in Section 4.1.3.7. However, the proposed increased minimum flow would also result in higher DO concentrations in the project's tailwaters where violations of DO standards have occasionally been measured. Implementing the water quality monitoring plan and (contingent) water quality mitigation plan discussed above would ensure that DO standards are met.

*Mercury*

We recommend that the license issued for this project be amended at a later date so that localized and cumulative impacts may be addressed if a definitive link is established between project operations and mercury bioaccumulation. We discuss why in Section 4.1.2.1.

*4.1.2.7 Messalonskee Projects*

Pond water level and flow regulation issues at the four Messalonskee Projects pertain to fish, wildlife, and wetland resources and we therefore discuss them in detail in sections 4.1.3.8 through 4.1.3.11 and 4.1.4.8 through 4.1.4.11.

*Water Quality*

Water quality sampling performed by CMP and MDEP indicates that the Rice Rips impoundment has not met Maine Class GPA standards and the Messalonskee Stream downstream of the Rice Rips impoundment has violated Class C standards for DO. MDEP has attributed these water quality problems to the discharge from the Oakland water treatment plant (WTP) into the Rice Rips impoundment, reduced flushing from the presence of the dams, and phosphorous loading from urban and agricultural runoff (MDEP 1995b).

To address the water quality problems, CMP has agreed to lease 60 acres of land to the Oakland WTP so that the plant can seasonally land apply the majority of its effluent rather than discharge it into the Rice Rips impoundment (MDEP, 1995b). CMP expects that removing this pollution source during the summer, coupled with its proposed minimum flow of 15 cfs at all four projects, would improve water quality.

MDEP has indicated in its WQC that the proposed corrective actions should allow applicable water quality standards to be met. However, it also recommended that CMP implement a water quality sampling program to document the expected attainment of standards.

MDEP will require the Oakland WTP to sample water quality in the Rice Rips impoundment as a condition of its pending discharge license. MDEP has recommended that CMP prepare and implement a plan to sample DO, temperature, and chlorophyll a in Messalonskee Stream. MDEP has further stated that if, after 5 years from FERC license issuance, based on a review of the water quality monitoring data, Rice Rips impoundment or Messalonskee Stream do not meet applicable water quality standards, additional structural or operational changes to the four Messalonskee Projects may be required.

We agree that the proposed modifications should improve water quality in Messalonskee Project waters. However, a major source of nutrients (related to algal blooms that contribute to violations of DO standards) would remain in the sediment and continue to cycle within the water system. Therefore, the potential would exist for continued water quality violations, although the problems would probably be less severe and less frequent than at present. We recommend that CMP develop and implement, in cooperation with the Oakland WTP and in consultation with MDEP, a water quality monitoring plan for Messalonskee Stream and the Rice Rips impoundment. The plan should clearly indicate the entity responsible for implementing each element of the plan. The plan should include MDEP's comments and should be filed with FERC for approval.

In addition, any license issued for the four Messalonskee Projects should include an issue-specific reopener clause condition that would allow incorporation of structural or operational changes to enable achievement of water quality standards if violations still occur after 5 years of monitoring. This condition would facilitate the potential adjustments envisioned by MDEP.

*4.1.2.8 Edwards*

Pond level and flow regulation issues pertain primarily to fish, wildlife, and wetland resources, and we discuss them in detail in sections 4.1.3.12 and 4.1.4.12.

Edwards proposes no specific measures to enhance water quality, and it states that water quality standards at the project are nearly always met. The lack of vertical stratification at Edwards dam would limit the effectiveness of altering release patterns at the dam.

The staff concludes that there do not appear to be adverse impacts on aquatic life in the Class B stretch of the Kennebec River due to discharges based on data presented in the 1990 LOTIC report and results of subsequent studies (SWETS, 1995a). MDEP, which has the lead role in evaluating compliance with state water quality standards, however, has not provided its opinion on this matter. MDEP indicated that the WQC for this project would not be issued before this EIS is completed.

Resource agencies and other commenters have not specifically commented on Edwards' proposal and potential water quality enhancement measures other than to question whether aquatic life standards (which we discuss elsewhere) could be met with the dam in place. MDEP has not yet determined whether the proposed operation of the project would meet applicable water quality standards. MDEP plans to make a decision on Edwards' request for a WQC after the FEIS in this proceeding is issued (letter from D. Murch, MDEP, to Bearl Keith, Edwards, December 12, 1996).

Our review of the record leads us to conclude that specific measures regarding water quality with either Edwards' original or recently revised proposals are not warranted. We note that assurance that project operation would not violate applicable water quality standards is MDEP's responsibility. We could incorporate water quality measures that MDEP may require in its WQC, when and if it is issued, in any license issued for this project.

*Dam Removal*

A detailed assessment of potential effects of dam removal on water quality was presented in SWETS (1995a), and comments on that assessment were responded to in Appendix B of this FEIS. The following section is based on findings made in that report and material entered into the record after the DEIS was issued.

We found elevated concentration of arsenic and cadmium in the impoundment, and we conclude that the dam did not prevent the downstream transport of these contaminants. Supplemental sampling upstream and downstream of the dam supports our conclusion (SWETS, 1995c). Our supplemental sampling has also provided evidence that cadmium or arsenic would not remain in the water column if contaminated sediments were resuspended. We concluded that removing the dam would not adversely affect sediment resuspension.

We recommend that, if the dam is removed, *Escherichia coli* of human origin be monitored near the dam to confirm that shorter residence time without the dam would not adversely affect water quality downstream of combined sewer overflows in Augusta. MDEP has noted it was unclear whether enteric bacteria might increase in the vicinity of the dam, but if a violation of water quality standards were to occur, it would be caused by a failure at an upstream treatment facility and probably not be pertinent to a decision about the dam (MSPO, 1995). Although we agree with MDEP's comment, we still recommend that our monitoring plan be included as an element of studies conducted in association with dam removal.

We also recommend that a water quality monitoring program be developed in consultation with resource agencies, and implement the program after FERC approval. Implementing our recommendations would ensure that if the dam were removed, water quality in the project area would be protected.

#### *4.1.2.9 Cumulative Effects*

*Streamflow*

Regulating storage and flow in the upper portion of the Kennebec River Basin moderates discharge throughout the basin compared with many other large watersheds in the Northeast United States. Existing upstream flow regulation currently increases flows during low flow periods. There would be slightly greater flows upstream of the Williams Project during the low flow summer months and during the winter when surface water availability is low due to snow and ice conditions if the proposed and recommended environmental enhancements at the Moosehead and Wyman Projects are made.

Increased flows would directly benefit fish habitat by providing more water during normally low flow periods and indirectly by moderating summer high temperatures and lower DO values, which occur naturally under low flow conditions. Upstream storage reduces flows during spring flow periods and moderates flood flows. With our recommended target flow from Moosehead Lake during the winter, there would be a slight increase in the amelioration of high spring flows at downstream locations. Flow moderation also benefits hydroelectric power generation by decreasing spillage during high flow events and providing greater flow during low flow events.

Projects downstream of the Williams Project would continue to operate in a run-of-river mode. River flows downstream of the run-of-river projects would be unaffected by plant operations and water quality, aquatic habitats, and downstream, water-dependent uses would not be altered. If our recommended feasibility study to reduce the degree of fluctuation of the Williams impoundment results in a change in releases from the Williams Project, however, the cumulative impacts may change. We would address such cumulative impacts before approving any suggested operational changes. We discuss the feasibility study in Section 4.1.3.4.

*Dissolved Oxygen*

Reduced aeration at dams could lower assimilative capacity in river reaches that are downstream of project sites. This potential is increased when multiple projects are close to each other, because they may limit natural processes that increase DO, such as turbulence in riffle areas. Reducing a river's ability to assimilate organic material that consumes oxygen could have a significant cumulative impact and thus preclude development or expansion of municipal wastewater treatment facilities and industrial discharges.

We conclude that the projects as proposed with our additional recommended enhancements would slightly increase flows during low flow periods at nearly all projects on the main stem of the Kennebec River. Generation would increase at most projects with our recommended enhancements (Appendix D). Low flow periods generally occur when there is little spillage and associated re-aeration. We do not expect this to change appreciably with future operations. We expect, however, that there would be a slight increase in the prevailing DO and assimilative capacity on the entire main stem of the Kennebec River because of turbulence in riffle areas and increased volume of water in free-flowing segments during the warmest months of the year.

*Temperature*

Impoundments increase the residence time of water within a given river reach and increase the water depth. These changes in physical character of a water body can reduce the daily fluctuations in temperature that occur because of natural meteorological conditions. The reduced ratio of surface area to water volume over which heat exchange occurs also can result in greater heat retention and higher daily minimum temperatures, depending on the volume of the impoundment and ambient air temperatures.

The longitudinal data collected by MDEP and the applicants show no apparent difference in temperature between the flowing and most impounded sections of the Kennebec River. The Wyman Project is the exception to this, but the deepwater withdrawal from the impoundment probably enhances the downstream temperature regime for salmonids, especially during the summer. Our recommended increased minimum flows would decrease, to a slight degree, residence times in most of the main stem reservoirs, especially during the summer. We therefore expect no cumulative adverse impacts on the prevailing temperature regime of the Kennebec River with continued operation of the projects and our recommended enhancements.

*Toxics*

Although there may be minor increases in sedimentation from construction of recreational facilities, fishways, and at the Weston Project, turbine upgrades, we expect such impacts would be localized and short term. We conclude that there would not be any cumulative impacts related to sedimentation in the project areas. We addressed potential bioavailability of mercury at projects with variable flow regimes and impoundment water levels in Section 4.1.2.1.

### 4.1.3 Fishery Resources

*4.1.3.1 Moosehead Lake*

*Lake Water Level*

KWP proposes to formalize the existing informal agreement with Maine Department of Inland Fisheries and Wildlife (MDIFW) that calls for the water level to generally be drawn down to its lowest level by October 10. According to KWP, this mode of operation fosters successful reproduction of lake trout and possibly salmon and brook trout. Depending on the water level achieved by October 10, the lake may be drawn down an additional 2 feet during the winter but not lower than elevation 1,024.5 feet (full pond is at elevation 1,029 feet). KWP proposes that any reductions of more than 2 feet below the October 10 elevation or any reductions below the base elevation of 1,024.5 feet must be warranted by climatic, hydrologic, or other conditions beyond the control of KWP and after notification of MDIFW.

MLURC (1994) has agreed with KWP's proposed water level regime. Interior (1993) has concurred that the drawdown limits established jointly between KWP and MDIFW would protect spawning lake trout. Interior asserts, however, that limiting the winter drawdown to only 1 foot would protect shoreline dwelling aquatic invertebrates and wildlife and would ensure that all spawning areas remain covered with water. CLF et al. (letter dated October 8, 1993) have agreed with Interior's recommendation.

We concur with KWP's proposed water level management plan, since by drawing the lake down up to 4.5 feet, KWP would gain more control over typically high spring flows to the East Outlet. We see no evidence that the existing drawdown regime is adversely affecting the game fish in Moosehead Lake. Our recommended East Outlet flow regime, discussed below, would be more difficult to maintain with the 1-foot drawdown proposed by Interior. During spring inflows in excess of 1,000 cfs, the lake would most likely fill by April and after this uncontrolled spills could adversely affect incubating salmon and trout eggs in the East Outlet. A 1-foot winter drawdown limit would substantially reduce available storage and the ability of Moosehead Lake to provide flood protection to downstream communities.

We recommend that KWP achieve drawdown of Moosehead Lake to its lowest impoundment level by a target date of October 10 annually, and to a target elevation of 1,024.5 feet. If climatic conditions or circumstances beyond KWP's control do not allow attainment of a lake level of 1,024.5 feet by October 10, KWP, without consultation, may draw down the lake level by a maximum of 2 feet beyond the October 10 level, but not lower than the elevation of 1,024.5 feet.

After October 10, any reductions in lake level below elevation 1,024.5 feet, or 2 feet below the October 10 lake level, should only be made in consultation and agreement with MDIFW and MLURC. Such additional drawdown must be warranted due to climatic, hydrologic, or other conditions beyond the control of KWP.

KWP indicates that its "water management objective for the summer season, up to Labor Day, is to maintain water levels on Moosehead as close to full pond as possible while still providing necessary downstream flows" and "the impoundment is then maintained at a relatively high level (typically within 1 to 1.5 feet of full pond level) during the summer to accommodate the extensive recreational use of Moosehead Lake."

We reviewed Moosehead Lake water levels from 1972 to 1988 in NAI (1990) and found that KWP maintained the impoundment within 1.5 feet of full pond during the majority of years during early August. KWP has not proposed a specific schedule for maintaining high summer water levels in its application, and MLURC has not specified summer lake water levels in its WQC for the project (MLURC, 1994). We are also not aware of documented recreation concerns about the current management of summer lake water levels. We do not, therefore, recommend modification to the proposal as it relates to maintenance of summer lake water levels.

We also recommend that KWP develop and implement a plan to monitor and report water surface elevations in consultation with resource agencies. This plan should clearly define climatic and hydrologic conditions beyond KWP's control. We expect such events to be rare. FERC should be notified of all cases when the water surface elevation decreases below 1,024.5 feet or more than 2 feet below the October 10 elevation. KWP should also provide FERC the reasons for such occurrences. The plan should include provisions for annual meetings with MDIFW, the U.S. Fish and Wildlife Service (FWS), the Maine Department of Conservation (MDOC), and other interested parties to discuss lake level management, the outlet flow regimes, and possible corrective actions.

*Fish Passage*

Interior (letter dated October 10, 1993) prescribes that KWP provide optimum attraction flow to the fishway at the East Outlet by operating the Taintor gates in the following manner: when only one gate is to be used to release flows, it shall be the northernmost gate. MDIFW has made a similar request (letter dated May 9, 1989) and indicates that operating in this manner is especially important during the July and August salmon smolt migration. KWP proposes to operate the Taintor gates as proposed by the resource agencies, and we concur.

Interior (letter dated October 8, 1993) has made a 10 (j) recommendation that KWP file a plan to monitor the effectiveness of operational changes designed to improve fish passage at the East Outlet. No further basis for the need for such studies was provided. KWP (letter dated November 24, 1993) has objected to this recommendation, since neither Interior or MDIFW have provided evidence that the existing fishway is not operating effectively.

We see no reason to develop a plan to monitor the effectiveness of the proposed operating changes at the existing fishway. Periodically, MDIFW uses the fishway as a trap to determine the contribution of East Outlet salmon to the Moosehead Lake fishery (Section 3.3.3.1). We consider this an appropriate fishery management activity for MDIFW. Any salmon that do not use the fishway to enter Moosehead Lake would contribute to the significant landlocked salmon fishery that now exists in the East Outlet. Given that MDIFW harvest goals for Moosehead Lake are presently met despite limited East Outlet production, fishway effectiveness does not seem to be of paramount importance. At the May 7, 1996, 10(j) meeting, MDIFW indicated that the fishway seemed to be working, and Interior agreed to defer to MDIFW's judgment on the need for effectiveness studies.

Interior could have requested fishway effectiveness studies during prefiling consultation. The fishway was constructed in 1958, and the Taintor gates were in place well before 1958. We therefore conclude that Interior's request for fishway effectiveness studies is outside the scope of Section 10(j).

Interior (letter dated October 8, 1993) has further reserved its authority to prescribe the construction, operation, and maintenance of fishways under Section 18 of the FPA.

*Outlet Flow Regulation*

KWP has conducted instream flow incremental methodology (IFIM) studies in the East and West Outlets to determine what releases would protect the game fish in these streams. The target species in both streams were landlocked Atlantic salmon and brook trout.

KWP has concluded that a flow of 500 cfs provides the best minimum flow for sustaining the evaluation species in the East Outlet. This flow optimized habitat for adult brook trout (Figure 4-3). Although habitat for adult salmon is optimized at 1,000 cfs (Figure 4-4), KWP considered the difference in weighted usable area (WUA) between 500 and 1,000 cfs to be minimal. KWP also concluded that most of the available spawning habitat remains watered at the proposed 500 cfs minimum flow.

Suitable spawning substrate for salmon and brook trout in the East Outlet is extremely limited. Appropriate spawning gravel was found at only 3 of 13 transects. Two of four known spawning areas were found to be dewatered at 500 cfs (letter from MLURC, January 9, 1995). Since spawning habitat is uncommon in the East Outlet, KWP has proposed to modify a side channel so that approximately 12,500 square feet of additional spawning habitat would be available to salmon and brook trout. This side channel, when modified, would not be dewatered at the proposed minimum flow. Conceptual plans of this additional habitat were described in a March 24, 1993, KWP submittal to the Commission in response to our Additional Information Request (AIR).

MLURC (1994), in its WQC for the Moosehead Project, has agreed with KWP's proposed year-round minimum flow of 500 cfs in the East Outlet. MLURC has further indicated that from October 15 to November 15 (the spawning season for brook trout and salmon) KWP should establish an annual specific target flow rate within the range of 1,000 to 2,000 cfs in consultation with MDIFW. Once established, the agreed upon flow would remain constant through November 15, optimizing habitat for spawning brook trout and salmon. Deviations from the agreed upon flow would only be made after consultation with MDIFW.

MLURC has noted that studies of aquatic invertebrates conducted by KWP in the East (as well as West) Outlet (Section 4.1.2.1) show extremely high numbers and densities of macroinvertebrates and concludes that both outlets meet Class C standards for macroinvertebrate life in the permanently wetted portions of the channels. MLURC proposes no additional macroinvertebrate studies.

Interior (letter dated October 8, 1993), in its 10(j) recommendations for the Moosehead Project, recommends a minimum flow regime that would maintain the same or greater flow rate

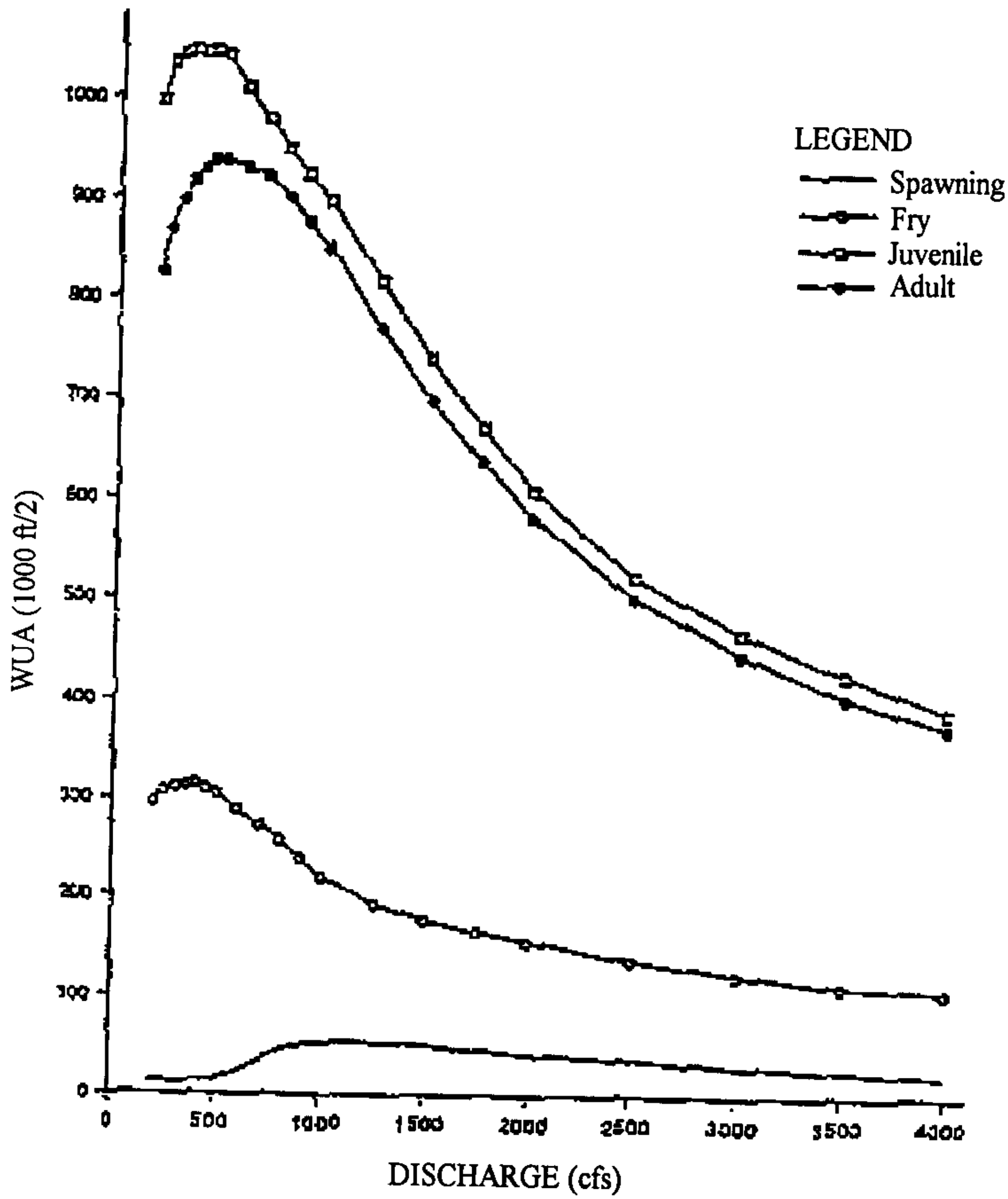



FIGURE 4-3
KENNEBEC RIVER BASIN EIS

Total WUA vs. Discharge for Life Stages of Brook Trout in the East Outlet of Moosehead Lake

Source: Central Maine Power, 1991, modified by staff.

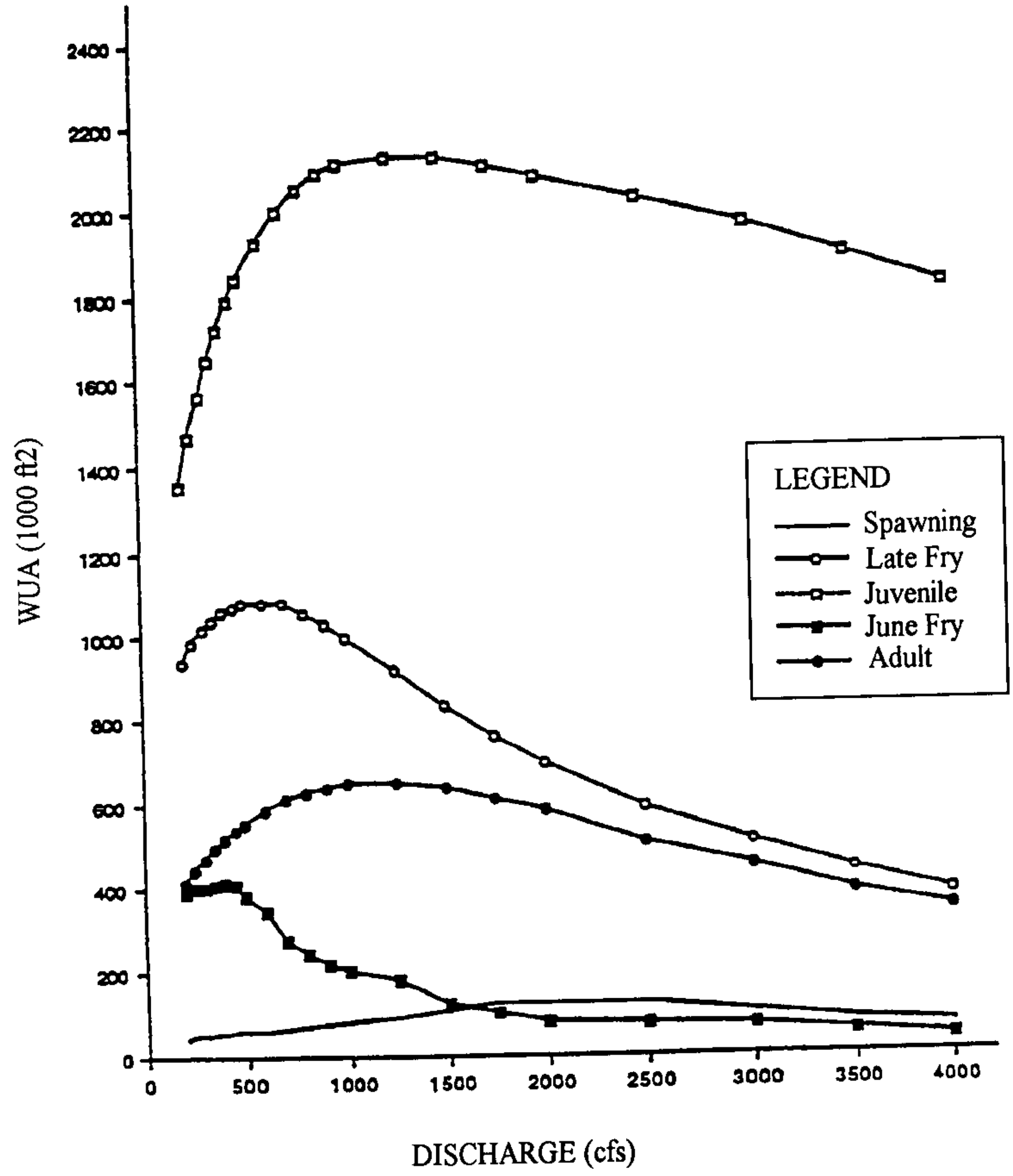



FIGURE 4-4.
KENNEBEC RIVER BASIN EIS
Total WUA vs. Discharge for Life Stages of Atlantic Salmon in the East Outlet of Moosehead Lake
Source: Central Maine Power, 1991, modified by staff.

during the egg incubation period (November 15 through May) as was present during spawning. Interior has indicated that if the minimum flow during the refilling of Moosehead Lake, which typically occurs during April and May, is established at 500 cfs, then the minimum flow during the spawning season should also be established at 500 cfs. This would restrict spawning to suitable habitat that would not be dewatered during the spring refill period. During the rest of the year, it has proposed that flows be increased to exceed 1,000 cfs, or inflow, to provide optimum habitat for the free-swimming older life stages of salmon. Interior has agreed with KWP that higher minimum flows would also help invertebrate populations in the East Outlet, but makes a 10(j) recommendation for additional invertebrate monitoring to determine how aquatic life responds to the new conditions.

Our recommended flow regime is based on the premise that the quantity of spawning habitat is in short supply in the East Outlet. An important component of the salmon population in Moosehead Lake and the East Outlet is maintained by natural reproduction, and adults of both wild and hatchery origin can move freely between the stream and the lake by the existing fishway. We therefore agree with MLURC's proposal to establish a target flow within the range of 1,000 to 2,000 cfs during the spawning season. This would enable the fish to spawn in the most extensive existing habitat identified during the instream studies. This spawning habitat is located at transect 1, at the Routes 5 and 15 bridge. These flows would enable use of from about 10,000 to over 60,000 square feet of WUA for spawning (Table 4-2). At 500 cfs, no WUA is available at this transect. Modest gains in WUA would also occur at these higher flows at transects 2 and 11, although there would be some loss of WUA at transects 7 and 10. The net gain in WUA over KWP's proposed 500 cfs minimum flow is estimated to be 17,965 square feet at 1,000 cfs and 62,022 square feet at 2,000 cfs.

Table 4-2. Landlocked salmon spawning habitat (WUA) in the East Outlet of Moosehead Lake at selected flows (Source NAI, 1990; modified by the staff)

| | Spawning Habitat (WUA) at Associated Flow | | | |
|---|---|---|---|---|
| Transect | 200 cfs (sq ft) | 500 cfs (sq ft) | 1,000 cfs (sq ft) | 2,000 cfs (sq ft) |
| 1 | 0 | 0 | 10,528 (+10,528)[1] | 61,185 (+61,185)[1] |
| 2 | 5,160 | 16,604 | 40,995 (+24,391) | 18,379 (+1,775) |
| 7 | 0 | 8,613 | 1,085 (-7,528 | 3,327 (-5,286) |
| 10 | 34,934 | 33,107 | 18,240 (-14,867) | 30,981 (-2,126) |
| 11 | 0 | 220 | 5,661 (+5,441) | 6,694 (+6,474) |
| Total | 40,094 | 58,544 | 76,509 (+17,965) | 120,566 (+62,022) |

1 Numbers in parenthesis represent change in habitat from KWP's proposed 500 cfs minimum flow.

Based on our review of the East Outlet monthly flow duration curves, enough water is available most of the time to sustain a target flow of at least 1,000 cfs from October 15 to the expected emergence time for fry in late May. We therefore recommend that KWP maintain the annual target flows agreed upon with MDIFW through May, between releases scheduled for downstream generation purposes, unless doing so would cause the water surface elevation to drop below the October 10 level. Our review of HEC-5 model outputs for existing conditions (baseline) (Appendix D), the proposed KWP and MLURC flows, and our proposed flows indicate that in all cases reviewed, the lake would reach full pond by the end of April.

If, in some years, it is necessary to reduce the East Outlet flow to avoid unacceptable decreases in the water level of Moosehead Lake, the minimum flow could be reduced to as low as 500 cfs or inflow, whichever is less. This flow should normally be available from minimum flow requirements of 425 cfs at the Brassua Project and 75 cfs from First Roach Pond (MSPO, 1993). We recognize that, when it is necessary to decrease flow below the established target flow, some dewatering of salmon and trout eggs is possible. However, with the spawning habitat now available at 500 cfs and the addition of the KWP's proposed side channel spawning habitat, existing conditions would be substantially enhanced, even if target flows could not be maintained through May of every year. We recommend that KWP finalize its conceptual side channel salmonid spawning habitat plan (including its March 24, 1993 proposed erosion and sedimentation control measures) with resource agency consultation prior to submitting the plan to FERC for approval. After May, we recommend a minimum flow of 500 cfs until October 15.

Salmon fry are especially sensitive to higher flows given their limited mobility and limited amount of available spawning habitat. Interior's recommended summer minimum flow is too high for salmon fry and brook trout. Its recommended higher flows could also cause the water elevation of Moosehead Lake to decrease more rapidly, which could have an adverse impact on wetlands, shoreline breeding wildlife, and recreational use because docks are designed to accommodate nearly full pond conditions during the summer.

Interior's recommendation for a summer minimum flow is within the scope of Section 10(j), but inconsistent with the 500 cfs minimum flow specified by MLURC in the WQC. Even though flows in excess of 1,000 cfs, considered optimal for juvenile and adult salmon but suboptimal for salmon fry and brook trout, already occur from 68 percent (August) to 85 percent (June) of the time during this time period, salmon fry would be adversely affected by Interior's consistently higher minimum flow. Adopting Interior's higher minimum flow, would be interfering with the state's determination that a 500 cfs minimum flow is needed to accommodate uses of the waterway other than the benefits to juvenile and adult landlocked salmon sought by Interior. Wetlands, wildlife, and recreational resources at Moosehead Lake could be adversely affected if the lake is drawn down more rapidly because of Interior's recommended flow.

At the Section 10(j) meeting held on May 7, 1996, Interior suggested considering its recommended summer flow as a target flow underlain by a continuous minimum flow of 500 cfs. Criteria could be developed for releasing less than the summer target flow if the Moosehead Lake water level was too low. This provision would resolve the 10(j) inconsistency and address our concern for Moosehead Lake water levels but still leaves open the question of potential adverse effects on salmon fry. Although Interior's flow recommendation could adversely affect the salmon fry, the staff recognizes that the higher flows would directly benefit adult and juvenile salmon. Interior's recommendation resolves the flow release issue without adversely affecting Moosehead Lake levels.

We recommend adopting Interior's recommendation that KWP release a target flow of 1,000 cfs to the East Outlet from June 1 to and including October 14 to enhance juvenile and adult landlocked salmon habitat and enhance flows for angling. This target flow may be reduced (but not below 500 cfs) if natural conditions would cause the water level of Moosehead Lake to be drawn down prematurely or if evidence is provided that landlocked salmon fry or riverine angling is adversely influenced by this summer target flow.

We consider Interior's recommendation for KWP to document the degree of improvement that our recommended flow regime would cause in the existing aquatic invertebrate community to be within the scope of Section 10(j). However, because Interior's recommendation is not supported by substantial evidence, it is inconsistent with the FPA. No evidence was presented by Interior that the amount of available food with the existing flow regime is limiting to the salmon or trout populations in the East Outlet. MLURC has already certified that, with the proposed operation, Class C standards for aquatic life in the East Outlet would be met, thus making the objective of additional macroinvertebrate sampling unclear.

KWP proposes to continue its present East Outlet ramping rate that limits changes in flow to no more than 350 cfs per minute. It also proposes to minimize the frequency of major flow fluctuations in the East Outlet such that a flow change of more than 1,000 cfs in one direction followed by a flow change in the opposite direction within any 7-day period is limited to once a month. MLURC (1994) and Interior (1993) have agreed with KWP's proposals regarding ramping rate and control of major flow fluctuations. Trout Unlimited (TU) (letter dated October 12, 1993) and CLF et al. (letter dated October 8, 1993) have opposed these flow fluctuation practices, although neither organization provides specific reasons for their opposition.

We concur that KWP's proposed measures to control flow fluctuations in conjunction with our recommended flow regime would minimize adverse effects of changing discharges. No party identified any specific problems with the proposed flow regime. (KWP now follows its proposed flow fluctuation practices.) We recommend that KWP's proposed East Outlet ramping rate regime and measures to minimize major flow fluctuations discussed in the previous paragraph be included in any license for this project. Our recommended annual meeting with resource agencies and other interested parties (including TU and CLF) regarding water level management and flows (discussed previously) would provide a mechanism to document problems associated with current and future flow fluctuations and propose corrective measures.

KWP has concluded that at a flow of 80 cfs, habitat requirements for most life stages of brook trout and salmon in the riffles of the West Outlet are supported. Adult trout and salmon are expected to have ample habitat in the many ponded segments of the West Outlet. This flow optimizes salmon spawning habitat (although suitable substrate is limited) and provides 97 percent of the optimal WUA for juvenile salmon (Figure 4-5). Habitat for juvenile brook trout was also optimized at this flow (Figure 4-6). KWP proposes to establish a minimum flow of 80 cfs from October to April and a target flow of 120 cfs from May to September (a minimum flow of 120 cfs is required to allow passage of a fully loaded canoe along the entire length of the West Outlet). This would enhance fish habitat for most studied life stages as well as for boating conditions. MLURC (1994) and Interior (1993) have agreed with KWP's proposed flow regime in the West Outlet, although they propose the 120 cfs as a minimum flow rather than a target flow. We consider a minimum flow of 80 cfs from October to April and a minimum flow of 120 cfs from May to September to be reasonable.

We recommend that KWP coordinate the development of its water surface monitoring plan with a plan to monitor and report flows from the East and West Outlets. As noted earlier, this plan should be developed in consultation with appropriate resource agencies. The plan should identify operational procedures that KWP would implement and criteria used to trigger a reduction in East Outlet target flows. The criteria should be sufficient to prevent unacceptable lake drawdowns during the entire year, ensure that Moosehead Lake reaches full pond by May, and allow flexibility to reduce flows based on biological (e.g., spawning success) or recreational (e.g., passage conditions for boaters) evidence while achieving the minimum flow of 500 cfs. We recognize that there is an element of uncertainty in predicting when flows should be reduced. Documenting and implementing procedures would, therefore, form the basis for our review of compliance with target flow conditions. Upon FERC approval, KWP would implement the flow monitoring plan. Annual consultations with MDOC, MDIFW, FWS and other interested parties would enable modifications in operations to be made within the general framework established in this EIS.

#### *4.1.3.2 Moxie*

*Pond Water Level*

The Owners and The Forks propose to hold the water level at full pond throughout the summer. Beginning after November 15, the pond would be drawn down an unspecified amount from full pond. Access of landlocked salmon and brook trout to tributaries used for spawning is prevented when the pond is drawn down more than 3 feet. Spawning of these two important game fish is usually completed by November 15. The impoundment would be refilled during the spring run-off season.

Subsequent to the filing of the application for a new license in 1991, meetings were held between resource agencies, other interested parties, and the Owners. These meetings

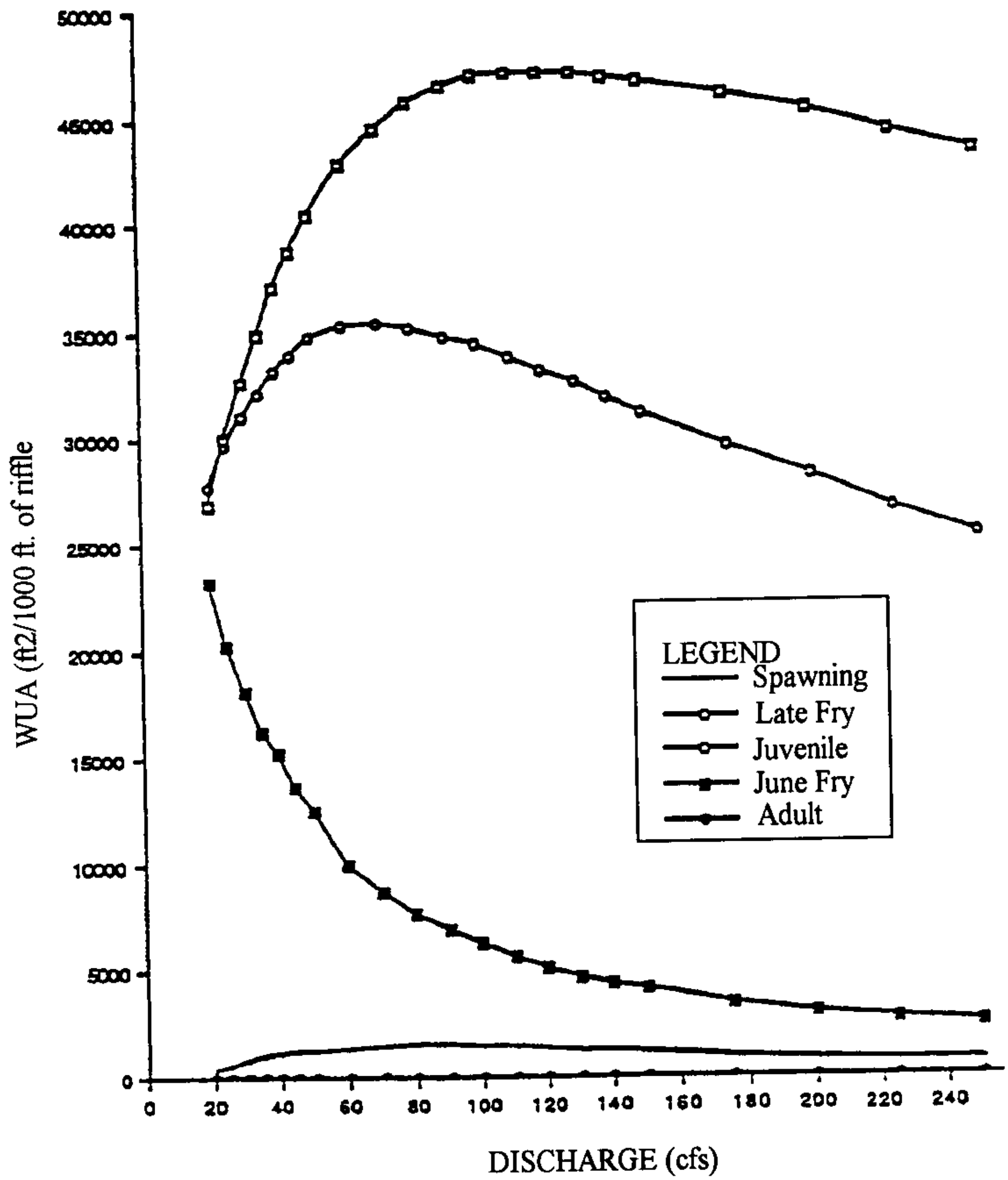



FIGURE 4-5.
KENNEBEC RIVER BASIN EIS
Average WUA per 1000 ft. of Riffle vs. Discharge for Life Stages of Landlocked Atlantic Salmon in the West Outlet of Moosehead Lake
Source: Central Maine Power, 1991, modified by staff.

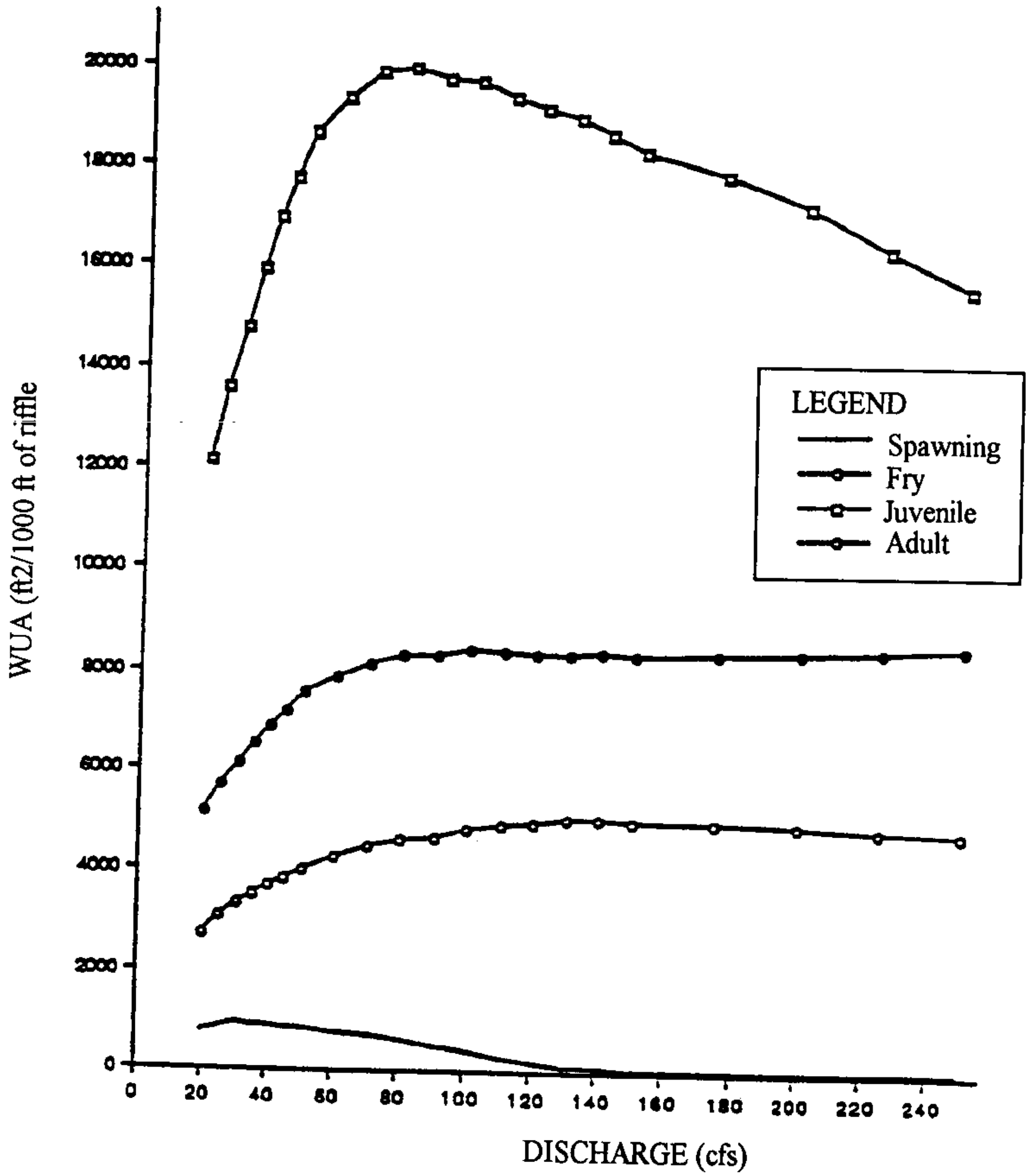



FIGURE 4-6.
KENNEBEC RIVER BASIN EIS

Average WUA per 1000 feet of Riffle vs. Discharge for Life Stages of Brook Trout in Riffles in West Outlet of Moosehead Lake

Source: Central Maine Power, 1991, modified by staff.

resulted in the development of a "consensus scenario" of project operations that was forwarded to FERC by the Owners (letter dated March 31, 1993). In this letter, the Owners also indicated that they intended to surrender their license for the Moxie Project. The consensus scenario calls for maintaining full pond (elevation 970.3 feet) from May 1 to and including October 15, and minimizing fluctuations to within 0.5 foot during this period. Between October 15 and November 15, the pond would be drawn down up to 1.5 feet and held at this level until it is refilled in the spring. In general, resource agencies and other interested parties support the terms of the consensus scenario, although some reservations still exist with individual elements of the scenario.

We consider the water level management regime of the consensus agreement to be protective of the fisheries resources of Moxie Pond. Access to salmonid spawning streams would be unimpeded by the proposed 1.5-foot drawdown in the fall. Maintaining nearly full pond during the summer should optimize nearshore invertebrate production, providing food for the coldwater fishery for which Moxie Pond is presently managed. We consider The Forks proposal to draw the impoundment down to an unspecified level to be unduly broad. Winter drawdown in excess of 1.5 feet could disrupt dormant aquatic life. Drawing down the impoundment between October 15 and November 15, rather than after November 15 as proposed by The Forks, could provide enhanced spawning conditions in Moxie Stream due to increased flows. We recommend that the Owners implement the Moxie Pond water levels as described in the consensus scenario.

*Outlet Flow Regulation*

The Owners originally proposed a minimum flow of 25 cfs from Moxie Pond to Moxie Stream. The Forks propose to release a minimum flow of 25 to 44 cfs or inflow, whichever is less, during spring refill. According to the Owners, at 25 cfs, water depth is sufficient to allow passage of brook trout between pools, and velocity is sufficient to sustain a healthy aquatic community. Gravel that is suitable for brook trout spawning was only found at 2 of 17 transects. At 25 cfs, this gravel would not be dewatered. In response to resource agency concerns regarding high flow impacts on downstream habitat, especially during the fall drawdown, the Owners originally proposed a maximum flow of 145 cfs or inflow, whichever is less. The Forks did not propose a maximum flow restriction. The Forks proposed to operate the project in run-of-river mode (outflow at the dam equals inflow to the pond) year-round except during fall drawdown and spring refill.

The 1993 consensus scenario called for operating the project in a modified run-of-river mode for the entire year except October 15 to and including November 15 when the pond would be drawn down. A guaranteed minimum flow of 25 to 44 cfs would be released at the bottom of the dam, if possible. If water were available, daytime recreational releases of at least 350 cfs would occur on weekends beginning October 15. The suggested fall recreational releases were not universally endorsed. MDOC (comments of G. Hannum at the January 29, 1993, consensus building meeting) had safety concerns, and TU (letter dated November 2, 1992) was concerned about salmonid egg washout.

Our review of the instream flow studies conducted by the Owners indicates that a minimum flow of 25 cfs, or inflow, would protect the salmonid habitat of Moxie Stream during the spring refill period. We also consider run-of-river operation to be the least intrusive operating mode in terms of protecting aquatic life in streams. We therefore recommend run-of-river operation except when the pond is being drawn down or refilled. When inflow is less than 25 cfs, a continued release of 25 cfs from the dam would cause the pond to be drawn down by an indeterminate amount. An unplanned drawdown during the summer would adversely affect shoreline aquatic communities (as well as wildlife and recreation). In extreme cases, it could restrict salmonid spawning in tributaries to Moxie Stream during the fall. We therefore do not recommend a guaranteed minimum flow of 25 cfs, as envisioned by the consensus scenario. We consider it appropriate to return Moxie Stream to as natural state as possible if the license is surrendered. Run-of-river operation, except during spring refill and fall drawdown, would achieve this objective.

To reduce the release of warm surface water during the summer, we recommend release of 25 cfs, or inflow, from the north or south gate from June to September, if feasible. These two gates draw cooler water from deeper strata; the middle gate draws water from the surface. According to water temperature data provided by the Owners, surface water in Moxie Pond can approach 25°C during the summer. Maintaining run-of-river operations by spillage only could result in the release of water to Moxie Stream that would stress brook trout which prefer water temperatures below 24°C (Smith, 1985).

We recommend that the maximum flow during drawdown be 145 cfs as originally proposed by the Owners. Based on the Owners' synthesized flow duration data, typical (50 percent exceedance values) October flows are 42 cfs and typical November flows are 107 cfs. Our proposed maximum flow would allow controlled drawdown of the pond and avoid sudden surges of water in the stream during the brook trout egg incubation season. Brook trout spawning habitat is uncommon in Moxie Stream, and we consider it appropriate to protect this limited resource to the extent possible by reducing the potential for washing incubating eggs out of the gravel. During refilling in April, the target flow should be similar to the maximum flow released during drawdown but no less than 25 cfs. The typical flow during April is 445 cfs, which is likely to fill the pond within 4 to 5 days, even if 145 cfs is released during refilling.

**Pond Water Level and Flow Monitoring Plan**

Because our recommended pond level and flow management regimes depart from historical operations, it is appropriate to develop and implement a plan to ensure our recommended pond level and flow regimes are achieved. We therefore recommend that the Owners and The Forks develop a pond level and flow monitoring plan in consultation with MLURC, MDIFW, MDOC, NPS, FWS, and USGS. The plan should identify the agency responsible for enforcing compliance with our recommended pond level and flow conditions.

*4.1.3.3 Wyman*

*Lake Water Level*

Lake drawdowns can adversely affect fish populations if access to tributaries used for spawning is impaired or if there are significant populations of fish that spawn in shallow-water, nearshore habitats.

CMP proposed in its license application to continue to limit normal impoundment fluctuations at Wyman to within no more than 2 feet of full pond elevation on a weekly basis. CMP proposes to continue to reserve the option to draw down the impoundment up to 8 feet during the spring to capture spring runoff and to minimize downstream flooding. This drawdown historically occurs when existing snowpack or predicted rainfall events are such that excessive inflows to Wyman Lake are likely.

MDIFW (letter dated December 17, 1990) and FWS (letter dated December 28, 1990) agreed that the continued operation of the Wyman Project with a fluctuation of up to 2 feet weekly would not adversely affect the fishery resources of Wyman Lake. Interior (letter dated May 10, 1993) has reiterated FWS's position that the 2-foot drawdown in the impoundment would not significantly affect present fishery management plans. Interior has noted that, if smallmouth bass populations expand into Wyman Lake, additional evaluations of reservoir drawdowns may be required.

MDEP's WQC (August 18, 1995), indicates that, from May 16 to and including July 31, the top 2 feet of the Wyman impoundment should be used to maintain minimum flows from the project (1,200 cfs). If the impoundment is already drawn down by 2 feet and inflow is less than 1,200 cfs, the project should be operated in run-of-river mode until inflow exceeds 1,200 cfs. During the rest of the year, MDEP would allow the top 4 feet of the impoundment to be used to meet minimum flow requirements. CMP, by letter to the Commission dated September 21, 1995, stated that it was amending its license application to be consistent with the conditions of the WQC.

CLF (letter dated May 20, 1993) has indicated that reservoir drawdowns should be restricted to no more than 1 foot during the smelt and smallmouth bass spawning season. Smelt normally spawn in April and May, and smallmouth bass normally spawn from May to July. CLF has further recommended that CMP conduct a study of the effects of the 1-foot drawdown on the breeding success of smallmouth bass and report the results to FERC within 5 years. If a stable smallmouth bass population cannot be maintained, Wyman Lake should be maintained at full pond during the smallmouth bass spawning season.

In response to CLF's May 20, 1993, submittal, CMP (July 2, 1993) reiterated that the impoundment does not support a significant smallmouth bass fishery and to manage the impoundment as if it does was not supported by any of the resource agency comments. State and federal resource agencies have indicated that the present 2-foot water surface fluctuation does not adversely affect impoundment fisheries.

We do not consider it appropriate to restrict the normal 2-foot drawdown of Wyman Lake to better enable establishment of a stable smallmouth bass population. The lake is presently managed for coldwater salmonids. Because smallmouth bass compete with trout, salmon, and smelt, measures to exclude smallmouth bass from waters that support coldwater fisheries are often implemented. Although we do not consider the normal 2-foot drawdown sufficient to prevent the establishment of smallmouth bass in Wyman Lake, it may slow their proliferation. In this case, we consider a limited smallmouth bass population a positive aspect of the current and proposed 2-foot, weekly drawdowns.

We initially had reservations about MDEP's allowance of CMP to use the top 4 feet of Wyman impoundment storage from August 1 to and including May 15 to ensure that a minimum flow of 1,200 cfs was released. We know of no studies that were conducted to ensure that a drawdown of 4 feet during salmonid and smelt spawning seasons would not prevent fish from entering tributaries to spawn or dewater eggs that were incubating along the shore line. Frequent 4-foot drawdowns could adversely affect the coldwater fisheries for which the Wyman impoundment is managed.

We used CMP's HEC-5 input files to assess whether drawdowns in excess of 2 feet could be expected on a regular basis. Figures 4-7 through 4-10 indicate that during a "representative year," a minimum flow of 1,200 cfs can be maintained without drawing the impoundment down more than 2 feet (the few instances when outflow dips below 1,200 cfs on the figures, we consider to be model aberrations rather than actual predicted values). We used a recommended target flow release from Moosehead Lake of

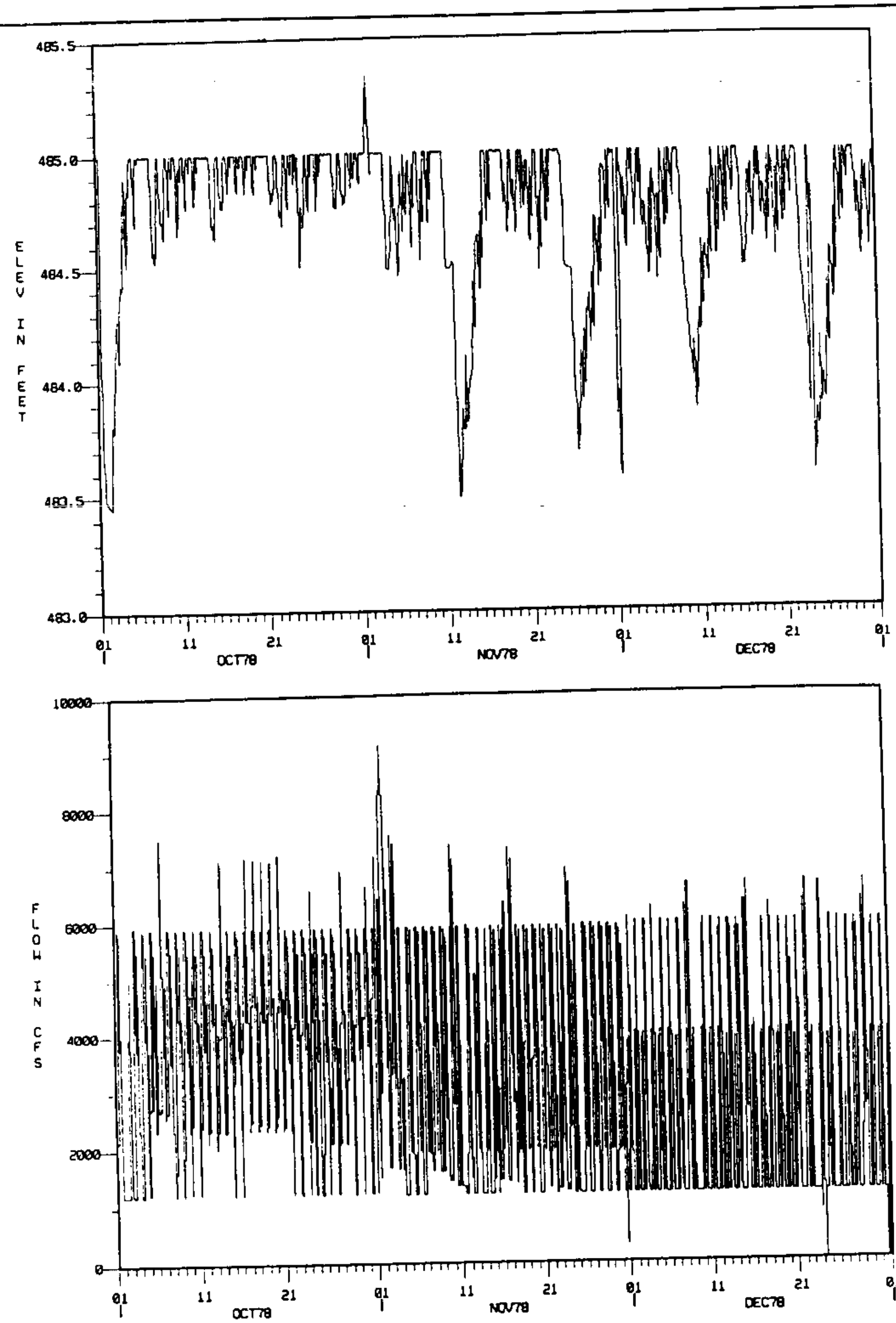



FIGURE 4-7.
KENNEBEC RIVER BASIN EIS
Predicted Wyman Impoundment Levels and Associated Project Discharges with our Recommended Flows at Moosehead and Wyman during a Representative Year (October-December)
Source: staff, HEC-5 Model run.

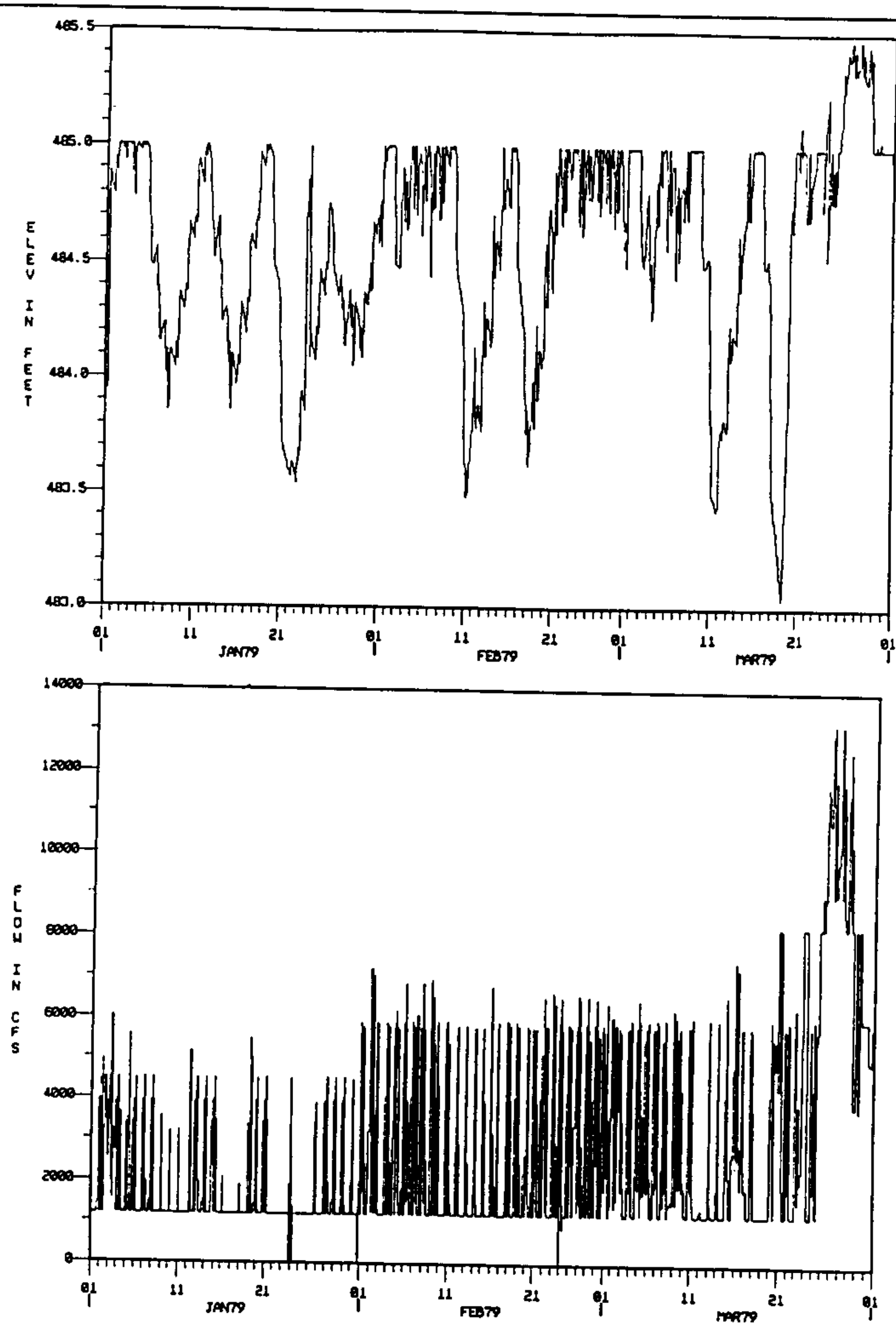



FIGURE 4-8.
KENNEBEC RIVER BASIN EIS
Predicted Wyman Impoundment Levels and Associated Project Discharges with our Recommended Flows at Moosehead and Wyman during a Representative Year (January - March)
Source: staff, HEC-5 Model run.

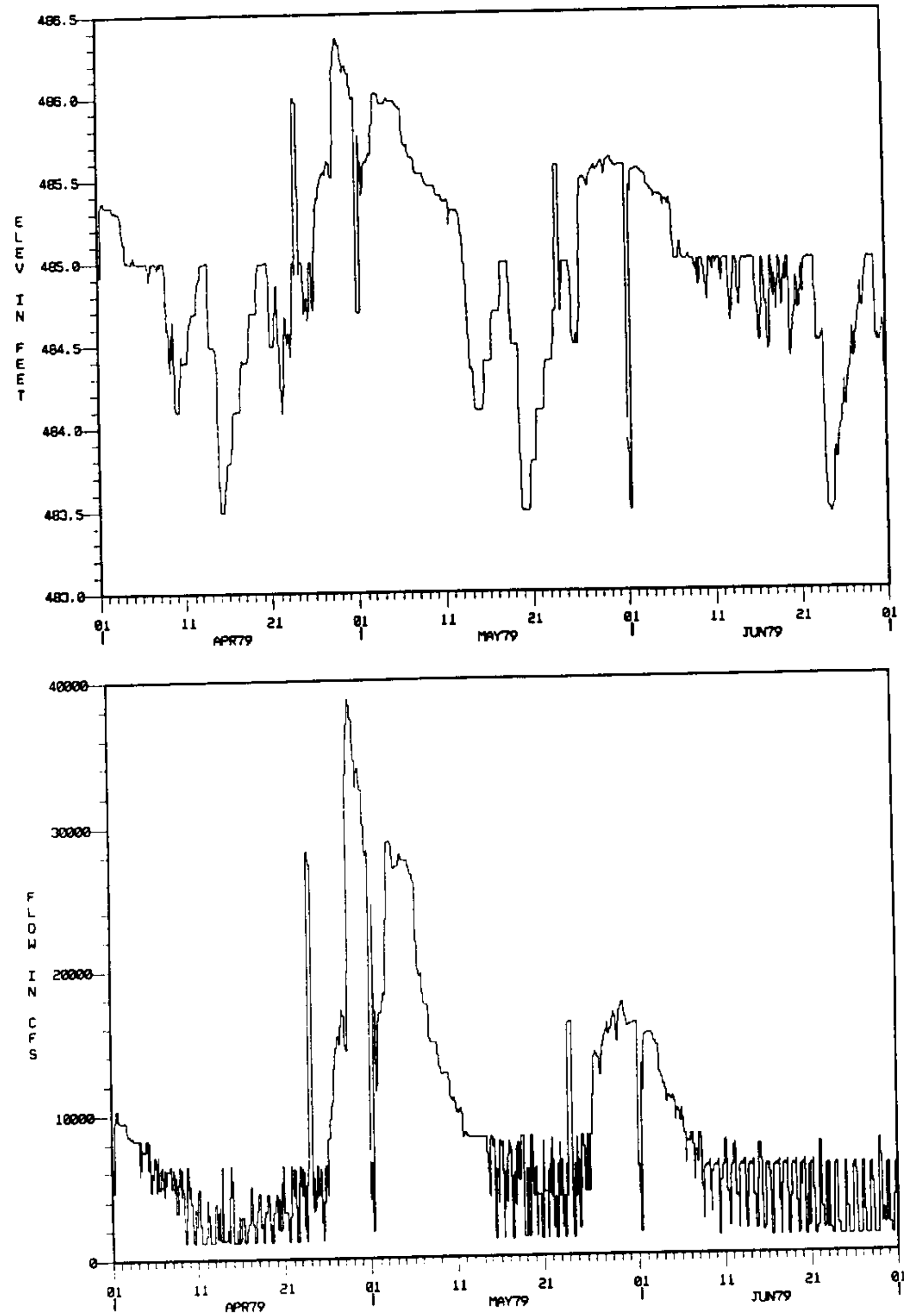



FIGURE 4-9.
KENNEBEC RIVER BASIN EIS
Predicted Wyman Impoundment Levels and Associated Project Discharges with our Recommended Flows at Moosehead and Wyman during a Representative Year (April - June)
Source: staff, HEC-5 Model run.

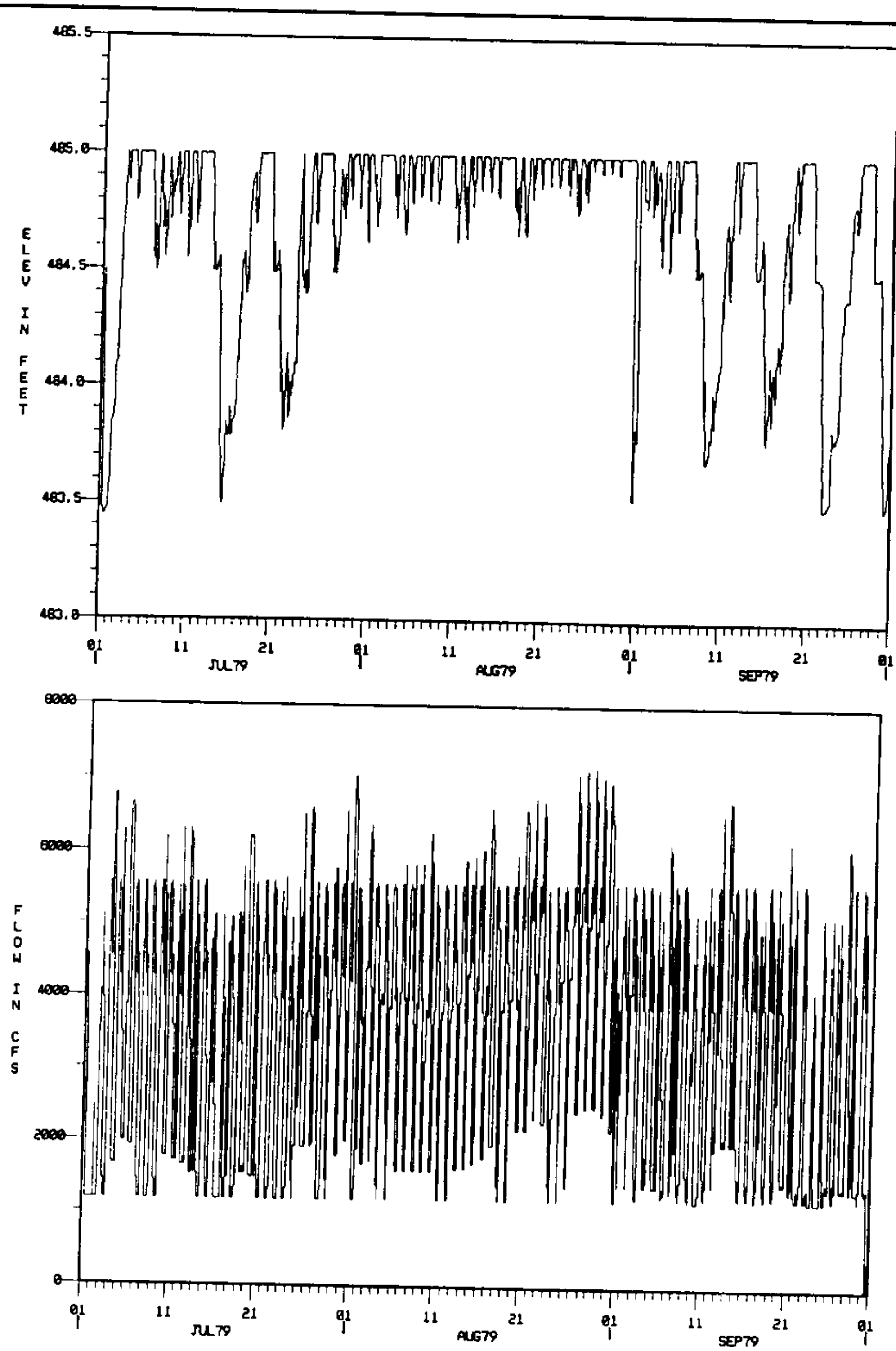



FIGURE 4-10.
KENNEBEC RIVER BASIN EIS
Predicted Wyman Impoundment Levels and Associated Project Discharges with our Recommended Flows at Moosehead and Wyman during a Representative Year (July - September)
Source: staff, HEC-5 Model run.

1,000 cfs (although higher flows could be set, based on agreement between KWP and fisheries agencies) from October 15 through May 31 for these figures. We also assessed MDEP's proposed Moosehead Lake release of a target flow of at least 1,000 cfs from October 15 to and including November 15 and a minimum flow of 500 cfs for the rest of the year.

The results were similar, except that lower releases during the winter with the MDEP flow resulted in a greater drawdown at Wyman during March (2 feet versus 1.5 feet), when Moosehead Lake begins to fill and outflow is restricted. This analysis assumes that the "representative year" selected by CMP is, in fact, representative. Drawdowns in excess of 2 feet may still occur during a dry year.

We recommend that any license issued for the Wyman Project include a condition to monitor the water surface elevation of the Wyman impoundment. The monitoring plan should include provisions for reporting the data to resource agencies and FERC. We also recommend that if the impoundment is drawn down more than 2 feet from October to May (the expected spawning and incubation period for salmonids and smelt) on a regular basis, CMP be required to assess potential impacts of the recurring drawdowns on salmonids and smelt, including potential measures to reduce the fluctuations, while maintaining a minimum flow of 1,200 cfs. FWS or MDIFW may request that the Commission require such an assessment based on agency resource review of the water surface elevation monitoring data. However, our analysis of flows indicates that it is unlikely that such an assessment would be require

CMP's proposal to retain the option to draw down the impoundment up to 8 feet to minimize downstream flooding may influence the existing fisheries to a greater extent than a 2-foot drawdown. According to CMP's application, the impoundment was drawn down more than 4 feet a total of 13 times between 1981 and 1989. All but two of these drawdowns occurred during months when trout or smelt eggs could be incubating in shoreline gravel and cobble deposits (October to May). In the future, such flood control drawdowns could dewater some of these incubating eggs.

Drawdowns of up to 8 feet for flood control purposes should be kept to a minimum to protect aquatic life. Such drawdowns could reduce damage to downstream properties and ecosystems and therefore could serve beneficial purposes that may outweigh the potential loss of salmonid eggs. But we also note that from 1981 to 1989 there were three major flood events with peak discharges in excess of 55,000 cfs and the impoundment was not drawn down for any of these three flood events. On two occasions (September 6, 1983 and January 27, 1985), the impoundment was drawn down in response to: (1) imbalances in storage and the Madison-regulated flow or (2) artificially high inflows due to scheduled drawdowns at upstream storage reservoirs. Alternatives to drawing down Wyman Lake in these two circumstances may have existed.

We recommend that prior to any proposed drawdowns for flood control purposes (i.e., greater than 4 feet), CMP contact MDIFW and appropriate state and federal emergency management agency officials and provide the basis for the proposed drawdown as well as any alternative measures that may serve the same purpose. Documentation of any state or federal emergency management agency and MDIFW comments regarding the need for the draw-down should be provided to the Commission within 10 days of the drawdown. We recommend that the water surface monitoring plan for the Wyman Project include proposed flood control drawdown notification and reporting procedures.

*Flow Regulation*

CMP conducted IFIM studies in the 4.75 miles of flowing river downstream of the Wyman Project to the upstream influence of the Williams impoundment. The species and life stage of most concern to resource agencies were adult rainbow trout and brook trout. Although adult landlocked Atlantic salmon also contribute to the fishery in this reach, it was concluded at a scoping meeting that adult rainbow trout would sufficiently represent the habitat needs of adult salmon (Acres, 1987). IFIM studies showed that adult brook trout habitat is maximized at 350 cfs (WUA = 185,000 square feet per 1,000 feet of river) and adult rainbow trout habitat is maximized at a flow of 1,200 cfs (WUA = 217,000 square feet per 1,000 feet of river) (figures 4-11 and 4-12). CMP originally proposed to maintain a year-round, instantaneous minimum flow of 750 cfs, or inflow, whichever is less, which would provide 92 percent of the peak WUA for both target species.

Another important aspect of flow regulation that influences the suitability of the tailwaters as salmonid habitat is the effect of daily high flows (typically up to about 6,000 cfs; figures 4-7 through 4-10) caused by peaking operations. Although sustained high flow is normal during the spring (April and May), daily periods of high flow during the summer are not normal and may adversely affect fish growth by causing the fish to expend excessive amounts of energy to maintain their position in the stream. Adult brook trout WUA at 6,000 cfs is about 38,000 square feet per thousand feet of river (21 percent of optimal) and adult rainbow trout WUA is 86,000 square feet per thousand feet of river (40 percent of optimal).

G. Russell of FWS, at a Joint Agency Meeting held on February 14, 1991, suggested that CMP investigate the use of physical habitat alterations in the river to reduce impacts from high flows. CMP indicated that instream salmonid habitat improvement structures might enhance existing fish habitat and fishing opportunities. In a response to a FERC AIR dated

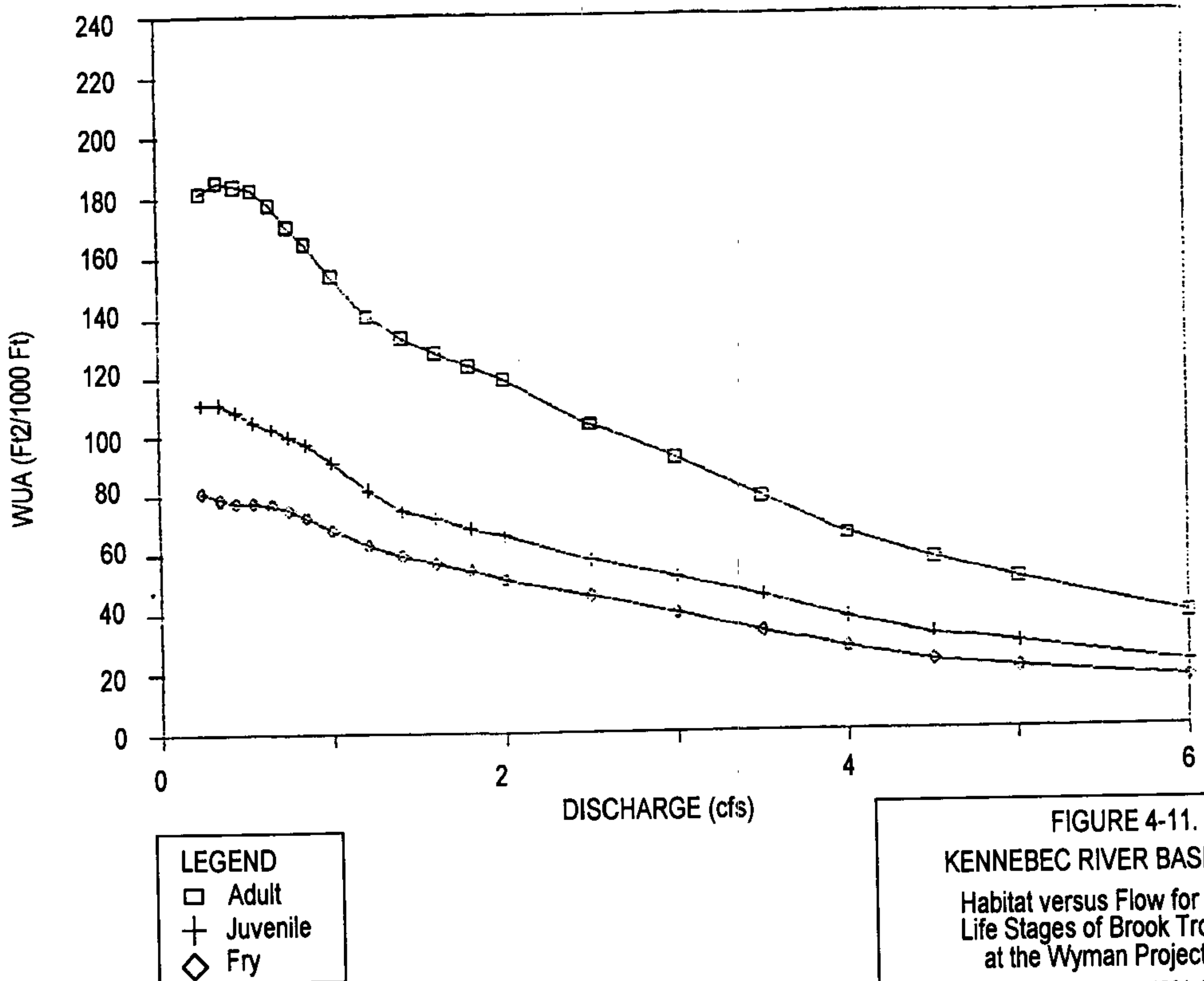



FIGURE 4-11.
KENNEBEC RIVER BASIN EIS

Habitat versus Flow for all Life Stages of Brook Trout at the Wyman Project

Source: Central Maine Power, 1991, Modified by Staff

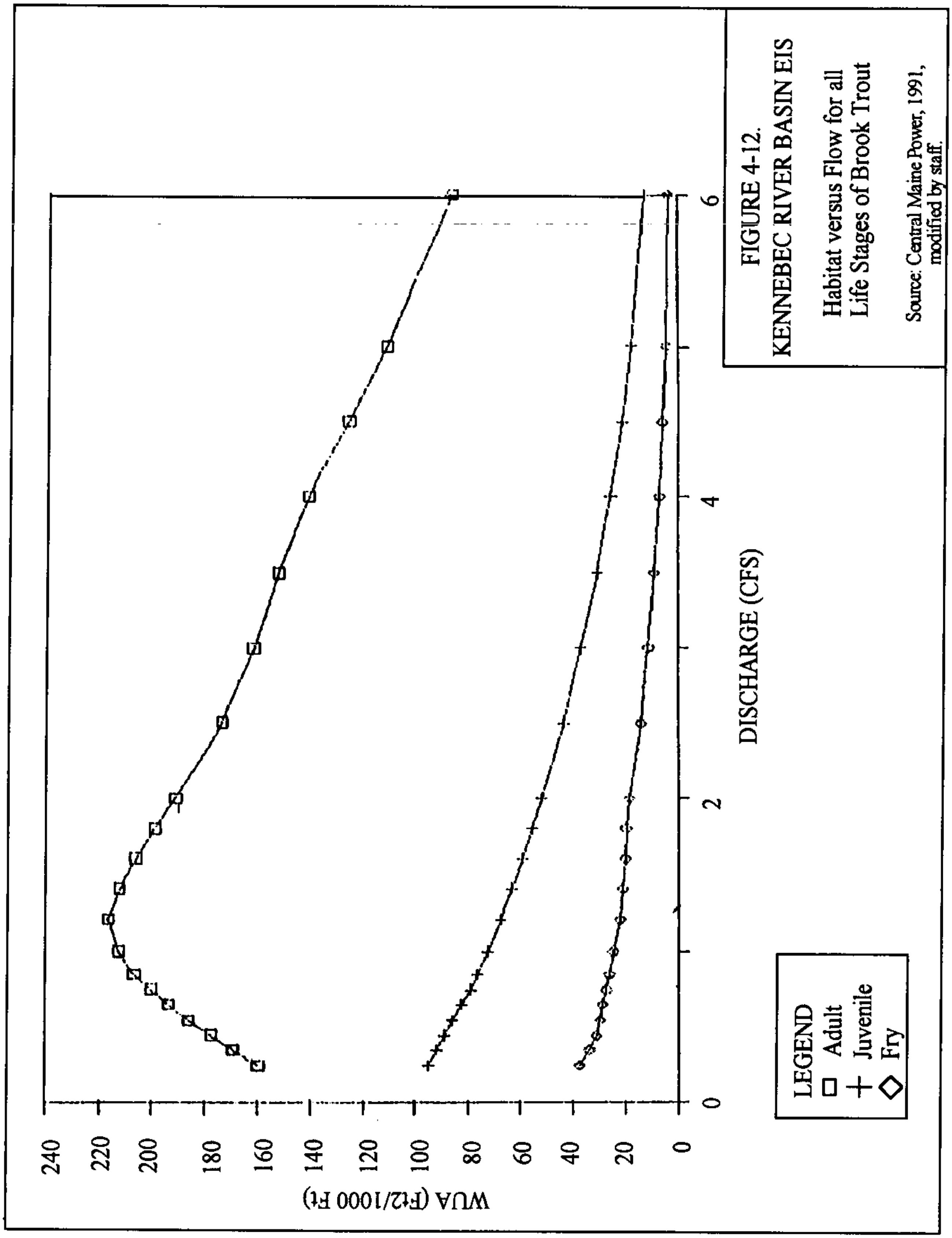



FIGURE 4-12.
KENNEBEC RIVER BASIN EIS

Habitat versus Flow for all Life Stages of Brook Trout

Source: Central Maine Power, 1991, modified by staff.

September 10, 1992, CMP consulted with resource agencies and developed a plan to install 6 prototype instream structures and evaluate their effectiveness in attracting fish and improving fishing opportunities. MDEP, in its WQC, has required CMP to implement the September 10, 1992 plan, whereas Interior has made a 10(j) recommendation that CMP develop a detailed plan for installing instream structures in consultation with resource agencies.

FWS and MDIFW have disagreed with CMP's proposed minimum flow of 750 cfs (letters dated April 4, 1988, and December 17, 1990, respectively), and have recommended that a minimum flow of 1,200 cfs be provided at all times downstream of the Wyman Project. The basis for this recommendation was that rainbow trout and landlocked salmon provided 63 percent of the salmonid catch below Wyman dam, and 1,200 cfs would optimize habitat for these two species. Interior (letter dated May 10, 1993) has made a 10(j) recommendation that an instantaneous minimum flow of 1,200 cfs or inflow, whichever is less, be provided downstream of the Wyman Project. MDEP, in its WQC, has required an instantaneous minimum flow of 1,200 cfs, using the top 2 feet of storage from May 16 to July 31, and up to 4 feet for the rest of the year. Inflow, rather than 1,200 cfs, could only be released if the pond level would drop below the designated elevation by releasing 1,200 cfs. CMP, by letter to the Commission dated September 21, 1995, stated that it was amending its license application to be consistent with the conditions of the WQC.

CLF (letter dated May 20, 1993) has supported a minimum flow of 1,200 cfs coupled with a reduction in the maximum flow releases if such modifications would result in the best overall management of nonpower resources in the upper river basin. TU, in comments filed on May 24, 1993, has supported run-of-river operation at Wyman, but if run-of-river is not possible, focuses on reducing maximum flows, especially from August to November, regardless of whether a minimum flow of 750 or 1,200 cfs is imposed.

CMP (AIR response dated January 29, 1992) has noted that the cost in lost generation of converting to run-of-river operations would be $15.6 million over a 30-year license period, and there would be virtually no change in brook trout or rainbow trout habitat conditions. CMP further noted (letter dated July 2, 1993) that with run-of-river flow, flows would be well in excess of the optimum flow of 1,200 cfs for rainbow trout and Atlantic salmon.

Operating Wyman in a run-of-river mode would be meaningless without also operating the upstream Harris Project in the same mode. Otherwise, inflow (and outflow) to the Wyman Project would continue to reflect the peaking releases at the Harris Project. TU also has requested consideration of run-of-river releases from the Moosehead Project. Our review of the annual flow duration curve for the Wyman Project, which represents unregulated (run-of-river) conditions, reveals that flows exceed 1,200 cfs, the optimum flow for adult salmon and rainbow trout, 100 percent of the time and average about 3,500 cfs. We conclude that although run-of-river operation may reflect a more natural flow regime, it would not enhance the Wyman tailwater fishery.

Converting the Wyman, Harris, and Moosehead Projects to run-of-river would substantially reduce the flood control benefits that are currently provided. Converting to run-of-river operation would result in greater extremes of flow on the entire main stem of the Kennebec River, which given the existing state of equilibrium, would be considered by most to be an adverse impact. Furthermore, run-of-river operation would drastically affect whitewater boating opportunities that now depend on scheduled project releases.

CMP (letter dated July 2, 1993) responding to resource agency and intervenor comments, has revised its proposed minimum flow at Wyman to 1,200 cfs or inflow, whichever is less, based on MDIFW's clear statement that rainbow trout and landlocked salmon were the management priority in this reach of the Kennebec River. By providing a minimum flow of 1,200 cfs, CMP has indicated that there would be a significant reduction in the range of flows at Wyman (i.e., now typically 490 to 6,000 cfs each day compared to the proposed 1,200 to 6,000 cfs) and when considered with its proposed instream habitat improvement plan, CMP's proposed minimum flow offers an outstanding enhancement for downstream fisheries habitat.

We address the issues of optimal and maximum flows together. Providing a minimum flow that optimized adult rainbow trout habitat when Wyman is not generating (most often at night) seems of little value if decreased habitat suitability caused from high day time flows is not also addressed. CMP has indicated (letter dated July 2, 1993) that to cap maximum flows at 5,100 cfs by restricting generation to only 2 units would have a total cost over a 30-year license of $18.3 million. Although such a high cost may not represent the best comprehensive use of the resources of the Kennebec River, evaluation of the effectiveness of six instream prototype structures by itself is not an adequate enhancement for high flow impacts.

We recommend that CMP finalize (in consultation with resource agencies) and implement its proposed instream prototype structure evaluation study as described in its September 10, 1992, submittal to FERC. This study would determine which of three possible structure designs is the most effective velocity refuge for salmonids. This study should also address the feasibility and cost of expanding the program to additional free-flowing portions of the Kennebec River between Wyman and the upper limit of the Williams impoundment. The final report for this study should include CMP's proposals for providing additional instream velocity refuges or other measures to reduce the impact of high flows. If additional velocity refuges do not appear to be warranted, the report should discuss alternative measures that could be implemented to reduce the impacts of high peaking flows. It should also include proposed erosion and sedimentation control measures.

Based on resource agency consultation associated with design of the prototype study, we recognize that expanding the placement of structures is not necessarily a foregone conclusion. MDIFW expressed concern that the structures might pose a navigational hazard to the small motorized boats that commonly troll the tailwaters. In other areas, existing structures or current patterns already provide velocity refuges. We are also concerned that providing access for equipment to install additional structures, in some cases, may not be practical, or could have adverse environmental impacts. Construction activities or altered angling focal points may have a negative impact on cultural sites along this reach of the river. Recommendations pertaining to the placement of additional instream structures should be made in consultation with FWS, MDIFW, MDOC, and the Maine State Historic Preservation Office (MSHPO). Comments of these resource agencies regarding CMP's proposals should be included in the final report provided to the Commission.

Given the predominant influence of daily high flow events on the downstream habitat, establishing a minimum flow to optimize adult rainbow trout habitat could only provide a moderate amount of habitat enhancement. The amount of time that flows are at minimum is relatively small, as illustrated by HEC-5 simulated outflow from Wyman during July to September with a minimum flow of 1,200 cfs (figures 4-7 through 4-10). It is clear to us, however, that the rainbow trout fishery in the Wyman tailwaters is a relatively unique fishery in Maine and should be afforded whatever enhancement can be gained with a minimum flow of 1,200 cfs. We therefore recommend an instantaneous minimum flow of 1,200 cfs. We make this recommendation with the expectation that the instream enhancement study that CMP should conduct would produce meaningful recommendations for protecting fish from the impacts of the high flows in this river reach. If CMP concludes that it is not possible to protect fish from high flow impacts and the Commission agrees, we recommend that CMP implement alternative measures to protect the tailwater fisheries from such impacts. A license issued for this project would also include a provision to prepare a minimum flow compliance plan.

MDEP, in its WQC, has also required CMP to assess the effect of its proposed minimum flow (1,200 cfs) on the macroinvertebrate community within 1,000 feet of the dam. This assessment would provide a basis for determining whether project operations meet applicable standards for aquatic life.

We concur that such an assessment would document the expected improvement in aquatic life caused by increased minimum flows. We recommend that the assessment be conducted under 1,200 cfs minimum flow operations (the most likely final minimum flow) and that the study plan be developed in consultation with resource agencies.

CMP proposes to limit to emergencies the simultaneous shut-down of all three units. This proposed shut-down restriction would eliminate sudden reductions in flow from about 6,000 cfs to 1,200 cfs (our recommended minimum flow) minimizing any potential impacts due to stranding of fish. FWS (letter dated December 28, 1990) believed that CMP adequately addressed the issue of damaging impacts on fish. MDEP has included CMP's statement in its WQC that simultaneous shut-down of all three units would be limited to emergencies to prevent fish stranding.

We concur with CMP's proposal to limit simultaneous shut-down of all three units to emergency situations and recommend including such a condition in any license issued for the Wyman Project.

Interior (1993) has further reserved its authority to prescribe the construction, operation, and maintenance of fishways under Section 18 of the FPA.

*4.1.3.4 Williams*

*Lake Water Level*

The environmental impacts of the typically daily 5- to 6-foot fluctuations in water surface elevation in the Williams impoundment are addressed in this EIS because they are caused from the pulsed releases from the upstream Wyman Project. The EA that accompanied the order issuing the Williams license on January 22, 1988, deferred addressing the influence of the Williams impoundment fluctuations to the Wyman relicensing proceedings.

We support the general concept of using the Williams Project to stabilize the fluctuating flows which are associated with peaking operations at the Wyman Project. Providing relatively constant flows to the Kennebec River downstream of the Williams Project is likely to benefit aquatic resources in the main stem of the lower Kennebec River. Upstream flow regulation reduces the disruptive forces of typical high spring flows that the lower Kennebec River would experience if there were no storage capability in the upper Kennebec River Basin.

The most obvious way to improve the fisheries habitat in the Williams impoundment is to reduce or eliminate the impoundment fluctuations. We anticipated that by increasing the minimum flows from Wyman, the magnitude of the fluctuations at Williams would at least be reduced. We sought to confirm this hypothesis by asking an AIR of CMP (dated November 17, 1994) and found that an increase in minimum flow from 490 to 1,200 cfs would not influence fluctuations at Williams (CMP response to AIR dated December 15, 1994). Our review of Kennebec River Basin HEC-5 output has confirmed CMP's response.

One reason that the fluctuations do not change is because the specified operating band for the Williams impoundment, the "rule curve", must be changed. We attempted to specify a different operating band for the Williams impoundment to see if we could consider at least a reduction in the amount of impoundment fluctuation while retaining the function of Williams as a re-regulating reservoir. We found that the HEC-5 model overrules changes in the Williams operating band to enable maintenance of downstream "set point" flows. In essence it establishes a relatively stable outflow from Williams as a higher priority than modifying the degree of impoundment fluctuation at this project.

We do not disagree with this conclusion, but we do not accept the validity of set point flows that are designed to meet contractual obligations of downstream water users rather than to minimize environmental impacts. We therefore recommend that CMP assess the feasibility of reducing the magnitude of daily fluctuations in the Williams impoundment while retaining its re-regulation function, given the increase in minimum flows at Wyman recommended in this EIS. This study should assess both year-round and seasonal (May to August) reductions in fluctuation. If re-regulation can be continued with reductions in the fluctuations in Williams impoundment, CMP should identify any potential impacts on the Williams tailwater fishery, potential remedial actions for those impacts, and any costs to CMP and other downstream water users that may be associated with implementing a program of reduced fluctuations. The plan for the study should be developed in consultation with FWS and MDIFW.

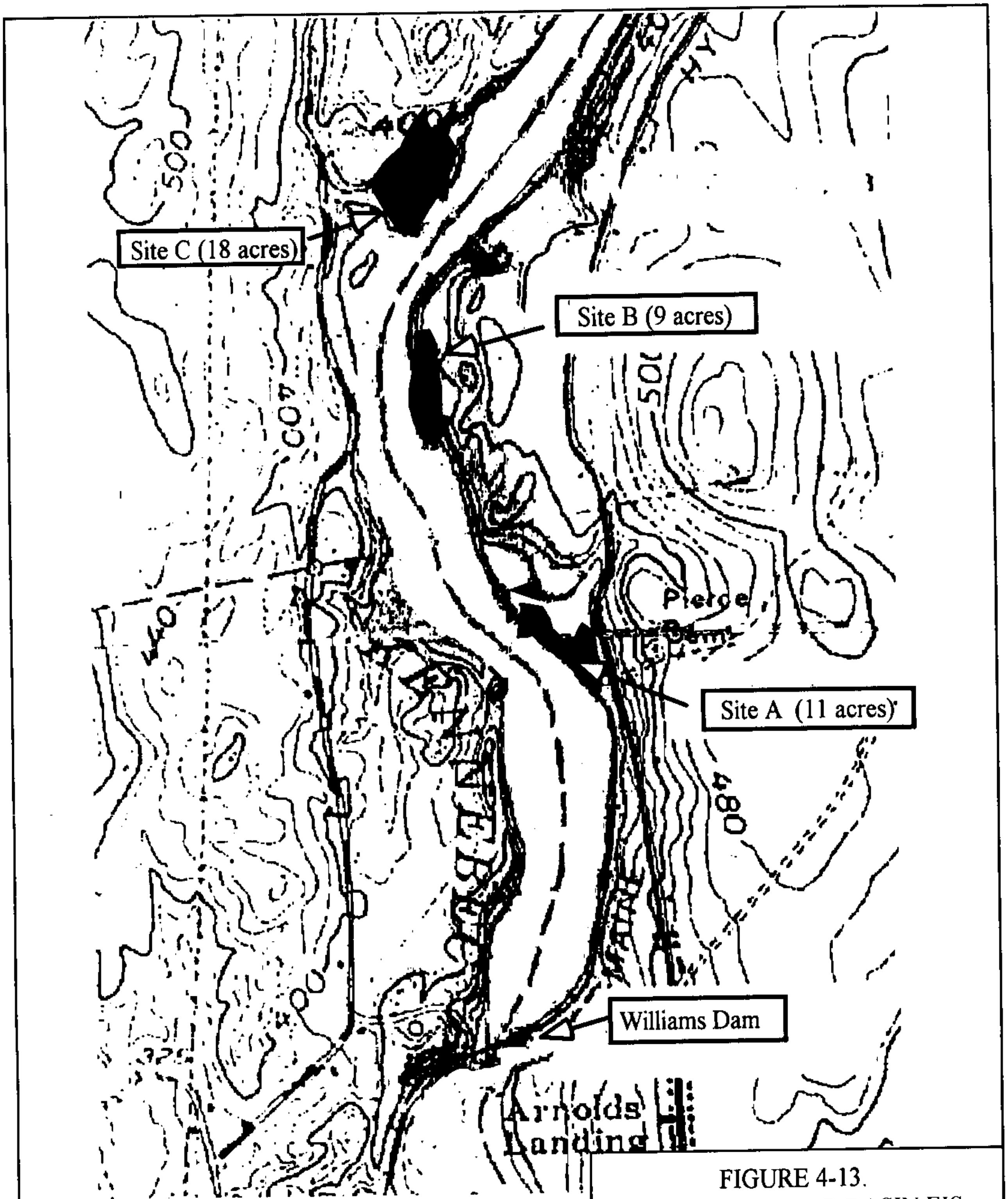
Regardless of the results of our recommended feasibility study, some degree of daily impoundment fluctuation will continue at Williams. To compensate for the effects of continuing impoundment fluctuations, we recommend that CMP develop and implement plans to enhance the existing shoreline aquatic habitat of the Williams impoundment. In the DEIS, we recommended that this enhancement take the form of constant level ponds to provide spawning and nursery habitat for warmwater fish. Comments received from resource agencies and the public clearly indicate that the impoundment should be managed for coldwater fish, and propagation of warmwater fish should be discouraged. Constant level ponds could still provide increased forage for salmonids (e.g., minnows and macroinvertebrates) as well as wetland and wildlife habitat enhancements if designed properly (Section 4.1.4.4 includes a discussion of potential wildlife benefits of such ponds). We therefore consider it appropriate to still consider constant level ponds as a shoreline enhancement measure. If alternative enhancements are agreed to during resource agency consultation, these alternative measures should be submitted to the Commission with evidence of agency consultation.

During our site visit, we noted two candidate sites (A and B) for potential constant level ponds (Figure 4-13). The wetland complex in the river bend on the west shore of the impoundment (described on page E3-9 of the Williams application for a new license) may also be a candidate site (C), but we did not review this location in the field. Review of available Soil Conservation Service (SCS) mapping suggest that up to 18 acres could be created at this site. Although we suggest that these three sites be evaluated by CMP, we do not intend to restrict CMP's options regarding development of these habitats or alternative enhancement measures that may be agreed to during resource agency consultation.

Site A is an existing pond on the east side of the abandoned railroad grade. It is connected to the impoundment by a submerged culvert and experiences similar water level fluctuations as the impoundment, although the fluctuations are somewhat attenuated by the culvert. Installing a standpipe at the culvert would stabilize the water level of this existing 11-acre pond and enhance its fish and wildlife value. Consideration should be given to removing the standpipe prior to the winter to prevent damage and to allow juvenile fish to overwinter in the deeper water of the impoundment.

Site B is also along the eastern shore and is associated with a point of land that extends into the impoundment. Although some emergent and submergent vegetation has become established in this area, it is of limited value to fish and wildlife because it is constantly dewatered. A berm could be created that extends from the downstream end of the point of land to the eastern shoreline adjacent to the abandoned railroad grade. Placing a weir in the berm would ensure water retention, yet allow occasional flushing of the pond during high impoundment conditions and would also allow entry and exit of young and adult fish. An existing tributary would provide a source of freshwater to this pond. We estimate that about 9 acres of enhanced habitat could be created at this site.

CMP should develop the plan for shoreline habitat enhancement in consultation with FWS and MDIFW and submit the plan to FERC for approval. The goal of the plan should be to provide the equivalent of at least 38 acres of enhanced fish and




= Potential Constant Level Pond and Wetland Site

FIGURE 4-13.
KENNEBEC RIVER BASIN EIS
**Williams Project**
Potential Constant Level Pond and Wetland Sites
Source: Central Maine Power, modified by staff.

wildlife habitat at more than one location. The plan should include erosion and sediment control measures to be implemented during construction and post construction monitoring plans to ensure that the proposed measures are serving their intended purpose.

*4.1.3.5 Sandy River*

*Pond Water Level*

MEW proposes to operate the project in run-of-river mode as defined by FWS. FWS (letter dated January 14, 1992) has defined run-of-river operation for the Sandy River as having head pond elevations which fluctuate less than 1 foot, with a minimum flow downstream of the powerhouse of 196 cfs, or inflow, whichever is less. A flow of 196 cfs represents the estimated August median unregulated flow in Sandy River. FWS has also stated that adherence to strict run-of-river operation (i.e., no cycling even at extreme low flows) would also accommodate its recommended minimum flow. MEW proposes to install an automatic headpond sensor system to regulate fluctuation, thus maintaining run-of-river operation. MEW would prepare a plan for documenting compliance with the run-of-river mode.

Interior (letter dated May 25, 1994) has made a 10(j) recommendation that MEW operate the project in run-of-river mode, where outflow from the project equals inflow on an instantaneous basis, and drawdowns in the impoundment do not exceed 1 foot (from the top of the flashboards, when in place, or from the crest of the dam if flashboards are absent). Interior also recommends that MEW develop a plan for ensuring and documenting run-of-river operations in consultation with FWS, United States Geological Survey (USGS), MDEP, MDIFW, Maine Department of Marine Resources (MDMR), and the Maine Atlantic Sea-Run Salmon Commission (ASRSC). MDEP, in its WQC for this project dated February 24, 1994, has also required run-of-river operation while passing a minimum flow of 196 cfs or inflow, whichever is less, except as temporarily modified by emergencies beyond the control of MEW. MDEP has also required water levels in the impoundment to be maintained within 1 foot of the normal full pond elevation of 180.5 feet, with flashboards in place, unless modified by conditions beyond the control of MEW. MDEP has also called for a plan to monitor impoundment water levels and run-of-river operations.

We concur with MEW's proposal to operate the project in run-of-river operating mode. This mode should ensure the protection of aquatic resources in the impoundment and downstream of the project. We consider the need to specify a minimum flow of 196 cfs, or inflow, below the project, as specified by MDEP, to be somewhat superfluous. A flow of 196 cfs or inflow, whichever is less, would be released below the project if operated as proposed by MEW.

We recommend that the impoundment be kept within 1 foot of the normal, full-pond elevation of 180.5 feet, with flashboards in place, unless deviations are warranted by circumstances beyond the control of MEW. We recognize that in some cases it may be necessary to draw the impoundment down more than 1 foot to conduct scheduled maintenance or inspections. We recommend that such scheduled maintenance be minimized from ice-out to and including July 31 to prevent the dewatering of centrarchid nests, especially those of smallmouth bass. These fish typically spawn along the shoreline from May through early July and the young may remain in the nest until August (Carlander, 1977). Scheduled draw-downs from ice-out to July 31 should occur only after consulting with MDIFW regarding the need for the draw-downs at least 2 weeks prior to such draw-downs. The Commission should be notified of any scheduled impoundment draw-down below elevation 179.5 feet within 10 days of such a draw-down. This notification should include the reason for the draw-down and documentation of MDIFW comments regarding the need for any scheduled draw-downs if they occur from ice-out through July 31.

We recommend that a headpond water level and run-of-river monitoring plan be developed and implemented as proposed by MEW and resource agencies.

*Fish Passage*

Upstream and downstream fish passage would eventually be required to allow restoration of American shad, alewives, and Atlantic salmon to their historical range in the Kennebec River Basin. Over 50 percent of the available Atlantic salmon habitat in the Kennebec River Basin is located in the Sandy River.

MEW has prepared conceptual upstream and downstream fish passage designs for the Sandy River Project and proposes to begin consultation with the FWS and Maine fisheries agencies by 1998, or 4 years prior to the need for fish passage (currently scheduled for May 1, 2002) to finalize the design of the fishways. MEW plans to file the functional fish passage design for the project with FERC by April 30, 1999, and a plan for monitoring the effectiveness of the fish passage facilities within 6 months prior to the completion of the facilities, or by November 1, 2001.

Interior (letter dated May 25, 1994) has established a schedule that is consistent with MEW's proposal. MDEP in its WQC for this project dated February 24, 1994, has included conditions that are consistent with MEW's proposal.

We concur with the proposed schedule to finalize the design, construct, and monitor the effectiveness of the upstream and downstream fishways. Our review of the conceptual fishway design indicates several areas of concern that we propose be addressed during MEW's final design consultation with resource agencies (scheduled for 1998).

One concern is that MEW consider and implement appropriate measures to minimize erosion and sedimentation during fishway construction. We therefore recommend that MEW include an erosion and sedimentation control plan with the finalized fish passage designs.

Another concern is that by constructing the fishway on the west side of the powerhouse, it would be necessary to place the fishway in a trench that at places would be over 8 feet below the existing grade. We are concerned that without supplemental lighting, the fishway channel may be dark enough (from shading) to discourage effective fish passage.

We raised these concerns with MEW during our site visit and asked if consideration was given to placing the fishways on the east side of the powerhouse to avoid the need for excavation and eliminate the sharp angles associated with the proposed conceptual design. MEW considered this option but did not pursue it, since it would significantly alter the appearance of the powerhouse. The powerhouse was declared eligible for listing in the National Register of Historic Places (NRHP) (letter from the MSHPO dated March 25, 1993). We asked MEW to provide a conceptual fishway plan that placed the fishway on the east side of the powerhouse and conceptual costs for constructing the fishway in either location. MEW's consultant provided this information on December 19, 1994. According to this submittal, constructing the fishway at the alternative location would cost about the same as the original location, but would be more susceptible to flood damage and would still require resolution of historical concerns.

We recommend that our concerns regarding fishway design be addressed during the agency consultation scheduled to begin in 1998. We recommend that this consultation include FWS, ASRSC, MDMR, and the MSHPO to address maintaining the historic integrity of the powerhouse.

*4.1.3.6 Weston*

*Lake Water Level*

CMP proposes to continue operating the project in a run-of-river mode and to maintain the headpond level within 1 foot of the normal pond level of 156.0 feet, except during maintenance activities and emergency conditions, when the impoundment level might fluctuate greater than the proposed range. CMP proposes to minimize to the extent possible, scheduled maintenance drawdowns during the period of June 1 to and including August 1 of each year. By operating in a run-of-river mode, CMP could pass a minimum flow of 1,947 cfs or inflow, whichever is less, to the Kennebec River below the project.

Interior (letter dated February 3, 1993) has made a 10(j) recommendation that the project be operated in a run-of-river mode and fluctuations above the project dams minimized. Interior has also recommended that a plan for operating the project in run-of-river mode and documenting compliance with this recommendation be developed in consultation with FWS, USGS, MDEP, MDIFW, MDMR, and ASRSC.

MDEP, in its WQC dated November 17, 1992, has also recommended that the project be operated as run-of-river, while providing a minimum flow of 1,947 cfs or inflow, whichever is less. It has also recommended that the impoundment level be maintained within 1 foot of full pond (elevation 156.0 feet) during normal operation and that to the extent possible, CMP limit scheduled maintenance drawdowns from "ice-out" to August 1 of each year. MDEP has also recommended that a plan for providing and monitoring the flows and water levels be developed and provided to FERC.

Maintaining a stable impoundment elevation during late spring through July would protect the eggs and larvae of smallmouth bass and other aquatic organisms that spawn or live in shallow water habitats. Minimizing scheduled maintenance drawdowns to periods when the young of most smallmouth bass and other shoreline spawning fish have left their nests and moved to deeper water should further protect aquatic resources. We consider the difference between CMP's June 1 and MDEP's "ice-out" start date for minimizing scheduled maintenance to be inconsequential. Identification of a specific date, as proposed by CMP, has the advantage of being readily enforceable. But we also recognize, under certain circumstances, fish and wildlife need protection prior to June 1. We are concerned, however, about setting a specific date for "ice-out" for the convenience of enforcement purposes. We consider it appropriate to define "ice-out" in terms that are clearly understood by CMP and agencies, and readily enforceable.

We recommend that CMP maintain the impoundment level within 1 foot of its full pond elevation of 156.0 feet during normal operation. We also recommend that CMP minimize, to the extent possible, all scheduled maintenance activities or inspections that require impoundment drawdowns in excess of 1 foot during the period of "ice-out" to and including July 31 of each year to protect aquatic resources. Scheduled draw-downs from "ice-out" to July 31 should occur only after consulting with MDIFW regarding the need for the drawdowns at least 2 weeks prior to such drawdowns. The Commission should be notified of any scheduled impoundment drawdown below elevation 155.0 feet within 10 days of such a draw-down. This notification should include the reason for the drawdown and documentation of MDIFW comments regarding the need for any scheduled draw-downs, if they occur from "ice-out" through July 31. We further recommend that CMP develop a plan for providing and monitoring the impoundment water surface levels and run-of-river operation in consultation with resource agencies. This plan should clearly identify the definition of "ice-out" to avoid misunderstanding during the term of the new license.

*Fish Passage*

Historically, American shad, alewives, and Atlantic salmon migrated through the Weston Project area. While there are no anadromous fish species currently in the project area, upstream and downstream passage of these species of anadromous fish in the Kennebec River Basin is an established fishery management goal of the resource agencies.

The Director, Division of Project Compliance and Administration, Office of Hydropower Licensing, issued 4 orders on January 25, 1989, which amended the licenses for the Weston Project plus 5 other Kennebec Hydropower Developers Group (KHDG) projects implementing the terms of the KHDG agreement to provide upstream and downstream fish passage for targeted species.[1]

CMP proposes to provide upstream and downstream fish passage facilities under the terms specified in the KHDG agreement and the amended license conditions. The schedule for the design, installation, and operation of upstream and downstream fish passage facilities at Weston, according to the Agreement and the Director's order, is as follows:

- May 1, 1998 — Submission of conceptual design plans to appropriate agencies for review and comment;

[1] 46 FERC ¶ 62,076, 62,077, 62,078, and 62,082 (1989). The other five KHDG projects whose licenses were amended were: Hydro-Kennebec Project (FERC No. 2611); Lockwood Project (FERC No. 2574); Shawmut Project (FERC No. 2322); Fort Halifax Project (FERC No. 2552); and Benton Falls Project (FERC No. 5073). Although the amendments were temporarily stayed for American Rivers' appeal [50 FERC Order 61,131-134 (1990)], the Commission denied rehearing and lifted the stays October 22, 1992 [61 FERC Order 61,095 (1992)].

- April 30, 1999 — Filing of finalized functional design drawings for Commission approval;
- December 31, 2000 — Completion of construction and testing/debugging; and
- May 1, 2001 — Operation of the upstream and downstream fish passage facilities.

Interior has stated that license conditions similar to articles contained in the amended Weston license should be included in any new license issued for the project. Interior also has noted that this would ensure that all fishways at the Weston Project would be designed, constructed, maintained, operated, and evaluated in accordance with fishery agency specifications. Given the inclusion of these conditions, Interior has stated that additional prescriptions pursuant to Section 18 of the FPA are not needed.

MDEP, as conditions in its WQC, has also stated that upstream and downstream fish passage should be installed and operated at the project as outlined in the KHDG agreement. MDEP further concurs with CMP's proposed schedule for the design, installation, and operation of the fish passage facilities.

Considering the following facts, we conclude that the portion of the Kennebec River upstream of the Weston Project is an integral part of the overall anadromous fish restoration efforts for the Kennebec River Basin (FERC, 1991):

- Potential alewife production in the Kennebec River system is an estimated 5.8 million with about 5 percent of this total from available habitat in the Sandy River upstream of Weston;
- Potential shad production is an estimated 689,000 with 29 percent of this total from available habitat in the mainstem Kennebec River upstream of Weston and the Sandy River; and
- Atlantic salmon nursery habitat in tributary streams downstream of Madison is estimated at 33,362 100-square-yard units with over 50 percent within the Sandy River.

We therefore recommend requiring CMP to fund, install, and operate downstream and upstream fish passage facilities, and conduct fisheries monitoring and other studies to facilitate the restoration of American shad, alewives, and Atlantic salmon to the Kennebec River Basin, in accordance with the terms and provisions of the "Agreement between the State of Maine and Kennebec

Hydro Developers Group," dated January 22, 1987. We also recommend that CMP develop an erosion and sedimentation control plan prior to constructing the fishways. CMP should include this plan with its conceptual design plans that are scheduled to be submitted to and reviewed by agencies by May 1, 1998. The Commission should preserve the right to modify the schedule for design and installation of fishways at Weston pending the disposition of fish passage issues at downstream projects or the submission of pertinent information from interested parties.

*4.1.3.7 Fort Halifax*

*Pond Water Level*

Routine impoundment drawdowns can adversely affect aquatic habitat, especially when the area exposed is extensive. CMP has concluded that the existing daily drawdowns of the Fort Halifax impoundment would discourage nesting in the littoral zone by smallmouth bass and other shoreline spawners, and it would thus be unlikely that nests would be dewatered during drawdowns. Continued operation of the project with up to 2.5 feet of drawdown as proposed would have little effect on the impoundment fisheries, according to CMP.

Interior (letter dated March 11, 1993) has made a 10(j) recommendation that the project be operated in a run-of-river mode during May and June (the peak anadromous fish migratory season) during which time fluctuations above the dam would be minimized. Interior has claimed that run-of-river mode would benefit the spawning of smallmouth bass and would allow for natural passage of anadromous fish through the upper reaches of the impoundment. Commerce (letter dated March 26, 1993) has made the same 10(j) recommendation.

MDEP, in its WQC dated July 26, 1994, has concluded that CMP's proposal to limit fluctuations in the impoundment to 2.5 feet would not result in significant adverse impacts on fish and fish habitat and conditioned the WQC accordingly. MDEP has noted that drawdowns of more than 2.5 feet to flush low DO water through the impoundment (as proposed by CMP) may be warranted, but should only be viewed as a last alternative which is caused by impacts on habitat.

We agree with MDEP that CMP's proposal to continue to allow daily drawdowns of up to 2.5 feet would not result in significant adverse impacts on fish and fish habitat. Our comparative basis for impact assessment is the project as presently licensed and essentially no changes to the present impoundment water level management are proposed. We acknowledge that stable pond water elevation would benefit shoreline spawning fish by increasing the habitat available for spawning into the typical 3- to 7.5-foot wide zone that is presently dewatered. Yet we see no evidence that the existing smallmouth bass population is not meeting the needs of local anglers.

The 10(j) recommendation by Interior and Commerce to operate Fort Halifax in a run-of-river mode with minimal impoundment fluctuation during May and June would not significantly benefit smallmouth bass. If cycling is resumed in July, most smallmouth bass eggs and larvae would still likely be in the nests (as would those of other centrarchids) and would suffer the same fate as if the project had cycled from May through July. Using CMP's logic, by holding the pond water level constant, nesting and spawning in the normal drawdown zone would not be discouraged by daily drawdowns. Consequently, resumption of drawdowns in July could result in significant impacts on centrarchid species caused by dewatered nests.

We recommend that the impoundment be kept within 2.5 feet of the normal full pond elevation of 51.5 feet, with flashboards in place, unless deviations are warranted by circumstances beyond the control of CMP. As noted by MDEP, drawdowns of more than 2.5 feet for the purposes of flushing low DO water from the impoundment should be considered a measure of last resort. We agree and recommend that prior to implementing such flushing flows, CMP consult with MDEP, MDIFW, and FWS to reach a consensus that the impacts of substantial pond drawdowns would be worth any resultant improvement in water quality.

We also recognize that in some cases it may be necessary to draw the impoundment down to conduct scheduled maintenance or inspections. We recommend, as we did at Sandy River and Weston, that such scheduled maintenance or inspections that require impoundment drawdowns in excess of 2.5 feet be minimized from ice-out (to be defined in the monitoring plan discussed under "flow regulation") to and including July 31 to prevent the dewatering of centrarchid nests, especially those of smallmouth bass. Scheduled draw-downs from "ice-out" to July 31 should occur only after consulting with MDIFW regarding the need for the drawdowns at least 2 weeks prior to such drawdowns. The Commission should be notified of any scheduled impoundment drawdown below elevation 49.0 feet within 10 days of such a drawdown. This notification should include the reason for the drawdown and documentation of MDIFW comments regarding the need for any scheduled draw-downs, if they occur from "ice-out" through July 31.

*Fish Passage*

Upstream and downstream passage of anadromous American shad, alewives, and Atlantic salmon in the Kennebec River Basin is an established fishery management goal of the resource agencies. The Director, Division of Project Compliance and Administration, Office of Hydropower Licensing, issued four orders on January 25, 1989, which amended the licenses for the Fort Halifax Project plus five other KHDG projects implementing the terms of the KHDG agreement to provide upstream and downstream fish passage for targeted species.[2]

CMP proposes to provide upstream and downstream fish passage facilities under the terms specified in the KHDG agreement and the amended license conditions. The schedule for the design, installation, and operation of upstream and downstream fish passage facilities at Fort Halifax, according to the Agreement and the Director's order, is as follows:

- December 31, 1991 — Installation and operation of permanent downstream fish passage facilities [installation of the permanent facilities was delayed due to an appeal granted to intervenors; the appeal was lifted in the fall of 1992 and permanent facilities installed by April 1993 (KHDG, 1995)];
- May 1, 1996 — Submission of conceptual design plans for upstream passage facilities to appropriate agencies for review and comment;
- May 1, 1997 — Filing of finalized functional design drawings of upstream passage facilities for FERC approval;
- December 31, 1998 — Completion of construction and testing/debugging of upstream passage facilities; and
- May 1, 1999 — Operation of the upstream fish passage facility.

Interior (letter dated March 11, 1993) has stated that license conditions similar to articles 16 through 19 of the amended Fort Halifax license should be included in the new license. This would ensure that all fishways at this project would be designed, constructed, maintained, operated, and evaluated in accordance with fishery agency specifications. Given the inclusion of these conditions, Interior states that additional prescriptions pursuant to Section 18 of the Federal Power Act are not needed. Interior also notes that if the Edwards dam is removed, CMP may have to implement additional

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[2] See footnote in Section 2.1.2.5 for list of the other projects included in the KHDG agreement.

measures, such as trapping and sorting of upstream migrants at the Fort Halifax dam, to ensure that anadromous fish restoration is not delayed.

Commerce (letter dated March 26, 1993) submitted fish passage conditions that are consistent with the terms of the KHDG agreement. Commerce made a 10(j) recommendation that if anadromous species other than American shad, alewives, and Atlantic salmon gain access to the Fort Halifax Project site, CMP should consult with all appropriate state and federal resource agencies regarding the need to conduct additional minimum flow studies, provide trapping and sorting facilities, or take other necessary steps to support agency management goals for anadromous fish in the Sebasticook River.

MDEP, as conditions of its WQC dated July 26, 1994, has stated that CMP should continue to abide by the terms of the KHDG agreement. This would provide for the construction of an upstream fishway (a downstream fishway is already in place) by May 1, 1999, and subsequent fish passage effectiveness studies.

CMP (letter dated May 12, 1993) has objected to Interior's and Commerce's recommendation that could require additional studies or capital expenditures related to fish passage at a later time, pending the outcome of the Edwards relicensing proceeding. CMP argues that the marginal economic benefits associated with this project make such undefined future costs burdensome in estimating the expected return on the project during its license life. CMP does not object to the inclusion of articles requiring them to install fish passage at this project, as previously reflected in its amended license and the existing KHDG agreement, although it objects to the reservation of possible future additional fishway construction under Section 18.

Considering the following facts, we conclude that the portion of the Sebasticook River upstream of the Fort Halifax Project is an integral part of the overall anadromous fish restoration efforts for the Kennebec River Basin (FERC, 1991):

- potential alewife production in the Kennebec River system is estimated at 5.8 million with about 79 percent of this total from available habitat in the Sebasticook River upstream of Fort Halifax;
- potential American shad production is estimated at about 689,000 with about 22 percent of this total from available habitat in the Sebasticook River from Fort Halifax dam to the confluence of East and West branches; and

- Atlantic salmon nursery habitat in tributary streams downstream of Madison is estimated at 33,362, 100-square-yard units with about 13 percent within the Sebasticook River.

We therefore recommend that CMP be required to fund, install, and operate downstream and upstream fish passage facilities, and conduct fisheries monitoring and other studies to facilitate the restoration of American shad, alewives, and Atlantic salmon to the Kennebec River Basin, in accordance with the terms and provisions of the "Agreement between the State of Maine and Kennebec Hydro Developers Group," dated January 22, 1987. We also recommend that CMP develop an erosion and sedimentation control plan prior to constructing fishways. CMP should include this plan with the conceptual design plans to be submitted to and reviewed by agencies. The Commission should reserve the right to modify the schedule for design and installation of fishways at Fort Halifax pending the disposition of fish passage issues at the Edwards Project or the submission of pertinent information from interested parties.

Commerce has made a 10(j) recommendation for additional agency consultation if anadromous species besides alewives, American shad, and Atlantic salmon gain access to the Fort Halifax tailwaters. This additional consultation would establish the need for more studies and measures to ensure achievement of resource agency anadromous fish restoration goals. The purpose of this consultation, according to a letter from Commerce to the Commission dated April 8, 1996, would be to ensure that if sturgeon, striped bass, and rainbow smelt are restored above Augusta, suitable facilities and procedures would exist at the Fort Halifax Project for sorting these species, if necessary, and flows below the dam would be adequate to prevent any adverse effects on these additional species. Commerce does not intend to seek passage of sturgeon, striped bass, or smelt upstream of the Fort Halifax Project.

We recognize that, regardless of the status of fish passage at Edwards dam, additional consultation between hydroelectric project owners and resource agencies on the appropriate location for trap and sort operations and other issues pertaining to anadromous fish restoration (including issues of design, timing of installation, and operation) would be necessary. We recommend including such consultation as a condition of the license for this project. Any resultant studies and modifications to project operations or facilities would require FERC approval.

*Flow Regulation*

Selecting appropriate minimum flow in the 1,400 feet of free-flowing river between the Fort Halifax Project and the confluence of the Sebasticook River and the main stem of the

Kennebec River is complicated by the backwater effects of the Kennebec River. Only the uppermost portion of this reach is not influenced by backwater effects during low Kennebec River flows.

CMP conducted an IFIM survey to provide a basis for selecting an appropriate minimum flow. Species and life stages considered were: juvenile and adult brown trout; juvenile and adult smallmouth bass; in-migrating, larval, and juvenile American shad; and in-migrating and juvenile Atlantic salmon. CMP's consultant concluded that no specific minimum flow was readily identified. The species and life stages included in the analysis often showed conflicting results and were variously benefited by high, low, or intermediate flow levels, all of which were strongly affected by the Kennebec River (Acres, 1990). Table 4-3 indicates the change in WUA at several Sebasticook River study flows with the Kennebec River flow as 3,000 cfs, which is typical of summer flow conditions.

Table 4-3. Fort Halifax IFIM results (WUA) Kennebec River 3,000 cfs (Source: CMP, 1991d, modified by the staff)

| Species | Peak WUA Flow (cfs) | % Peak WUA @ 20 cfs (current minimum flow) | % Peak WUA @ 150 cfs (proposed seasonal minimum flow) | Change in WUA % |
|---|---|---|---|---|
| Brown Trout Adult | 400 | 20 | 83 | +63 |
| Brown Trout Juvenile | 400 | 58 | 94 | +36 |
| Smallmouth Bass Adult | 0 | 100 | 87 | -13 |
| Smallmouth Bass Juvenile | 0 | 100 | 81 | -19 |
| Shad Juvenile | 1,300 | 1 | 54 | +53 |
| Salmon Juvenile | 500 | <1 | 52 | +51 |

CMP also conducted a zone-of-passage assessment to determine what minimum flow would still provide for upstream passage of anadromous fish targeted for restoration (alewives, American shad, and Atlantic salmon). Based on this study, a flow of 150 cfs was considered adequate to allow unimpeded migration of anadromous fish (Ritzi, 1991). Consequently, CMP proposes a minimum flow of 150 cfs, or inflow, during the April to November anadromous fish migration period, and leakage (estimated at 5 to

20 cfs) for the remainder of the year. It points out that this would also substantially enhance the habitat for most resident species over the existing conditions.

Interior (letter dated March 11, 1993) has indicated that CMP's proposed minimum flow would "...not further agency management goals if the operation of the project continues to inhibit use of downstream habitat by resident and anadromous fish." Interior's 10(j) recommendation regarding flows is to operate the project in a run-of-river mode during the peak upstream migration period (May and June). It has recommended a minimum flow of 400 cfs or inflow for the rest of the year which would provide optimum conditions for brown trout, juvenile Atlantic salmon, and out-migrating American shad. Commerce (letter dated March 26, 1993) has agreed with Interior's minimum flow recommendations. Both agencies recommend the design and implementation of a minimum flow monitoring plan.

Interior has acknowledged that its higher minimum flow and existing generation flows of about 1,700 cfs would adversely affect smallmouth bass. To compensate for this and provide velocity refuges below the dam, Interior has recommended that CMP design and install additional cover below the dam in consultation with the resource agencies. Most likely the cover would consist of boulder clusters or precast structures.

MDEP, in its WQC dated July 26, 1994, has agreed with CMP's proposed minimum flows. It has stated that operating the project run-of-river during May and June, as proposed by other resource agencies, does not consider the needs of Atlantic salmon, which migrate from April to November. MDEP considers habitat gains realized with a 400 cfs minimum flow to be minimal relative to the 166 percent increase in flow over CMP's proposed minimum flow. MDEP has also agreed with CMP that the majority of resident and migratory fish would have moved out of the lower Sebasticook River from December to March, and Kennebec River backwatering would provide sufficient habitat for any fish that remained in this reach. It concluded that no substantial benefits would be realized by increasing minimum flow during this period. MDEP has recommended design and implementation of a minimum flow and pond water level monitoring plan.

In response to Interior's and Commerce's proposed flow regime, CMP (letter dated May 12, 1993) has asserted that both agencies have not indicated disagreement with CMP's studies regarding minimum flows and its conclusion that the proposed flow regime would effectively allow anadromous fish passage at Fort Halifax. It has also stated that the agencies have not provided any evidence that run-of-river operation would improve passage conditions. CMP considers its proposed flow regime to be a balanced proposal that considers migrating fish, downstream habitat for resident and anadromous species, and project economics.

Our review of the flow duration curves for this project indicate that inflow to the project would exceed the generation capacity of 1,700 cfs almost 100 percent of the time in April, about 50 percent of the time in May, and about 10 percent of the time in June. When inflow exceeds turbine capacity, the project is operated in a run-of-river mode which encompasses much of the peak upstream migration period for targeted anadromous fish. According to the transcript of the May 23, 1991, joint agency review meeting (at page 21), Fort Halifax typically begins its cycling mode from mid-May to the end of June. Hence the agency recommendation for run-of-river operation during May and June is satisfied much of the time with existing project operations.

Proposed and recommended minimum flows when the project is not operating in a run-of-river mode diverge considerably. A concern of state and federal resource agencies that is not reflected in their formal comments was raised at the May 23, 1991, agency consultation meeting. T. Squiers of MDMR (at page 29) commented that at Sebasticook River flows of 150 cfs, American shad and alewives may not have sufficient attraction flows to be drawn to the Fort Halifax Project due to the competing volume and velocity of the main stem of the Kennebec River. He voiced the opinion that flows higher than 150 cfs would be more effective in attracting upstream migrating anadromous fish. MDEP's D. Murch noted that at the 1,700 cfs generation flows, more fish may be passed than if a constant higher minimum flow was passed during the day (at page 29).

We concur with MDEP's and CMP's proposed flow regime at the Fort Halifax Project. The existing sportfishery in the 1,400-foot tailwater reach is for brown trout and smallmouth bass. Our review of water temperature data for this reach indicates that from July to August, water temperature is frequently over 24°C. These warm temperatures are suboptimal for brown trout, which according to Scarola (1987), prefer temperatures in the range of 18 to 24°C. Raleigh et al. (1986) report that optimal temperature requirements for good growth and survival of brown trout are 12 to 19°C. Although brown trout can survive at water temperatures in excess of 27°C (27.2°C is near lethal), they normally seek the coldest water available during the summer (Scarola, 1987). The coldest water available during the summer is more likely to occur in the deeper water of the main stem of the Kennebec River than in the relatively shallow Fort Halifax tailwaters, and few brown trout would be expected to occur in the tailwaters. We consider the summer water temperature in the tailwaters to be more favorable for adult smallmouth bass which, according to Emmig (1966), prefer temperatures between 21.1 and 26.7°C. In our opinion, minimum flows that optimize brown trout habitat during the summer at the expense of smallmouth bass are inappropriate.

The Fort Halifax tailwaters are even less suited for juvenile and adult Atlantic salmon during the summer, which exhibit signs of physiological stress at water temperatures over 21°C (Scarola, 1987). The temperature regime of both the Fort Halifax tailwaters and the main stem of the Kennebec River between Augusta and Waterville is too warm to enable these areas to be significant summer holding areas for juvenile or adult Atlantic salmon when (and if) they are restored to the Kennebec River Basin.

Although CMP's proposed minimum flow of 150 cfs from April to November would only provide about 54 percent of the maximum WUA for young American shad (with Kennebec flows of 3,000 cfs), we do not consider the Fort Halifax tailwaters to be a prime shad larvae and juvenile holding area. Larvae and juvenile shad tend to aggregate in eddies and backwaters (Stier et al., 1985). We observed few such areas in the Fort Halifax tailwaters but many eddies and backwaters in the main stem of the Kennebec River between Augusta and Waterville.

At the Section 10(j) meeting held on May 7, 1996, Interior and NMFS continued to support the need for their recommended flow regime. Interior noted that landlocked salmon had recently been stocked in the area and evidence from field observations indicated that salmonids were holding in areas similar to the Fort Halifax tailwaters at higher temperatures than suggested by the literature. MDEP distributed a letter dated May 1, 1996, at the meeting stating that Interior's and NMFS' higher minimum flows did not conflict with the conditions of the WQC.

Although we concur with CMP's and MDEP's recommended flow at the Fort Halifax Project, we now conclude that Interior's and NMFS' alternative flow regime is consistent with applicable law. We adopt their recommendation that CMP operate the Fort Halifax Project in a run-of-river mode from May 1 to and including June 30 and release an instantaneous minimum flow of 400 cfs or in flow, whichever is less, for the remainder of the year.

We consider the requirement to conduct extensive upstream passage effectiveness studies when the fishway is installed, specified in Article 18 of the existing amended license and carried forward to the new license, to be an appropriate means to identify if the Fort Halifax Project is adversely influencing agency anadromous fish restoration goals. If the studies show that the flow regime at Fort Halifax is insufficient to attract anadromous fish to the fishway in meaningful numbers, modifications to the operation and design of the fishway would be necessary. We consider attraction flow alteration to be an option.

Article 36 of the amended license for the Lockwood Project (FERC No. 2574) on the main stem of the Kennebec River in Waterville, requires the licensee to install operational upstream fish passage at the same time as required at Fort Halifax and "...conduct fisheries monitoring and other studies to facilitate the restoration of American shad, alewives, and Atlantic salmon to the Kennebec River Basin." Designing the monitoring studies at Fort Halifax and Lockwood in a coordinated manner would enable the concerns raised by state and federal resource agencies during the May 23, 1991, agency consultation meeting regarding provision of sufficient attraction flows in the Sebasticook River to be evaluated. Such studies would be consistent with the studies that Mr. Russell of FWS would apparently entertain. They would also provide data to support or refute claims of differential attraction efficiencies between the Sebasticook River and the main stem of the Kennebec River. Consideration should be given to purposely providing flows at Fort Halifax that encourage salmon to use the upstream passage at Lockwood. As clearly indicated in Table 3-10 (Section 3.1.4), the majority of salmon nursery habitat in the Kennebec River Basin is upstream of the Lockwood Project.

We conclude that Interior's 10(j) recommendation to install structures which provide velocity refuges in the Fort Halifax tailrace is unnecessary to compensate for high flow releases that degrade the smallmouth bass habitat. The three transects established for CMP's IFIM study were considered representative of this reach by all parties (CMP and resource agencies) involved in pre-study consultation. We reviewed substrate data for each transect in the input data decks presented in Appendix D of Acres (1990) and found that boulders are already a major component of the substrate at each transect. In fact, most of the substrate at transects 2 and 3, which represent over 80 percent of the entire 1,400-foot river reach, is boulders. Photographic documentation provided by CMP as an attachment to the transcript of the May 23, 1991, agency consultation meeting supports the prevalence of boulders in this reach. Currently, there are sufficient instream structures that provide adequate velocity refuges for those smallmouth bass that are present. Adding boulders or precast structures would do little if anything to improve the smallmouth bass habitat in the tailwaters.

Interior indicated at the May 7, 1996, Section 10(j) meeting that numerous boulders were present between the dam and the bridge, but that there were few boulders large enough to provide velocity refuges downstream of the bridge and that other species besides smallmouth bass would benefit from these structures. MDIFW voiced support for Interior's position at the meeting.

Although we still conclude that the need for velocity refuge structures is not strong, Interior's recommendation is not inconsistent with applicable law. We, therefore, recommend that

CMP develop and implement a plan to place structures sufficient to provide velocity refuges for fish between the railroad bridge and the confluence of the Sebasticook River with the Kennebec. It may be possible to implement this plan at considerably less cost than estimated by CMP ($89,500 in 1996 dollars). Following the 10(j) meeting, we again reviewed the Fort Halifax tailwaters and noted two large concrete structures along the shoreline of the Fort Halifax Park. It may be possible to tow these structures into the channel to provide the requested velocity refuge structures. CMP should develop the plan in consultation with FWS and MDIFW, and submit it to the Commission for approval.

*4.1.3.8 Oakland*

*Lake Water Level*

CMP proposes to restrict water levels in Messalonskee Lake to within 0.5 foot of the normal full pond level during the summer months (June 1 to and including August 31) and within 1 foot of full pond during the remainder of the year, except for extreme hydrologic conditions when the potential for flood damage exists. This water level management program would benefit the fishery resource of Messalonskee Lake, particularly the largemouth and smallmouth bass fishery. These two species spawn in shallow near-shore nests during the summer which can be dewatered with excessive lake drawdowns. CMP proposes to restrict water level fluctuations at the Oakland impoundment to within 1 foot of full pond elevation throughout the year.

MDEP, in its WQC for all four Messalonskee Projects dated August 28, 1995, has stated that CMP's proposal to maintain water levels in Messalonskee Lake and the Oakland impoundment would benefit the fisheries resources of the project waters and has proposed certification conditions that reflect CMP's proposed water level management regime. Interior (letter dated January 26, 1994) has agreed that the existing water level control regime results in favorable conditions for spawning and early life stages of the naturally reproducing resident fish community and has concurred with CMP's proposed regime.

Our review of the available information indicates that the fisheries resources of Messalonskee Lake are meeting resource agency expectations with both the existing and proposed water level management regime. We therefore recommend that CMP hold the water level in Messalonskee Lake within 0.5 foot of full pond (elevation 235.9 feet) from June 1 to and including August 31, and within 1 foot of full pond for the remainder of the year unless circumstances arise that are beyond the control of CMP. We recommend that CMP hold the water level of the Oakland impoundment within 1 foot of full pond (elevation 207.1 feet) for the entire year.

In some cases, it may be necessary to draw down the impoundment to conduct scheduled maintenance or inspections. We recommend, as we do at Sandy River, Weston, and Fort Halifax, that any scheduled maintenance that required drawdowns in excess of 0.5 foot (June 1 to August 31) and 1 foot (remainder of year) of full pond at Messalonskee Lake and 1 foot at the Oakland impoundment, respectively, be minimized from ice-out (to be defined in the monitoring plan discussed under "flow regulation") to and including July 31 to avoid dewatering centrarchid nests, especially those of smallmouth and largemouth bass. Scheduled drawdowns from ice-out to July 31 should occur only after consulting with MDIFW regrading the need for such drawdowns at least two weeks prior to such drawdowns. The Commission should be notified of any scheduled impoundment drawdowns below elevation 235.4 feet (June 1 to August 31) or 234.9 feet (remainder of year) at Messalonskee Lake and below elevation 206.1 feet at the Oakland impoundment within 10 days of such a drawdown. The notification should include the reason for the drawdown and documentation of MDIFW comments regarding the need for any scheduled drawdowns if they occur from ice-out through July 31.

*Fish Passage*

CMP proposed to replace the 3/4-inch clear-spaced fish screen adjacent to Messalonskee Lake dam with a screen having larger bar spacing to reduce the need for screen cleaning that is inherent with the existing narrow bar spacing. This modification was contingent on fishery agencies and CMP reaching agreement on an appropriate bar spacing. CMP also proposes to formally assume maintenance responsibility for the screen.

Interior (letter dated January 26, 1994) has indicated that FWS considered continued use of a fish screen at Messalonskee Lake dam to be appropriate. Consequently, Interior has made a recommendation that CMP be required to file a plan for modifying and maintaining an effective fish screen at the Messalonskee Lake dam. Interior has also requested reservation of authority to prescribe the construction, operation, and maintenance of fishways under Section 18 of the FPA.

In response to Interior's letter, CMP (letter dated March 10, 1994) has indicated that during consultations regarding larger bar spacing, MDIFW maintained that it would require a minimum 1-inch clear spacing. CMP determined that the benefit in terms of reduced cleaning which would result by changing the existing 3/4-inch spacing screen to a 1-inch screen did not justify the cost of fabricating and installing a new screen. CMP decided to retain the existing screen and continue to clean the screen as needed. It therefore objects to Interior's recommendation to file a plan for installing and maintaining a fish screen, since the existing screen adequately prevents drop down of landlocked salmon.

We agree that, unless there are proposed modifications to the existing fish screen, it is unnecessary for CMP to file a plan for modifying and maintaining an effective fish screen at Messalonskee Lake dam. The existing screen should prevent out-migration of nearly all stocked fish and keeping the screen clean is obviously in the best interest of CMP in that it ensures free flow of water to all Messalonskee Projects. We conclude that developing a plan for maintaining the screen is not warranted. Interior withdrew its recommendation at the May 7, 1996, Section 10(j) meeting.

We recommend that CMP assume responsibility for maintaining the 3/4-inch clear-space fish screen at Messalonskee Lake dam. CMP should revise appropriate Exhibit F drawings to include the fish screen as a project feature.

*Flow Regulation*

CMP proposes to release a minimum flow of 15 cfs from the Messalonskee Lake dam and the Oakland powerhouse. This release is primarily intended to provide the necessary flow for proposed fish habitat enhancements at the three downstream projects.

Interior in its 10(j) recommendations has disagreed with CMP's proposed minimum flows based primarily on its assessment of habitat needs at the Union Gas Project. However, Interior notes that by providing its recommended 100 cfs minimum flow from Messalonskee Lake dam, the 1,900-foot reach below the dam to the head of the Oakland impoundment would also benefit. Interior has further recommended that CMP develop and implement a plan to monitor minimum flow requirements. MDEP has agreed with CMP's proposal to release a minimum of 15 cfs at the Messalonskee Lake dam and Oakland powerhouse. MDEP has further stated that a minimum flow does not need to be provided to the Oakland bypassed reach. MDEP has recommended that CMP develop and implement a plan for providing and monitoring minimum flows and impoundment levels at Messalonskee Lake and the Oakland impoundment.

Interior's recommended minimum flow (100 cfs or inflow, whichever is less) is purported to provide potential benefits to the aquatic community in the reach between Messalonskee dam and the head of the Oakland impoundment. As noted in Section 3.3.3.8, this reach is characterized by high gradient cascades and substrate dominated by cobbles, boulders, and bedrock. MDIFW indicated that it had no coldwater fish management plans for this reach, and did not require that studies be conducted on this reach during prefiling consultation. FWS also did not request that this reach be studied. We anticipate that some fish may reside in this reach, originating from those individuals that pass through the 0.75-inch trashrack upstream of the dam. The primary ecological function of this reach is likely to be for production of aquatic invertebrates.

The effect of Interior's minimum flow recommendation would be to substantially reduce the amount of time that generation flows of 570 cfs could be released from Messalonskee dam. After Messalonskee Lake was drawn down 0.5 foot during the summer, all inflow to the lake would be released at the dam, and the lake would not refill. The estimated median inflow to Messalonskee Lake is 31 cfs, 22 cfs, and 20 cfs during July, August, and September, respectively. Therefore, the actual flow released to the reach below Messalonskee dam, and at all three downstream hydroelectric projects, would typically be 16 cfs, 7 cfs, and 5 cfs greater than CMP's proposed 15 cfs minimum flow during July, August, and September, respectively.

The increase in flow with Interior's recommendation probably would result in an increase in aquatic invertebrate production in reaches downstream of Messalonskee dam. However, the primary value of aquatic invertebrates to the ecosystem is to provide food for forage fish and gamefish most of which are downstream of Messalonskee dam to Oakland impoundment reach. A major downstream dispersal mechanism for macroinvertebrates is drift during high flow events. With the reduction in peaking generation flows, especially during the summer, invertebrate availability as food to downstream fisheries resources probably could remain unchanged or decrease. We conclude that Interior's recommended minimum flow would not substantially enhance the overall aquatic resources of Messalonskee Stream.

The primary enhancement value of releases from the Oakland Project to aquatic resources is at the Union Gas Project. Therefore, the remainder of our analysis of appropriate flows is presented in the discussion of the Union Gas Project (Section 4.1.3.11). However, provision of appropriate flows to the three downstream projects depends on releases from the Oakland Project and is integrally related to water level management at Messalonskee Lake. We therefore recommend that the owners of all four projects (CMP and KWD), develop and implement an integrated plan to monitor the recommended flows and impoundment water levels at the 4 projects. This plan should be developed in consultation with appropriate resource agencies. Strong consideration should be given to providing instrumentation (possibly in cooperation with USGS) at or near the Messalonskee Lake dam, which controls the flow at the downstream projects, to accurately measure discharge. Currently, only simulated hydrographs are available to characterize the flow regime of Messalonskee Stream. Accurate discharge and Messalonskee Lake water level data are essential to allow appropriate future decisions regarding competing resources issues (lake versus stream resources).

#### *4.1.3.9 Rice Rips*

*Lake Water Level*

CMP proposes to restrict water level fluctuations at the Rice Rips impoundment to within 1 foot of full pond elevation throughout the year. MDEP, in its WQC, and Interior have agreed with CMP's proposed water level management regime.

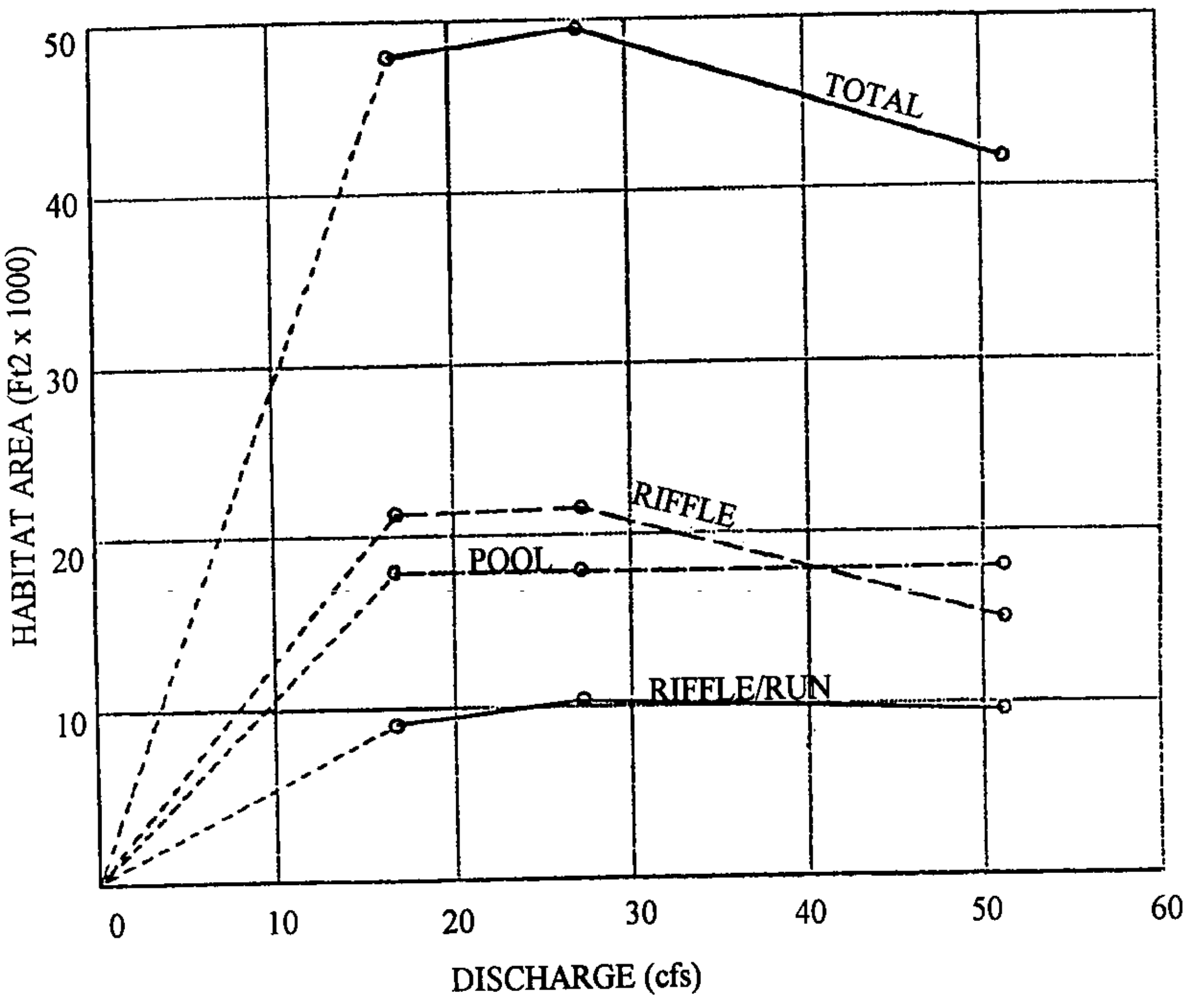
Keeping the Rice Rips impoundment within 1 foot of full pond should protect aquatic life. There are circumstances where a greater drawdown may be warranted to implement flushing flows in the event of severe water quality problems in the impoundment. Such a drawdown would be covered in the emergency provision language that we would include as a condition of a license issued for this project. Flushing drawdowns, especially during the summer, would adversely affect aquatic habitat and should only be considered as a last resort.

We recommend that CMP hold the water level of the Rice Rips impoundment within 1 foot of full pond (elevation 139.1 feet) for the entire year unless circumstances arise that are beyond the control of CMP. To prevent unnecessary drawdowns during the centrarchid nesting season, we recommend that scheduled maintenance that would require a drawdown of greater than 1 foot not be conducted from ice-out until after August 1.

*Flow Regulation*

Flow regulation issues pertaining to water quality problems in the Rice Rips impoundment and, on occasion, downstream reaches of Messalonskee Stream were previously discussed in Section 4.1.2.9 (water quality and quantity). The following discussion centers on appropriate flows for aquatic habitat in the 2,400-foot Rice Rips bypassed reach. This reach is a focal point of MDIFW's experimental brown trout management plan because it is an attractive and accessible location for trout fishing in a riverine habitat.

CMP conducted a flow evaluation assessment using the best professional judgement of a team of fishery biologists. Bypassed reach flows of 16.5, 26.9, and 50.9 cfs were assessed. Based on the results of this study, it was concluded that adult brown trout habitat is maximized at 27 cfs and that at a flow of 16 cfs, 94 percent or more of the maximum habitat is available (Figure 4-14). CMP proposed a minimum bypassed reach flow of 15 cfs based on its hydrologic analysis that higher flows are not available for much of the summer. This inability to reach higher flows is attributable to the 8 cfs minimum flow requirement at the Wings Mill dam, which represents the primary inflow to the Messalonskee Projects.




GEOMETRIC MEAN HABITAT INDEX $\sum_{1-1}^{20}$ [(Area) (Depth rating x Velocity rating x Cover rating $^{1/3}$ ) x 1/3] where 1 = each study section

FIGURE 4-14.
KENNEBEC RIVER BASIN EIS

Geometric Mean Habitat Index vs. Discharge in Rice Rips Bypass Channel Habitat Based Flow Study

Source: Central Maine Power, 1991, modified by staff.

MDEP, in its WQC (August 28, 1995), has recommended that a minimum flow of 15 cfs be provided below each of the Messalonskee Projects, including the Rice Rips bypass, at all times. MDEP has concluded that this minimum flow would adequately protect fish resources in the bypassed reach.

Interior (letter dated January 26, 1994) has recommended that CMP provide an instantaneous minimum flow of 25 cfs or inflow, whichever is less, to the Rice Rips bypassed reach to optimize brown trout habitat. It has also recommended that CMP discharge an instantaneous minimum flow of 100 cfs or inflow to the project area, whichever is less, from the Messalonskee Lake dam and from each of the four downstream hydroelectric projects. A flow of 100 cfs was identified as optimal for brown trout in the IFIM study conducted by CMP in the Union Gas tailwaters. To provide this flow at the lowermost development, it would be necessary to make a similar discharge from the Messalonskee Lake dam (the intermediate projects are operated in run-of-river mode). Although this minimum flow applies to all four Messalonskee Projects, it is based on habitat considerations at the Union Gas tailwaters. We therefore present our analysis of the 100 cfs minimum flow in our discussion of the Union Gas Project (Section 4.1.3.11).

CMP, in its March 10, 1994, response to Interior, has stated that the small habitat gains achievable with the recommended 100 cfs minimum flow with 25 cfs in the Rice Rips bypassed reach is not justified, since it would make the Messalonskee Projects uneconomical to operate.

A key consideration in our minimum flow recommendation for the Rice Rips bypassed reach is the experimental nature of the brown trout fishery. As of the date of the WQC (August 28, 1995), MDIFW had not yet evaluated whether brown trout stocking in Messalonskee Stream would be continued. We agree that a year-round minimum flow of 15 cfs in the Rice Rips bypassed reach which, based on professional judgment of a team of resource agency and CMP representatives, would provide 94 percent of the maximum available brown trout habitat, is sufficient to protect the existing bypassed-reach fishery. We therefore recommend that CMP provide a year-round, instantaneous minimum flow of 15 cfs or inflow, whichever is less, to the bypassed reach.

Our recommended flow and lake level monitoring plan for all the Messalonskee Projects is discussed in Section 4.1.3.8. Because of the importance of accurately characterizing flow releases from the Rice Rips impoundment for water quality and habitat enhancement purposes, we assume that instrumentation would need to be installed at the Rice Rips Project.

*Bypassed Reach Habitat Enhancement*

According to Northrup, Devine and Tarbell (NDT) (1991), about 60 percent of the bypassed reach consists of shallow, fast-flowing riffles with little instream cover. NDT states that the lack of cover substantially limits the suitability of this reach for brown trout.

During our November 1993 site visit, we noted that streamside trees had been recently cut to prevent interference with a transmission line that parallels the bypassed reach. Although we recognize the need for such maintenance activities, removing streamside vegetation increases solar exposure of the stream. In a stream where the prevailing temperature is already marginal for brown trout, the resultant warming would further reduce the suitability of this reach for salmonids.

We recommend that CMP develop and implement a bypassed reach habitat enhancement plan in consultation with MDIFW and FWS. Strategic plantings of streamside shrubs that would provide shading but not interfere with the transmission lines (e.g., alders), and installing log and rock deflectors and log check dams to provide cover and velocity refuges should be considered. CMP should specify erosion and sedimentation control measures. If MDIFW decides to discontinue the experimental brown trout stocking in Messalonskee Stream, our recommended habitat enhancement program would not be necessary and we would no longer require CMP to implement it.

CMP should solicit assistance in the design and implementation of this plan from local angling clubs and the Kennebec Valley Chapter of Trout Unlimited. Such volunteer assistance could reduce CMP's implementation costs. The level of volunteer involvement would also indicate the level of angler interest in the experimental brown trout fishery. MDIFW could use this information to make future management decisions as to whether to continue the Messalonskee Stream stocking program.

*4.1.3.10 Automatic*

*Lake Water Level*

KWD proposes to restrict water level fluctuations at the Automatic impoundment to within 1 foot of full pond elevation throughout the year. MDEP, in its WQC, and Interior have agreed with KWD's proposed water level management regime.

We concur that keeping the Automatic impoundment within 1 foot of full pond should protect aquatic life. We therefore recommend that KWD hold the water level of the Automatic impoundment within 1 foot of full pond (elevation 94.3 feet) for the entire year, unless circumstances arise that are beyond the control of KWD. To prevent unnecessary drawdowns during the centrarchid nesting season, we recommend that scheduled maintenance requiring a drawdown of greater than 1 foot not be conducted from ice-out until after August 1.

*Flow Regulation*

Flows released from the Rice Rips Project are passed through the Automatic Project due to the limited storage capacity of the Automatic impoundment. CMP's proposal to release a minimum flow of 15 cfs from the Rice Rips Project, therefore, equates to a minimum flow of 15 cfs from the Automatic Project. Releases from the Automatic Project pass to a reach that is essentially backwatered by the Union Gas impoundment.

MDEP, in its WQC dated August 28, 1995, has required a year-round, instantaneous minimum flow of 15 cfs.

Interior (letter dated January 26, 1994) has recommended a year-round minimum flow of 100 cfs or inflow to the project area, whichever is less, at all four Messalonskee Projects, including Automatic, to provide optimum brown trout habitat in the Union Gas tailwaters. Our analysis of Interior's recommend flow is presented in the discussion of flow regulation at the Union Gas Project (Section 4.1.3.11).

Flow regulation at the Automatic Project is primarily related to aquatic enhancements at the downstream Union Gas Project. The short and relatively inaccessible Automatic tailwater has not been identified as a sensitive habitat by any entity. We therefore recommend that the Automatic Project operate in a run-of-river mode on a year-round basis. This recommendation would result in a minimum flow release of at least 15 cfs from the Automatic Project. Our recommended flow and lake level monitoring plan for all the Messalonskee Projects is discussed in Section 4.1.3.8.

*4.1.3.11 Union Gas*

*Lake Water Level*

CMP proposes to restrict water level fluctuations at the Union Gas impoundment to within 1.3 feet of full pond elevation throughout the year. MDEP, in its WQC, and Interior have agreed with CMP's proposed water level management regime.

We concur that keeping the Union Gas impoundment within 1.3 feet of full pond should protect aquatic life. We therefore recommend that CMP hold the water level of the Union Gas impoundment within 1.3 feet of full pond (elevation 69.1 feet) for the entire year unless circumstances arise that are beyond the control of CMP. To prevent unnecessary drawdowns during the centrarchid nesting season, we recommend that scheduled maintenance requiring a drawdown of greater than 1.3 feet not be conducted from ice-out until after August 1.

*Flow Regulation*

The 1,300-foot predominantly riffle-and-run habitat tailwater reach between the powerhouse and the small island is most affected by releases from the Union Gas Project. This reach was the subject of an IFIM study by CMP. The remaining portion of the tailwaters (the split stream on both sides of the island and the lower gradient reach backwatered by the Kennebec River) was qualitatively assessed. The target species and life stages for the IFIM study were spawning through juvenile life stage American shad and adult brown trout. The results of the IFIM indicate that brown trout habitat is maximized at about 100 cfs whereas habitat for American shad is maximized at flows equal to or greater than 300 cfs (Figure 4-15).

Present nongeneration flows of about 15 cfs result in 76 percent of the maximum WUA and present normal generation flows (about 600 cfs) result in 73 percent of the maximum WUA for brown trout. CMP has concluded that the shallow, swift channel in the 700-foot reach at the island has virtually no cover and represents extremely poor brown trout habitat at all flows from 15 cfs to 600 cfs. Conversely, the 3,000-foot backwater reach is considered by CMP to represent excellent brown trout habitat at all discharges.

CMP concludes that the shallow riffles with high velocities in the channels around the island (greater than 5 fps) would most likely prevent shad from migrating into the upper reach. It considers it unjustified to maximize flows to enhance shad habitat in the upper reach, especially when it may be at the expense of other species. The lower reach offers suitable depth and substrate for shad. Spring flows would create velocities that are optimal for shad spawning and incubation in the lower reach. Lower summer flows would reduce velocity, but CMP expects larval and juvenile shad to find the reach suitable and attractive, with free access to the main stem Kennebec River.

CMP proposes to provide a continuous minimum flow of 15 cfs below the Union Gas Project. This flow would provide 76 percent of the maximum WUA for adult brown trout, which would be consistent with the 73 percent maximum WUA available during generation flows. CMP claims that optimizing brown trout habitat (which would require a constant release of 100 cfs) is not possible due to basin hydrology, upstream regulation of flows into Messalonskee Lake (the estimated median monthly inflow from July to September is less than or equal to 31 cfs), and the existing and proposed water level management of Messalonskee Lake.

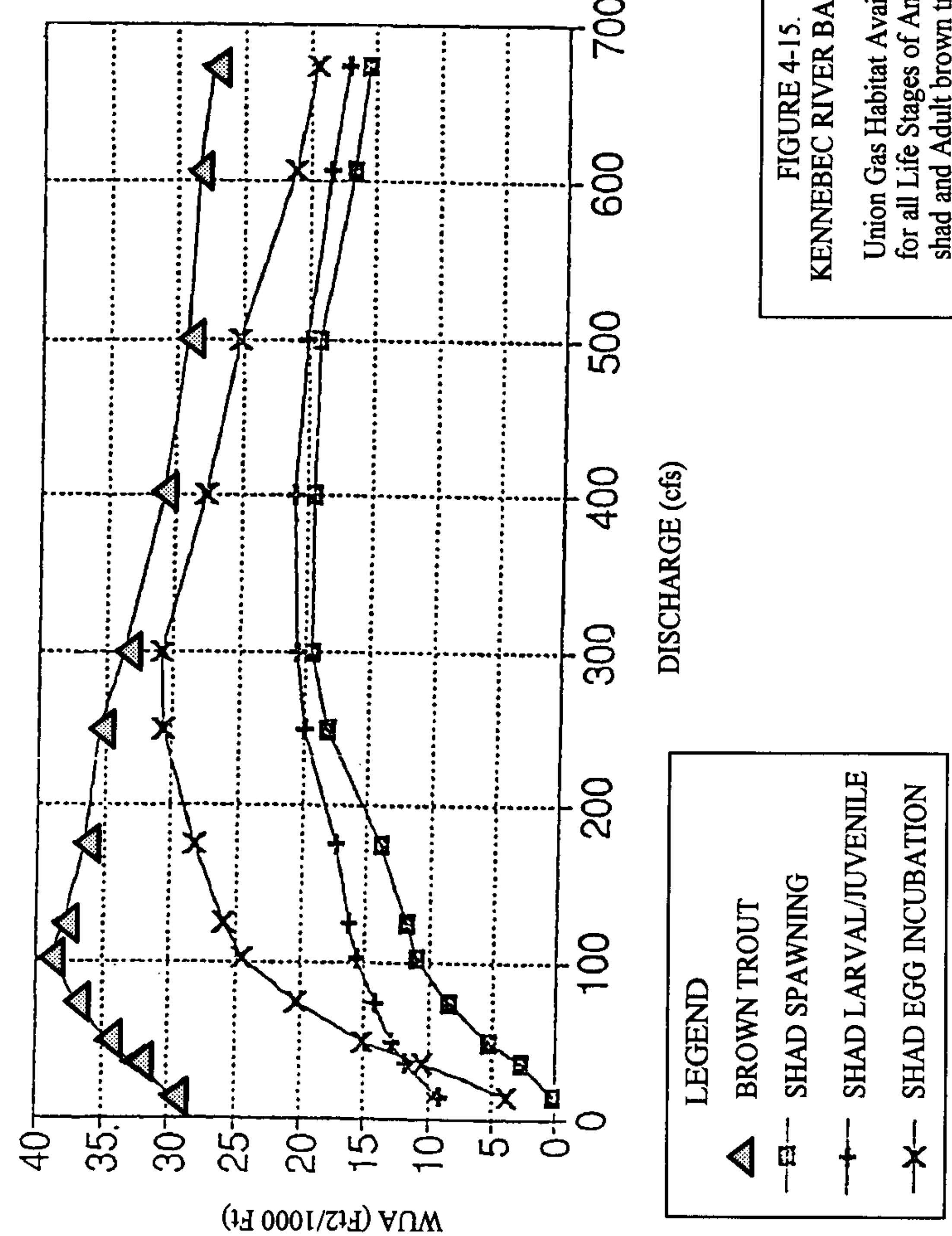



FIGURE 4-15.
KENNEBEC RIVER BASIN EIS

Union Gas Habitat Availability for all Life Stages of American shad and Adult brown trout

Source: Central Maine Power, 1991, modified by staff.

MDEP, in its WQC dated August 28, 1995, has recommended that a year-round, instantaneous minimum flow of 15 cfs be provided below each of the four Messalonskee Projects.

Interior (letter dated January 26, 1994) has recommended that CMP provide an instantaneous, year-round minimum flow of 100 cfs or inflow, whichever is less, from each of the Messalonskee Projects to maximize adult brown trout habitat in the Union Gas tailwaters. Interior has acknowledged that higher flows would optimize American shad habitat. However, since there are no plans to extend shad runs in Messalonskee Stream and since the project typically operates in a run-of-river mode due to high stream flow during the peak shad spawning period of May and early June, Interior has concluded that the needs of shad would be adequately protected by its proposed minimum flow of 100 cfs.

CMP, in its March 10, 1994 response to Interior, has stated that the small habitat gains achievable with the recommended 100 cfs minimum flow is not justified because it would make the Messalonskee Projects uneconomical to operate.

As with our assessment of appropriate minimum flows for the Rice Rips bypassed reach, the experimental nature of the MDIFW brown trout management plan for Messalonskee Stream is a key factor. The Union Gas tailwater is the other stream reach of interest to the MDIFW besides the Rice Rips bypassed reach. Until MDIFW evaluates the experimental brown trout stocking program, there is no assurance of continued brown trout stocking in Messalonskee Stream. Brown trout could continue to gain access to the Union Gas tailwaters from the main stem of the Kennebec River, where a successful brown trout stocking program is well established.

Flow to the Union Gas Project exceeds the hydraulic capacity of the project about 83 percent of the time in March, 97 percent in April, 70 percent in May, and 31 percent in June. That means that during much of the spring, tailwater flows are beyond the control of CMP and 73 percent or less of the maximum WUA for year-round brown trout is available due to high flow. Providing a minimum flow of 15 cfs as recommended by MDEP for water quality enhancement purposes, would serve to enhance the quality of the tailwaters for brown trout. Based on CMP's IFIM study, about 76 percent of the maximum brown trout WUA would be available with a flow of 15 cfs. Considering the relatively infrequent periods of generation during July, August, and September (less than 15 percent of the time according to the flow duration curves for Union Gas), the minimum flow would have more of an influence on habitat than during periods of frequent or constant generation.

Summer temperatures in the tailwater are relatively high (23 to almost 27°C) and are suboptimal for brown trout, although the tailwater may still represent a summer holding area for a limited number of brown trout. The tailrace is at least 9 feet deep, according to Exhibit F drawings, and much of the upper study reach is shaded by shoreline trees. As such, the prevailing water temperature may be the coolest water available to brown trout, which normally seek the coldest water available during the summer (Scarola, 1987). We would expect this relatively deep tailrace channel to maintain its holding properties with a minimum flow of 15 cfs as long as DO levels remain reasonable (which is expected as a result of proposed, corrective measures upstream). Higher minimum flows would displace pockets of cool water with warmer water from the impoundment. We conclude that the CMP proposal and MDEP's recommended minimum flow of 15 cfs would provide at least 76 percent of the maximum brown trout WUA and represents an acceptable degree of habitat enhancement, given the uncertain future of the experimental Messalonskee Stream brown trout management program. As discussed in Section 4.1.3.8, with Interior's recommended minimum flow, the actual flow to the Union Gas tailwater from July through September would typically only be 5 to 16 cfs higher than CMP's recommended flow and would certainly not maximize brown trout habitat.

Our review of CMP's study results and field observations by Stone & Webster staff on November 15, 1993, in the lower 3,000 feet of the Messalonskee Stream near its confluence with the main stem of the Kennebec River, suggest that this reach is well suited as a shad spawning and nursery habitat. We consider it unlikely that any shad (adult or young) would be able to pass upstream of the shallow riffle area immediately upstream of the reach which is backwatered by the Kennebec River. We agree with CMP that it is inappropriate to provide flows in the upper reach to benefit shad.

We recommend that CMP provide a year-round, instantaneous minimum flow of 15 cfs, or inflow, whichever is less. Our recommended flow and lake level monitoring plan for all the Messalonskee projects is discussed in Section 4.1.3.8. Interior's recommended minimum flow of 100 cfs would mean that three of the four Messalonskee projects could not generate for most of the summer (only Union Gas can generate with flows as low as 100 cfs). Without periodic flushing flows from generation in the Rice Rips impoundment during the summer, Interior's flow could adversely influence water quality. We estimate that the annual cost of lost generation from a minimum flow of 100 cfs at all four projects would be $56,400 compared to $20,700 with our recommended flows.

At the May 7, 1996, Section 10(j) meeting, Interior continued to support its minimum flow recommendations. In addition, MDEP distributed a letter at this meeting indicating that Interior's recommendation was not in conflict with the terms of the WQC. We questioned this conclusion, indicating that the reduction in summer flushing flows in the Rice Rips impoundment could have an adverse influence on the water quality (specifically DO) of Messalonskee Stream. MDEP reassessed the effects of reduced flushing flows and concluded, in its letter to the Commission dated May 13, 1996, that Interior's minimum flow recommendation would not have an adverse impact on water quality.

We conclude that Interior's minimum flow recommendation of 100 cfs or inflow, whichever is less, is consistent with applicable law and therefore adopt it.

In response to studies that showed that during downramping of the Union Gas Project there was some stranding of fish in a 1/3-acre area that was rapidly dewatered, CMP evaluated an alternative downramping sequence (Figure 4-16). The alternative sequence gradually closes the wicket gates from 70 percent open to 40 percent open before completely closing. This gradual closing allows more time for fish to move into deeper water during downramping. CMP proposes to formally adopt this new downramping sequence. MDEP and Interior have agreed with CMP's proposed new downramping sequence.

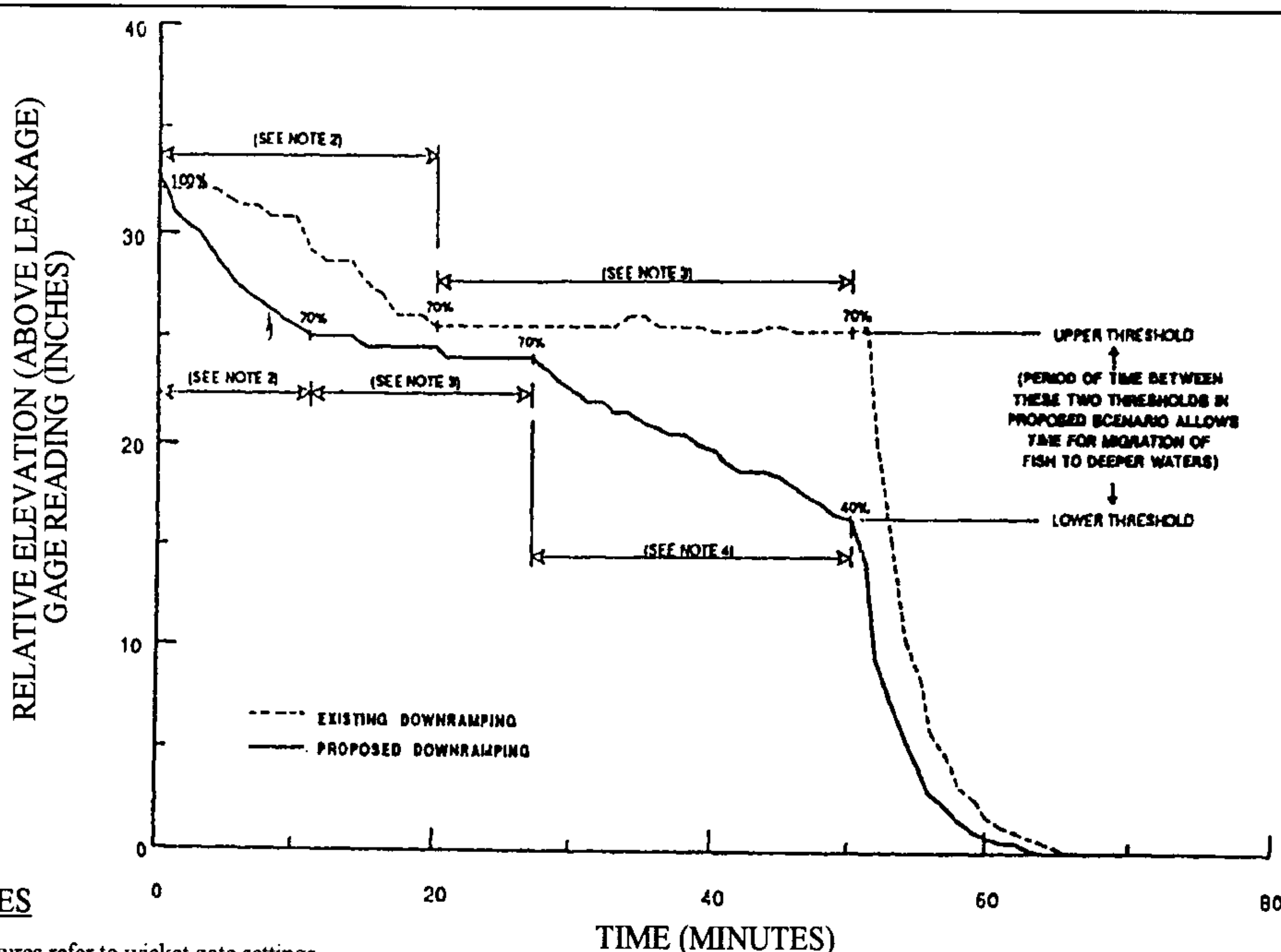
We conclude that the revised downramping sequence reduces the potential for stranding fish when the Union Gas Project is taken off line. We therefore recommend that CMP implement its proposed downramping sequence as shown in Figure 4-16.

*4..1.3.12 Edwards*

*Lake Water Level Under Staff's Licensing Alternative*

The present operation of the Edwards Project is plagued by frequent washout of some or all of the 4.5-foot-high flashboards. In 1988, Edwards improved the dam crest and flashboard system which reduced the frequency of flashboard failure. When flashboards fail, the impoundment must be lowered to elevation 21.0 feet to enable replacement. This causes the water surface of the impoundment to fluctuate substantially, especially from April through August (Figure 4-17) when many resident fish are spawning. Shoreline spawning fish, which include centrarchids (most notably smallmouth bass), chain pickerel, and minnows, can be adversely affected by these drawdowns. Direct effects include the dewatering of nests which contain eggs and relatively immobile fry and could result in substantial population impacts. Indirect effects could result from impaired emergent and submergent plant growth which would limit the amount of shallow water cover, an often preferred nursery habitat.

Edwards plans to improve project operation by adding new inflatable crest control devices to the existing dam. The present plan calls for the addition of inflatable crestgates along the entire length of the primary spillway. With this new crest gate, the spillway could support impoundment elevations at




NOTES

1. % figures refer to wicket gate settings
2. Under both scenarios, period of time from 100% to 70% gate varies depending upon inflow into impoundment
3. Under both scenarios, period of time unit holds at 70% gate varies depending upon inflow into impoundment
4. Under proposed scenaio, period of time from 70% to 40% gate is fixed at 30 minutes, or 1% gate closure/minute.
5. Minor difference in relative elevations at 70% gate between existing and proposed possibly due to elevation fluctuations at leakage and/or minor backwater influence

FIGURE 4-16
KENNEBEC RIVER BASIN EIS

Union Gas Project
Tailwater Elevations

Source: Central Maine Power, 1991, modified by staff.

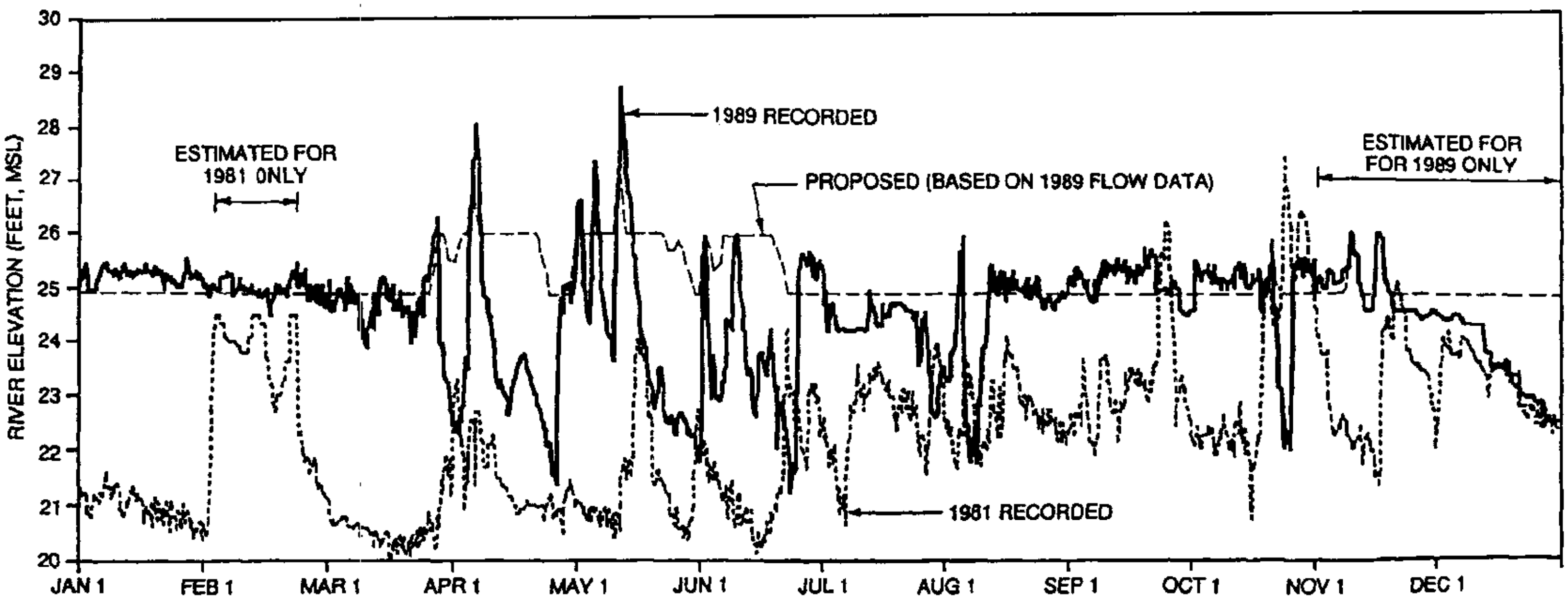



FIGURE 4-17.
KENNEBEC RIVER BASIN EIS

Edwards Project Headwater Levels 1981, 1989 and Proposed

Source: Edwards Manufacturing Company, 1991, modified by staff.

the dam up to elevation 26 feet, at which point the crest would be overtopped by 1 foot. The impoundment elevation could be adjusted by completely deflating a section or sections of the inflatable crest control. The anticipated effect of the new crest control on the impoundment water surface (shown in Figure 4-17) would result in considerably more stability of the impoundment surface water level.

Edwards still plans to maintain its agreement with CMP which allows Edwards to lower the impoundment up to 4 feet for power system emergency or system dispatch. Edwards, however, contends that it would be speculative to estimate the frequency of drawdown events because CMP dictates the need for emergency power (NDT, 1994). CMP has not dispatched this operational mode at the project. Consequently, Edwards believes that there would be no impacts from any drawdown because they would be limited in number and duration.

FWS (letter dated September 19, 1991) has indicated that with the inflatable rubber dam proposed by Edwards to provide water level control, existing habitat values would be maintained. MDIFW (letter dated September 19, 1991) has also agreed with Edwards' proposed rubber crest gate.

The present frequency of impoundment fluctuation at the Edwards Project is unacceptable, even with the improved flashboard system which was installed in 1988. We disagree with Edwards' assessment that only 3.5 acres of wetland would be exposed during infrequent, 4-foot emergency drawdowns dictated by CMP. Figure 4-17 clearly indicates that 4-foot drawdowns typically occur several times during the critical late spring and summer spawning and nursery period. Our observations from August through November 1994 reported in SWETS (1995a,b) confirm that 4-foot impoundment drawdowns still occur frequently. Our studies indicate that approximately 33 acres of wetlands are hydraulically connected to the impoundment and therefore affected to some degree by existing drawdowns. The most likely effect of drawdowns on aquatic life is in emergent wetlands, which we estimate to be nearly 6 acres.

With more stable water levels, we anticipate that these wetlands would be much more accessible as fish spawning, nursery, and foraging habitat. Perhaps of more significance is the now relatively barren shoreline of the impoundment. NDT (1994) has estimated that nearly 80 acres of unvegetated substrate (silt, sand, gravel, cobble, and ledge) is exposed by a 4-foot drawdown. Our field observations indicate that in many areas there are fairly robust beds of submergent plants at depths greater than 4 feet from full pond. We frequently observed that the substrate was suitable to support both submergent and emergent plant growth in shallower water, yet at present such growth is limited or non-existent, substantially reducing the value of this aquatic habitat. Stable water levels would most likely enable plants to become established and represent a significant enhancement of the spawning and nursery habitat for sunfish, largemouth bass, yellow perch, and minnows. Where the shoreline is now predominately gravel and cobble, stable water levels would substantially improve smallmouth bass spawning and nursery habitat.

We concur with Edwards' proposal to install new crest control structures on the dam to eliminate the now frequent inadvertent impoundment drawdowns. We believe the inflatable crestgates proposed by Edwards would ensure relatively stable impoundment water levels throughout the year. In addition to environmental benefits, better control of river flow would enable Edwards to capture more flow for generation purposes. We also support the idea that when spillage occurs, it can be directed by deflating specific sections of the crestgates. This controlled spillage is important for fish habitat downstream of the dam. These ramifications are discussed in the flow regulation section that follows.

The present flashboard system is not reliable and should be replaced. We recommend that as long as Edwards dam is in place, it be equipped with inflatable crest gates as shown on sheets 4 and 5 of 10 in Exhibit F of the original application for new license. Further, Edwards should finalize the crest gate design in consultation with FWS, MDMR, and MDIFW. The final crestgate design should be approved by the Commission prior to implementation. We also recommend for fish protection purposes that Edwards maintain the impoundment within 1 foot of full pond elevation (elevation 25.0 feet).

We recommend that Edwards operate the project in a run-of-river mode on a year-round basis unless circumstances arise that are beyond the control of Edwards. We recommend that Edwards develop a plan to monitor impoundment water levels on a continuous basis and run-of-river operation. This plan should be developed in consultation with resource agencies and submitted to FERC for approval. Upon FERC approval, Edwards should implement the plan.

*Water Level Under Dam Removal Alternative*

If the dam is removed, more than 11 miles of now predominantly lacustrine habitat would be converted to a riverine ecosystem with pools, runs, and riffles. As such, water level fluctuations would resemble those of a natural river, although they would still be controlled to some degree by flow regulation at upstream hydroelectric projects. The overall effect of upstream regulation would be to reduce the magnitude of peak flows and increase the magnitude of seasonal low flows.

After removal of the dam, wetlands occurring along the shoreline of the impoundment may convert to upland and riparian environments, with increases in the depth of the water table. However, new riparian and wetland areas would emerge in portions of the river substrate that are presently inundated by the impoundment. It is not possible to quantify the magnitude of these changes without detailed topographic and hydrogeological data.

*Fish Passage Under Staff's Licensing Alternative*

Edwards originally filed an application to amend its existing license on December 17, 1990, to allow construction of a fish lift at its existing project. The application also sought a 10-year extension of the original license to ensure the ability to finance the fishway. The fish lift would replace the previously used fish pump which was not effective in passing all targeted species. Downstream passage would be integrated into the design of the upstream passage. The existing downstream fish bypass at the unit 7 and 8 forebay would also continue to operate. The fish lift would have at least two entrances (Lakeside Engineering, 1990). Initially, it would be designed to pass an annual run of 82,000 alewives, 40,000 American shad, and 250 Atlantic salmon. It would be operated from May through November.

If Edwards were granted a new license for the project in accordance with that application, it would incorporate the proposed fish passage facility into an expanded facility to accommodate its proposed redeveloped project. Preliminary conceptual site plans presented in Exhibit F of the application indicate that additional upstream fishway entrances would be located in the tailrace of the new powerhouse as well as at the base of the dam near the existing gate house.

The interim fish lift proposed by Edwards was designed to only pass Atlantic salmon, alewives, and American shad. The species-specific capacity of the interim fish lift would be insufficient to fully stock appropriate upstream habitat. For example, passing 250 Atlantic salmon (the stated design capacity of the fish lift according to Lakeside Engineering, 1990) would only be enough to stock Sevenmile Stream and the Sebasticook River (Table 3-10) and assumes that no fish would be harvested upstream of Edwards dam. A minimum of an additional 2,900 salmon per year (given potential upstream passage inefficiencies) would need to be passed to fully stock all identified salmon nursery habitat. Eventual alewife passage at Edwards would have to be at least 1,538,668 to fully stock all targeted production habitat (Table 3-8), rather than the proposed 82,000 per year design capacity.

During a January 18, 1995, fishway construction consultation meeting, J. Stahlnecker of MDMR noted that based on 1994 peak sampling days near the Edwards Project, 11,000 to 13,000 alewives per day could require passage by the fish lift. J. Truebe (Lakeside Engineering) replied that Edwards' proposed holding tank and loading silos could accommodate this number of alewives (meeting report submitted to FERC by CMP (letter dated March 31, 1995). An advantage of a fish lift is that it is amenable to staged construction (size of facility increases as fish runs increase) (Quinn, 1994). Edwards is cognizant that permanent upstream fish passage would eventually need to pass substantially more alewives, shad, and Atlantic salmon than indicated in its interim conceptual fish lift design to fully stock all spawning and nursery habitat (page A-19 of the 1991 license application).

Phase I stocking of alewives in selected lakes in the Kennebec River Basin by MDMR and KHDG have resulted in recent dramatic increases in the return of adult alewives to the base of Edwards dam. While over 69,000 alewives were trapped at Edwards dam in 1995, it was only a fraction of the population returning to the river that year (MDMR, 1996). Estimated returns of adult alewives from 1989 through 1999 range up to 1.2 million for the year 1999. Between 1993 and 1995, over 700,000 adults were projected to have returned to the base of Edwards dam.

This relatively recent population increase is encouraging but has a bearing on upstream fish passage design because of potential crowding effects. With so many returning adult alewives reaching the base of the dam, many would enter the entrance of the proposed fish lift and most likely occupy most of the available space in the fish lift hopper. This could exclude the other targeted species and result in delays in upstream passage. To compensate for potential crowding effects, Edwards agreed to initially size the fish lift to pass the maximum design populations of anadromous fish: 1,548,000 alewives, 371,000 American shad, and 7,500 Atlantic salmon (reply comments submitted by Edwards dated May 23, 1996). We consider it likely that even with the expanded fish lift capacity, alewife crowding could exclude other targeted species from being effectively passed upstream. If and when Phase II stocking of alewives begins, considerably more alewives would be expected to return to Edwards dam than the projected 1.2 million in 1999. Crowding of fish lifts by alewives could prevent or delay upstream passage of American shad and alewives.

The Commission granted Edwards a license amendment by order issued December 14, 1994. The rationale for issuing the order was that construction of the proposed facilities would accelerate the restoration of American shad, alewives, and Atlantic salmon to the river basin. The approved facilities would suffice for these purposes, at least as an interim measure, until the new license proceedings for this project were completed. The

Commission would not grant Edwards' request for a 10-year extension of its original license because to do so would eliminate until 2004 its authority to require project retirement and dam removal.

Edwards requested a rehearing of this order on January 13, 1995, claiming that there was no assurance that it could recover its construction costs with the degree of uncertainty regarding the future of the project. Given these circumstances, it would be unable to finance the cost of fishway construction. Edwards indicated willingness to proceed with construction if the Commission granted a 10-year extension to its existing license to allow adequate time to recover its investment in the new facilities, even if it was not granted a new license. Afterwards, it would withdraw its first passage offer.

The State of Maine and the Kennebec Coalition said that they would not oppose Edwards' request to withdraw its offer of fish passage because extended judicial challenges could delay the relicensing proceeding which in turn would delay removal of the dam. Interior and Commerce supported the order to install fish passage as long as it did not preclude an ultimate decision to require dam removal.

The Commission, by order dated May 16, 1995, allowed Edwards to withdraw its application to provide interim fish passage facilities and vacated its December 14, 1994, order regarding this proceeding. The Commission concluded that completing the pending relicensing proceeding is the best way to support the Kennebec River restoration program.

On October 30, 1995, Edwards filed an amended license application to increase the generating capacity from 3.5 to up to 4.5 MW. The revised proposal would also provide for fish passage. The designed capacity of the proposed fish lift is the same as the interim fish lift that is proposed in Edwards' 1990 application to amend the project license.

The state has indicated that its goal is to restore all anadromous fish except lampreys to their historical range (MSPO, 1993). Striped bass, rainbow smelt, Atlantic and shortnose sturgeon historically migrated to Waterville and these species, according to MSPO, "do not use fishways." The state therefore considers removal of Edwards dam to be the most effective means of fish passage because of its unique position at the river's head-of-tide. Dam removal, according to MSPO (1993) would also reduce the cumulative impacts associated with fish passage inefficiencies to species that do use fishways (Atlantic salmon, American shad, and alewives).

FWS and NMFS (letters dated August 11, 1994 and August 12, 1994, respectively) have expressed similar views to the state regarding the need for strong consideration of dam removal as the most efficient means of fish passage. In a joint Commerce and Interior filing dated March 27, 1995, in support of a motion filed by the Kennebec Coalition on March 10, 1995, requesting establishment of a decommissioning fund requirement on the Edwards Project, a stronger position was espoused: "The Departments take the position that it is desirable and justified in the public interest that no new license should be issued and that the dam should be removed."

Commerce and Interior (letters dated June 2, 1995 and June 5, 1995, respectively) made preliminary Section 18 fishway prescriptions for use if FERC issues a license for the Edwards Project. These prescriptions would require Edwards to install fishways that would allow safe and timely upstream and downstream passage of fully restored populations of Atlantic sturgeon, shortnose sturgeon, striped bass, rainbow smelt, Atlantic salmon, American shad, river herring, and American eel using best available technology. Fishways would consist of fish ladders, lifts, locks, sorting facilities, breachways, or other such structures. Since this time, Commerce and Interior have determined that no effective passage technologies exist for passing Atlantic sturgeon, shortnose sturgeon, striped bass, and rainbow smelt. Their revised fishway prescriptions are described below.

Both Interior and Commerce submitted final Section 18 fishway prescriptions that would be applicable if the Commission decides to issue a license for the Edwards Project (both letters dated October 7, 1996). The prescriptions of both agencies, addressed in greater detail in Section 2.2.2 of this FEIS, are essentially identical, calling for design and construction of upstream and downstream fish passage facilities for target species populations of American shad (371,000), alewives (1,548,000), Atlantic salmon (3,500 to 7,500), American eel (unquantified), and blueback herring (unquantified). The upstream passage facilities would include spillway and powerhouse fish elevators, a spillway eel fishway, fish counting and sorting facilities, and associated structures. The downstream passage facilities would consist of an angled rack and fish bypass in the power canal. Interior suggests that staging of construction of the two upstream fish elevators such that the tailrace facility is operational within 5 years of initiation of operation of the spillway facility would be biologically acceptable. MSPO submitted 10(j) recommendations on April 4, 1996, that included stipulation for construction of upstream and downstream passage facilities as prescribed by Interior.

In regard to the upstream passage facilities, Commerce and Interior prescribe two fish lifts, one located near Wheelhouse No. 4 and the other near the spillway. Commerce and Interior state that two fish lifts are needed to reduce potential crowding and delays in upstream migration (Commerce, 1996; Interior, 1996). If only one fish lift were built near Wheelhouse No. 4, migration delays could be substantial because large numbers of alewives, American shad, and Atlantic salmon are known to be attracted to the area below the spillway (approximately 350 to 400 feet upstream) during periods of spill.

In its submittal, Interior states that the fishways it prescribed would not: (a) afford opportunity to fully accomplish the restoration goals because there is not reliable technology available to pass all nine target species; (b) adequately provide for achieving the State of Maine fisheries management goals to restore target species to their historic habitat; and (c) enable the State of Maine to fulfill its fiduciary duties to protect and enhance commerce and fisheries under the Public Trust Doctrine. Thus, Interior maintains its recommendation to remove Edwards dam. NMFS states in its submittal that Edwards dam has an extraordinarily adverse effect on anadromous and catadromous fish restoration efforts in the Kennebec River Basin, and that the most serious of these impacts cannot be mitigated through the installation of fishways. As stated above, both agencies conclude that no known fish passage technologies would successfully pass smelt, Atlantic sturgeon, shortnose sturgeon, or spawning striped bass. They also state that the efficacy of downstream passage facilities for successfully guiding post-spawned adults of these species is unknown.

As is discussed in more detail in Section 5.4.4, in their 10(j) recommendations, MSPO and Commerce call for downstream passage effectiveness studies of striped bass, smelt and sturgeon, and MSPO calls for study and evaluation of experimental upstream and downstream passage for these species. Both agencies withdrew those recommendations during the May 20, 1997, 10(j) meeting, based on their position that there would be no restoration benefit to passing those species upstream of the dam, should they be taken in the prescribed fish passage facilities, and no need for downstream passage if all individuals of these species taken in the prescribed fish passage facilities are returned to waters downstream of the dam. Additionally, Commerce's and MSPO's recommendation to evaluate impoundment habitat use by Atlantic sturgeon, shortnose sturgeon, striped bass, and rainbow smelt is no longer appropriate or necessary because none of these species would be released upstream of the dam.

Both Interior and Commerce have also reserved authority to prescribe the construction, operation, and maintenance of fishways under Section 18 of the FPA. Interior has further stated that its fishway prescription could be modified as necessary in light of any new information which is generated as a result of the licensing proceeding.

Commerce has disagreed with the suggestion that with dam removal there could be a decrease in shortnose sturgeon habitat (SWETS, 1995b) because the impounded habitat is presently inaccessible to sturgeon and because spawning and juvenile sturgeon tend to prefer deep areas with swift currents rather than pooled deep water.

Commerce has concluded that if the Edwards Project is relicensed, Atlantic sturgeon passage to and from upstream spawning habitat would continue to be blocked and the impoundment would remain unsuitable for spawning. It does not consider the example of successful sturgeon passage past a dam on the Volga River (SWETS, 1995b) as a reliable predictor of Atlantic sturgeon passage at Edwards dam.

Most other agencies that commented on the Edwards Project have supported the need for dam removal for improved fish passage. We received numerous letters from private citizens both in favor of and opposed to dam removal.

The Kennebec Coalition, in its June 5, 1995, filing with the Commission, has noted that it found no evidence that any fish passage measure has been able to pass spawning populations of Atlantic sturgeon, shortnose surgeon, smelt, or striped bass both upstream and downstream. It has noted that where other species of sturgeon have been passed, it has often been on rivers with a considerably larger sturgeon population and in which the percentage of fish passed upstream was low. It and MDMR (in MSPO, 1995) have cited an example on the Volga River where 20,000 sturgeon were transferred upstream of a dam but this constituted not more than 10 to 12 percent of the stock aggregated at the dam. It has also questioned how downstream passage for all targeted species would be achieved.

The Kennebec Coalition favors dam removal. If FERC issues a license for the Edwards Project, however, the coalition recommends that upstream and downstream fish passage pass at least 90 percent of the migrating runs of alewife, shad, and smelt and 100 percent of the migrating runs of salmon, Atlantic sturgeon, shortnose sturgeon, and striped bass. The fish passage system should also provide for removal of undesirable species. Target numbers for measuring success of the fish passage system should be established in consultation with resource agencies. If the fish passage is not in operation within 2 spawning seasons of license issuance, Edwards should pay $25,000 per month into a fish and wildlife mitigation fund. If after the third spawning season after the fish passage system is in operation, it fails to meet the criteria established by resource agencies for successful fish passage, Edwards should surrender its license and remove the dam at its expense.

Edwards (letter dated August 15, 1994) asserted that if enhancing the restoration of anadromous fish is the objective of removing Edwards dam, then dam removal at Fort Halifax, Weston, and Sandy River is also appropriate because restoration is proposed above these dams. However, the licensees of the Fort Halifax, Weston, and Sandy River projects proposed to install upstream and downstream fishways by May 1, 2001. These projects, therefore, would not be inhibiting restoration efforts because the installation of fishways at these projects would provide a means for restoring herring, shad, and salmon populations to upstream areas, and there are no restoration plans to establish the other species that do not use fishways (sturgeon, striped bass, and smelt) upstream of the dam.

Edwards claimed that fish lifts elsewhere show that striped bass, smelt, and sturgeon were effectively moved past dams, and dam removal, therefore, is not necessary to achieve restoration of all anadromous fish species to their historic range. Edwards provided no specific evidence on fishway effectiveness for striped bass, smelt, or sturgeon.

Although fish lifts in the northeast and mid-Atlantic states have effectively passed Atlantic salmon, American shad, and river herring (alewives and blueback herring), we know of none that have effectively passed shortnose sturgeon, Atlantic sturgeon, rainbow smelt, or striped bass. There is a paucity of data on whether a fish lift can effectively pass all the anadromous fish which are targeted for passage over Edwards dam.

The basic premise cited by most parties that favor dam removal is that all anadromous fish targeted for restoration do not use fishways. We provide evidence in SWETS (1995b) that striped bass, smelt, and sturgeon use fish lifts in certain instances. Quinn (1994) states that a significant advantage of the fish lift is that, unlike most other fishways, it can be designed to pass spawning-sized striped bass and sturgeon. There is insufficient information available, however, to conclude that the fish lift operation would effectively allow enough individuals to be passed to actually use available habitat and contribute to agency management objectives. In response to the DEIS, much information was provided by various commenters that suggests that it would be difficult to design a fish lift to effectively pass spawning sized striped bass, shortnose sturgeon, and Atlantic sturgeon. FWS canvassed all regional offices and found no evidence that fishways could successfully pass sustainable numbers of adult shortnose sturgeon, Atlantic sturgeon, striped bass or rainbow smelt. They then considered all conventional forms of fish passage and concluded that it is not feasible to design fish passage facilities that could pass all four species of fish (Interior letter dated April 4, 1996).

Interior provided anecdotal information (letter dated April 4, 1996) that smelt pass through a navigational lock at the head-of-tide on the Charles River, Massachusetts, because they are known to spawn at the base of an upstream dam. There is no other evidence that smelt have been passed by fish lifts or locks in sufficient quantities to establish spawning populations. Interior (letter dated April 4, 1996) and Dadswell (1996) provide documentation that the only striped bass known to use fish lifts or navigational locks were juveniles.

Interior indicates that the fish lifts on the Volga River known to successfully pass sturgeon actually resemble navigational locks. The lifts consist of twin chambers that are square (28 feet on a side) and rely on an attraction flow of 2,600 cfs. Personal communications with Russian fish lift operators (letter from Commerce dated April 8, 1996) indicate that, although some fish lifts successfully pass sturgeon in Russia, others of similar design do not. There is no known reason for the difference in effectiveness. Kynard (in press) reported that, although shortnose sturgeon enter the fish lift at Holyoke dam, upstream passage was infrequent. An average of three adult shortnose sturgeon per year were lifted during April to October from 1975 to 1995. This passage rate would not likely be sufficient to fully use the habitat upstream of the dam.

Establishing fish lift design criteria for Atlantic and shortnose sturgeon, smelt, and striped bass will prove difficult given the lack of comparable operating data. It is probable that the existing design would require modification pending the assimilation of available relevant data. The operation of the fish lift would also need to be modified to accommodate the additional 4 target species. Operation during the early spring would be necessary to accommodate smelt and shortnose sturgeon spawning runs. Interior, in its April 4, 1996, letter indicates the conventional upstream fish passage facility would need to operate from April to November. Lengthening operating time could result in substantially greater operation and maintenance costs over the originally proposed May to November time frame.

Based on information available when the DEIS was prepared, we had reason to believe that all targeted species of fish could be effectively passed upstream and downstream of the Edwards Project. However, it is clear to us that reasonable criteria are not available to begin to design such fishways for sturgeon, striped bass, and smelt for the Edwards Project and that limited studies are unlikely to provide the basis for developing such criteria. There would be an unacceptable amount of trial and error associated with designing the fish lift to pass all targeted species of anadromous fish.

The existing and proposed 1.25-inch clear-spaced trash racks should effectively divert downstream migrating adult salmon and clupeids to bypass facilities. Small adult alewives (about 9-inches long) are about 1.25-inches wide and adult shad (about 15-inches long) are about 2.5-inches wide (Smith, 1985). Out-migrating adult salmon would be greater than 1.25 inches wide based on proportional information presented in Smith (1985). The prescribed angled trashrack has 1-inch clear-spacing and would replace the existing trashrack. Commerce and Interior state that a 1.25-inch spacing, which is 25 percent greater than the prescribed 1-inch clear spacing, would result in greater entrainment of juvenile shad, juvenile herring, and adults eels (Commerce, 1996; Interior, 1996). Commerce and Interior state that an unstable upwelling flow field would occur with the licensee's bypass intake due to the proximity of boundary walls. Commerce and Interior conclude that the flow field at the prescribed downstream bypass facilities would be more conducive to effective passage by guiding migrants in a downstream direction to a converging point at the bypass entrance (Commerce, 1996; Interior, 1996).

Thus, we recommend that, should the Commission decide to license Edwards dam, the upstream and downstream passage facilities be constructed as prescribed and recommended by the agencies, targeting only alewife, blueback herring, American shad, Atlantic salmon, and American eel. We also recommend that any license issued by the Commission include an article that requires the applicant to release downstream of the dam any striped bass, Atlantic sturgeon, shortnose sturgeon, or rainbow smelt taken in the upstream fish passage facilities.

We also recommend that fish passage facilities include a trapping and sorting facility that would be operated by Edwards-funded staff. This sorting facility, although not required to pass anadromous fish upstream, would prevent or curtail upstream passage of undesirable species such as carp and lampreys and allow return of striped bass, smelt, and sturgeon to waters below the dam. This would clearly serve to protect upstream and downstream fisheries resources. We also recommend that the fishways include a steel walkway for providing access to the spillway lift and sorting facilities. This would be the primary means for accessing these facilities from Canal Street, and it could be used by the personnel operating the counting and sorting facility as well as agency personnel during inspections of fishway operations. Agency inspections would be appropriate to ensure that passage facilities are operating safely and efficiently.

Some entrainment of out-migrating juvenile clupeids and salmon could occur with the existing and proposed projects. Turbine mortality is difficult to accurately quantify and often requires studies to account for site-specific variables. It could approach 20 percent through Francis turbines (EPRI, 1992) which represents existing conditions as well as conditions under the revised proposed project. Most young anadromous fish out-migrating would occur when river flows are less than 6,000 cfs. With the original proposal, Edwards would most likely operate its proposed Kaplan turbine with these flow conditions. Average mortality through Kaplan turbines is about 8 percent for salmonids and 4 percent of juvenile clupeids (EPRI, 1992).

If the dam remains in place, we recommend that Edwards develop and implement fish lift and downstream passage efficiency studies. The study plans should clearly identify criteria for determining the effectiveness of passage for Atlantic salmon, American shad, river herring, and American eels and the methods to be used in determining conformance with the criteria. Downstream passage studies should address survival of fish using the facilities. In at least one instance, mortality of fish using a bypass was greater than those passing through turbines (Francfort et al., 1994). The study plans should be finalized in consultation with appropriate resource agencies and submitted to FERC for approval within 1 year of license issuance. We would include a reopener clause in any license issued for the Edwards Project to account for the possibility that major modifications of constructed facilities might be necessary.

*Fish Restoration Fund*

Edwards proposes to stock Atlantic salmon (mostly smolts) in the Kennebec River as an enhancement measure. After an initial stocking of about 25,000 parr at an upstream location, Edwards would stock about 10,000 smolt below Edwards dam for 4 years. Edwards estimates that from 40 to 100 additional adult salmon per year would return to the river based on these stockings. Near the end of the 5-year program, it would be assessed and a decision made regarding whether to continue the program. Besides benefitting the sportfishery, Edwards states that this stocking would provide a good start to active restoration efforts, which are not yet scheduled.

ASRSC (letter dated October 1, 1991) has deferred comment on Edwards proposed stocking plan to a later time. It noted that such stocking would require a stocking permit from MDIFW.

The EA for license amendment that incorporated the terms of the KHDG agreement into the licenses of the six affected projects (including Fort Halifax and Weston) found that the amendments:

> "...would be most consistent with the state of Maine's plan for restoring anadromous fish in the Kennebec River Basin" (FERC, 1991). The orders amending the license issued on October 22, 1992, concluded that" the amendments are a reasonable course of action and should be reaffirmed."

The KHDG agreement is a coordinated management tool to allow hydroelectric project owners to work with resource agencies to effectively restore alewives, shad, and salmon to their historic spawning habitats.

We recommend that, if the dam is left in place, the financial resources that Edwards would have committed to its stocking program instead be used to establish an anadromous fish restoration fund. Based on Edwards' description of the stocking plan, presented in a letter to the ASRSC dated September 16, 1991, and a June 20, 1991, cost summary from a private salmon hatchery provided by Edwards, we estimate that the total cost of Edwards stocking program would be $165,000 (1991 dollars). The anadromous fish restoration fund would be an extension of the funds provided to implement the KHDG agreement at upstream hydroelectric plants. Allocation of the funds for anadromous fish restoration purposes would be at the discretion of MDMR, ASRSC, MDIFW (all signatories to the KHDG agreement), NMFS, and FWS. Edwards should develop, with resource agency consultation, and submit a plan describing how the funds would be administered to FERC for approval.

Edwards should submit a plan developed in consultation with resource agencies that clearly describes how the funds would be administered and the decision making process by which funds would be allocated to specific projects. With this fund established, it is possible that if the resource agencies agree with Edwards' proposed stocking program, they could authorize its implementation. Due consideration would be given to the cumulative benefit to the overall anadromous fish restoration management plan.

*Fish Passage and Upstream Habitat with Dam Removal*

We assessed the potential environmental consequences of dam removal to anadromous fish passage in Section 7.5.2 of SWETS (1995b). We summarize the conclusions reached in the following section, but details of the analysis and conclusions are contained in SWETS (1995b). We also provide the new information used to reach a different conclusion than that described in the DEIS.

**American shad.** We conclude that, overall, there would be little net benefit or loss in restoration potential for this species if the dam is removed.

- Removing the dam would cause a loss of in-migrating, spawning, and incubation habitat for American shad at typical May river flows. Dam removal would compensate for this loss to some degree by eliminating upstream and downstream passage inefficiencies.

**Alewives.** We conclude that overall, there would be little net benefit or loss in restoration potential for this species if the dam were removed.

- Removing the dam would slightly decrease zooplankton levels (preferred food for juvenile alewives) in the lower portion of the now-impounded river (downstream of Sevenmile Island). Short-term (and possibly long-term, pending evaluation of the Phase I restoration results) upstream restoration of alewives would not be substantially affected by the status of the dam because of its reliance on trap and truck stocking of targeted upstream spawning and nursery habitat. Trap and truck operations for alewives are more suited to the Edwards Project than upstream projects because upstream migrants are likely to be more concentrated in the Edwards tailwaters which would lead to more catch per effort and more efficient stocking. With the dam removed, some upstream migrants would be diffused to Messalonskee Stream (Union Gas tailwaters), where no upstream passage is currently proposed; the Sebasticook River (Fort Halifax Project tailwaters); and the main stem of the Kennebec River (Lockwood Project tailwaters).

  MDMR (letter dated April 3, 1996) considers it likely that most adults would seek to return to their natal waters, much of which is in the Sebasticook River Basin (see Table 3-8). If this occurs, there could be a natural separation of alewives from returning adult shad and salmon, which would mostly return to waters upstream of the Lockwood Project. This could reduce upstream passage inefficiencies for shad and salmon because alewife crowding would be less pronounced at the Lockwood Project fishway.

  If fisheries agencies elect to discontinue alewife trap and truck operations, relying instead on upstream fishways to stock targeted lakes, there would be some expected upstream passage inefficiencies for alewives moving past Edwards dam, but the separation of shad and salmon from alewives at the next dams upstream would still occur. Continued operation of the project would cause some downstream passage inefficiencies.

**Atlantic salmon.** We conclude that removing the dam would provide net benefits in restoration potential for this species.

- There would be increased availability of preferred food (relatively large aquatic insects) without the dam as well as elimination of upstream and downstream passage inefficiencies. However, we do not consider the river between Augusta and Waterville to be suitable salmon nursery habitat because of warm summer water temperatures. Until an active salmon restoration plan is implemented for upstream areas, the benefits of dam removal on Atlantic salmon restoration to the Kennebec River Basin will go unrealized.

**Shortnose sturgeon.** Based on quantitative habitat mapping in SWETS (1995b), the staff concluded that removal of the dam would result in a reduction in available habitat for nearly all life stages of the endangered shortnose sturgeon. However, based on new information submitted with comments on the DEIS, we revised our conclusions. MDMR (letter dated April 3, 1996) considers it unlikely that juveniles and non-spawning adults would use the river upstream of Edwards dam to any great extent if the dam were to remain. MDMR considers the habitat that would be upstream of Augusta if the dam were removed to be most important for shortnose sturgeon spawning incubation, and larval development. Kynard (in press) presents information that the preferred spawning location for shortnose sturgeon is generally as far upstream as the adults can get (up to a limit of about 125 miles), and he presents a formula that predicts the population size based on the distance upstream that sturgeon can travel before passage is blocked. Using this formula, MDMR predicts that with dam removal, the population would increase by about 5,000 fish.

Some of the new information received with DEIS comments indicates that shortnose sturgeon prefer only the free-flowing reaches of rivers. Dadswell (1996) considers the only suitable habitat for shortnose sturgeon spawning with Edwards dam in place to be the 2 miles of free flowing river upstream of the impoundment. MDMR interprets recently released data for the existing land-locked population on the Connecticut River above Holyoke dam to indicate almost no use of the impounded river by shortnose sturgeon (Kynard, in press).

Dadswell (1996) analyzed the habitat suitability upstream of Edwards dam for shortnose sturgeon and concluded that habitat would be substantially improved with dam removal. With dam removal, the prevailing velocity of the river would increase, thus scouring sand and fine material from the interstitial spaces of the gravel and cobble substrate that SWETS (1995b) indicates is common. Shortnose sturgeon eggs settle into interstitial spaces shortly after spawning and remain there until hatching. On hatching, the yolk-sac larvae and early larval feeding stages remain in the crevice habitat. Without the dam, the prevailing water depth would be much lower, enabling light to penetrate to the bottom. This would stimulate algal growth on the gravel and cobbles, and benthic invertebrate production would also increase. The food source for crevice dwelling early life stages of shortnose sturgeon would therefore be enhanced with dam removal.

When the larvae reach about 16 mm in length, they swim up out of the gravel and are transported by currents to preferred juvenile estuarine feeding habitat in areas with soft substrate. Dadswell states that removal of the dam would permit unrestricted movement of the larvae to downstream habitat.

Dadswell (1996) further notes that greater algal growth stimulated by shallower water depths would promote increased populations of benthic snails. These could form an important food source when post-spawned adults break their pre-spawning fast and would more than compensate for any reduction in sphaerid clam populations that could result from dam removal.

There is disagreement among fisheries scientists about what conditions are optimal for shortnose sturgeon spawning. With dam removal, there would be an increase in habitat diversity compared to existing conditions. Dadswell (1996) suggests that this would better enable shortnose sturgeon to select optimal spawning habitat.

We agree with the above site-specific analysis offered by Dadswell, an acknowledged shortnose sturgeon expert. Given the uncertainty regarding the probability of successful upstream and downstream passage of a sustainable number of shortnose sturgeon and the predicted enhanced habitat conditions for egg and larval development, we conclude that dam removal would have a positive effect on the restoration potential of the endangered shortnose sturgeon.

**Atlantic sturgeon.** Removing the dam would decrease the quantity but increase the quality of habitat for early life stages of Atlantic sturgeon. The abundance of a preferred adult food (sphaerid clams) would be reduced due to the downstream transport of sand. However, as noted in the previous discussion of shortnose sturgeon, the clams could be replaced by snails (also a food source) if the dam is removed. It is likely, however, that adult sturgeon would not remain in the Augusta/Waterville portion of the river following spawning, since the fish prefer more saline portions of the estuary. Dam removal would allow access to new habitat and eliminate the possibility of any downstream passage mortality. We conclude that dam removal would have a positive effect on the restoration of Atlantic sturgeon to the Kennebec River.

**Rainbow smelt.** Based on quantitative habitat mapping for the life stages of smelt of concern to resource agencies immediately downstream of Edwards dam, the staff had concluded that removal of the dam would result in a reduction of juvenile and adult habitat upstream of the dam (SWETS, 1995b). However, new information from comments on the DEIS alters our conclusions. MDMR (letter dated April 3, 1996) and Dadswell (1996) consider it unlikely that the river upstream of Augusta would be used by juvenile and non-spawning smelt if they are able to access it. They also consider it likely that currents would sweep most smelt larvae downstream of Augusta shortly after hatching.

MDMR and Dadswell (1996) consider the primary value for smelt of the river from Augusta to Waterville to be for smelt spawning. Habitat mapping (SWETS, 1995b) indicates that there would be modest gains in optimal smelt spawning habitat with dam removal. However, the habitat suitability curves used in our analysis assumed that optimal spawning conditions exist at water depths equal to or greater than 0.5 foot. Given that most smelt populations are known to spawn in relatively shallow water, it is likely that considerably more optimal smelt spawning habitat would exist without the dam than the mapping results show.

We modify our position from that presented in the DEIS and consider dam removal to have a positive effect on the potential restoration of smelt to their historic range due to expected increases in spawning habitat and elimination of upstream and downstream passage inefficiencies.

**Striped bass.** We conclude that removing the dam would have a positive effect on the restoration potential of striped bass.

- Removing the dam would increase habitat for all life stages of striped bass during representative flow conditions. Adult striped bass would most likely congregate in the Fort Halifax and, to a lesser degree, Lockwood tailwaters rather than what are now the Edwards tailwaters. (This would displace, to some degree, the recreational fishery for striped bass from Augusta to the Waterville area.) Adult distribution is primarily determined by presence of suitable forage fish, and the forage base for striped bass in the foreseeable future is likely to be primarily out-migrating juvenile alewives. We conclude that if the dam were removed, localized reproductive potential for striped bass would benefit. The significance of this is unclear given the paucity of evidence that striped bass spawn in the Kennebec River downstream of the dam (an area that also appears well-suited to striped bass spawning). Currently, nearly all adult striped bass in the Kennebec estuary are believed to originate from the Hudson River or Chesapeake Bay.

We also conclude that removing the dam would have a net beneficial effect on the existing successful brown trout fishery due to increased availability of preferred food (large aquatic insects and fish) but a net adverse impact on the existing successful smallmouth bass fishery due to the increased numbers of striped bass and the corresponding increase in predation of striped bass on juvenile smallmouth bass.

*Flow Regulation Under the Staff's Licensing Alternative*

As previously indicated, Edwards' originally proposed project upgrade would increase the hydraulic capacity of the project from 3,300 to 8,500 cfs. This would result in a substantial decrease in the amount of time that spillage occurs at the dam. Based on our review of Edwards' flow duration curves, no spill or low spill conditions (flows less than or equal to 4,000 cfs) for the existing project are likely to occur about 17 percent of the time on an annual basis. On a monthly basis, this figure ranges from 0 percent in April to 30 percent in August. With the originally proposed project (with an hydraulic capacity of 8,500 cfs), no spill or low spill conditions could be expected about 71 percent of the time on an annual basis, ranging from about 5 percent in April to 85 percent in August (NDT, 1992). No or low spill conditions would be similar to existing conditions with Edwards' revised proposal (up to 4,000 cfs would pass through the turbines). Spillage would occur on a slightly less frequent basis (by several percent).

The originally proposed project would shift an additional 5,200 cfs of river flow away from the dam and through the generating facilities. The tailrace of existing Wheelhouse No. 4 would experience diminished flows when total river flow is between 2,500 and 8,500 cfs (which is likely to be most of the year). At levels below 5,200 cfs, flow to the Wheelhouse No. 4 tailrace would be limited to leakage and fish passage related discharges. Instead, most of this flow would pass through the new unit and enter the river about 750 feet downstream of the dam. This change in the flow regime of the river could influence the fish community in the tailwaters. Interpretation of the influence of flow regulation is confounded by the tidal influence below the dam which during minimal spillage can range from about 1 foot at the dam to nearly 5 feet about 3,000 feet downstream of the dam (NDT, 1992).

Edwards has conducted qualitative assessments of the effects of the modified flow regime on several fish species based on its originally proposed project. It has concluded that the originally proposed project would enhance brown trout, smallmouth bass, in-migrating American shad (by reducing attraction flows at the spillway and enabling more adults to find fishway entrances), and, to a limited extent, shortnose sturgeon (due to the creation of suitable spawning habitat in the new tailrace area) (NDT, 1992). It has also concluded that the originally proposed project would have little effect on Atlantic salmon, striped bass, Atlantic sturgeon, rainbow smelt, and young American shad. Edwards has conceded that the reduction of spillage caused by the expanded project would reduce habitat which is suitable for American shad spawning and egg incubation below the spillway, but that such reduced spillage would be infrequent during the spawning season (May and June) and therefore would not represent a significant impact on American shad.

Edwards provided quantitative habitat data on how the modified flows of the originally proposed project would affect representative species in the 3,000-foot reach between the dam and the Father Curran bridge (Figure 4-18). These data include tables of WUA for this reach at low and high tide, with and without the originally proposed project expansion at flows up to 14,500 cfs (NDT, 1994).

Interior (letter dated June 5, 1995), Commerce (letter dated April 8, 1996), and MDMR (letter dated April 4, 1996) have made a 10(j) recommendation that Edwards should maintain an instantaneous release at the dam of 4,500 cfs or inflow to the project area, whichever is less, each year during the month of July to protect Atlantic sturgeon spawning habitat. Interior has indicated that this species has dramatically declined in numbers in recent years. Under existing conditions, typically only about 1,000 cfs of water spills at the dam during the Atlantic sturgeon spawning period in July. Spillage would cease during July with the originally proposed project expansion. This altered flow pattern would have a serious effect on Atlantic sturgeon spawning, according to Interior.

Commerce (letter dated April 8, 1996) and MSPO (letter dated April 4, 1996) both made 10(j) recommendations that Edwards should maintain an instantaneous release at the dam of 6,000 cfs or inflow, whichever is less, each year from April 15 through May 31 to protect shortnose sturgeon spawning habitat. The basis for this recommendation was that there is a substantial increase in WUA for spawning and incubation in Area A as river flow increase from 8,500 cfs to 9,000 cfs (high tide) and 9,000 cfs to 9,500 cfs (low tide). Data from NDT, 1994, flow duration curves, and Figure 4-25 in the DEIS were used to support this recommendation.

Based on our analysis of the Edwards data (NDT, 1994), we conclude that the proposed flow regimes (both original and revised proposals) would have little effect on brown trout, smallmouth bass, Atlantic salmon, rainbow smelt, and striped bass habitat downstream of the dam. However, an increase in hydraulic capacity (as Edwards originally proposed) would decrease the amount of spillage at the dam and divert it to the tailrace of the generating unit. Our review of WUA for all evaluated life stages of these five species reveals that the amount of habitat

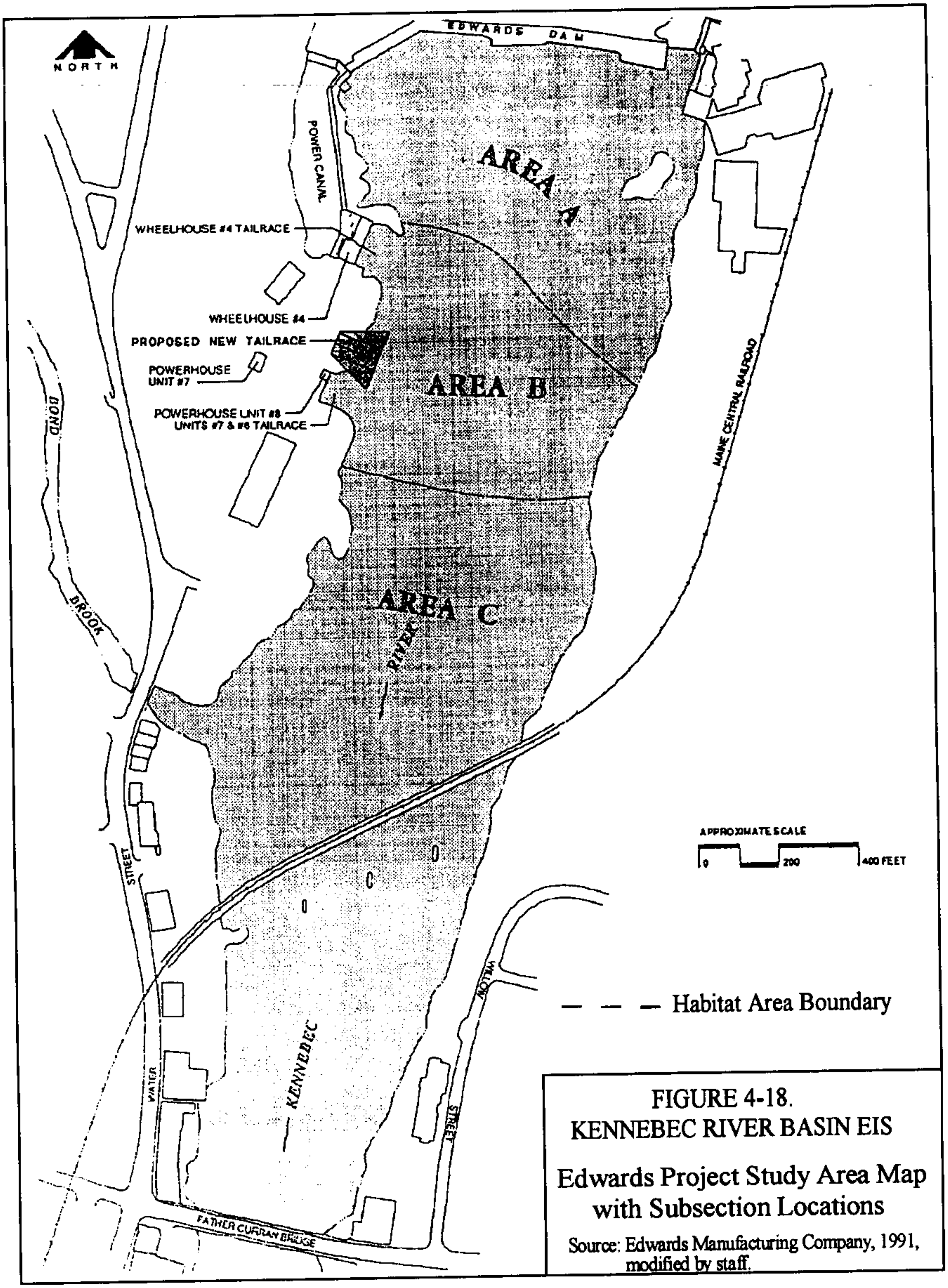



FIGURE 4-18.
KENNEBEC RIVER BASIN EIS

Edwards Project Study Area Map with Subsection Locations

Source: Edwards Manufacturing Company, 1991, modified by staff.

in the study area is nearly identical under existing and originally proposed flow regimes regardless of river flow.

In regard to flow effects on American shad, shortnose sturgeon, and Atlantic sturgeon, project expansion as originally proposed could adversely affect American shad spawning, incubation, larvae, and juvenile habitat at flows less than about 10,000 cfs (figures 4-19 through 4-22). May and June are the months when most shad spawning and early life stages are likely to be present in the Kennebec River (MSPO, 1993). According to NDT (1992) flow duration curves, flows during May exceed 10,000 cfs about 69 percent of the time in May but only about 21 percent of the time in June. However, we do not consider the physical habitat requirements for spawning shad to be particularly restrictive. Recent studies indicate that shad seem to spawn as frequently in slow-moving water (0 to 1 ft/sec) as in moderate current velocities (1 to 2 ft/sec), essentially invalidating any lower suitability limit (Ross et al., 1993). The suitability index used by NDT (1994) was developed by Stier and Crance (1985) and indicates zero suitability for spawning shad at water velocities less than or equal to 0.3 ft/sec. If optimum shad spawning conditions are present at little or no water velocity, the originally proposed project expansion would have much less of an adverse affect on shad spawning.

If flows below the dam are not suitable for shad spawning, we expect that spawning would be displaced to more suitable downstream locations. Following spawning, the semi-buoyant eggs would be transported downstream while they were incubating and most larval and juvenile development would occur at suitable downstream locations. Consequently, although we view the originally proposed project as having a negative impact on American shad based on Edwards' habitat quantification, we do not consider the effect to be substantial in terms of the overall population.

Habitat quantification for American shad with Edwards' revised proposal would be similar to the figures which show existing conditions. Most likely, the "bench" that ends at flows of approximately 3,300 cfs would not end until a flow of 4,000 cfs was reached, signifying the commencement of spillage. Flows greater than 5,000 cfs occur 95 percent of the time in May and 70 percent of the time in June. We conclude, therefore, that the revised proposal would most likely have little, if any effect on spawning and young American shad relative to existing conditions.

Unlike shad, we consider it more likely that the originally proposed project expansion could have a significant impact on sturgeon due to the sturgeon's restrictive habitat characteristics. Documented shortnose sturgeon spawning sites on the tidal portion of the Kennebec River Estuary are characterized by a substrate of gravel, rubble, and large boulders adjacent to

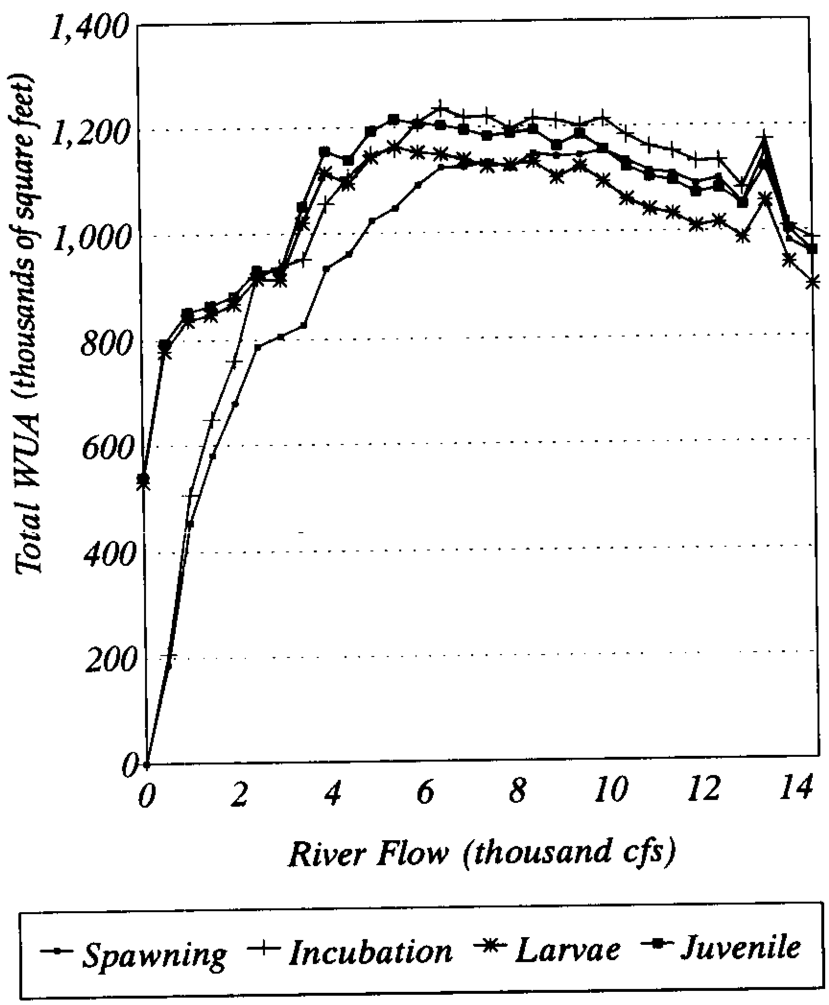



FIGURE 4-19.
KENNEBEC RIVER BASIN EIS
**American Shad Habitat at Low Tide at Edwards Project Tailwaters for Existing Operation and Revised Proposal**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

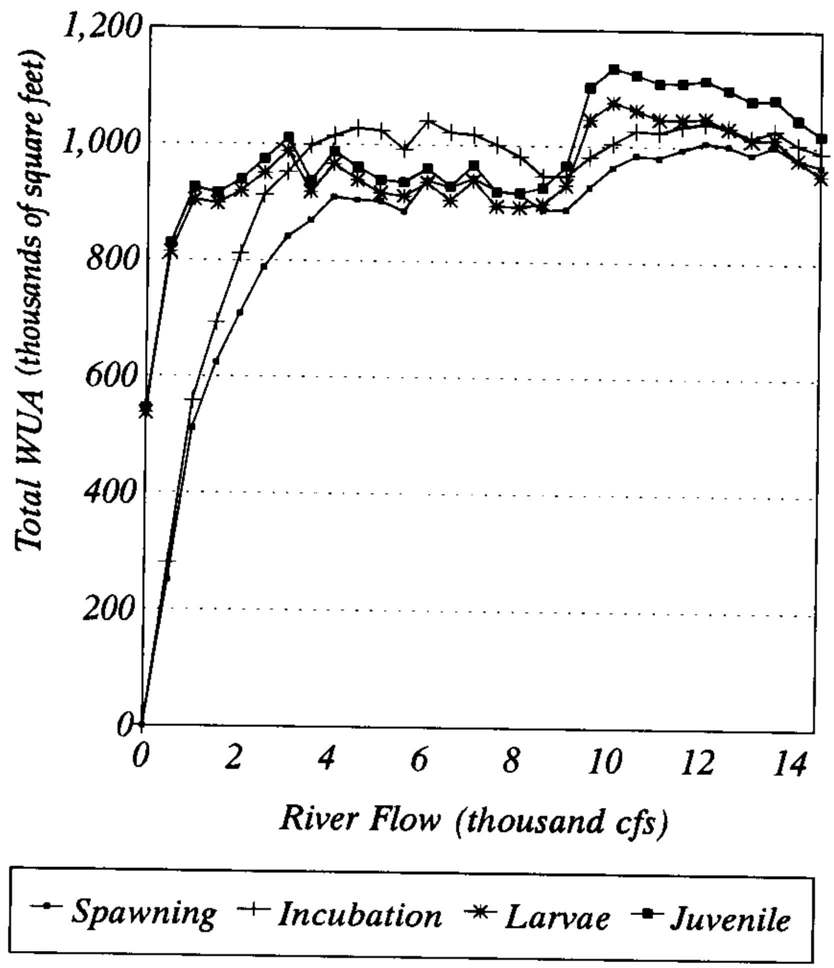



FIGURE 4-20.
KENNEBEC RIVER BASIN EIS
**American Shad Habitat at Low Tide at Edwards Project Tailwaters as Originally Proposed**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

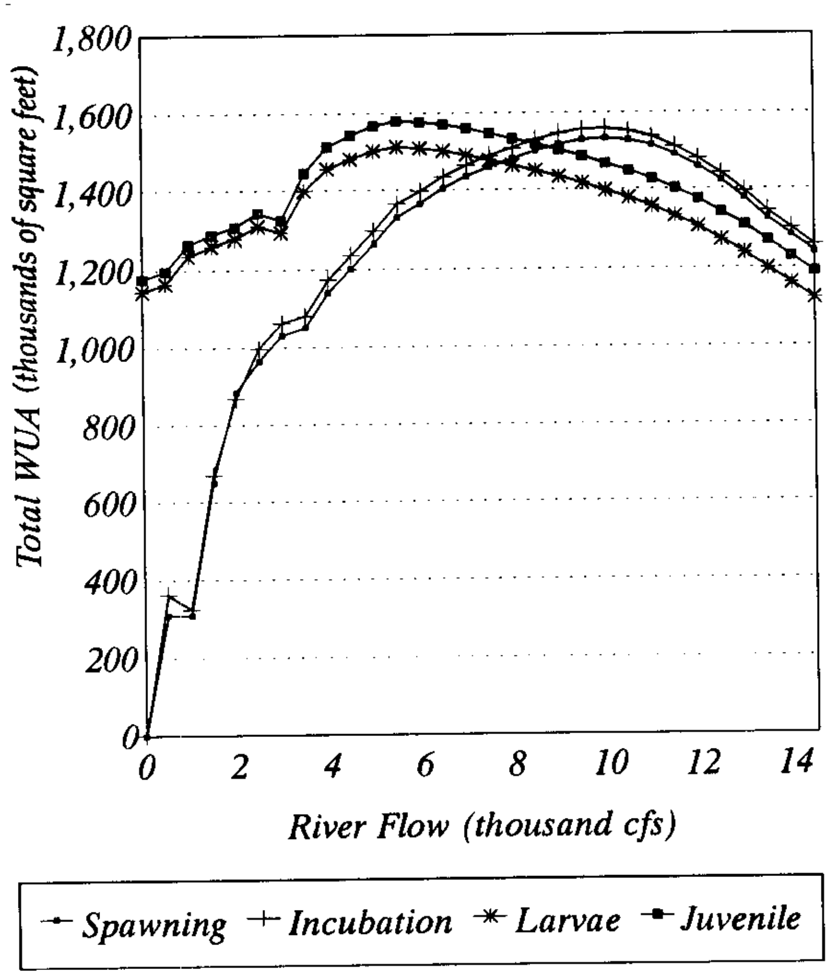



FIGURE 4-21.
KENNEBEC RIVER BASIN EIS

American Shad Habitat at High Tide at Edwards Project Tailwaters for Existing Operation and Revised Proposal

Source: Northrup, Devine & Tarbell, 1994, modified by staff.

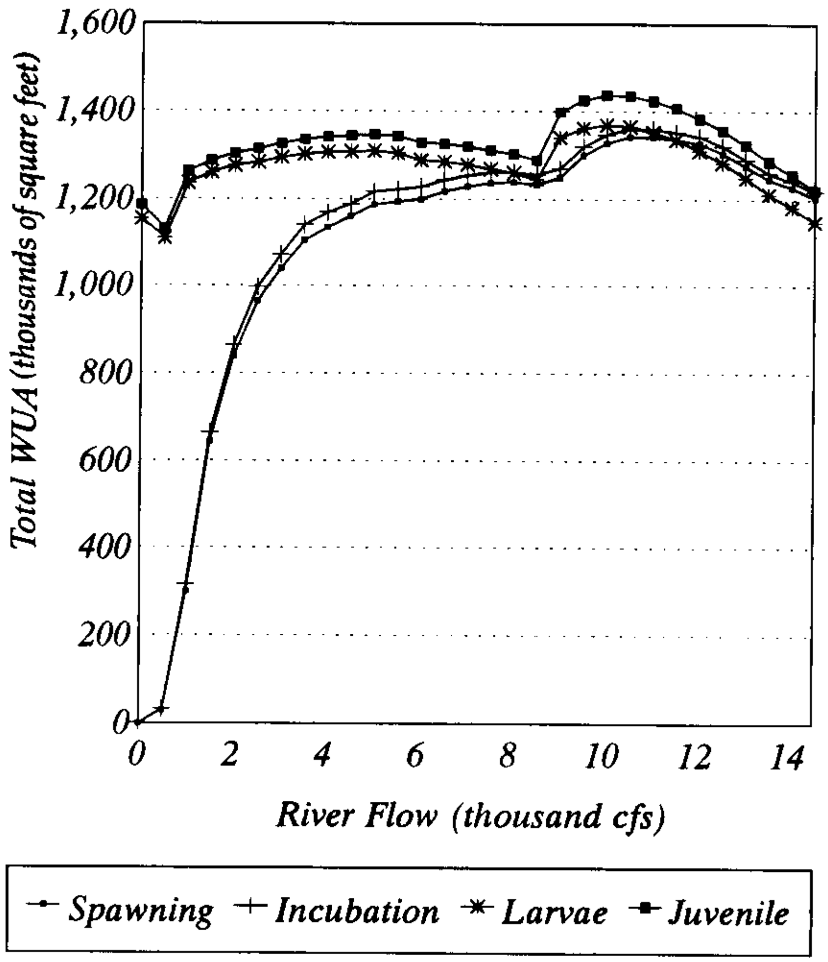



FIGURE 4-22.
KENNEBEC RIVER BASIN EIS
**American Shad Habitat at High Tide at Edwards Project Tailwaters as Originally Proposed**

Source: Northrup, Devine & Tarbell, 1994, modified by staff.

deep, turbulent areas (Squiers, 1988). Atlantic sturgeon are reported to spawn over hard substrate in running water and in pools below waterfalls with rugged bathymetry varying by as much as 18 feet (Murawski et al., 1977). These rather specific habitat requirements describe the deep area below the dam, especially the deep hole on the western side of the channel. Project operations most influence this area because when water is diverted from the dam through the powerhouse it returns to the river at the upstream end of Area B (Figure 4-18). We therefore focused our assessment of the potential influence of the original and revised proposed project on sturgeon to Area A (figures 4-23 through 4-26).

The effects of spillage on Atlantic sturgeon spawning and incubation with the originally proposed project are readily apparent (figures 4-23 and 4-24). As soon as spillage begins, WUA for both spawning and incubation increases dramatically. Spawning and incubation is most likely to occur during July. With the existing project, July flows that result in spillage at the dam occur about 88 percent of the time; with the originally proposed project, spillage during July would only occur about 7 percent of the time. Existing project operation would result in up to about 111,000 square feet of additional Atlantic sturgeon spawning WUA at low tide and 130,000 square feet of additional Atlantic sturgeon spawning WUA at high tide in Area A compared to the originally proposed project. Similarly, existing project operation would result in up to about 141,000 square feet of additional Atlantic sturgeon incubation WUA at low tide and 172,000 square feet of additional Atlantic sturgeon incubation WUA at high tide in Area A compared to the originally proposed project.

If 4,500 cfs or inflow to the project, whichever is less, is released at the dam during July as recommended by Interior and Commerce, it would effectively provide the equivalent of 8,000 cfs to Area A in terms of WUA as shown on Figure 4-23. This would increase the WUA for Atlantic sturgeon spawning and incubation by over 100,000 square feet in Area A compared to existing and revised proposed conditions. With the existing and revised proposed project generation during July, flows that would produce an equivalent amount of habitat would only be available about 8 percent of the time. We agree that Interior's and Commerce's recommendation would substantially improve the suitability of existing Atlantic sturgeon spawning and incubation habitat at the base of the dam over existing or proposed operation.

We assessed Atlantic sturgeon spawning and incubation habitat in Area B to see if the originally proposed project operation would result in habitat gains that could compensate for the habitat loss in Area A. Spawning and incubation habitat in Area B is very similar with existing and proposed project

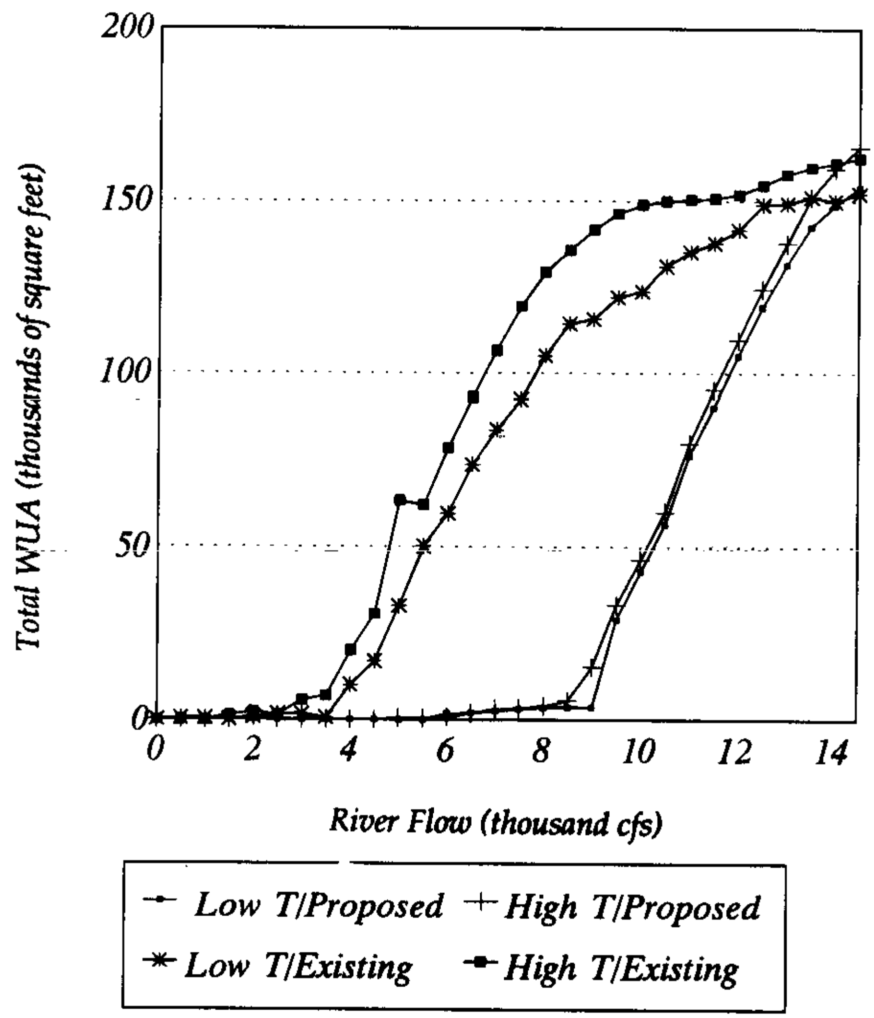



FIGURE 4-23.
KENNEBEC RIVER BASIN EIS
**Atlantic Sturgeon Spawning Habitat in Area A at High and Low Tide for Existing Operation and Original Proposal**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

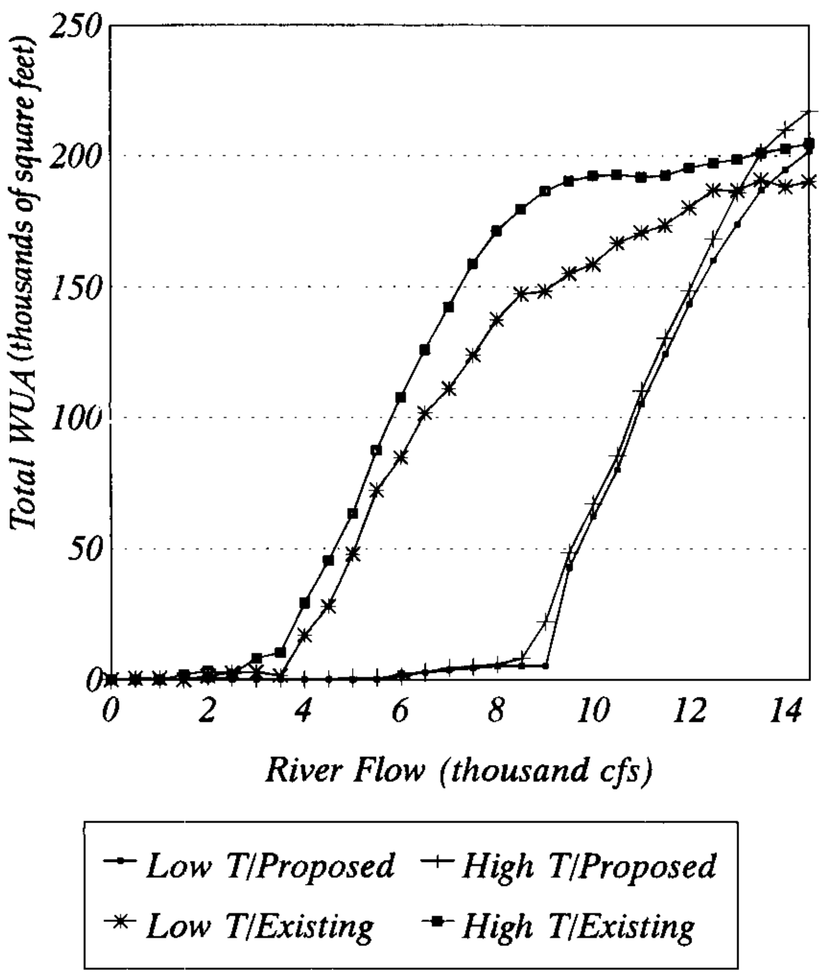



FIGURE 4-24.
KENNEBEC RIVER BASIN EIS
**Atlantic Sturgeon Incubation Habitat in Area A at High and Low Tide for Existing Operation and Original Proposal**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

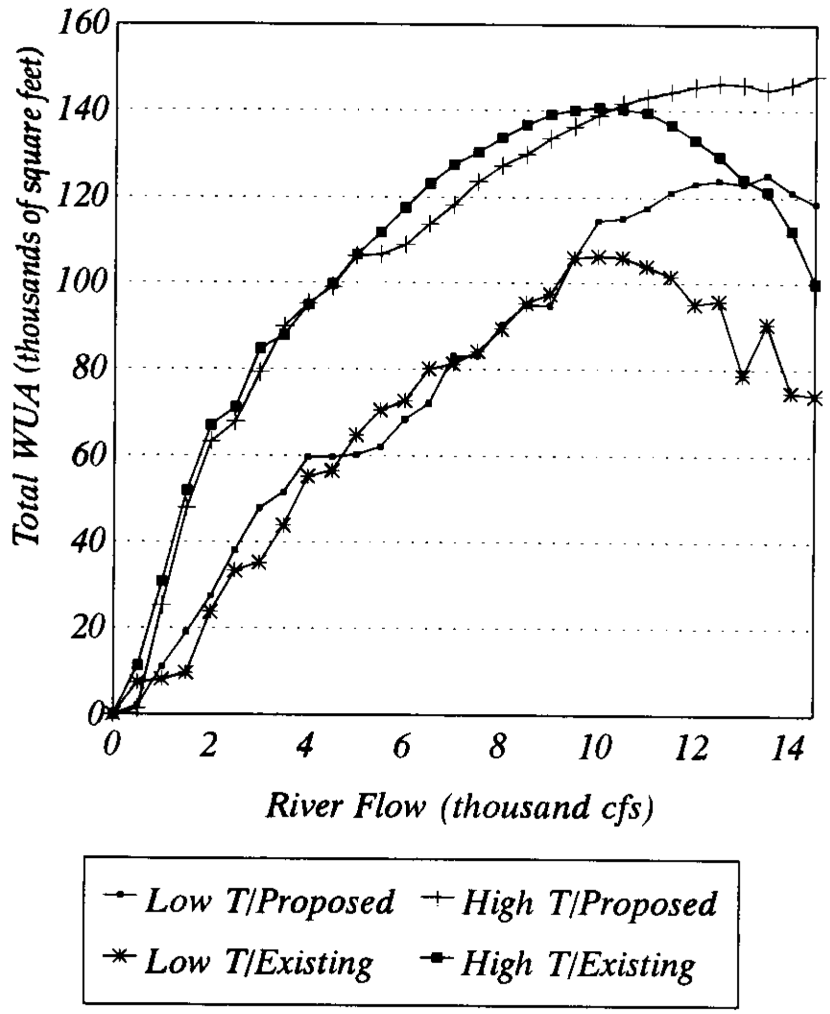



FIGURE 4-25.

KENNEBEC RIVER BASIN EIS

**Atlantic Sturgeon Spawning Habitat in Area B at High and Low Tide for Existing Operation and Original Proposal**

Source: Northrup, Devine & Tarbell, 1994, modified by staff.

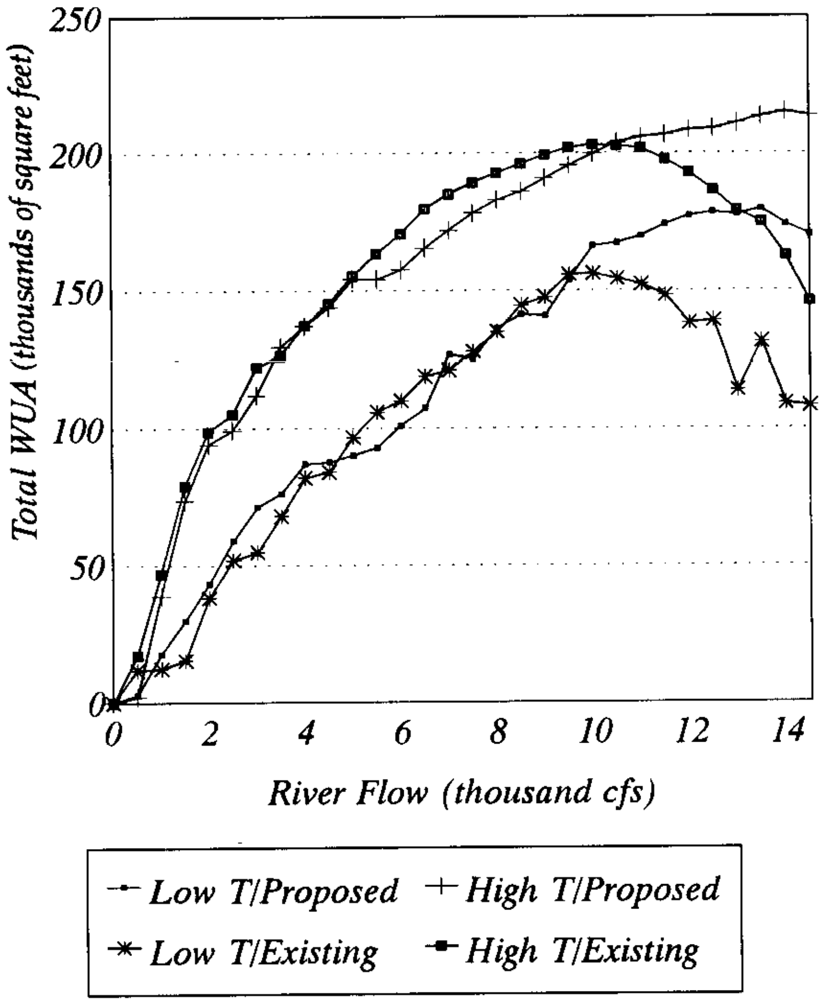



FIGURE 4-26.
KENNEBEC RIVER BASIN EIS

**Atlantic Sturgeon Incubation Habitat in Area B at High and Low Tide for Existing Operation and Original Proposal**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

operation until flows exceed 9,500 cfs, at which point the proposed project operation would provide more habitat than the existing project operation (figures 4-25 and 4-26). However, flows in July exceed 9,500 cfs only about 5 percent of the time. We do not consider this a compensation for lost Area A habitat that would be incurred with the originally proposed project.

Given the restrictive nature of Atlantic sturgeon spawning and incubation habitat characteristics and the fact that Atlantic sturgeon are now known to be present at the base of the dam, we consider the habitat loss that would result from the originally proposed project expansion to represent a potential significant impact on this species. We also conclude that Interior's and Commerce's recommendation to release 4,500 cfs or inflow, whichever is less, at the dam during July represents a significant habitat enhancement measure for Atlantic sturgeon with existing or revised proposed operation and would recommend this measure as a condition of any license issued for this project.

The effect of spillage on spawning and incubation habitat in Area A to the endangered shortnose sturgeon is similar to that of Atlantic sturgeon (figures 4-27 and 4-28). With the existing and revised proposed project, spillage begins at much lower flows than it would with the originally proposed project operation. WUA for spawning and incubation increases substantially at flows over 3,000 cfs with existing project operation. An analogous increase would not occur with the originally proposed project operation until flows exceeded 8,500 cfs. Shortnose sturgeon spawning and incubation is most likely to occur during April and May. Flows exceed 3,000 cfs 100 percent of the time in April and May, so that with existing and revised proposed project operation there would always be at least some spillage when shortnose sturgeon are spawning and their eggs are incubating. Flows exceed 8,500 cfs about 95 percent of the time in April and 77 percent of the time in May. During April there would generally be at least some spillage with the originally proposed project operation, but in May spillage would not occur about 23 percent of the time. Existing project operation could result in up to 160,000 square feet of additional WUA for shortnose sturgeon spawning and incubation (figures 4-27 and 4-28).

We acknowledge that during typical April and May river flows the difference in WUA would be much less, but for all flows evaluated in NDT (1994), the existing project provides more WUA than the originally proposed project would in Area A. We assessed Commerce's and MSPO's new recommendation to release 6,000 cfs from the dam at all times to protect shortnose sturgeon spawning and incubation. Our review of the same information that they reviewed does not indicate a substantial increase in WUA in Area A when river flow increases from 8,500 cfs to 9,000 cfs (high tide) and 9,000 cfs to 9,500 cfs (low tide).

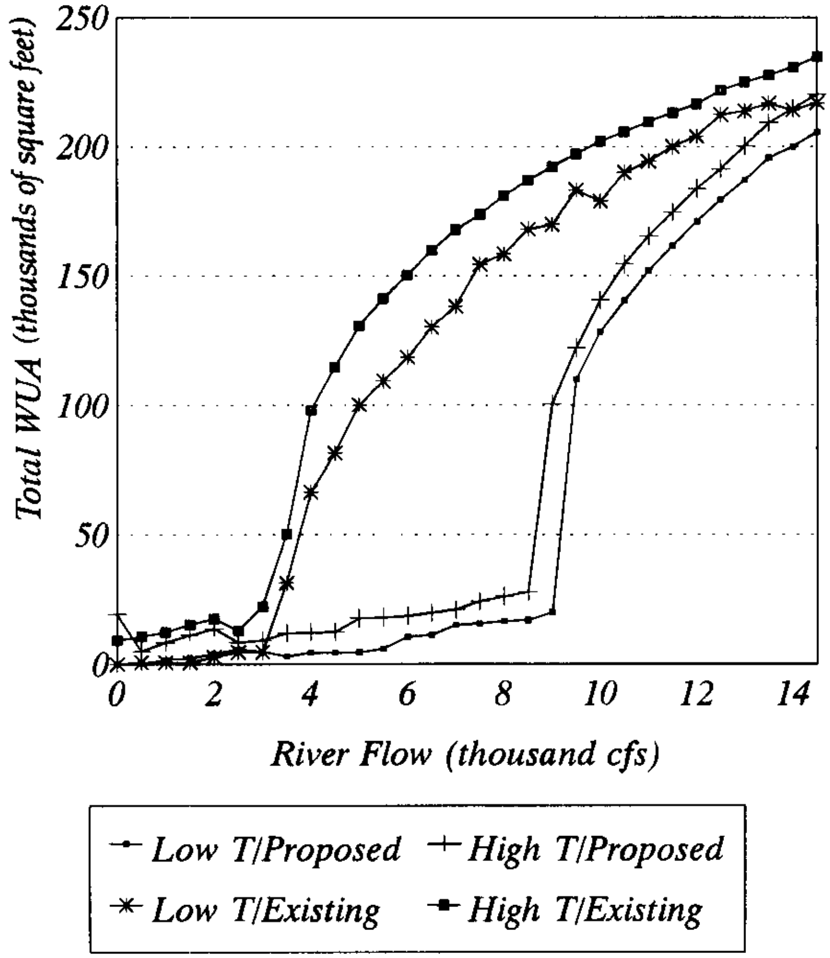



FIGURE 4-27.
KENNEBEC RIVER BASIN EIS

**Shortnose Sturgeon Spawning and Incubation Habitat in Area A at High and Low Tide for Existing Operation and Original Proposal**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

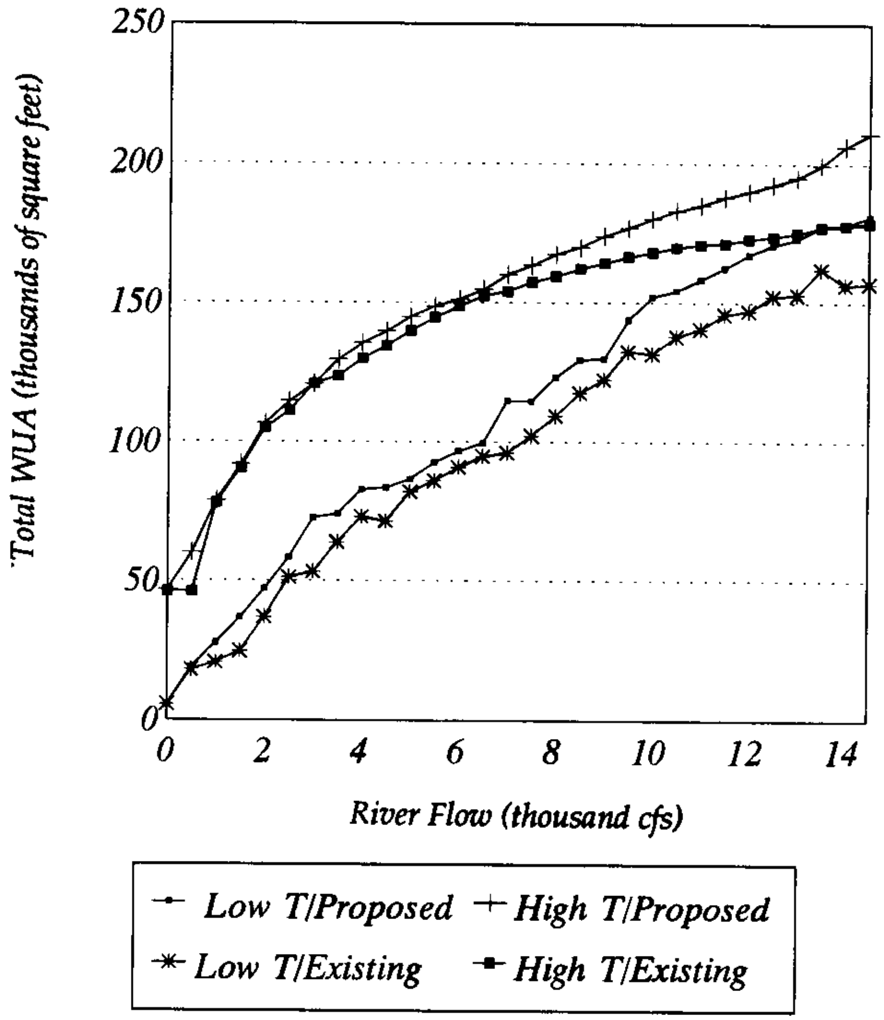



FIGURE 4-28.
KENNEBEC RIVER BASIN EIS

**Shortnose Sturgeon Spawning and Incubation Habitat in Area B at High and Low Tide for Existing Operation and Original Proposal**

**Source: Northrup, Devine & Tarbell, 1994, modified by staff.**

This substantial increase is evident for the Edwards Project as originally proposed (expanded project) as indicated on Figure 4-25. However, the recommendation would result in increased shortnose sturgeon spawning and incubation habitat.

We assumed a worst case scenario to quantify the effects of a required 6,000 cfs spillage: inflow to the project was 6,000 cfs, meaning that all flows would be spilled over the dam. This flow is exceeded 98 percent of the time in April and 87 percent of the time in May. The following table summarizes the WUA with existing project operations (about 3,500 cfs passing through the powerhouse) and with Commerce's and MSPO's recommended spillage.

| | Existing Operation (sq. feet) | With 6,000 cfs Spillage (sq. feet) | Increase in WUA (sq. feet) |
|---|---|---|---|
| High Tide | 150,421 | 197,119 | 47,077 |
| Low Tide | 118,706 | 183,325 | 64,619 |

Implementation of this recommendation would result in an increase in WUA of about 50,000 square feet. Given the endangered status of this species, this increase in habitat would represent a substantial enhancement. Therefore, if a license is issued for this project, we would recommend that 6,000 cfs or inflow, whichever is less, be spilled at the dam from April 15 through May 31 to enhance shortnose sturgeon spawning and incubation habitat.

We evaluated Edwards' conclusion in NDT (1992) that the originally proposed new tailrace would create additional shortnose sturgeon spawning habitat by reviewing Area B WUA. At river flows expected during shortnose sturgeon spawning and incubation, operation of the originally proposed project would consistently provide 10,000 to 20,000 square feet more WUA than the existing project operation (Figure 4-28). This would be enough to compensate for the habitat lost in Area A only at the highest simulated flows (over 13,000 cfs).

We consider the potential for significant impact on shortnose sturgeon of the originally proposed project operation to be far less than for Atlantic sturgeon due to the expected higher prevailing flows during shortnose sturgeon spawning and incubation periods. Given the endangered status of this species, however, we consider it inappropriate to propose an alternative (original project expansion) that would most likely result in a consistent incremental impact on shortnose sturgeon populations even though that impact may be relatively small most of the time. We therefore recommend that if Edwards dam is left in place, the project should not be expanded to increase its hydraulic capacity over 4,000 cfs due to potential adverse impacts on shortnose and Atlantic sturgeon.

Conclusions

The primary reason resource agencies and most intervenors give for advocating retirement of the Edwards Project and removal of Edwards dam is to restore all targeted anadromous fish to their historical range in the Kennebec River Basin. We assessed the information and comments provided in response to the DEIS and conclude that it would be unlikely that effective fish passage could be provided for all targeted species. We also conclude, based on new information provided, that dam removal would enhance the restoration potential for Atlantic salmon, rainbow smelt, striped bass, Atlantic sturgeon, and shortnose sturgeon. We make our recommendation in Section 5.4 of this FEIS.

*4.1.3.13 Cumulative Effects*

There may be cumulative effects on resident fisheries and related resources from the proposed operation of the Moosehead and Wyman projects. There also may be cumulative effects on efforts to restore anadromous fish to their historic ranges from the proposed operation of the Sandy River, Weston, Fort Halifax, and Edwards Projects. In the following section, we address these potential cumulative effects.

*Resident Fisheries and Related Resources*

We assessed potential cumulative impacts that the proposed operation of the Moosehead Project, with our recommended enhancements, could have on downstream fisheries resources and related aquatic ecosystems. To provide a basis for our assessment, we requested available information from the Harris Project (FERC No. 2142) and the Flagstaff Project (FERC No. 2612). Harris is a peaking project downstream of the Moosehead Project and Flagstaff is the other major storage project in the Kennebec River Basin (Figure 1-1 shows the location of these projects). Both projects are scheduled to be relicensed in the near future.

Some commenters requested that we also consider First Roach Pond and Brassua, which affect inflow to Moosehead Lake. The dam at First Roach Pond was determined by FERC on August 1, 1994 to be nonjurisdictional. On January 10, 1995, the Roach River Dam Company notified the Commission that it had transferred ownership of the dam and associated lands to the State of Maine, acting through MDIFW. Although flows in the Roach River are relatively low (a minimum flow of 75 cfs was set before transfer of ownership), we consider MDIFW to be an appropriate party to ensure protection of the important spawning and nursery habitat for landlocked Atlantic salmon and brook trout and the associated

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