DOE/EIS-0166

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Final Environmental Impact Statement for Construction and Operation of the Proposed Bangor Hydro-Electric Company's Second 345-kV Transmission Tie Line to New Brunswick

August 1995

United States Department of Energy
Assistant Secretary for Fossil Energy
Office of Fuels Programs

DOE/EIS-0166

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United States Department of Energy
Assistant Secretary for Fossil Energy
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Washington, DC 20585

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United States Government | Department of Energy

memorandum

DATE: April 13, 1995

REPLY TO ATTN OF: Office of NEPA Policy and Assistance:Thurston:6-1509

SUBJECT: Approval of the Final Environmental Impact Statement for the Bangor Hydro-Electric Transmission Line Project (DOE/EIS-0166)

TO: Patricia Fry Godley
Assistant Secretary
Office of Fossil Energy

This is in response to your December 23, 1994, memorandum requesting approval of the subject Final Environmental Impact Statement (the Final Statement). The Office of NEPA Policy and Assistance has reviewed the subject Final Statement in accordance with our responsibilities under DOE Order 5440.1E regarding compliance with the National Environmental Policy Act (NEPA) of 1969, as amended. We note that on March 7, 1995, the Environmental Protection Agency completed its review of the Draft Environmental Impact Statement and rated the project LO for "Lack of Objections."

Based upon my staff's review and their recommendations, and after consultation with the Office of General Counsel, I have determined that the Final Statement, subject to incorporation of the attached comments, is adequate for printing and distribution. The Office of NEPA Policy and Assistance will continue to assist your office in filing the Final Statement with the Environmental Protection Agency and in other distribution matters.

for Tara O'Toole, M.D., M.P.H.
Assistant Secretary
Environment, Safety and Health

Attachment

cc: Jim Johnson, FE-6
NEPA Compliance Officer

COVER SHEET

Final Environmental Impact Statement for Construction and Operation of the Proposed Bangor Hydro-Electric Company's Second 345-kV Transmission Tie Line to New Brunswick

a) Lead Agency: U.S. Department of Energy, Assistant Secretary for Fossil Energy, Office of Fuels Programs

b) Proposed Action: Issuance of Presidential Permit PP-89 to Bangor Hydro-Electric Company

c) For additional copies or further information on this statement, please contact:

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For general information on the U.S. Department of Energy's environmental impact statement process, contact:

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1000 Independence Avenue, S.W.
Washington, DC 20585
(202) 586-4600 or (800) 472-2756

d) Designation: Final EIS (FEIS) (DOE/EIS-0166)

e) Abstract: This final environmental impact statement (FEIS) was prepared by the U.S Department of Energy (DOE). The proposed action is the issuance of Presidential Permit PP-89 by DOE to Bangor Hydro-Electric Company to construct and operate a new international transmission line interconnection with New Brunswick, Canada. The proposed new interconnection, referred to as Bangor Hydro-Electric Company's Second 345-kV Transmission Tie Line to New Brunswick, would consist of an 83.8-mile (U.S. portion), 345-kilovolt (kV) alternating current transmission line from the U.S.-Canadian border at Baileyville, Maine, to an existing substation at Orrington, Maine. The Orrington substation would be expanded to accommodate the new transmission line, and two other substations would be upgraded to accommodate the new power loads throughout the New England Power Pool (NEPOOL) system. The new transmission line would serve to meet projected NEPOOL load growth, reduce energy losses now experienced along the existing tie line, and improve system reliability. The principal environmental impacts of the construction and operation of the transmission line would be incremental in nature and would include the conversion of forested uplands (mostly commercial timberlands) and wetlands to right-of-way (small trees, shrubs, and herbaceous vegetation). The proposed line would also result in localized minor to moderate visual impacts and would contribute a minor incremental increase in the exposure of some individuals to electromagnetic fields.

FOREWORD

This final environmental impact statement (FEIS) is issued by the U.S. Department of Energy (DOE). It assesses the potential environmental impacts of issuing Presidential Permit PP-89, which would allow the construction and operation within Maine of Bangor Hydro-Electric Company's second electric transmission tie line with New Brunswick, Canada.

The DOE determined that the issuance of PP-89 would be a major federal action significantly affecting the quality of the environment. Therefore, in accordance with the National Environmental Policy Act of 1969 (NEPA), as implemented by the regulations promulgated by the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] Parts 1500-1508) and DOE's implementing guidelines (10 CFR Part 1021), DOE has prepared this FEIS to provide environmental input to the decision whether to grant (with conditions and limitations as deemed necessary) or deny the permit. A Notice of Intent to prepare this EIS was issued May 22, 1989, and a public scoping process was conducted. A draft environmental impact statement (DEIS) was issued in October 1993. The availability of the DEIS was announced in the Federal Register on December 23, 1993. Federal and state agencies, as well as the public, were invited to comment on the DEIS. In addition to written comments, three public hearings were held on January 10-11, 1994, to solicit oral comments on the DEIS. All comments have been considered and appropriate modifications have been made in this FEIS. DOE will issue a Record of Decision not less than 30 days following publication of the notice of availability of this FEIS.

The format of this FEIS follows the suggested format in the CEQ regulations. Section 1 documents the purpose and need for action. Section 2 describes the proposed action and alternatives considered and provides a comparison of the proposed and alternative routes. Section 3 discusses affected environments along the proposed and alternative transmission line routes. Section 4 provides detailed information on analyses of the environmental consequences of the proposed action and alternatives, as well as mitigative measures to minimize impacts. Section 5 presents a glossary; Section 6 presents the names and professional qualifications of the persons responsible for preparing the FEIS; and Section 7 contains the distribution list for the FEIS. More detailed information and analyses (including a wetland and floodplain assessment and a bald eagle assessment), as well as comments received on the Draft EIS and the Department's responses, are provided in several appendixes.

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NOTATION

The following is a list of the abbreviations, acronyms, chemical symbols, and units of measure used in this document.

ABBREVIATIONS, ACRONYMS, AND CHEMICAL SYMBOLS

AC	alternating current
ACSR	aluminum conductor steel reinforced
ANL	Argonne National Laboratory
BHE	Bangor Hydro-Electric Company
CAI	Commonwealth Associates, Inc.
CB	citizen band
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO	carbon monoxide
CSPP	cogeneration and small power production
DEIS	draft environmental impact statement
DOE	U.S. Department of Energy
ECAR	East Central Area Reliability Council
EHV	extra high voltage
EIA	environmental impact assessment
EIS	environmental impact statement
ELF	extremely low frequency
EMF	electromagnetic field
EMI	electromagnetic interference
EPA	U.S. Environmental Protection Agency
ER	Bangor Hydro-Electric Co. Environmental Report
FEIS	final environmental impact statement
FR	*Federal Register*
FUA	Powerplant and Industrial Fuel Act of 1978
HVAC	high-voltage alternating current
HVDC	high-voltage direct current
HVTL	high-voltage transmission line
IPP	independent power producer
MDEP	Maine Department of Environmental Protection
MDIFW	Maine Department of Inland Fisheries and Wildlife
MEPCo	Maine Electric Power Company
MNHP	Maine Natural Heritage Program
MPCB	Maine Pesticide Control Board

MSL	mean sea level
MVAR	megavolt ampere reactive
NBPC	New Brunswick Power Commission
NEPA	National Environmental Policy Act of 1969
NEPOOL	New England Power Pool
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NO_x	nitrogen oxides
NRHP	National Register of Historic Places
NRPA	National Resource Protection Act
NUG	nonutility generator
NYPP	New York Power Pool
O_3	ozone
ODC	ornithine decarboxylase
Pb	lead
PJM	Pennsylvania-New Jersey-Maryland
PURPA	Public Utility Regulatory Policies Act of 1978
RF	radio frequency
RI	radio interference
ROW	right-of-way
SNR	signal-to-noise ratio
SO_2	sulfur dioxide
SVC	static var compensator
TSP	total suspended particulates
TV	television
TVI	television interference
VHF	very high frequency
WHO	World Health Organization

UNITS OF MEASURE

cm	centimeter(s)	ha	hectare(s)
dB	decibel(s)	Hz	hertz
dBA	A-weighted decibel(s)	in.	inch(es)
°F	degree(s) Fahrenheit	kHz	kilohertz
ft	foot (feet)	kcmil	1,000 circular mil(s)
ft^2	square foot (feet)	kV	kilovolt(s)
ft^3	cubic foot (feet)	kV/m	kilovolt(s) per meter
ft^3/s	cubic foot (feet) per second	kWh	kilowatt-hour(s)
gal	gallon(s)	lb	pound(s)
gal/min	gallon(s) per minute	lb/acre	pound(s) per acre

lb/ft^2	pound(s) per square foot
m	meter(s)
$\mu g/m^3$	microgram(s) per cubic meter
mi	mile(s)
mG	milligauss
MHz	megahertz
min	minute(s)
MVA	million volt-ampere(s)
MW	megawatt(s)
MWh	megawatt-hour(s)
ppb	parts per billion
ppm	parts per million
s	second(s)
µg	microgram(s)
V	volt(s)
yd	yard(s)
yd^3	cubic yard(s)

SUMMARY

The proposed action is the issuance of Presidential Permit PP-89 by the U.S. Department of Energy (DOE) to Bangor Hydro-Electric Company (BHE) to operate its second international electrical power transmission interconnection with New Brunswick, Canada, at normal operating power levels of 500 megawatts (MW) and to construct new transmission facilities to distribute this power. The proposed transmission line is needed to (1) complement and share electrical load with the existing 345-kilovolt (kV) interconnection (which would result in conservation of up to 24 MW annually), (2) enhance the sharing of generation between New England and New Brunswick (thereby reducing reserve generation requirements by sharing capacity during emergencies), and (3) increase the reliability of the overall transmission system. The availability of the additional electricity would have a beneficial effect on the economy and should enhance continued residential, industrial, and economic growth and improvement in the service area, the state of Maine, and New England.

The proposed new facilities, referred to as the second 345-kV tie line to New Brunswick, consist of two principal elements. The first, and major, element is the proposed construction of an 83.8-mile-long, alternating current (AC) transmission line that would cross the U.S.-Canadian border at Baileyville, Maine, and continue southwest to Orrington, Maine. The second element involves the proposed expansion of the existing substation at Orrington to accommodate the new 345-kV AC transmission line. Two other substations would also be upgraded to accommodate the new power loads throughout the system.

Most of the proposed transmission line would be constructed within commercial timberlands. Wetlands, rivers, and streams within these areas would also be involved. The environmental impacts associated with construction of the proposed line would be incremental (i.e., similar to impacts that presently occur from logging operations). Construction impacts would include clearing and control of vegetation, loss or alteration of wildlife habitat, displacement or disturbance of wildlife (e.g., from construction noise), disturbance of aquatic resources (e.g., from river and stream crossings and construction in wetlands), and release of gaseous pollutants and dust. Impacts from operation and maintenance of the transmission facilities would include potential collision of birds with structures, visual intrusion, and possible health and safety effects associated with the electromagnetic environment close to the proposed line.

About 1,625 acres would be converted from present uses (mostly commercial timberland) to project-related uses (i.e., transmission line corridor and associated access roads). Of this total, less than 5 acres would be permanently converted to project-related uses that would preclude multiple use of the corridor (e.g., as wildlife habitat).

Visual impacts of the proposed project would be minor and incremental (e.g., adding to the visual intrusiveness of the existing lines where the proposed line would parallel the existing 345-kV line).

To minimize impacts to the extent practicable, BHE has committed to numerous mitigative measures. These measures and others identified by DOE are delineated in this environmental impact statement (EIS). Should PP-89 be granted, the permit would include terms and conditions that would require the applicant to implement the mitigative measures.

In addition to the proposed route, three alternative corridor routes (including one addressed in detail that essentially parallels the existing 345-kV line) were considered. This evaluation revealed that none of the alternative corridors was environmentally preferable to the proposed route.

If DOE were to deny PP-89, the applicant could implement an alternative action (e.g., construction and operation of new conventional or unconventional generating facilities, conservation and load management, decentralized energy sources, fuel conversion, and purchase of power from other utilities) or maintain the status quo (no action).

1 INTRODUCTION

1.1 HISTORY AND BACKGROUND

In 1970, Maine Electric Power Company (MEPCo), a partnership of Central Maine Power Company, Maine Public Service Company, and Bangor Hydro-Electric Company (BHE), placed in service the first 345-kilovolt (kV) transmission tie-line interconnection with New Brunswick Power Commission (NBPC) of Canada. Companies within MEPCo also are members of the New England Power Pool (NEPOOL), a regional electric power coordinating council representing more than 100 utilities throughout New England. The BHE system now comprises about 600 miles (mi) of transmission line corridors, including the existing 106-mi transmission tie line.

The purpose of this *Environmental Impact Statement for Construction and Operation of the Proposed Bangor Hydroelectric Company's Second 345-kV Transmission Tie Line to New Brunswick* (DOE/EIS-0166) is to provide an environmental evaluation as a basis for the U.S. Department of Energy's (DOE's) decision on whether to grant Presidential Permit PP-89 to BHE (also referred to herein as the applicant) for construction of the proposed second 345-kV alternating current (AC) transmission line interconnection with NBPC. The construction and operation of a transmission line that crosses an international boundary requires the approval of DOE pursuant to Executive Order No. 10485, as amended, and Title 10, Code of Federal Regulations, Sections 205.320-205.329 (10 CFR §§205.320-205.329).

Criteria for issuance of a Presidential permit for construction, operation, maintenance, or connection of electric transmission facilities at the U.S. international border in accordance with Executive Order 10485 are as follows. First, a finding must be made that issuance of the permit is consistent with public interest. Second, a favorable recommendation from the Secretaries of State and Defense must be obtained. The Department of Energy has consistently interpreted "public interest" to be the impact of the proposed project on the reliability of the U.S. electric power supply system. Documentation of this impact is contained in DOE's "Reliability Determination," which is made part of the record in all Presidential permit proceedings. The Department believes that determinations of need for such projects are best made by state, rather than federal, regulators upon issuance of certificates of necessity and convenience. These certificates are typically issued as a result of overall prudency findings at the state level in which issues of need and economic viability are usually considered in great detail. The Certificate of Public Convenience and Necessity, the last step in the permitting process before the new facility can be constructed, is expected to be issued by the Maine Public Utilities Commission after DOE issuance of a Presidential permit.

The proposed project (referred to as the second 345-kV tie line to New Brunswick) would require the construction of an 83.8-mi-long 345-kV transmission line that would cross the U.S.-Canadian border at Baileyville, Maine, and extend to an existing substation at Orrington, Maine (Figure 1.1). The 12.2-mi segment leading into the Orrington substation

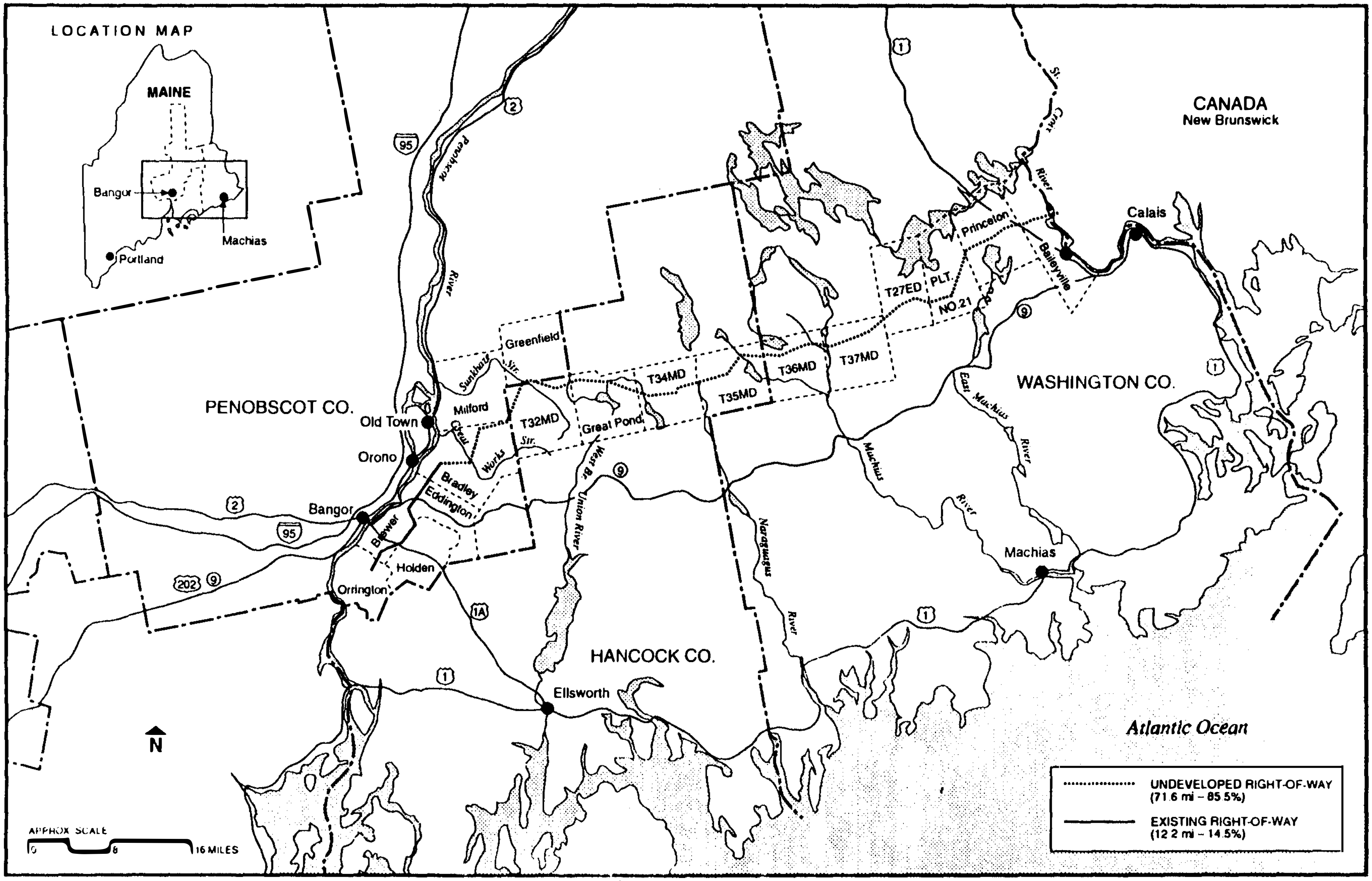

FIGURE 1.1 Proposed Route of the 345-kV Transmission Tie Line (Source: ER 1991)

would parallel the existing 345-kV tie line. The remainder of the line would be within a new right-of-way corridor. The substation at Orrington would be modified to accommodate the new line. Minor modifications to two other substations would also be required for system reliability.

1.2 PURPOSE AND NEED

The following discussion of the purpose and need for the interconnection has been extracted from BHE's environmental report for the project (BHE 1991c), hereafter commonly referred to as the ER (1991), and the company's application for a presidential permit. (Complete citations for references mentioned in this report are provided in Appendix H.) Additional information on purpose and need, as well as a detailed cost/benefit analysis, is provided in the ER, which is available at each town office and selected libraries in the project area, as well as at BHE corporate headquarters in Bangor, Maine, and at BHE division offices in Machias, Lincoln, Ellsworth, and Bangor.

The new transmission line is needed to complement and share electrical load with the existing 345-kV interconnection. The proposed line is designed for a normal load of 500 megawatts (MW), a heavy load of 700 MW, and an emergency load of 1,000 MW. The project is needed to reduce the current level of transmission losses, increase economic power transactions, meet projected load growth, and increase tie-line capacity reserve benefits. Indirectly, the project would increase system reliability for all of New Brunswick and New England.

During 1990, electricity generated by NEPOOL was produced by oil (26%), coal (15.5%), nuclear (35.1%), natural gas (5.8%), hydro (5.3%), purchases from utilities outside New England (6.3%), nonutility generators (NUGs) (5.5%), and wood and waste burning (0.5%). By the year 2000, contributions from NUGs should be 11%, and demand-side management programs are projected to reduce the summer peak by 11% (Electric Council of New England 1991). Despite these additional resources (which do not include oil and gas use associated with purchases from NUGs), the New England region is still expected to use oil and natural gas for about 31% of its energy requirement in 1995. The need for NEPOOL to install additional generating capacity is currently reduced because of the existing 345-kV interconnection. Reserve requirements are reduced by about 400 MW because of NEPOOL's ability to share capacity with NBPC during emergencies. The proposed project could further reduce the need to install additional generating capacity beyond that which is currently planned (ER 1991).

Another reason for constructing and operating the new tie line is to reduce the transmission line losses now experienced along the existing transmission tie line. Current line losses for the existing transmission tie line total 38 MW, for an annual energy loss of 223,000 megawatt-hours (MWh), at a cost of more than $17.8 million. With the proposed line equally sharing transmission with the existing line, line losses would drop to 14 MW, for an annual energy loss of 82,000 MWh. This change would equate to a cost of energy loss of less than $6.6 million. Therefore, net annual line loss savings would be 24 MW (141,000 MWh annually), reducing costs from line losses by almost $11.3 million annually. The 24 MW of power conserved is equivalent to the amount produced annually by one new wood-fired or small coal-fired plant. The projected capital cost for the applicant's portion of the project is $45 million. (The cost of the 60-mi transmission line installed by NBPC to complete the interconnection would be $20 million.)

Besides reducing line losses, the proposed project would provide an additional 300 MW of transmission capacity over which additional volumes of economy transactions could be achieved. In the past, NEPOOL and NBPC have routinely interchanged power to reduce the cost of operating their respective systems. During the period 1981-1989, NEPOOL's annual savings ranged from more than $3.1 million to $9.8 million. Additional annual economic savings from the proposed line (assuming a cost savings of $0.012/kilowatt-hour [kWh]) would range from about $5.26 million for 50 MW to the maximum of nearly $15.8 million for 150 MW.

As previously mentioned, the existing tie line allows NEPOOL to reduce its reserve requirements by about 400 MW through sharing capacities with NBPC during emergencies. Additional annual economic savings associated with the additional reserve sharing made possible by the proposed project would be $5 million per 25 MW of additional reserve sharing (up to the maximum of $60 million for 300 MW).

Overall, annual net economic savings could range from about $21.6 million (24 MW line loss savings, 50 MW average increased economy, and 25 MW additional reserves sharing) to more than $87 million (24 MW line loss savings, 150 MW average increased economy, and 300 MW additional reserve sharing). In addition to direct economic savings, the proposed project would improve system reliability (e.g., by serving as a back-up if the existing line had an outage or by providing a measure of backup to the static var compensator [SVC] installed on the existing line). The SVC is needed to maintain electric system reliability in New England should the NEPOOL/Quebec Phase II interconnection suffer an outage.

1.3 PERMIT REQUIREMENTS

The major permits, licenses, and approvals required for construction and operation of the proposed interconnection are listed in Table 1.1. The federal, state, and local agencies responsible for each action are also identified. As part of the process of receiving agency permit approvals, BHE must comply with various standard permit requirements. In addition, other minor permits or authorizations not listed in Table 1.1 may be required by responsible agencies. The present schedule calls for construction of the new line to begin upon the issuance of federal, state, and local permits and for the line to be in service by 1998.

1.4 ENVIRONMENTAL EFFECTS ABROAD OF MAJOR U.S. FEDERAL ACTIONS

The analyses in this environmental impact statement (EIS) are restricted to those environmental impacts that would occur within the United States. The New Brunswick

TABLE 1.1 Selected Permit and Consultation Requirements

Agency	Nature of Action or Consideration
Federal Agencies	
U.S. Department of Energy, Assistant Secretary for Fossil Energy	Issue presidential permit
	Evaluate potential floodplain effects (Executive Order 11988 — *Floodplain Management*)
	Evaluate potential wetland effects (Executive Order 11990 — *Protection of Wetlands*)
U.S. Department of the Interior, Fish and Wildlife Service	Issue biological opinion on threatened and endangered species (Section 7 of Endangered Species Act)
	Consultation on ways to avoid or minimize effects on migratory birds (Migratory Bird Treaty Act)
	Impounding, diverting, or controlling waters in excess of 10 acres of surface area (Fish and Wildlife Coordination Act)
U.S. Department of Agriculture, Soil Conservation Service	Impacts to U.S. farmlands (Farmland Protection Policy Act)
U.S. Department of Defense, Army Corps of Engineers	Issue nationwide or individual permit(s) (Section 404) for placement of dredge or fill in waters of the United States, including wetlands
	Issue permit(s) (Section 10) for structures affecting navigable waters of the United States
U.S. Department of Transportation	
Federal Aviation Administration	Determination of no hazard (notice of proposed construction or alteration)
Federal Highway Administration	Issue permit(s) to cross federal-aid highways
State of Maine Agencies	
Department of Environmental Protection	Site Location of Development Law

TABLE 1.1 (Cont.)

Agency	Nature of Action or Consideration
State of Maine Agencies (Cont.)	
Maine Land Use Regulatory Commission	Utility line permit
Department of Transportation	Structure location and road crossing permits
Department of Inland Fisheries and Wildlife	Issue biological opinion on state rare and endangered wildlife, deer wintering areas, and other wildlife concerns
	Federal Bald and Golden Eagle Protection Act
Critical Areas Programs	Protection of state rare and endangered plant species
Occupational Safety and Health Administration	Issue permit for occupational safety and health during construction, operation, and maintenance activities
State Historic Preservation Office	Issue cultural resources clearance; required before construction
Local Agencies[a]	
Town of Brewer	Planning Board permit
Town of Holden	Planning Board permit

[a] No Planning Board permits would be required for the following towns: Baileyville, Bradley, Greenfield, Milford, Orrington, and Princeton (Morrell 1991).

portion of the proposed interconnection would be subject to approval and licensing by the National Energy Board of Canada. Additionally, NBPC is required to prepare an environmental impact assessment (EIA) on the potential impacts of the Canadian portion of the proposed interconnection. The Canadian EIA is equivalent to the EIS prepared for the U.S. portion of the interconnection and is subject to review by various provincial and federal agencies in Canada, as well as by the public. The New Brunswick portion of the proposed project would be subject to Canadian regulatory authority. Impacts that could occur in Canada are not discussed for the reasons outlined below.

Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions*, was issued on July 4, 1979 (44 *Federal Register* [FR] 1957). It represents the exclusive and complete determination by the executive branch on the procedural and other actions to be taken by federal agencies to further the purposes of the National Environmental Policy Act (NEPA) with respect to the environment outside of the United States, its territories, and possessions. The major federal actions included under this executive order that would require the analysis of environmental effects outside of the United States fall into four categories:

1. Those actions significantly affecting the environment of the global commons outside the jurisdiction of any nation;

2. Those actions significantly affecting the environment of a foreign nation not participating with the United States and not otherwise involved in the action;

3. Those actions significantly affecting the environment of a foreign nation, which provide to that nation specified products or physical projects that would be prohibited or strictly regulated in the United States; or

4. Those actions significantly affecting natural or ecological resources of global importance designated for protection under the executive order by the President. For resources protected by international agreement binding on the United States, the Secretary of State may designate such resources for protection under this executive order.

The executive order also designates a series of specific exceptions to its provisions, including actions not having a significant effect on the environment outside of the United States as determined by the federal agency.

In making its determination as to whether an action will have a significant effect on the environment outside of the United States, DOE may adopt all or part of existing environmental analyses, including those prepared by foreign countries or international organizations, when it believes that those analyses are adequate in scope and content to make a determination.

In the present case, the major federal action is to grant or deny a presidential permit for the proposed construction and operation of an electric transmission line and related facilities that would connect at the international boundary of the United States but would be constructed completely within the United States. These activities do not fall under the jurisdiction of Executive Order 12114 because none of the four specified categories stated above is the subject of the proposed action.

1.5 ENVIRONMENTAL REVIEW PROCESS

The first step in the EIS process, regulated by NEPA and the Council on Environmental Quality (CEQ) Regulations (40 CFR Parts 1500-1508), is to publish in the *Federal Register* a Notice of Intent (NOI) to prepare an EIS. The NOI for this EIS was published in the *Federal Register* on May 22, 1989 (54 FR 22006) and was subsequently sent to appropriate federal agencies and others for comment.

The purpose of scoping, the next step in the environmental review process, is to determine the significant issues and concerns related to the proposed action and alternatives that should be addressed in the EIS. To ensure public input to the planning and preparation of this EIS, public scoping meetings were held on June 13-15, 1989, in Brewer, Calais, Machias, and Milford, Maine. At each meeting, representatives of DOE explained the purpose of the meeting, the role of the federal government, and the EIS process. A BHE representative briefly described the proposed project and alternatives. During the remainder of each meeting, DOE received comments from agencies, groups, and individuals, and invited interested parties to submit any additional written comments by July 21, 1989, the close of the EIS scoping period. Attendance at each public scoping meeting was generally fewer than 50 individuals. Sixty-four comments were received at the scoping meetings and during the scoping comment period. All relevant concerns and suggestions resulting from the scoping process are addressed throughout the impact assessment portions of this EIS.

The next step in the process is the preparation of an implementation plan, which summarizes the proposed action, outlines issues to be addressed in the EIS, and discusses the subsequent procedures for the EIS preparation. The implementation plan for this project was made available to the public in January 1992.

The Draft EIS (DEIS) was then prepared and published in October 1993. A Federal Register notice announcing the availability of the DEIS was published on December 23, 1993. Members of the public and federal, state, and local agencies then had the opportunity to attend three public hearings (January 10-11, 1994) and to submit formal comments on the DEIS. The 45-day public comment period ended on February 7, 1994. However, comments received after that period were accepted. Following the public comment period, DOE prepared this FEIS. All comments (and associated responses) received on the DEIS (including the U.S. Environmental Protection Agency's [EPA's] review and rating of the DEIS) are presented in Appendix I of this EIS. Where appropriate, the text and tables of the DEIS have been modified in response to comments received.

2 PROPOSED ACTION AND RELATED ALTERNATIVES

2.1 PROPOSED ACTION

The proposed action is to issue Presidential Permit PP-89 to allow BHE (the applicant) to construct and operate a new transmission line and modify existing substations in order to ensure system stability. This action would increase the transmission capacity between New Brunswick and the New England region and enable additional quantities of energy to be purchased from New Brunswick. The new 345-kV AC transmission line (Figure 1.1) would cross over the St. Croix River at the U.S.-Canadian border at Baileyville, Maine. The aboveground transmission line would then extend 83.8 mi from the river crossing southwest to the existing substation at Orrington, Maine. The Orrington substation would be expanded to accommodate the new 345-kV AC transmission line. Other substations would be modified to ensure overall system stability. Substation expansion and upgrades would be on existing utility properties.

One of the data sources used for the description of the proposed project is the applicant's Environmental Report (ER) (1991). Other data sources that were prepared by the applicant and used in the preparation of this EIS include the preliminary environmental report, the Department of the Army Corps of Engineers permit application, and the state permit application (BHE 1989, 1991a,b). Clarification of information in those reports and additional information was also provided by the applicant (Murphy 1991, 1992).

2.1.1 Study Area Selection and Description

The term "study area" as used in this document refers to those areas investigated in order to characterize the baseline conditions and evaluate the potential impacts of the proposed project. For a given resource, the study area was chosen to (1) provide sufficient data to allow description of the existing conditions for that resource and (2) encompass the area where impacts could be reasonably expected to occur. Thus, the extent of a specific study area depended on the environmental resource being considered. For instance, the socioeconomic study areas were based primarily on town, or in some cases county, boundaries along the proposed route, while climatic considerations were based on a broader area (eastern Maine). In a similar manner, consideration of the expected level of impact to soils and vegetation was confined primarily to the actual work areas, while evaluation of visual impacts often involved considering an extended area away from the immediate project site. The study areas considered for each resource (or affected environmental parameter) are described in Section 3.

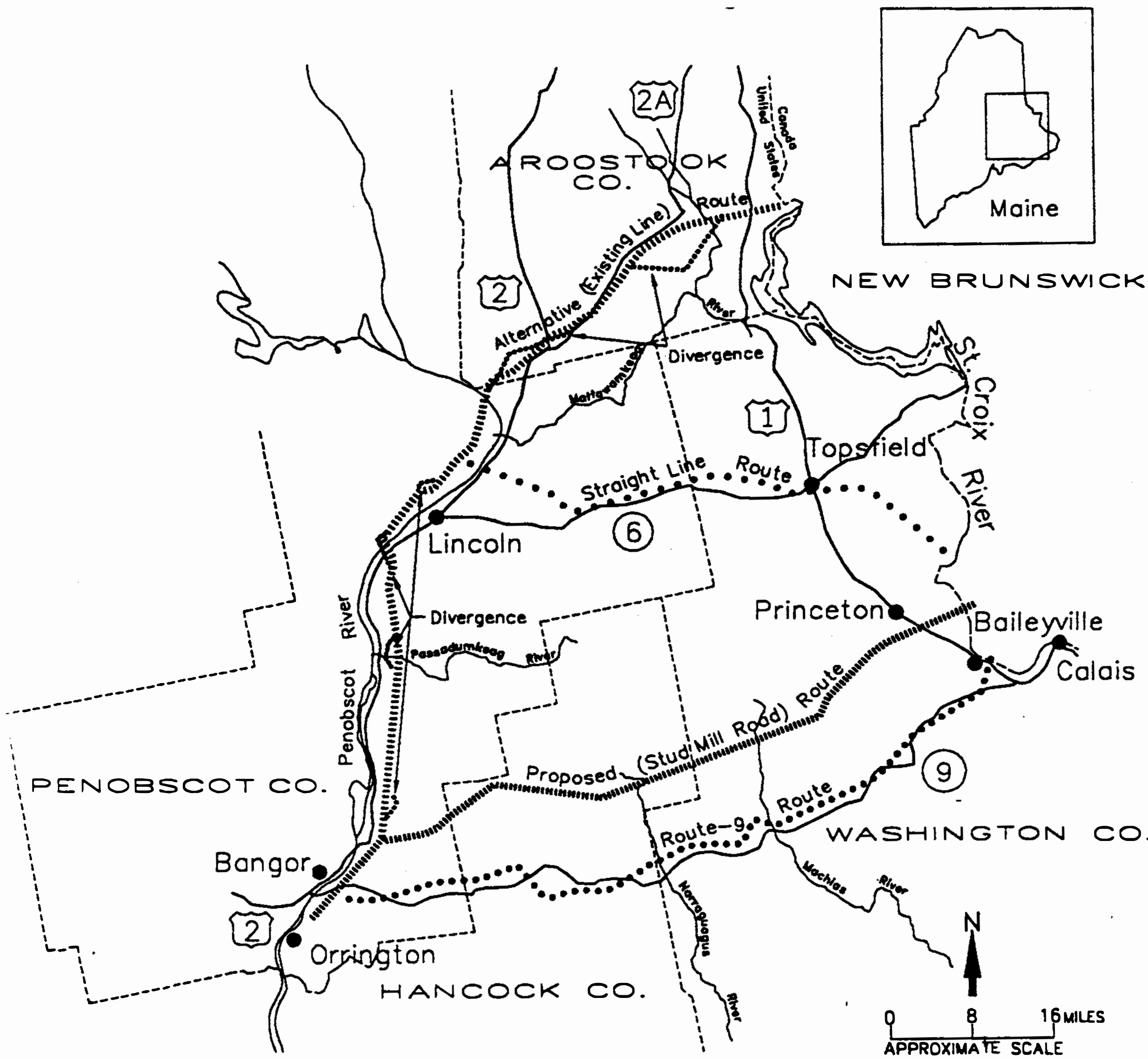

FIGURE 2.1 Routes Initially Considered for Proposed Transmission Line (Source: Modified from ER 1991)

2.1.2 Corridor and Route Selection

Four routes where a new transmission line could be sited were initially identified by the applicant (Figure 2.1). The Stud Mill Road route (Figure 1.1) was designated as, and will hereafter be referred to as, the proposed route on the basis of a number of factors suggested by local authorities, local zoning and planning regulations, cost and engineering criteria, and environmental and land use considerations. Public opinion regarding the proposed route was solicited and considered through procedures required by the state of Maine and through four public scoping meetings conducted June 13-15, 1989, by DOE. Those meetings were designed to solicit concerns and suggestions from property owners, local residents, government agencies, and public interest groups.

2.1.3 Description of the Proposed Route

The proposed route, beginning at its international crossing over the Woodland Flowage impoundment of the St. Croix River near Baileyville, Maine, is shown in Figure 1.1. The first 71.6 mi of the proposed line would be located within a new right-of-way. Where the route turns southerly just past Great Works Stream, it would meet the existing MEPCo transmission line corridor at a point just north of Blackman Stream in the town of Bradley. The proposed line would be 100 ft east of and parallel to the MEPCo line as it bears south from Blackman Stream, crosses Maine Route 9, and proceeds to the Orrington substation.

The proposed route is also referred to as the Stud Mill Road route because much of the line would be located near Stud Mill Road, an existing timber haul road jointly owned and maintained by Georgia-Pacific Corp. and Champion International, Inc. (ER 1991). The proposed line would cross 3 counties and 17 municipalities or townships (Table 2.1).

The first 71.6 mi of the proposed line (starting at the crossing of the St. Croix River) would be in a new 170-ft-wide right-of-way (Figure 2.2). Within the remaining 12.2 mi of the route, the new line would share right-of-way space with the existing MEPCo 345-kV interconnection and other lines as follows: (1) 350-ft-wide right-of-way shared with the existing 345-kV interconnection, 115-kV line 64, and 46-kV line 5 — length 4.4 mi (Figure 2.3); (2) 270-ft-wide right-of-way with steel-pole-type structures and shared with existing 345-kV interconnection — length 0.4 mi (Figure 2.4); (3) 298-ft-wide right-of-way shared with existing 345-kV interconnection and 46-kV line 1 — length 0.6 mi (Figure 2.5); (4) 270-ft-wide right-of-way shared with existing 345-kV interconnection — length 5.3 mi (Figure 2.6); and (5) 405-ft-wide right-of-way shared with existing 345-kV interconnection, 115-kV line 248, and 115-kV line 249 — length 1.5 mi (Figure 2.7). In all of the shared right-of-way segments, the proposed line would be located 100 ft (from centerline) east of the existing 345-kV interconnection, with the centerline of the proposed line being 85 ft from the eastern edge of the right-of-way.

TABLE 2.1 Counties and Municipalities Traversed by the Proposed Route

County	Municipality	Type of Municipality[a]
Washington	Baileyville	Town
	Princeton	Town
	Township No. 21	Unorganized township
	T27ED	Unorganized township
	T37MD	Unorganized township
	T36MD	Unorganized township
Hancock	T35MD	Unorganized township
	T34MD	Unorganized township
	Great Pond	Town
	T32MD	Unorganized township
Penobscot	Greenfield	Unorganized township
	Milford	Town
	Bradley	Town
	Eddington	Town
	Holden	Town
	Brewer	City
	Orrington	Town

[a] Unorganized townships technically are not "municipalities" under Maine law. They have been referred to as such in this EIS, however, for convenience.

Source: ER (1991).

2.1.4 Project Design Considerations

2.1.4.1 Line Specifications

Basic design parameters for the proposed AC transmission line are listed in Table 2.2. The three current-carrying conductors each would consist of two-bundle aluminum-conductor-steel-reinforced (ACSR) subconductors. The subconductors would be spaced 18 in. apart and in a horizontal plane, with horizontal spacing of the three electrical phases being 26 ft. On the steel pole dead-end structures, the jumper loops would be slightly off vertical. Vertical phase spacing on the steel pole dead-end structures would be 20 ft. Clearance would be 23.5 ft and 25.0 ft between the lower and middle and the middle and upper phases, respectively, on the steel pole tangent structure. These structures are shown in Figures 2.8 through 2.12.

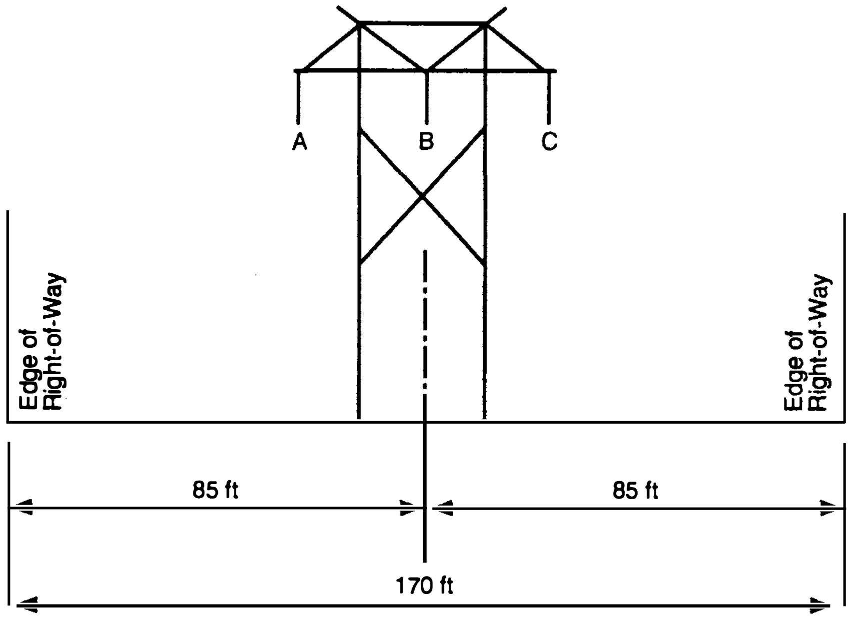

FIGURE 2.2 Placement of Proposed Transmission Line in New Right-of-Way (71.6 mi) (Source: ER 1991)

The conductors would be protected from lightning strikes by grounding systems installed at each structure and by two aerial ground wires (shield wires). The transmission line would be constructed to have a wire security zone (clear area required for the safe operation of the transmission line between the conductors and vegetation) of 20 ft below the maximum sag of the conductors at a temperature of 190°F.

The transmission line design would meet the National Electric Safety Code specifications for heavy loading district conditions (radial ice of 0.5-in. thickness and 4 lb/ft^2 of wind pressure) and extreme wind conditions (wind pressure of 25 lb/ft^2). In addition, the transmission structures would be designed to withstand heavy icing as determined from a review of meteorological data (radial ice of 1.3-in. thickness) and longitudinal loading imbalance due to differential ice buildup and sheering.

2.1.4.2 Support Structures

Most tangent structures (497) would be wood-pole, self-supporting H-frames; there would also be two single-shaft steel-pole tangent structures. (Tangent structures are structures used where the line is essentially along a straight path.) The 39 light- to medium-angle structures would be three-pole wood structures. Most (22 of 25) dead-end structures would be lattice galvanized steel towers; two of the remaining dead-end structures would be self-supporting single steel poles, and one would be a wood-pole structure. Dead-end

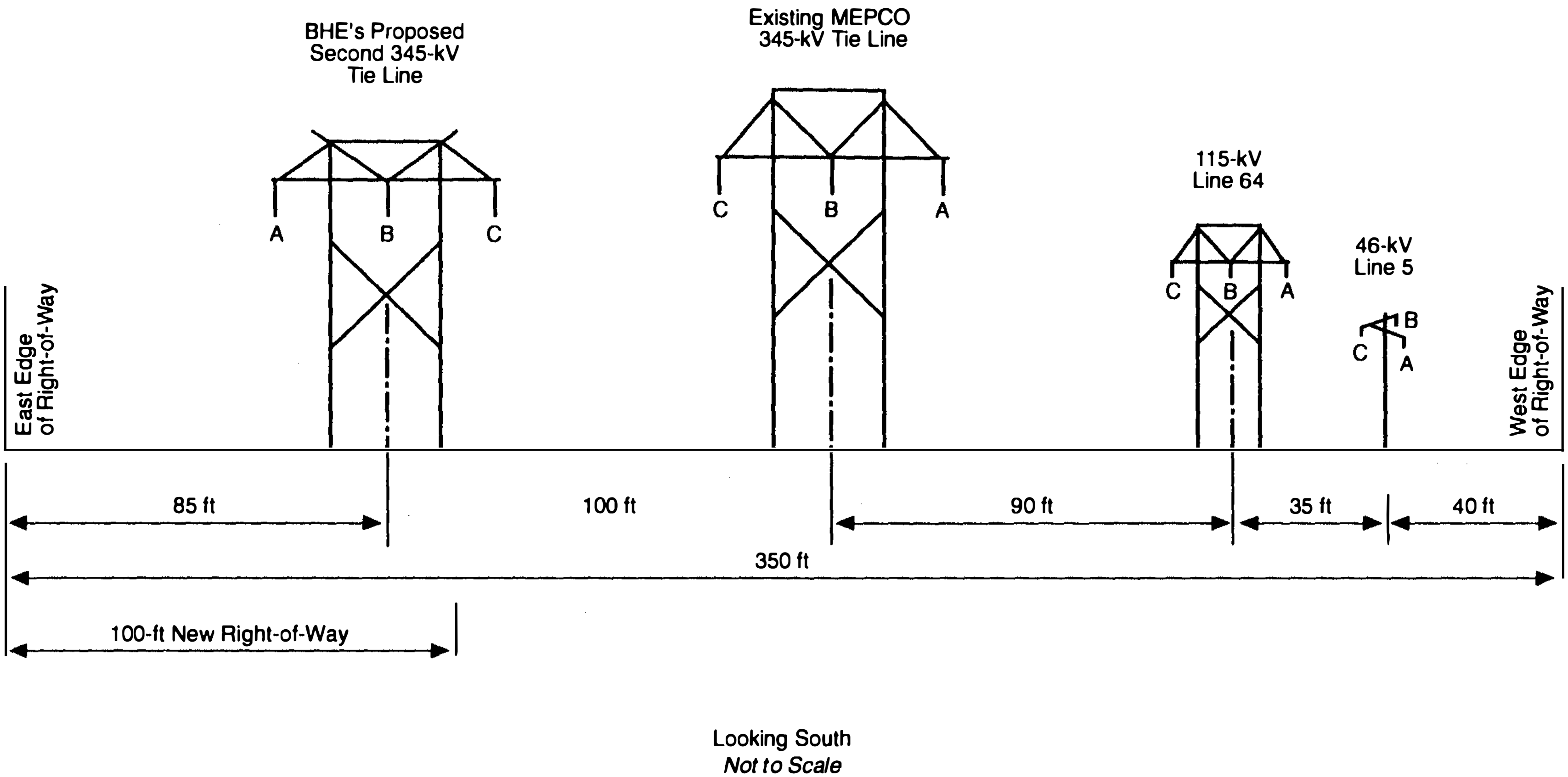

FIGURE 2.3 Placement of Proposed Transmission Line Adjacent to Existing Right-of-Way with Existing 345-, 115-, and 46-kV Lines (4.4 mi) (Source: ER 1991)

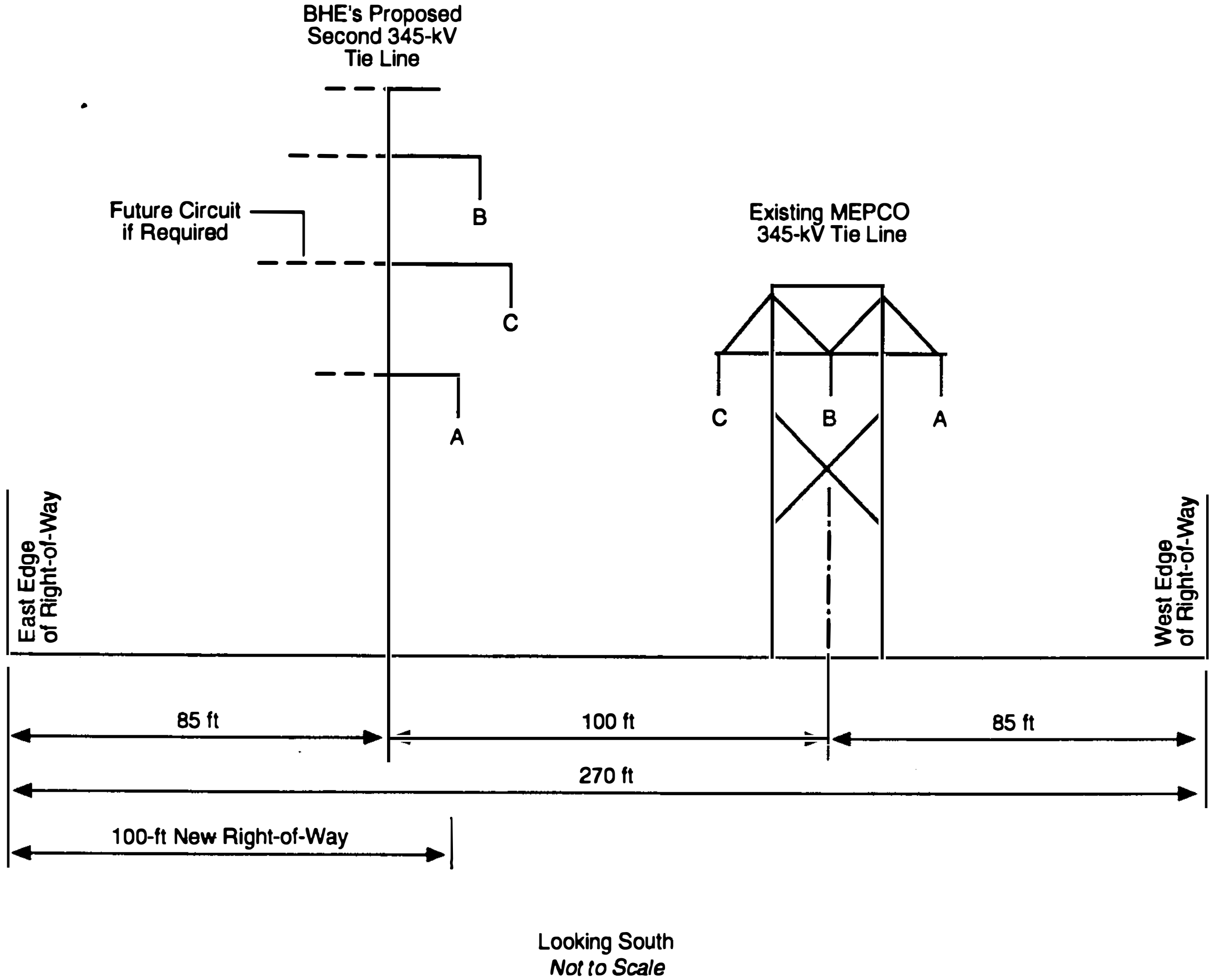

FIGURE 2.4 Placement of Proposed Transmission Line with Steel-Pole-Type Structures Adjacent to Existing Right-of-Way with Existing 345-kV Line (0.4 mi) (Source: ER 1991)

structures are required either (1) where the line makes an angle of 30° or more or (2) after 7-8 mi of continuous suspension-type (tangent and light- and medium-angle) structures to prevent the potential of cascading of the line in the event of a major accident. Wood poles would have a preservative treatment. They would be 70-110 ft long and would be embedded 9-12 ft in the ground. The steel lattice towers would be about 85 ft tall, and each tower would have four cast-in-place concrete foundations measuring 5 ft in diameter and about 22 ft deep. The steel-pole dead-end structures would be 123 ft tall; the steel-pole tangent structures would be 137.5 ft tall. The steel-pole tangent structures would have a cast-in-place concrete cylinder foundation 7 ft in diameter and about 21 ft deep. The steel-pole dead-end structures would be supported by concrete cylinder foundations 9 ft in diameter and about 27 ft deep (ER 1991).

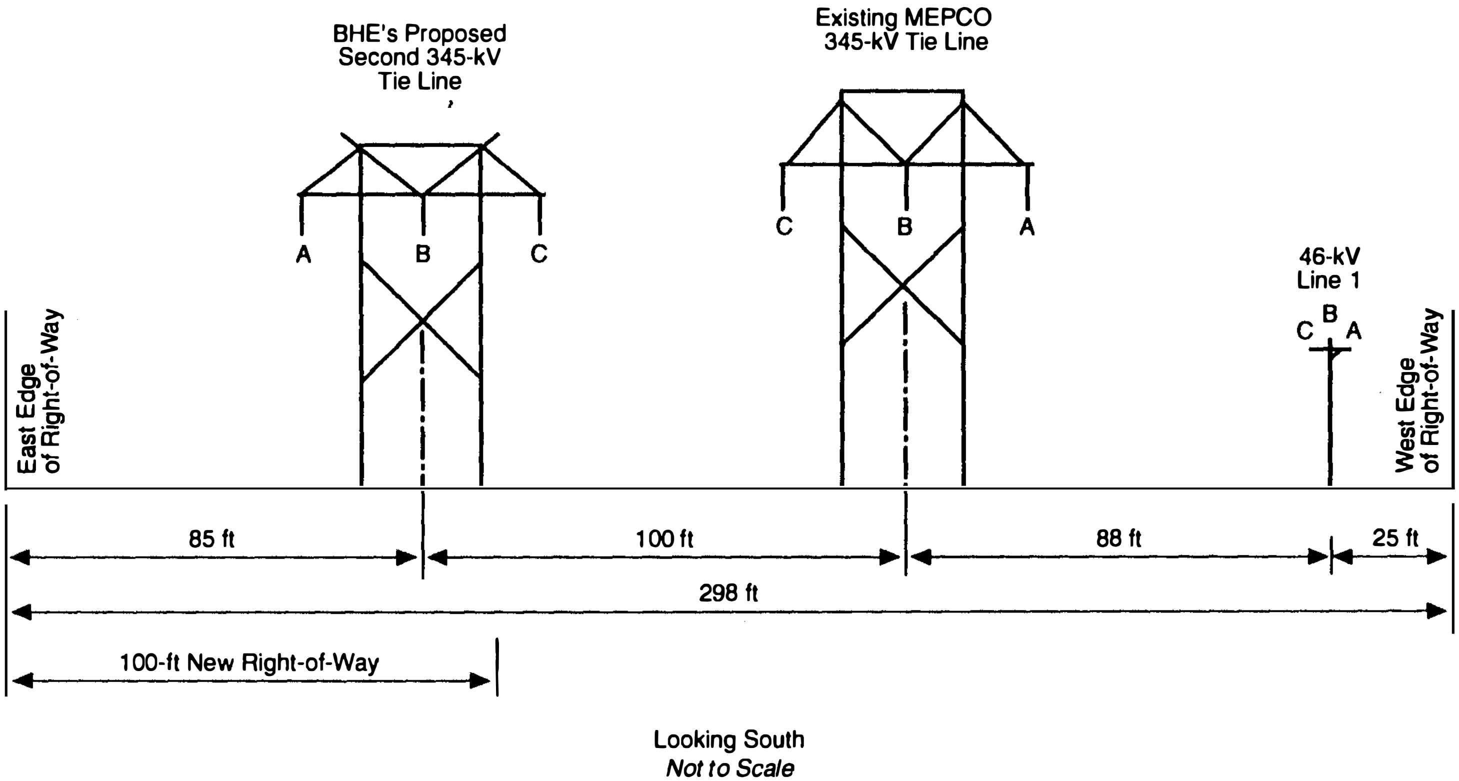

FIGURE 2.5 Placement of Proposed Transmission Line Adjacent to Existing Right-of-Way with Existing 345- and 46-kV Lines (0.6 mi) (Source: ER 1991)

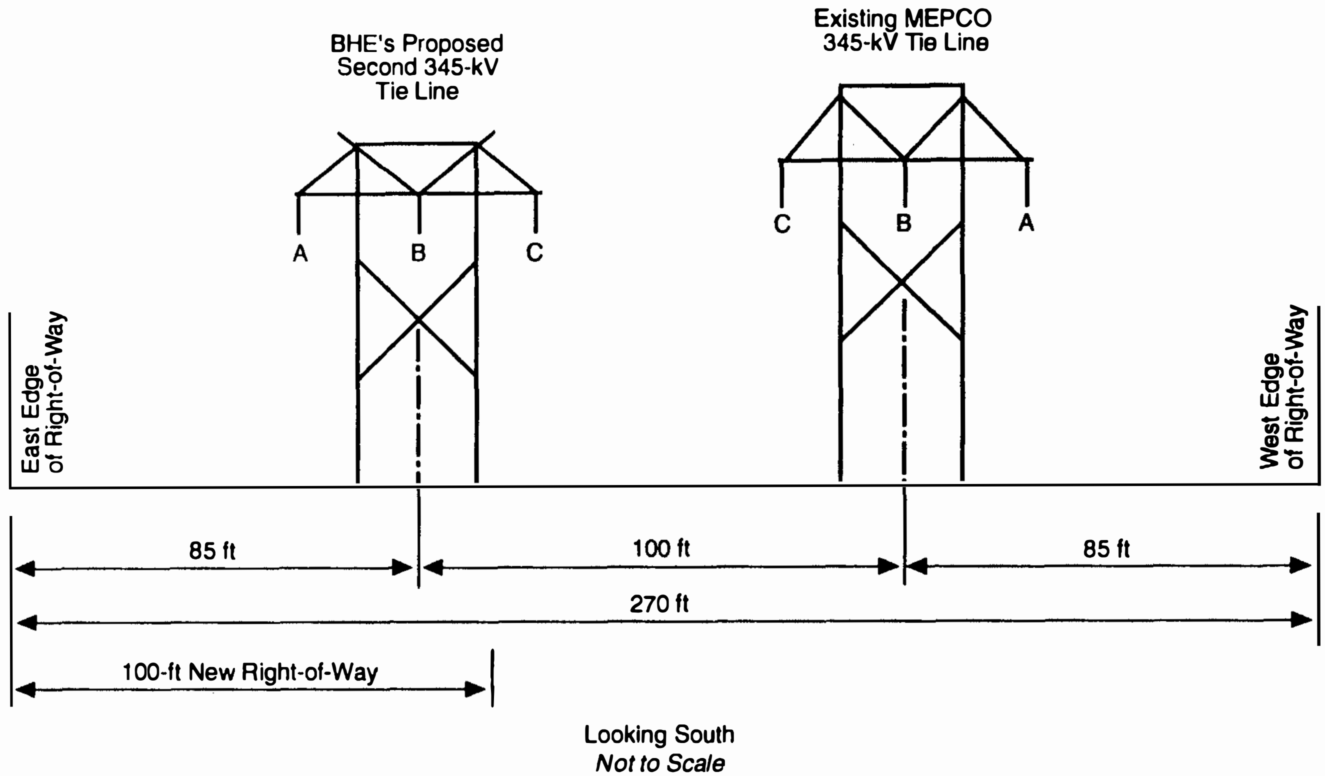

FIGURE 2.6 Placement of Proposed Transmission Line Adjacent to Existing Right-of-Way with Existing 345-kV Line Only (5.3 mi) (Source: ER 1991)

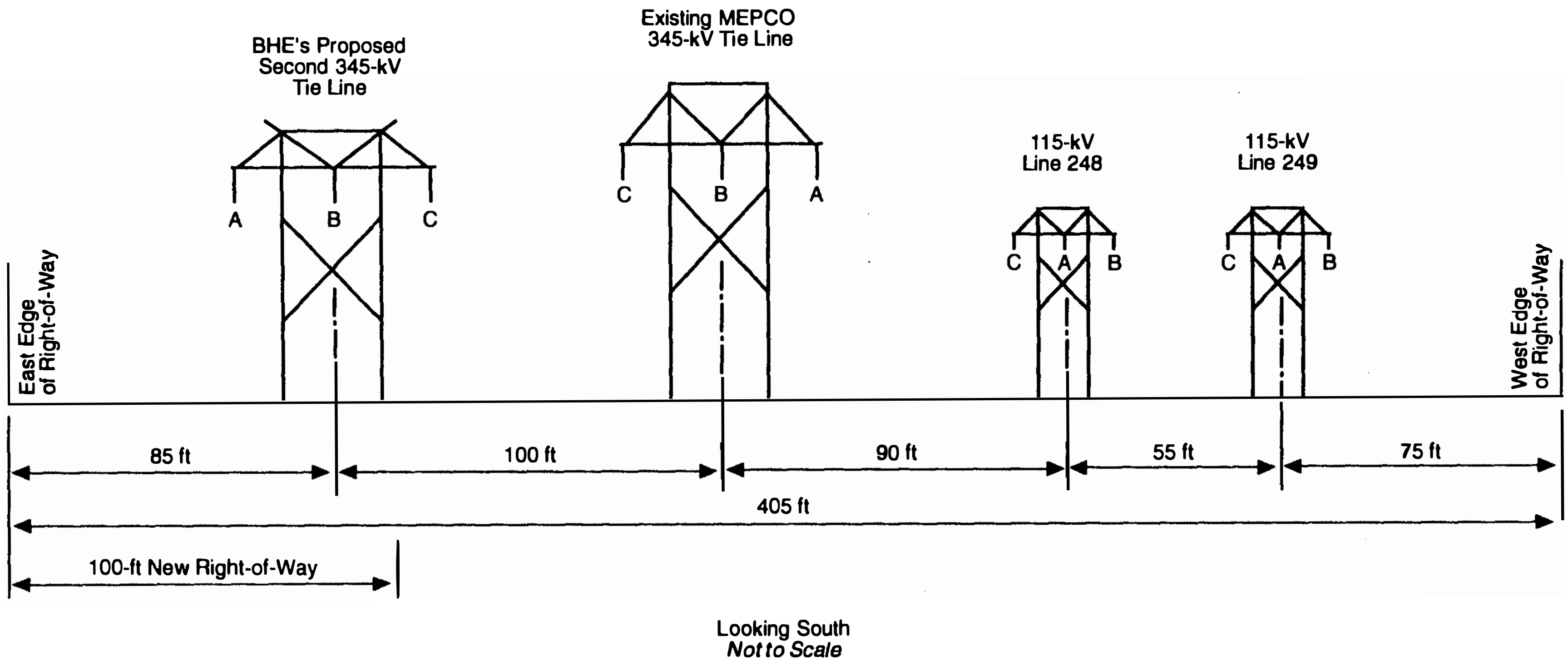

FIGURE 2.7 Placement of Proposed Transmission Line Adjacent to Existing Right-of-Way with Existing 345-kV and Two 115-kV Lines (1.5 mi) (Source: ER 1991)

TABLE 2.2 Design Parameters for the Proposed Second Transmission Tie Line to New Brunswick

Parameter	Value
Length of line (U.S. portion)	83.8 mi
Voltage	345 kV
Capacity	500 MW[a]
Conductors	Standard 1192.5 kcmil 45/7 ACSR code name "bunting," 1.302-in. diameter, bundled two per phase with 18-in. horizontal spacing
Shield wires	Standard 7 #8 aluminum-clad steel strands, 0.385-in. diameter
Guy wires	7 #5 alumoweld, 0.546-in. diameter
Insulators	
Conductor	5 3/4-in. × 10-in. porcelain ball and socket or polymer composite units
Shield wire	Porcelain pin-clevis type
Number of structures	
Wood	
Tangent	497
Light angle	1
Light medium angle	19
Heavy medium angle	19
Tangent dead-end	1
Steel lattice	
Light dead-end	16
Heavy dead-end	6
Steel pole	
Tangent	2
Light dead-end	2
Average span length	787 ft

TABLE 2.2 (Cont.)

Parameter	Value
Right-of-way widths (beginning at St. Croix River)	170 ft (71.6 mi — new ROW[b]); 350 ft (4.4 mi — 100-ft new ROW added to existing ROW); 298 ft (0.6 mi — 100-ft new ROW added to existing ROW); 270 ft (5.3 mi — 100-ft new ROW added to existing ROW); 405 ft (1.5 mi — 100-ft new ROW added to existing ROW)
Minimum vertical clearance[c]	
Vegetation (e.g., trees)	20 ft
Cultivated lands	28 ft
Roads	33 ft
Railroads	34 ft
Conductors, shield wires, or guy wires of other lines	13 ft
Communication conductors	15 ft
Supporting structures of other lines	15 ft
Bridge superstructures	18 ft
Bridge approaches	26 ft
Minimum horizontal clearance	
Conductors of other lines	
345 kV	16 ft
230 kV	12 ft
161 kV	10 ft
138 and 115 kV	9 ft
≤ 69 kV	8 ft
Shield and guy wires, communication conductors	8 ft
Supporting structures of other lines	12 ft
Tie line terminal	Orrington substation
Estimated cost (U.S. portion)	$45 million

[a] Maximum capacity of 1,000 MW during emergency conditions.

[b] ROW = right-of-way.

[c] Vertical clearances listed are for plan-profile plotting purposes and include an allowance for high-temperature creep and tolerances for plotting structure setting and surveying. Clearances listed are based on a conductor plotting temperature of 190°F final sag condition.

Source: CAI (1990); ER (1991); Murphy (1991).

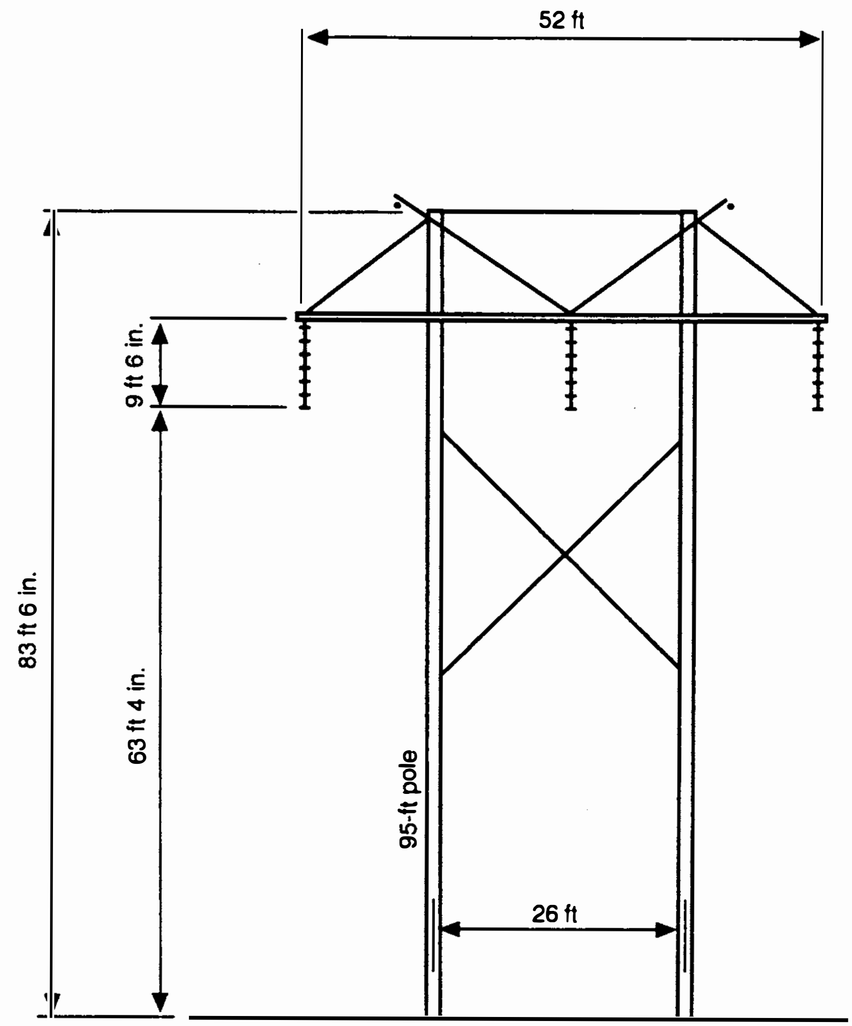

FIGURE 2.8 Wood-Pole Tangent Structure (Source: ER 1991)

The average span between structures would be 787 ft. The span between H-frame support structures would vary between 340 and 1,240 ft, while spacing between tower structures would vary from 500 to 1,220 ft (ER 1991).

2.1.4.3 Substation Alterations

The existing Orrington 345-kV substation (located on Fields Pond Road in Orrington, Maine, and operated by MEPCo) would have to be modified to accommodate the new interconnection. Additionally, Central Maine Power Co.'s Maxcys and South Gorham substations, located in southern Maine, would require expanded capacitor banks to ensure overall electrical system stability. All changes to the substations would be conducted within existing substation boundaries (ER 1991).

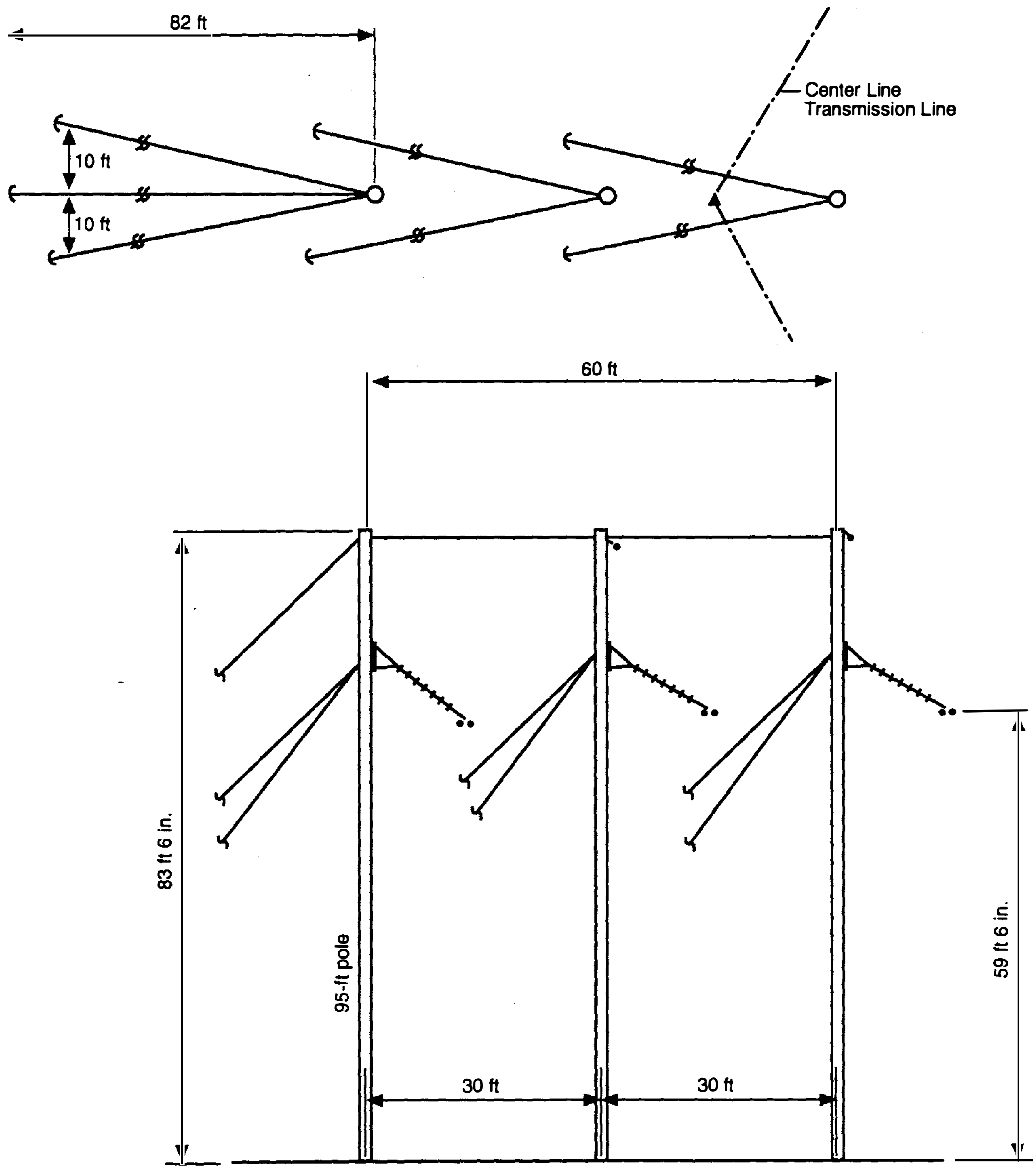

FIGURE 2.9 Wood-Pole Angle Structure (Source: ER 1991)

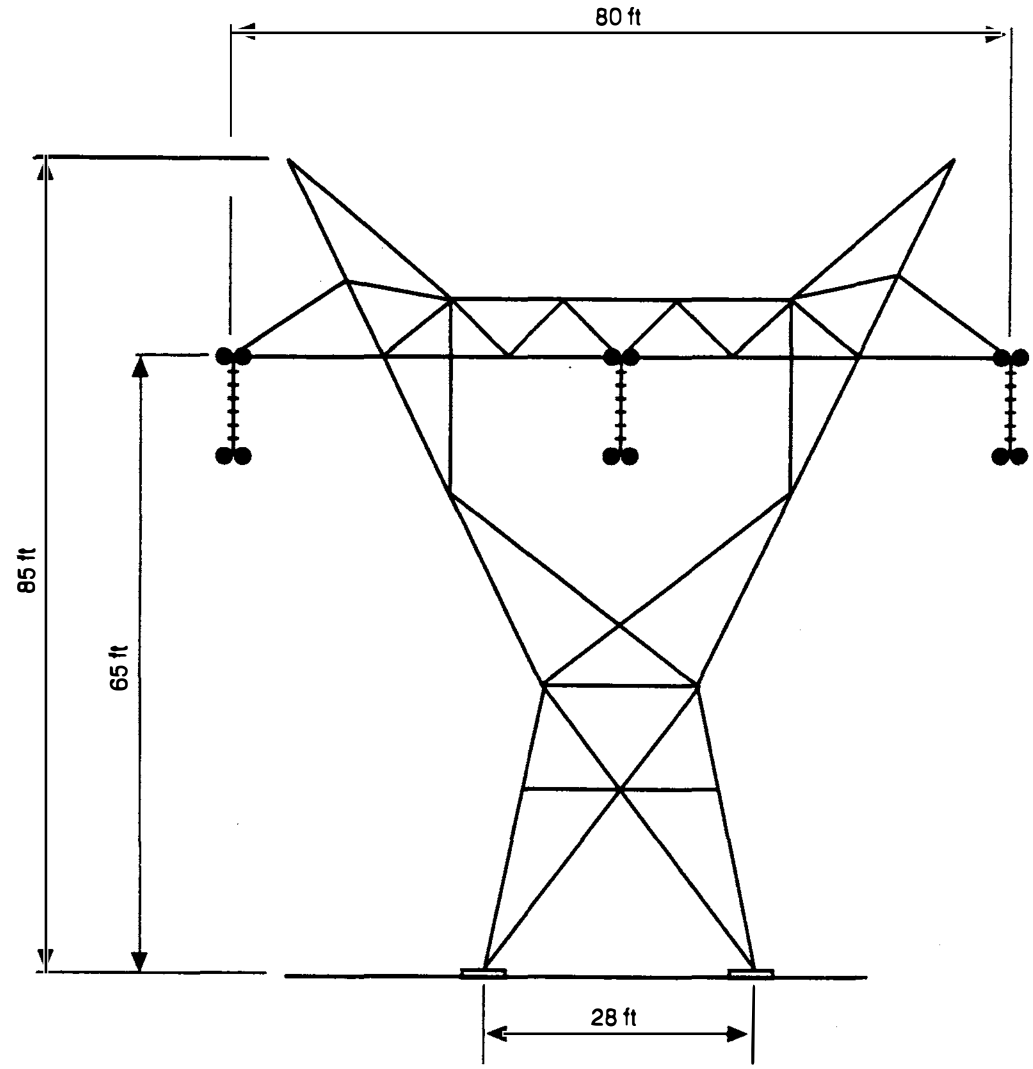

FIGURE 2.10 Steel Lattice Dead-End Structure (Source: ER 1991)

The expansion of the Orrington substation would involve installation of (1) a new lattice steel support structure to terminate the existing 345-kV circuit to Maxcys (line 392), (2) new 345-kV circuit breakers and associated disconnect switches, and (3) new relays and control equipment and wiring. The 345-kV wood H-frame transmission structure located immediately south of the substation also would be modified or relocated (Murphy 1991).

Modifications to the Maxcys and South Gorham substations would involve the addition of two 50-megavolt-ampere-reactive (MVAR) and two 60-MVAR capacitor banks, respectively. The capacitor banks at both locations would be connected to the existing 115-kV bus via a circuit breaker and switching equipment (Murphy 1991).

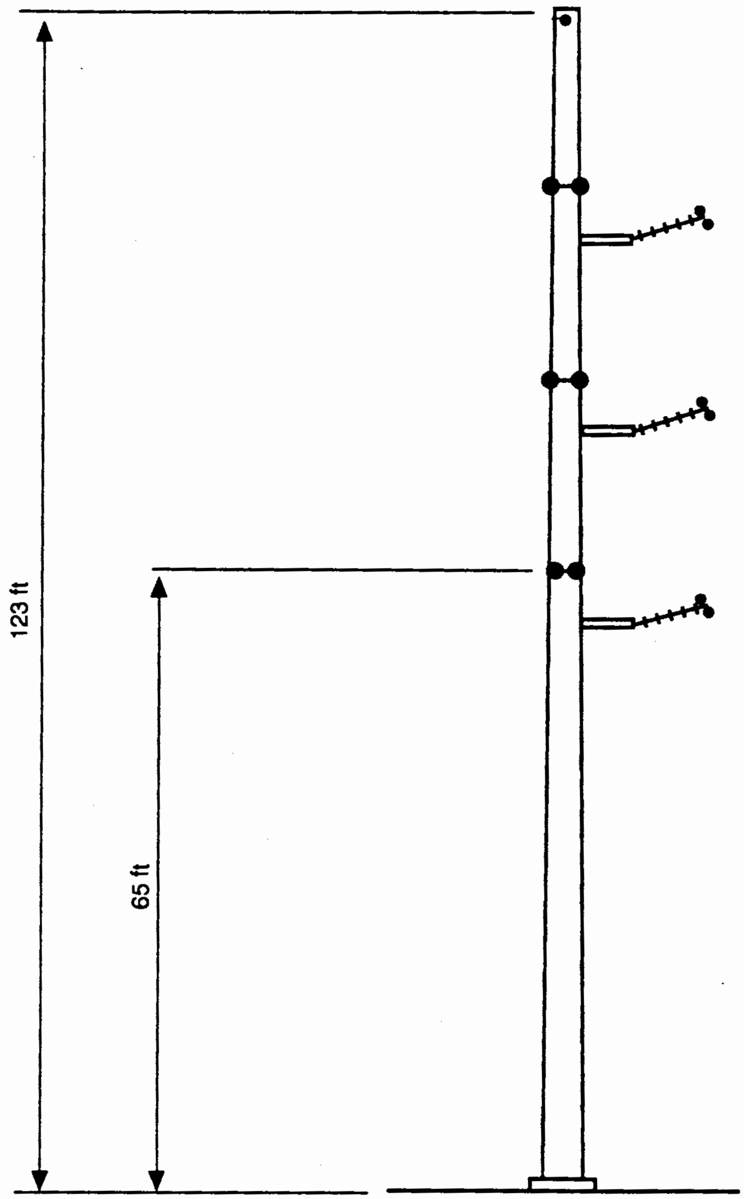

FIGURE 2.11 Steel-Pole Dead-End Structure (Source: ER 1991)

2.1.5 Construction Activities

2.1.5.1 Schedule

Right-of-way surveys began in September 1989 and are continuing on an intermittent basis. Construction is scheduled to begin with right-of-way clearing upon issuance of federal, state, and local permits. Right-of-way clearing is anticipated to begin in the latter part of 1996 and would be completed by July 1998. Access roads and structure pads would be

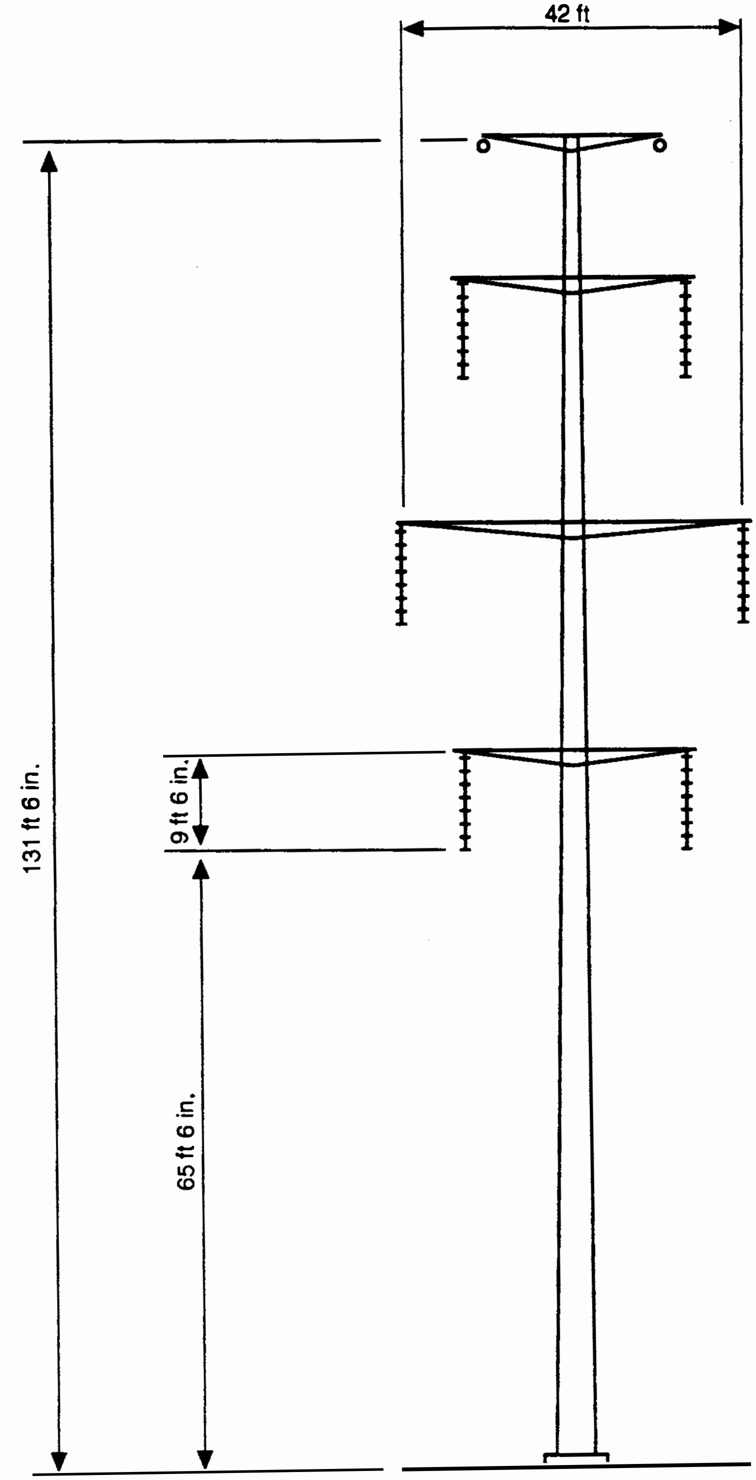

FIGURE 2.12 Steel-Pole Tangent Structure (Source: ER 1991)

constructed between January 1997 and mid-March 1998. Installation of line support structures would begin about February 1997 and would be completed about mid-March 1998. Shield wires and conductors would be strung between October 1997 and the end of June 1998. Substations would be modified as needed during the same period as the stringing operations. Final right-of-way restorations would be conducted from March to July 1998; however, site-specific mitigation and restoration activities would be carried out during all phases of construction. Plans call for the project to be completed and the line energized by mid- to late-1998.

2.1.5.2 Right-of-Way Clearing Practices

Trees within the right-of-way would be cleared only where necessary in order to facilitate (1) staking, access, assembly, and erection of structures; (2) installation of conductors; (3) provision of adequate clearance for energized lines; and (4) maintenance. Woody vegetation would be left undisturbed where possible. The clearing program would be planned and implemented to encourage growth of desirable, low-growing plants. This procedure would help stabilize the right-of-way against erosion and provide for natural vegetation control.

Because about 73% of the proposed right-of-way is forested (including forested wetlands), several methods of clearing would be used. Cutting can be generally categorized into (1) normal or clear-cutting (type E clearing) or (2) one of four types of selective cutting methods (types A through D). Additionally, danger trees (trees that could pose a threat to the operation of the line) would be cleared outside of the designated right-of-way to provide the physical clearance necessary for proper, safe, and reliable operation and maintenance of the energized line. About 19% of the proposed route recently has been clear-cut by timber operations. Overall, slightly more than 1,625 acres within the proposed corridor would require clearing by one of the five types of clearing methods.

Normal cutting (type E) would occur over about 48% of the right-of-way (781.1 acres). This type essentially involves the manual cutting of all trees within the right-of-way, while leaving shrubs and brush to the extent practicable. As part of land-clearing operations, much of the merchantable wood materials (e.g., sawlogs and pulpwood) would be salvaged by the clearing contractor. Tops of trees, cull material, and branches would be chipped on-site and hauled to local power plants for use as fuel. As one option, trees less than 2 in. in diameter could be cut and left on-site to create forest floor and to deter the formation of new drainage channels in areas susceptible to erosion. In areas of low erosion potential, other options for such trees would include windrowing, mulching, or burning (Murphy 1992). Because most tree removal operations would be done so as to minimize incidental impacts to the environment (e.g., minimize ground disturbance), methods of handling cut trees and other woody materials are discussed as mitigative measures in Section 4.4. Following cutting and removal of the timber, the tree stumps of deciduous species would receive a basal application of herbicide applied by a low-pressure, backpack applicator.

To accommodate installation of steel poles and wood structures, at each installation site an area about 100 ft wide and 170 ft long would be cleared of all growth except low shrubs and brush. Installation of each steel lattice structure would require clearing of an area about 140 ft wide and 200 ft long. The structures would be placed in these work areas. Smaller woody plants would also be removed from the structure locations.

Selective cutting (types A through D) would occur over about 52% of the right-of-way (about 845 acres). Type A clearing applies to surface water buffer zones. Type A clearing would be used for about 6.5% (105.7 acres) of the corridor. Surface water buffer zones generally would be 100 ft wide on each side of a perennial or intermittent stream. However, the buffer zone would be 250 ft on each side of streams considered by the state to be of special significance. Three such streams would be crossed by the proposed line: the St. Croix, Machias, and Narraguagus rivers. In type A clearing, only the vegetation within the actual conductor security zone would be removed, and all clearing would be by hand or feller-bunchers. Felled trees would be moved to the edge of the buffer zone by a feller-buncher or by cutting in place and rigging out (whichever is less disturbing). No herbicides would be used within surface water buffer zones. Only four wood structures and one steel lattice structure would be located within surface water buffer zones. Right-of-way maintenance within surface water buffer zones would be limited to cutting only those trees that could present a safety hazard to the transmission line before the next cutting period (4-5 years).

Type B cutting would be conducted in selected areas to help prevent illegal deer drives and to maintain habitat continuity. Slightly more than 3% (52.9 acres) of cutting operations would be done by type B clearing. Type B cutting would involve leaving a 200-ft zone of vegetation and stumps between spans. The vegetation in such zones could be at least 6 ft high but would not extend into the conductor security zone (20 ft below maximum conductor sag). The remainder of the area between the spans would be cut by the normal (type E) cutting method.

Type C cutting would occur in visually sensitive areas (e.g., significant road crossings and viewpoints), in likely deer wintering areas, and in buffer areas along state class I and II wetlands (see Section D.2.1.1, Appendix D, for definitions). About 23.5% (381.6 acres) of cutting operations would be done by type C clearing. This type of clearing would leave the maximum amount of vegetation possible within the right-of-way without infringing on the conductor security zone. Type C clearing differs from type A clearing in that for type C, access roads would be allowed, structures could be installed, and basal application of state-approved herbicides could occur. Forty-six wood structures and two steel structures would be located within 100 ft of class I and II wetlands.

Type D selective clearing practices apply to cutting vegetation (primarily trees) within wetlands that would otherwise occur within the conductor security zone. Forested wetlands (primarily white cedar swamps and black spruce bogs) are of primary concern, because they could require removal of significant amounts of vegetation. Other wetland types (e.g., marshes) generally do not require extensive removal of vegetation. Almost 19%

(305.2 acres) of clearing operations would be done by type D clearing. Any clearing involving use of machinery in wetlands must be done during the winter when the ground is frozen and snow cover is present. Manual cutting of trees could occur at any time of the year. No herbicides would be used within wetlands.

2.1.5.3 Access and Maintenance Roads

To the extent possible, existing roads would be used to gain access to project sites. The extensive network of timber haul roads that traverses much of the project area was a primary reason for selecting the Stud Mill Road route as the proposed route. Additionally, use of MEPCo's corridor to access the southern 12.2 mi of proposed transmission line would minimize the need to construct new roads within that area. However, some of the existing roads would require upgrading (such as alignment improvement, grading, and widening), and a number of new access roads would still have to be constructed, both within the right-of-way and from existing roads to the right-of-way. Most of these new roads would be temporary, but a few would remain after completion of line construction. Table 2.3 summarizes the temporary and permanent access road requirements for uplands and wetlands.

Temporary light-duty access roads would be constructed primarily for installation of wood pole structures, with some roads constructed to facilitate the hauling of material from the right-of-way as part of the clearing operations. Wetland temporary light-duty access roads would be constructed only when no other practical means was available to access wood pole structures in a wetland. Such roads would be in place in wetlands for a maximum of 12 months. When these roads were no longer required, the materials used to construct them would be removed from the wetlands.

TABLE 2.3 Access Road Requirements for the Proposed Route

Access Road Type	Number of Road Segments	Road Width (ft)	Total Linear Distance (ft)	Total Acreage
Temporary				
Wetland on-grade crossing	57	12	12,616	3.48
Wetland nonfill	57	16	15,268	5.61
Wetland fill	9	20	5,700	2.62
Upland unimproved bladed ground	324	12	327,070	90.10
Permanent				
Wetland fill	7	20	1,208	0.55
Upland	25	20	21,501	9.87

Source: ER (1991).

Fifteen of the structures that would be located in wetlands would have to be installed during the winter to prevent excessive damage to sensitive or soft and wet areas. The contractor may elect winter construction for other wetland structures to facilitate scheduling.

Permanent heavy-duty roads would be constructed to permit access to most of the lattice steel towers and the steel pole structures. The only exception would be for the three steel lattice towers north of Route 1A, where use of temporary light-duty access roads in conjunction with existing facilities is judged adequate to permit construction and maintenance of these towers.

Erosion and sediment control measures for all access roads would consist of one or more of the following measures: filter strips, riprap, silt fence and/or hay bales, slash in the roads, check dams, cross-drainage culverts, broad-based drainage dips, water bars, humps in the road, and temporary or permanent seeding. Permanent facilities associated with upland heavy-duty access roads would include one or more of the following: cross-drainage culverts, humps in the road, broad-based drainage dips, stone-filled drainage ditches, riprap, and seeding and mulching. Installation of cross-drainage culverts would be the primary method of ensuring that access roads do not impede sheetflow of water through flat wetland areas.

A total of 39 waterway crossings have been identified as necessary to provide access over drains, brooks, and streams. Nine of these crossings would involve permanent roads. Depending upon site characteristics, permanent waterway crossings would consist of a log bridge, corrugated metal pipe culvert, or stone-lined ford. Temporary waterway crossings would be one of the following types: in-situ frozen water and soil, log bridge, poled or sawn timber mat ford, stone-lined ford, or corrugated metal pipe culvert. These waterways are listed in descending order of desirability of use.

2.1.5.4 Construction Staging Areas

Four staging areas would be used during construction of the proposed transmission line. The proposed locations are in areas previously disturbed by clearing or staging for timber operations. These areas are identified below.

Route 178 Staging Area: This staging area is located in Bradley on the western side of Maine Route 178 opposite the entrance to the Penobscot Experimental Forest (about 9 line miles from the Orrington substation). The area to be used is presently cleared land and covers about 5 acres.

Pickerel Pond Staging Area: This staging area, located at an abandoned air strip owned by Champion International, Inc., is near Pickerel Pond and adjacent to Stud Mill Road. This area is about 16 line miles from the Route 178 staging area. The area to be used is presently cleared of vegetation and encompasses about 6 acres.

Machias River Staging Area: This staging area would encompass about 6.5 acres of land along Stud Mill Road, about 0.25 mi west of the Machias River, owned by Champion International. The site is about 32 line miles from the Pickerel Pond staging area. This former work-camp site is presently cleared on a slight knoll. About 1 acre of the staging area is located north of Stud Mill Road. This section is surrounded by a security fence and is presently used by Champion International as a maintenance facility.

Huntley Brook Staging Area: This site is located near the crossing of Huntley Brook by the Stud Mill Road on land owned by Georgia-Pacific Corp. It is 16 line miles from the Machias River staging area. About 4.5 acres of presently cleared land would be used.

2.1.5.5 Support Structure Installation, Framing, and Stringing

Foundations for the steel towers and poles would be steel-reinforced, cast-in-place concrete caissons. Holes would be augured in the ground, a stub angle or anchor bolt cage installed, and concrete placed to complete the foundation. For the wood structures, a foundation hole would be excavated at each pole location, and backfill would be placed around the pole after installation. Section 2.1.4.2 discusses depths for the foundation holes. Guy anchors for the wood angle structures would be steel anchor rods connected to a log buried in a trench about 7 ft deep.

The H-frame structures would be assembled on the ground and erected by a crane with a long boom. The major subunits of the lattice steel structures (e.g., leg extensions, body extensions, and bridge section) would be assembled on the ground and then connected in the air. The steel poles could be assembled in the air or assembled entirely on the ground and then erected.

Total construction time for a wood structure would be less than a day. Steel lattice and pole structures would each take less than four days per structure site.

After the support structures were in place, insulators would be installed and aerial ground wires and conductors strung. Conductors and shield wires would be pulled through the stringing blocks by tensioning equipment to keep them from coming in contact with the ground or other objects that could cause damage.

2.1.6 Postconstruction Maintenance Practices

Postconstruction maintenance would consist primarily of line inspection and vegetation management. The line would be examined by air about four times per year. A detailed ground patrol would be conducted on a five-year cycle, with about a fifth of the line inspected each year. During these inspections, about 10% of the structures would receive a full climbing examination. Lattice steel and steel pole structures are considered to have a service life of 40 years. The wood H-frame structures have a service life of 25 years. Rather than replace the structures along the entire line at the end of this service period, it is likely that the wood structures would receive extra maintenance, including a program to test the soundness of the structures and crossarms. Defective or questionable poles and crossarms would be replaced, thus extending the service life.

Postconstruction vegetation management would be based on the following zones: (1) areas of selective (types A through D) clearing (including buffers and wetlands), (2) areas of clearing along the edge of the right-of-way, and (3) areas of normal (type E) clearing within the right-of-way. Areas designated for selective clearing would be checked every four to five years. Within these areas, all tree cutting, topping, and pruning would be performed in accordance with electric utility industry standards to ensure adequate clearance from the top of the trees to the energized conductors. Cutting along the edge of the right-of-way would involve the removal of encroaching branches from each side of the right-of-way (i.e., side trimming). The areas within the right-of-way that receive normal (type E) clearing would be maintained by hand and mechanical cutting only, combined with optimal basal application of herbicides.

The basal stem treatment would be used to apply approved herbicides with low-pressure backpack sprayers. The applicator would treat unwanted deciduous tree species with a handheld wand to deliver the herbicide to the bottom 12-15 in. of the stem or trunk. Only herbicides registered with the U.S. Environmental Protection Agency (EPA) and the Maine Pesticide Control Board (MPCB) would be used to control deciduous woody plants.

2.2 DESCRIPTION OF ALTERNATIVES TO THE INTERCONNECTION

The action under consideration is for DOE to grant or deny Presidential Permit PP-89 that would authorize an international transmission line interconnection to be used for electric power exchanges between the applicant and New Brunswick Power Commission. Granting of the permit would result in the construction and operation of the interconnection. If the permit were denied, the applicant could (1) maintain the status quo by taking no action or (2) pursue alternatives (e.g., alternative sources of energy) to the interconnection. The no-action alternative of maintaining the status quo is evaluated in this EIS, and a discussion of alternative electric generation sources and their viability as options is provided in Section 2.2.2. In addition, alternative routes to the proposed (Stud Mill Road) transmission line route are considered to be reasonable alternatives to the proposed action and thus are evaluated for their environmental impacts. In particular, the alternative route that largely parallels the existing 345-kV interconnection is the primary alternative route evaluated in detail (Sections 2.3, 3.2, and 4.2). Under the no-action alternative, the existing environment and land use activities within the study area would generally be maintained. Environmental impacts associated with the no-action alternative are evaluated in Section 4.3.

2.2.1 No-Action Decision — Maintain Status Quo

If DOE denied the presidential permit, the proposed interconnection would not be constructed, and the electricity cost and capacity requirement savings associated with the proposed action would not occur.

2.2.2 No-Action Decision — Pursue Alternative Actions

The proposed interconnection is not intended to provide additional energy sales from New Brunswick at this time, but it would provide capacity benefits. It would increase the capacity benefit of tie lines between the two areas and would reduce the amount of generating capacity reserves needed in New England, thus reducing the need for NEPOOL to install additional generating capacity to provide for its required reserves. Table 2.4 shows NEPOOL's need for an additional 1,200 MW of generating capacity by 1996 and 5,200 MW by 2001. The existing transmission tie line allows NEPOOL to reduce its reserve requirements through sharing capacities with New Brunswick during emergencies, and the proposed project would provide an additional 300 MW of transmission capacity. The remaining need for capacity reserve resources may be obtained from New Brunswick or from the other alternative supply sources discussed below (e.g., uncommitted nonutility generators [NUGs], additional demand-side management [DSM], additional power purchases, and additional utility generation). A DOE denial of the Presidential permit (i.e., the proposed project would not be completed) would limit, but not eliminate, what alternatives NEPOOL could look to New Brunswick to provide. Additionally, the electricity cost and capacity

TABLE 2.4 NEPOOL Resource Adequacy, 1996 and 2001

Resource Factor	1996 (MW)	2001 (MW)
NEPOOL committed capacity	26,750	25,386
Additional capacity needed to achieve 1 day in 10 years criterion	1,190	5,238
Identified but uncommitted contingency resources		
Expansion of DSM	690	865
Additional NUGs	1,732	2,918
Additional purchases	1,716	3,316
Additional utility capacity	2,402	4,837
Total	6,540	11,936

Source: ER (1991).

requirement savings associated with the proposed action would not occur. Adding the proposed interconnection would protect NEPOOL customers against problems that could result if other generating sources are less available or less reliable.

2.2.2.1 Construction and Operation of a New, Conventional Central-Station Generating Facility

One alternative to the proposed interconnection would be construction of a new central-station, non-oil-fired generating plant. Candidate plant types would be nuclear, coal, hydroelectric, and natural gas. BHE currently is attempting to license several hydroelectric projects within its service territory. Additional hydroelectric development beyond that currently proposed would not be viable because of the limited number of sites remaining for such development (ER 1991; Electric Council of New England 1991). The availability of natural gas for generating facilities is quite limited in Maine. Natural gas is currently being imported from Canada to Maine but not in sufficient quantities to generate power at a utility scale. However, the applicant is evaluating combined-cycle technology (use of natural gas and oil) for the repowering and life extension of its Graham Station oil-fired facility in Veazie, Maine (ER 1991).

While construction of a nuclear or coal-fired generating plant could achieve the same level of reduction in oil consumption as the proposed action, the time required to license and construct such a plant would not permit placing such an alternative facility in service until the year 2001 or later. The length of time required to license and build a new nuclear plant is 10-15 years, and the average lead time for a new coal-fired plant is 8 years (Energy Information Administration 1984). In addition, new transmission lines would have to be built from the central-station power source. The effects of constructing new transmission lines associated with the new power plant would be qualitatively similar to those discussed in Section 4 for the proposed interconnection.

Nine nuclear plants (including Seabrook) are currently operating in New England. During 1990, nuclear plants provided 35% of New England's electric energy requirements; this level is expected to be maintained through the year 2000 (Electric Council of New England 1991). No other nuclear plants are contemplated by any New England utility.

2.2.2.2 Construction and Operation of Nonconventional Generating Facilities

Solar-, wind-, and biomass-powered facilities of the size required to meet the energy supply level of the proposed interconnection are not considered reasonable alternatives to the proposed action, even though these fuels are now available and will be used increasingly at small, dispersed sites throughout New England.

Generally, solar- and wind-powered facilities are limited to single-residence or business applications for solar water or space heating, or to small-scale windmills. Research on these technologies is ongoing (Electric Council of New England 1991), but commercial-scale developments of the size comparable to the proposed project are not feasible for the near future.

The cost of fuel for biomass plants is uncertain. Furthermore, a substantial increase in whole-tree harvesting might seriously deplete the resource and impact the timber products industry in Maine. Additionally, air pollution and solid waste disposal are serious environmental issues for this application. Such facilities are also small (e.g., 15-25 MW). Operation of each facility would require the harvesting of significant forestland annually. For example, a 15-MW biomass plant must harvest about 2,200 acres of timberland per year; a 25-MW unit requires about 3,600 acres; and a 50-MW plant about 7,300 acres. Generally, about 15,000 acres would be harvested annually for every 100 MW of capacity (BHE 1991b).

The first peat/wood-fired generating facility in North America is located in the town of Deblois in BHE's service territory. Additional plants are planned for Maine. Nevertheless, environmental concerns about harvesting peat (e.g., impact to wetland habitat and associated biota) are significant (BHE 1991b).

Supply of solid waste is a limiting factor in the development of solid waste plants in Maine. Also, ash disposal and air emission problems, as well as legislative pressures, make further development unattractive (BHE 1991b). Burning of wood and waste accounted for only 0.5% of New England's total energy requirements in 1990 (Electric Council of New England 1991).

2.2.2.3 Conservation and Load Management

Demand-side management is a program of energy conservation, efficiency improvements to energy-using devices, and load management (e.g., shifting of energy consumption from on-peak to off-peak hours) (Electric Council of New England 1991). Implementation of conservation measures (e.g., installation of insulation, weatherization, use of energy-efficient appliances or machinery, and installation of more efficient lighting and heating) in any of the customer classes (residential, industrial, or commercial) results in reduced energy use. Conservation and energy management are already part of the applicant's least-cost resource plan (BHE 1991b). Load management is a method to increase the base load by reducing peak power demands while filling in low-demand periods of the load cycle. This more effective use of utility generating capacity is accomplished by attempting to alter customer use patterns.

In 1990, demand-side management programs reduced the NEPOOL region's summer peak by 3%; these programs are projected to contribute an 11% peak reduction by the year 2000 (Electric Council of New England 1991). While load management initiatives have reduced, and will continue to reduce, energy demand, expected growth rates for electricity consumption are still projected to be high enough to require additional generating capacity in the New England region within the next 5 to 10 years (Electric Council of New England 1991).

2.2.2.4 Decentralized Energy Sources

Dispersed applications of various small-scale energy technologies — for example, (1) solar, primarily for single-residence or business applications of solar water or space heating and photovoltaic power generation; (2) wind-electric generation; (3) low-head hydroelectric installations; (4) cogeneration; and (5) wood stoves for home and business space heating — could also decrease electric energy demand and reduce the need for oil-based electric energy.

The Public Utility Regulatory Policies Act of 1978 (PURPA) requires, subject to certain conditions, that utilities offer to purchase cogeneration and small power production (CSPP) energy at just and reasonable rates that are no higher than the cost of alternative sources of electric energy. NEPOOL purchases power from cogenerators and other independent power producers (IPPs) who do not fall under PURPA regulations (Electric Council of New England 1991). Benefits of such actions include (1) adding the resources in smaller increments to match natural load growth and (2) the short lead time between inception to commercial operation. However, there are several disadvantages, including questionable reliability, nondispatchability, and potential need for system upgrades to handle the interconnection of the CSPPs. Nonutility generators (NUGs) contributed 5.5% of New England's total energy requirements in 1990 and are projected to contribute up to 11% by the end of the century (Electric Council of New England 1991). The applicant depends heavily on IPPs and NUGs. However, supply reliability, operational problems, and financial stability make reliance on such sources undesirable as a long-term option.

2.2.2.5 Fuel Conversion

Pursuant to implementation of the Powerplant and Industrial Fuel Use Act of 1978 (FUA — Public Law 95-620), DOE evaluated the benefits and environmental effects of converting up to 42 power plants in the northeastern United States from the use of oil and natural gas to the use of coal (DOE 1982). It was concluded that as many as 27 power plants could qualify for the voluntary conversion provisions of the Omnibus Budget Reconciliation Act of 1981 (DOE 1982). Thirteen oil-burning plants have been converted to coal-burning within the NEPOOL system. Also, several oil-burning plants can be switched to burn coal or natural gas, and one plant can burn a mixture of oil and natural gas (Electric Council of New England 1991). The approval or denial of a presidential permit for the proposed interconnection would neither preclude nor promote additional coal conversion activities.

2.2.2.6 Purchase of Power from Other Utilities

Several NEPOOL members purchase power from New York Power Authority, Hydro-Quebec, the New Brunswick Power Commission, and (to a limited extent) Ontario Hydro. The search for alternative sources of purchased power can be broken down into two areas: (1) contiguous utility systems and (2) systems that are far removed from NEPOOL. However, to be considered a viable alternative, a potential source must be able to provide

NEPOOL with a comparable quantity of firm (guaranteed) energy at prices that are competitive with those of the proposed second tie-line agreement.

The New York Power Pool (NYPP) is one of the contiguous utility systems that is a potential source of purchased power. It consists of the major electric utilities in New York State, is heavily dependent upon oil for the production of electric energy, and is a competitor of NEPOOL for the surplus hydroelectric energy available in Canada and the coal-fired surpluses in the midwestern United States. Therefore, purchase of power from NYPP would not be considered a viable alternative to the proposed project.

The Midwest is another potential source of purchased power because of its present surplus of non-oil-fired capacity. The Midwest generally is considered to include the utilities within the East Central Area Reliability Council (ECAR). The ECAR, one of the nine regional reliability councils of the North American Electric Reliability Council, includes electric utilities in Michigan, Indiana, Ohio, Kentucky, West Virginia, and parts of Virginia and Pennsylvania. Several factors that preclude consideration of midwestern energy as a viable alternative to the proposed action are as follows:

- Load and capacity projections indicate that the present capacity surpluses enjoyed by the ECAR utilities would not last long enough to sustain a firm energy sale to NEPOOL through the 1990s.

- Any available surpluses are likely to be purchased by utilities in the Pennsylvania-New Jersey-Maryland (PJM) region that have existing direct transmission connections to ECAR utilities.

- Any power purchased from ECAR must flow through the central New York State and PJM systems. The transmission systems in these areas are already heavily used and could not readily withstand the additional load imposed by transmitting midwestern energy to New England.

- The construction of additional transmission lines through New York or the states of the PJM systems could encounter various regulatory, legal, and environmental obstacles that could prevent or delay implementation and raise the final cost of the energy.

2.2.3 Description of Alternative Routes and Designs

2.2.3.1 Route Alternatives

Potential alternative routes (including the proposed route) as identified by the applicant in Section 2.1.2 are (1) the existing-line route, (2) the straight-line route, (3) the Stud Mill Road route (proposed), and (4) the Route 9 route (Figure 2.1). The applicant evaluated these alternative routes in terms of environmental and economic considerations.

The DOE staff has reviewed the methodology and rationale employed in the applicant's evaluation, and on the basis of that review concludes that the alternatives identified by the applicant provide an adequate basis for comparative evaluation with the proposed route.

Existing Line Route

The existing-line route would generally parallel the existing 345-kV line right-of-way crossing the international border at Orient, Maine, extending parallel to the existing route to Chester, Maine, and then to the Orrington substation. However, because of the presence of several sensitive environmental areas (e.g., extensive wetlands), the existing-line route would make several diversions from the existing 345-kV line right-of-way (Figure 2.1). The six staging areas required for the existing-line route would be located as follows: (1) Bradley (western side of Route 178 near the junction with the Experiment Forest Road); (2) Enfield (northern side of Route 155 adjacent to the Maine Central Railroad); (3) T2/R8 N.W.P. (western side of Route 116, about 1 mi north of access road to I-95); (4) Mattawamkeag (northern side of Route 157 adjacent to the existing 345-kV line); (5) Glenwood (southern side of Lake Road adjacent to the existing 345-kV line); and (6) Orient (western side of Route 1 on logging road adjacent to existing 345-kV line) (Murphy 1991). Total distance would be 156 mi (106 mi in Maine).

The existing-line route is considered a viable alternative to be compared with the proposed route in regard to environmental impacts. Therefore, in the rest of the document, the existing-line route is referred to as the "alternative" route.

Straight-Line Route

The straight-line route would cross the international border just north of Kellyland, Maine, and the Grand Falls Flowage in Fowler Township, Maine. The route would travel northwest to the Topsfield, Maine, area and then west to Lee, Maine. The line would then proceed northwest to Chester, where it would parallel the existing 345-kV line to the Orrington substation. The total distance would be 175 mi (115 mi in Maine).

The straight-line route was eliminated from further study as a viable alternative because the route would (1) cross extensive areas of wetlands, including Dead Man Stream; (2) pass through more populated areas along Route 2 and Route 6; (3) cross Route 6 in several places and be more visually intrusive than the other routes; (4) pass through relatively undisturbed areas of forest that contain few roads; (5) pass near or through a series of white cedar swamps in Lee, Springfield, and Carroll that contain rare plants; (6) pass the southern edge of the large flowage area at Baskahegan Stream called Middle Deadwater; (7) cross the Grand Falls Flowage on the St. Croix River in an area of active bald eagle nesting; and (8) likely be the cause of a number of landowner constraints along the corridor length (ER 1991).

Stud Mill Road Route

The Stud Mill Road route (the proposed project route) is described in Section 2.1.3. Total distance for the route would be 145 mi (83.8 mi in Maine).

Route 9 Route

The Route 9 route would cross the international border in Woodland, Maine, and generally parallel the major east-west highway between Bangor and Calais. Total distance would be 143 mi (83 mi in Maine).

The Route 9 route was eliminated as a viable alternative for the following reasons: (1) several major crossings of Route 9 would be required, possibly in sections designated as scenic highway; (2) river crossings of the south-flowing St. Croix, Machias, Narraguagus, and Union rivers would be more difficult and extensive (because of greatest river widths among the four alternative routes); (3) the Maine Department of Transportation is planning to significantly reconstruct Route 9, which may involve substantial reroutings of the road, thus making transmission line location more difficult; (4) several lakes and large wetlands would likely have to be traversed or would likely force significant route changes, especially at Whalesback (Union River), Mopang Lake, Crawford Lake, and Meddybemps Lake; (5) the corridor is more hilly and rugged, particularly west of the Machias River, than the other alternative routes (thus, for example, making construction more difficult and increasing the potential for erosion); and (6) more individual property owners (compared with the other alternative routes) would be involved, thereby complicating the routing of the corridor (ER 1991).

2.2.3.2 Design Alternatives

Design alternatives would include differences in the types of structures that could be used (e.g., steel-pole H-frame, steel-pole single shaft, lattice-steel towers, lattice-steel H-frame) rather than the wood H-frames selected as the predominant structure type. The wood H-frame structure was chosen in large part because of economic considerations (ER 1991). Because most structure types would cause similar impacts, further comparisons based on environmental concerns are not warranted. However, the use of lattice-steel towers usually requires permanent access roads to accommodate the maintenance vehicles that would be required for the towers. Construction of these roads would result in longer-term impacts than temporary access roads required for most of the proposed H-frame wooden structures. An increased amount of permanent access roads could result in more significant environmental impacts, especially because of the extent of wetlands within the project area.

2.2.3.3 Underground Transmission System

Installing the transmission line underground is a technically feasible alternative to construction of the proposed overhead transmission line. However, the environmental impacts and construction costs would be greater and system reliability would be lower for an underground system than for an overhead system.

An underground 345-kV AC transmission line would require three parallel high-pressure, oil-filled, pipe-type cable systems that would be installed in a continuous trench. The trenches would be at least 3 ft wide and 5 ft deep, with the cables placed at least 3.5 ft below ground level. Spacing between pipes would be at least 4 ft. Thermal sand and clean backfill would be used to refill the trench. The land over and in the vicinity of the line would have to be maintained free of trees and shrubs. Improved access would also be required for the length of the line. Cable splices would be required about every 0.5 mi, and aboveground oil pumping stations would be needed every 5-10 mi. One or more aboveground reactive compensation stations would also be needed (DOE 1987).

For the line to be constructed underground, a continuous work area generally about 40 ft wide would be needed. Additionally, new right-of-way might have to be acquired in areas where the line would have to deviate from the proposed right-of-way centerline because of such obstacles as wetlands, steep slopes, areas of high erosion, and areas of rocky terrain. In a number of situations, wetlands probably could not be avoided. A similar situation would occur for stream crossings, where dredging or similarly disruptive procedures would have to be used to place the cables. Transition stations would be needed for the line to switch between underground and overhead as necessary. These stations generally require an area about 200 ft by 200 ft (about 0.9 acres). Bus work, termination structures, and a control equipment building would be located at each site. Maximum structure height would be about 80 ft. Finally, operation and maintenance costs and periods of outage would be greater for an underground system than for an overhead system.

The primary impacts associated with an underground system that preclude its use as a viable alternative include (1) extensive excavation, grading, and backfill; (2) potential for oil contamination of soils; (3) disruption of land use patterns along the entire length of the route; (4) limitation on land uses allowed over or near the route; (5) instream disturbance to all waterways the route would cross; (6) potential for oil spills or leaks into surface waters and wetlands; (7) potential for oil contamination of shallow groundwater aquifers; (8) decreased habitat diversity along the route (area would have to be maintained in a grassy condition); (9) increased potential to damage surface and subsurface archaeological sites; and (10) increased worker safety concerns because of the greater amount of construction and maintenance activities that would be required.

2.3 COMPARISON OF THE PROPOSED AND THE ALTERNATIVE ROUTES

Extensive descriptions and comparisons of the proposed (Stud Mill Road) and the alternative (existing line) transmission line routes were presented in the applicant's preliminary ER (BHE 1989) and in the final ER (BHE 1991c). The principal construction-related comparisons are outlined in Table 2.5. Because differences in structure types would not significantly alter environmental impacts, these types of design alternatives are not discussed further. Because of economic factors, the applicant has elected to use primarily wood-pole structures; this decision is addressed in the ER (1991). The following sections summarize and compare the impacts of the proposed and alternative routes.

2.3.1 Air Quality

Air quality conditions along the proposed and alternative routes are very similar. These conditions are discussed in Section 3.1.1. Changes in air quality conditions related to construction and operation would be similar for both overhead routes.

2.3.2 Land Features

The geologic and soil impacts associated with the proposed and alternative overhead transmission line routes would be similar because the major design, construction, and operational features of the lines would be similar. Because the alternative route is longer, the total mileage of new access roads would be greater, possibly resulting in relatively greater potential impacts in terms of soil erosion, floodplain displacement, terrain modification, and the commitment of sand and gravel resources for road construction. The condition of the access road system for the existing line is mostly unsuitable for use by the construction vehicles that would be needed to construct the new line. Thus, new access roads would be required for most of the alternative route.

2.3.3 Land Use

Compared with the proposed route, the alternative route would be about 22 mi longer, require an additional 508 acres of land, and extend across 184 more land parcels. The principal change in land use for both routes would be the conversion of forestland to utility right-of-way.

2.3.4 Hydrologic Resources

Potential surface water impacts related to erosion, water quality, drainage patterns, surface runoff, and damage to stream banks would be similar for the proposed and alternative routes. The proposed route would cross 130 streams (perennial and intermittent), but only 30 temporary and 9 permanent access roads would cross these streams. The alternative route crosses 59 perennial waterways, but the exact number of crossings is not certain because small brooks and intermittent streams are not considered in this total. However, because of the lack of existing, usable access roads along the alternative route, more stream crossings by access roads would occur for the alternative route than for the proposed route (Murphy 1991).

TABLE 2.5 Major Construction Comparisons between the Proposed and Alternative Routes

Construction Parameter	Proposed Route	Alternative Route
Line length (mi)	83.8	106
Number of wood structures		
Tangent	497	833
Light angle	1	0
Light medium angle	19	15
Heavy medium angle	19	3
Tangent dead-end	1	1
Number of lattice steel structures		
Light dead-end	16	23
Heavy dead-end	6	4
Number of steel poles		
Tangent	2	2
Light dead-end	2	2
Total structures	563	883
Average span length (ft)	787	635
Temporary access roads (mi)	68.3	108.3
Permanent access roads (mi)	4.3	8.7
Number of staging areas	4	6
Right-of-way (acres)	1,623[a]	2,081[b]
Right-of-way in wetlands (acres)	374	~832
Right-of-way in wetlands (%)	23.0	~40.0

[a] Based on 71.6 mi of new 170-ft-wide right-of-way and 12.2 mi of an additional 100-ft width added to existing, maintained right-of-way.

[b] Based on 93.8 mi of new 170-ft-wide right-of-way (59.8 mi of additional 170-ft width added to existing 345-kV right-of-way and 34 mi of new right-of-way diverging away from existing 345-kV right-of-way) and 12.2 mi of an additional 100-ft width added to existing, maintained right-of-way.

Sources: BHE (1991a); ER (1991); Murphy (1991).

The types of potential adverse impacts to groundwater, including disruption of shallow groundwater flow patterns and aquifer contamination, would be similar for the proposed and alternative routes. However, the potential extent of adverse impacts would differ between the routes. Disturbance of the shallow groundwater flow pattern would be more extensive for the alternative route because that route would be longer and require more and longer access roads than the proposed route. On the other hand, the right-of-way for the proposed route crosses 130 acres of significant sand and gravel aquifers, compared with about 47 acres for the alternative route. If herbicides were used within the areas of significant sand and gravel aquifers with other than backpack spray units, the potential for aquifer contamination would be greater for the proposed route than for the alternative route.

2.3.5 Biotic Resources

The ecological characteristics of the proposed and alternative routes are similar. Differences are related to the amount of the various habitat types within each route. Of major concern are the amounts of forested habitat that would require clearing and the extent of disturbance to wetlands. Differences in the number of stream crossings by the line are of minimal concern because those water bodies would be spanned by the line in almost all cases. However, the number of stream crossings required for access roads would differ between the routes. The differing amounts of open (nonforested) upland habitat are not of major concern as far as biotic resources because such habitats would be minimally impacted by structure placement, laydown area development, and access road improvements. Additionally, such areas can be more readily restored than can forested or wetland habitats.

About 1,175 acres of forest clearing would be required for the proposed route, compared with about 1,845 acres of forest clearing for the alternative route. The alternative route would cross about 27 more miles of wetlands than the proposed route. Thus, the number of structures and length of access roads required within wetlands would be greater for the alternative route. The amount of scrub/shrub wetlands would also be increased along the alternative route because forested wetlands occurring within the alternative route would have to be modified. A larger number of stream crossings would be required for the alternative route, and, thus, the extent of instream disturbance to aquatic biota would be greater for the alternative. Extending the width of the right-of-way over smaller streams along the alternative route would increase the potential for and extent of stream warming, which could have a localized adverse effect on coldwater aquatic species.

2.3.6 Socioeconomics

Construction along either route would provide the same employment benefits, with an average of 60 workers (ranging at times from 11 to 133 workers) (ER 1991). Workers employed for construction along the alternative route would be required for about 24 months, compared with about 18 months for the proposed route (Murphy 1991). The population would temporarily increase by about 150 residents (workers and their families) within the counties through which the transmission line passed.

Fewer dwellings are located near the proposed route and its associated staging areas than the alternative route. Within 600 ft to either side of the centerline of the route and 2,000 ft from each staging area, there are 126 dwellings near the proposed route and 207 dwellings near the alternative route.

2.3.7 Visual Resources

Installation of the transmission line would result in more visual impacts along the proposed route than along the alternative route. Many of the visual impacts along the alternative route would be incremental because about 68% of the route would parallel an existing transmission line. In comparison, only 15% of the proposed route would parallel an existing transmission line. A total of 98 houses, trailers, commercial structures, and camps are located within 600 ft of either side of the centerline of the proposed route, while 150 such structures are located within 600 ft of either side of the centerline of the alternative route. It should be noted that 91 of these structures are within the 12.2-mi portion of the route that would be identical for both the proposed and alternative corridors.

2.3.8 Cultural Resources

The potential for archaeological sites to be adversely affected is greater for the alternative route than for the proposed route because of the greater number of stream and river crossings along the former (Cox et al. 1991). Cultural resource surveys of the alternative route, similar to those conducted for the proposed route, would be needed to fully assess the adverse impacts.

2.3.9 Health and Safety

Health and safety concerns would be similar for the proposed and alternative overhead transmission line routes. However, because of phase interactions between the existing and proposed line, magnetic field exposures to residents located near the two-line corridor would actually be lower than are currently produced by the existing single 345-kV line alone. On the other hand, more residential housing occurs along the alternative route than along the proposed route. People living along the proposed route would not be exposed to electromagnetic fields (EMF) from the new transmission line if the alternative route were selected, and vice versa. The exception to this would be the last 12.2 mi of the route, where the proposed and alternative routes are the same.

Worker safety concerns would be similar for the proposed and alternative transmission line routes. However, the alternative route would be less safe to construct because of its increased length (more access roads, structures, and other associated facilities would have to be constructed).

2.3.10 Radio and Television Interference

For the alternative route, the duration of radio interference to vehicles passing under the existing right-of-way would increase because of the additional transmission line that would be added to the corridor. The potential for radio and television interference at nearby residences also would increase, particularly at those residences on the southern or eastern side of the existing corridor where the new transmission line would be located. In contrast, the proposed route passes through timber lands where no residences are close enough to the line to be affected by line-generated radio noise except for the last 12.2 mi, where the proposed and alternative routes are the same.

3 AFFECTED ENVIRONMENT

3.1 PROPOSED ROUTE

3.1.1 Atmospheric Environment

3.1.1.1 Weather and Climate

Information on the weather and climate in the study area has been derived from the National Oceanic and Atmospheric Administration (NOAA 1980), unless noted otherwise. The area between Orrington and Baileyville is categorized as "humid continental." The area has warm to hot summers and relatively cold winters (ER 1991). The climate of east-central Maine is highly changeable and subject to extreme ranges in temperature (diurnal and annual), great differences in temperature during the same seasons in different years, equitable distribution of precipitation, and considerable diversity in weather from place to place.

The average annual state temperature is about 44°F, with the highest recorded temperature reaching 105°F and the lowest dropping to -48°F. Temperatures reach 90°F or more on an average of two to seven days per year. The average length of the growing season is about 120 to 140 days. The last freezing temperature generally occurs in early May, with the freeze-free season generally ending in September.

Storm systems are the main year-round moisture producers in the state. Such systems are somewhat less active in summer. Thunderstorms can produce 1-2 in. of rain an hour and may result in minor washouts of roads and soil erosion. Monthly precipitation totals can range from negligible to 10 in. or more. Prolonged droughts are infrequent. Total annual precipitation averages slightly more than 40 in. Winter precipitation occurs primarily as snow. Freezing rain occurs infrequently and can result in heavy ice buildups on trees and wires. Measurable precipitation occurs on an average of one day in three over most of the state.

Average seasonal snowfall is between 60 and 90 in. Local topography greatly influences snowfall. Generally, there is a seasonal increase of 1 in. of snowfall for each 25-ft increase in elevation. One or more inches of snow occurs on 20-30 days each year. Most years will have several snowstorms of 5 in. or more, with most portions of the state having recorded over 20 in. in a single day. The snowfall season generally begins late October to early November and lasts until April or sometimes May. January (the snowiest month) generally averages more than 20 in. of snow.

Annual precipitation in the area of the proposed route averages 40.78 in. at Orono (western portion of proposed route), 43.87 in. at Grand Lake Stream, and 44.92 in. at Woodland (eastern portion of proposed route). Seasonal snowfall averages 90.8 in. at

Woodland and 76.9 in. at Orono (no records exist for Grand Lake Stream) (ER 1991). Extended dry spells can occur in late summer or fall, creating serious forest fire hazards.

Widespread flooding is infrequent. Floods most frequently occur in early spring when substantial rains and melting snow combine to produce heavy runoff. However, snow melt is usually gradual enough to prevent serious flooding. Flash floods occasionally occur in smaller streams during the summer.

Occasionally, a tropical storm may affect Maine in the summer or fall. Some may have near or full hurricane-force winds. On average, this type of storm occurs two or more times per year during only 1 year in 20 years. Several tornadoes occur on average each year, but most are small and affect only a very localized area. Thunderstorms occur 15 to 30 days per year. Glaze and ice storms are usually of brief duration, although a few widespread, prolonged ice storms have occurred. In addition to the potential damage from the weight of the ice, ice load also magnifies wind stress by increasing the effective surface area of an object exposed to the wind.

3.1.1.2 Air Quality

Air quality along the proposed route is considered good because of the rural character of the area and the small incidence of major pollutant sources. All airborne pollutants measured by the Maine Department of Environmental Protection, Air Quality Control Bureau for 1987 and 1988 at stations along or near the project in Woodland, Brewer, Orrington, Bangor, and Dedham met national ambient air quality standards for total suspended particulates (TSP), sulfur dioxide (SO_2), lead (Pb), and ozone (O_3) (no readings were taken for nitrous oxides [NO_x] or carbon monoxide [CO], which are monitored primarily in more densely populated areas). All state standards were met at the towns mentioned above except the maximum TSP within a 24-hour period at Woodland (245 $\mu g/m^3$ compared with the standard of 150 $\mu g/m^3$) and the maximum hourly O_3 levels at Dedham for 2.0% of the year (standard of 0.081 parts per million [ppm]). Air quality levels in Brewer, Orrington, and Bangor reflect the influence of the greater Bangor urbanized area and are not representative of the majority of the route's more rural character (ER 1991).

3.1.2 Land Features

3.1.2.1 Physiography

The proposed route traverses the New Brunswick Highland physiographic region of New England (Denny 1982). Most of the areas crossed by the route are characterized by low to moderate relief with broad ridges and shallow sweeping valleys (ER 1991). Elevations range from 150 to 1,100 ft above mean sea level (MSL).

The terrain covered by the route changes from east to west. West of Baileyville, the terrain is characterized by the flat lowland of the St. Croix valley and a few knobs of exposed bedrock remnants. West of the Baileyville, the terrain rises, and the number of bedrock remnants increases. These remnants form numerous mountains, such as Pocomoonshine Mountain, Second Lake Ridge, Fletcher Peak, Woodchopping Ridge, and Eagle Mountain, in Washington and Hancock counties. The relief of the mountains may be as high as 1,100 ft MSL, or several hundred feet above the surrounding areas.

Numerous streams and brooks flow generally to the south-southeast (Section 3.1.4). Wetlands are extensively distributed. Eskers, long narrow ridges deposited by streams in stagnant glaciers (locally called horsebacks), are commonly associated with major streams that cross the area.

As the proposed route enters Penobscot County, elevations decrease to less than 250 ft MSL. Bedrock remnants are less dominant. The route in this area is primarily confined to the drainage basin of the Penobscot River.

3.1.2.2 Geology

Three main types of bedrock are found in the area of the proposed route. More than 76% of the general area is underlain by calcareous sandstones, siltstones, interbedded sandstone, impure limestones, and low-grade metamorphic rocks (e.g., slate, phyllite) of Silurian and Devonian ages (ER 1991; Griffin 1976a,b; Ludman 1986; Ludman and Hill 1986). These types of bedrock occur primarily in the eastern third (Ludman 1986; Ludman and Hill 1986) and western third (Griffin 1976a,b) of the route. In between, the route is primarily underlain by Devonian granitic rocks, with minor amounts of sandstones. Mafic igneous rocks, which underlie about 1% of the traversed land, are exposed near Pocomoonshine Mountain.

Numerous folds and faults have been mapped in the general area (Osberg et al. 1985). These features trend in a northeastern-southwestern direction. Most of the bedrock is either exposed as bedrock remnants after glacial erosion or slightly buried by a layer of till from 10 to 20 ft thick (ER 1991). The till may be replaced by sand and gravel along the previous glaciofluvial channels.

The surficial geology of the proposed route was affected by the last Wisconsinan Glaciation about 13,500 years ago (Thompson and Borns 1985). Upon the retreat of the last glacier, a blanket of glacial till was left covering most of the area along the proposed route. The till is a heterogeneous mixture of sand, silt, clay, and boulders. Beds or lenses of stratified sediments may be present in places in the till. The topography in the till-covered areas is more or less controlled by the bedrock underlying the till.

Several glaciofluvial channels and their associated eskers are crossed by the proposed route. These channels include the Sunkhaze Stream, the Narraguagus River, the West Branch of Machias River, the Machias River, and the Little Musquash Stream. The eskers and glaciofluvial channels usually contain coarse-grained sand and gravel. Glaciomarine deposits were laid down in the St. Croix and Penobscot river valleys after the last glacier retreated. The deposits commonly are composed of clayey silt and present a flat to gently sloping landscape.

3.1.2.3 Geological Resources and Hazards

The proposed route does not cross any identified major peat resources. The only peat resource that is adjacent to the route is the Sawtelle Heath, which is located in Baileyville Township near Highway 1 (Cameron et al. 1984a,b; Lepage and Mullen 1982).

Sand and gravel resources are extensively distributed in eastern Maine, primarily along previous glacial drainage channels, where eskers are commonly found. Major sand and gravel deposits were mapped near Anderson Brook in Baileyville Township, Scott Brook in Township No. 21, Little Musquash Stream and Machias River in Township T37MD, West Branch of the Machias River and Narraguagus River in Township T34MD, and the Sunkhaze Stream in Township T32MD (Borns and Anderson 1982; Borns and Thompson 1981; Holland 1986a-e; Tolman 1981a,b).

Landslides and earthquakes would not pose potential hazards to a transmission line in the study area because of the relatively flat terrain crossed by the proposed route. No landslides are known in the area of the proposed route (Novak 1987). Between 1975 and 1986, the largest earthquake recorded in Maine was an event in May 1983 that measured 4.4 on the Richter scale. The epicenter of the earthquake was near Dixfield, about 85 mi west of Bangor (Johnston and Foley 1987). An event of magnitude 5 or greater would cause property damage. The area crossed by the proposed route is within seismic zone 2 (Corps of Engineers 1983). No structural damage from an earthquake would be expected in a seismic zone 2. The zone is rated as "minor risk," the second lowest risk rating next to the "no risk" rating.

In 1974, the Maine Legislature established the Maine Critical Areas Program to identify significant botanical, geological, zoological, and scenic areas worthy of preservation. A geologically significant area is one containing geologic features that are unique to Maine or New England and that have significant scientific or educational value (Caldwell 1982). The areas to be crossed by the proposed route contain no identified significant areas of rose quartz (Thompson 1977a), tourmaline (Thompson 1977b), bedrock fossils (Forbes 1977), esker segments (Borns 1979), or emerged glaciomarine delta localities (Borns 1977). Available information indicates that no critical exposure of bedrock occurs along the proposed route (Marvinney 1990).

3.1.2.4 Soils

Five major types of soil occur in the area crossed by the proposed route: glacial till, glaciomarine deposits, thin drift, glaciofluvial deposits, and swamp deposits. Table 3.1 briefly describes these types.

TABLE 3.1 Soil Types Crossed by the Proposed Route

Soil Type	Description
Glacial till	A mixture of sand, silt, clay, and stones forming sandy loam, stony loam, or stony silty loam
Glaciomarine deposits	Silt, clay, and local sand, forming silty loam, fine sand loam
Thin drift	Thin surficial deposits over-lying bedrock, or outcrops; soil may contain high percentage of bedrock fragments or stone
Glaciofluvial deposits	Near previous drainage channels and eskers, composed of sand and gravel
Swamp deposits	Peat, muck, clay, and silts in swamp, marsh, and bog

Source: BHE (1989).

In an evaluation of potential impacts of a proposed construction project, special consideration must be given to the highly erodible soil and prime farmland (as defined in the U.S. Department of Agriculture's Farmland Protection Policy Act of 1981 [Public Law 97-98]). Highly erodible soils often are loamy soils located on steep slopes. Accelerated erosion occurs when the protective surface vegetation of the highly erodible soils is cleared.

Although soil surveys have been published for Penobscot County (Soil Conservation Service [SCS] 1962, 1964), very little information has been published on the soils in the areas traversed by the proposed route in Washington and Hancock counties. On the basis of available information and the origin of surficial material and surface slope, it is estimated that the proposed route crosses a total of about 1 mi of highly erodible soil, encompassing a total area of 14-15 acres. Most areas of highly erodible soil crossed by the route are along steep stream banks and on steep slopes of eskers. Information from a soil map published by the Soil Conservation Service (SCS 1962), indicates that the area in Penobscot County traversed by the proposed route right-of-way includes about 51 acres of prime farmland. Only very limited soil data are available for Hancock and Washington counties; therefore, the amount of prime farmland crossed in those counties can only be approximated. Provided that the geologic history among all three counties is similar and given the scarcity of data for Hancock and Washington counties, it is assumed that the percentage of prime farmland relative to the total length of the transmission route is the same for Hancock and Washington counties combined as for Penobscot County. On the basis of these assumptions, the right-of-way would cross 8.7 mi (180 acres) of prime farmland in Hancock and Washington counties combined. Thus, the proposed route would cross a total of about 230 acres of prime farmland in the three counties. This represents about 14% of the total area of the right-of-way.

3.1.3 Land Use

Land use activities along the proposed route consist of (1) commercial forestry, (2) dispersed recreation, (3) scattered residential, commercial, and industrial development, (4) military use, (5) transportation and utility rights-of-way, and (6) agriculture. The areal extent for each land use category within the three-county study area (Penobscot, Hancock, and Washington counties) and the state of Maine is provided in Table A.1 (Appendix A).

3.1.3.1 Forestry

Forest-related activities strongly dominate land use throughout most of Maine, which is considered one of the most heavily forested states in the nation (Ferguson and Kingsley 1972). Harvesting and processing of timber have long been important to the economy of the state, and forest industries remain the leading manufacturing sector in terms of value of product (Nevel et al. 1985; Colgan et al. 1986). Most of the forest industry owners harvest for sawlogs, pulpwood, and firewood (Birch 1982).

The land area within the three-county study area totals about 4.83 million acres, of which about 89% is classified as forestland. Most of this forestland (96%) qualifies as commercial timberland (Brooks et al. 1986). The two principal forest types along the proposed route are (1) mixed forest of deciduous and coniferous species (white and yellow birch, red and sugar maple, beech, hemlock, white spruce, and balsam fir) and (2) xeric coniferous forest (red and white pine or red spruce, balsam fir, and hemlock). In addition, there are two lesser forest types of (1) deciduous hardwood forest (white and yellow birch, red and sugar maple) and (2) forested wetlands (red and black spruce or northern white cedar) (ER 1991).

A 1982 inventory shows that 96% of the state's 17 million acres of timberland is held in various classes of private ownership, while only 4% of the timberland is publicly owned (Birch 1982). Private and public timberland ownership for the three-county study area is listed in Table A.2 (Appendix A).

Companies or individuals operating primary wood-using plants constitute a major class of private timber ownership. The majority of the commercially forested lands located along the proposed route are owned by Champion International, Inc., and Georgia-Pacific Corp. (extending along 70% of the proposed route), with the remaining lands owned by 11 different landowners. In addition, noncommercial forestry lands are owned by the Maine Forest and Logging Museum and various private landowners (ER 1991).

3.1.3.2 Agriculture

The amount of land used for agriculture in Maine has decreased markedly since the turn of the century. In 1900, about 65,000 farms existed in Maine, with about a third of the state's land area used for agricultural production (Colgan et al. 1986). Currently, only about

10% of these farms still exist, with less than 3% of state land actually used for crop production; open land constitutes only 8% of the land area within the state. Over the past 15 years, the number of farms and amount of acreage have stabilized. Only 3-6% of the land within the three-county study area is devoted to agricultural use (Brooks et al. 1986; ER 1991). Most of the agricultural use near the proposed route is located along the U.S. Interstate-95 (I-95) highway corridor. Much of this area has been planted in hay, with the remaining areas open pastureland. Agricultural use within the three-county study area is summarized in Table A.3 (Appendix A).

3.1.3.3 Recreation

Most recreational resources within the study area are associated with the natural and scenic features of the region (e.g., mountains, lakes, and streams). These resources are either linear (e.g., rivers, trails) or site-specific (e.g., lakes, camps) and are used for outdoor recreational activities. Much of the participation in outdoor recreation in Maine involves individuals engaged in various types of dispersed recreational activities, such as fishing, hiking, camping, hunting, river touring (canoeing, boating, kayaking), auto-touring, bicycling, snowmobiling, all-terrain vehicle use, and cross-country skiing.

The proposed route extends between the Penobscot and St. Croix rivers and includes the Machias and Narraguagus river valleys. Most recreational use along the proposed route consists of water-related activities in rivers, streams, and lakes. During spring and early summer, many recreational activities (e.g., canoeing and fishing) occur along the rivers and streams. Ponds and lakes and associated campsites are visited with greater frequency later in the summer when stream levels and flows begin to decline. Important wildlife-related activities include wildlife viewing (e.g., eagles, ospreys, and loons), trapping (e.g., beaver, muskrat, and fox), and hunting (e.g, deer, bear, and waterfowl) (ER 1991; Land and Water Associates 1989).

A 1989 recreational survey conducted in the study area indicated that almost a third of the respondents owned or leased property in the area, with most persons remaining in the area from several hours to several days per visit. Major recreational activities included fishing, pleasure driving, wildlife viewing, camping, canoeing, boating, berry picking, and hunting (ER 1991).

The type and level of recreational use at the lakes, streams, and woodlands located along the proposed route also are related to the easy access afforded by Stud Mill Road (a two-lane gravel road), which serves as an important transportation link between the St. Croix and Penobscot river valleys. The public is allowed free access along this privately owned timber-haul road and along the connecting haul roads, which are owned and maintained by Georgia-Pacific Corp. and Champion International, Inc. However, the road is closed from March 15 to May 12 to limit road damage caused by haul trucks during the spring. Recreational use and facilities located along the proposed route are described in Table 3.2.

TABLE 3.2 Recreational Resource Areas and Use along the Proposed Route

Resource Areas	Type and Relative Amount of Use
St. Croix River/Woodland Flowage	Most heavily fished area of the proposed route; boat access; guided canoe trips; out-of-state use
U.S. Route 1, other roads, woods, woodlands	Among the most heavily used areas for hunting and trapping
South Princeton Road woodlands	One of the most heavily used areas for hunting and trapping
Pocomoonshine Lake	Developed camps along the eastern shore with space for 4-5 camping parties; among the most heavily hunted and trapped woodlands
Allen Stream, Lewys Brook	Moderate use for fishing
Huntley Brook	Relatively high use for fishing; suitable for canoeing; nearby woods heavily hunted and trapped
Big Lake	Heavily fished area; camps, commercial camps; out-of-state use
Clifford Lake and Stream	Heavily fished, suitable for canoeing, several camps; public campground
Monroe Lake, East and West Monroe ponds	Primitive campsites, heavily fished
Machias River and Machias lakes	One of Maine's 10 backcountry canoe trips; 15 camps (First and Second lakes); boat access on First Machias Lake; campsites, boat access on Second Machias Lake; 3 camps on Fifth Machias Lake; guided canoe trips
Fletcher Brook and associated woodlands	High use for bear hunting; heavily fished
Burnt Land Lake	Moderately used campground
Sabao Lake	12 camps; campground; moderately used for fishing
Green Lake, Campbell Lake	1 camp at Green Lake; 3 camps at Campbell Lake
Deer Lake, Narraguagus River	5 camps; heavily used campground (Maine Forest Service); boating; canoeing

TABLE 3.2 (Cont.)

Resource Areas	Type and Relative Amount of Use
Jimmies Mountain	4-wheel drive access only; no reported use
Alligator Lake and Stream	5 camps; heavily used for ice fishing
Main Stream	Moderately to heavily used for canoeing
Great Pond	U.S. Air Force Recreation area
Pickerel Pond	Boat launch
Sunkhaze Stream and National Wildlife Refuge	Boat launches on northern and southern sides with relatively high use
Baker Brook access road	Amount of deer hunting high because of large deer populations near settled areas
Milford/Bradley woodlands	Amount of deer hunting high because of large deer populations near settled areas
Great Works Stream	3 camps; high hunting near Bradley, particularly deer
Peaked Mountain and trail	Highest use for hiking along the proposed route
Eddington/Orrington woodlands	High hunting activity; high use for fishing, camping, and boating at Fields Pond

Sources: ER (1991); DeLorme Mapping Co. (1987).

3.1.3.4 Residential, Commercial, and Industrial

Only about 8% of the land area within the three-county study area is used for residential, commercial, and industrial purposes (Table A.1, Appendix A). Most of the land along the proposed route is uninhabited. Most of the inhabited land occurs along the westernmost portion of the proposed route and, to a lesser extent, near the eastern end. The city of Bangor has the largest concentration of residential, commercial, and industrial facilities in the study area. Communities located in the vicinity of the proposed route and their populations are listed in Table E.1 (Appendix E).

Industrial development is essentially limited to paper companies. Some commercial development is located within the small towns and is generally associated with supporting the needs of the local communities, the timber industry, and recreational activities. Mining activities within the three-county study area are very limited and generally involve small sand and gravel operations.

3.1.3.5 Transportation and Utility Corridors

Transportation within the three-county study area consists of several state and federal highways and numerous improved and unimproved public and private roadways. The proposed transmission corridor basically parallels Stud Mill Road for much of the route (Figure 1.1). Average daily traffic counts for the major roadways within the vicinity of the proposed route are listed in Table 3.3. Several small airports are located within the vicinity of the proposed route. Restricted airspace is located about 12 mi east of Millinocket and extends to about 12 mi east of Machias valley. The most notable existing transmission line in the area is the first 345-kV tie line to New Brunswick, which extends between Monument Brook at the U.S./Canadian border near Orient and the Orrington substation south of Bangor. The proposed route would share right-of-way with this and several other lower voltage lines for the last 12.2 mi of the corridor (Section 2.1.3, Figures 2.3 through 2.7).

3.1.3.6 Special Uses

A large tract of land within the study area has at various times been proposed for development and use for training purposes by the Maine Army National Guard. This proposed facility, referred to as the Deep Wood Training Area, would consist of a 711,000-acre tract owned by Champion International Corp. and the 7,600-acre Deep Wood Cantonment Area owned by the state. The training area would be used for military ground and aerial maneuvers, excluding artillery firing and aerial bombing (ER 1991).

3.1.4 Hydrologic Resources

3.1.4.1 Surface Water

The area traversed by the proposed route has extensive surface water resources (ER 1991). The route crosses the Eastern Coastal drainage basin, which includes the St. Croix River, the East Machias River, the Machias River, the Narraguagus River, the Union River subbasins, and the Penobscot River drainage basin (Figure 3.1). The route has a total of 130 crossings of rivers, streams, and brooks. The water bodies crossed include 3 major rivers (the St. Croix, the Machias, and the Narraguagus), 10 named perennial streams, 20 named perennial brooks, and 13 intermittent streams (Table B.1, Appendix B). A few streams are crossed several times. No ponds or lakes are crossed, but 22 ponds and lakes are located within 1 mi of the route (ER 1991).

The lowest stream flows in the region occur in winter and the highest in spring (Bartlett et al. 1989). The maximum recorded discharges ofthe St. Croix River at Baring and the Narraguagus River at Cherryfield are 23,500 ft^3/s and 10,400 ft^3/s, respectively (both in 1961). The 30-year average discharge of the St Croix River is 2,658 ft^3/s, while the 41-year average discharge of the Narraguagus River is 498 ft^3/s (Bartlett et al. 1989). The flows of

TABLE 3.3 Annual Average Daily Traffic on Public Roads in the Vicinity of the Proposed Route

			Annual Average Daily Traffic[a]			
Road Name	Reference Point	Town	1986	1987	1988	1989
U.S. Route 1	Northwest of South Princeton Road intersection	Princeton	2,780	-[b]	-	3,720
	Southeast of South Princeton Road intersection	Princeton	2,630	-	-	3,500
South Princeton Road	Between Route 1 and Stud Mill Road	Princeton	200	-	-	220
Stud Mill Road	Near South Princeton Road intersection	Princeton	-	-	-	50
Route 9	0.25 mi east of Route 178 intersection	Eddington	4,870	3,120	5,540	-
	West of Holden Road intersection	Eddington	-	4,000	4,420	-
U.S. Route 1A	Intersection with railroad tracks, east of Route 395	Brewer	12,060	-	-	-
Wiswell Road	West of Green Point Road intersection	Brewer	-	-	480	-

[a] Number of vehicles.

[b] Data not available.

Source: Unpublished data provided by Maine Department of Transportation.

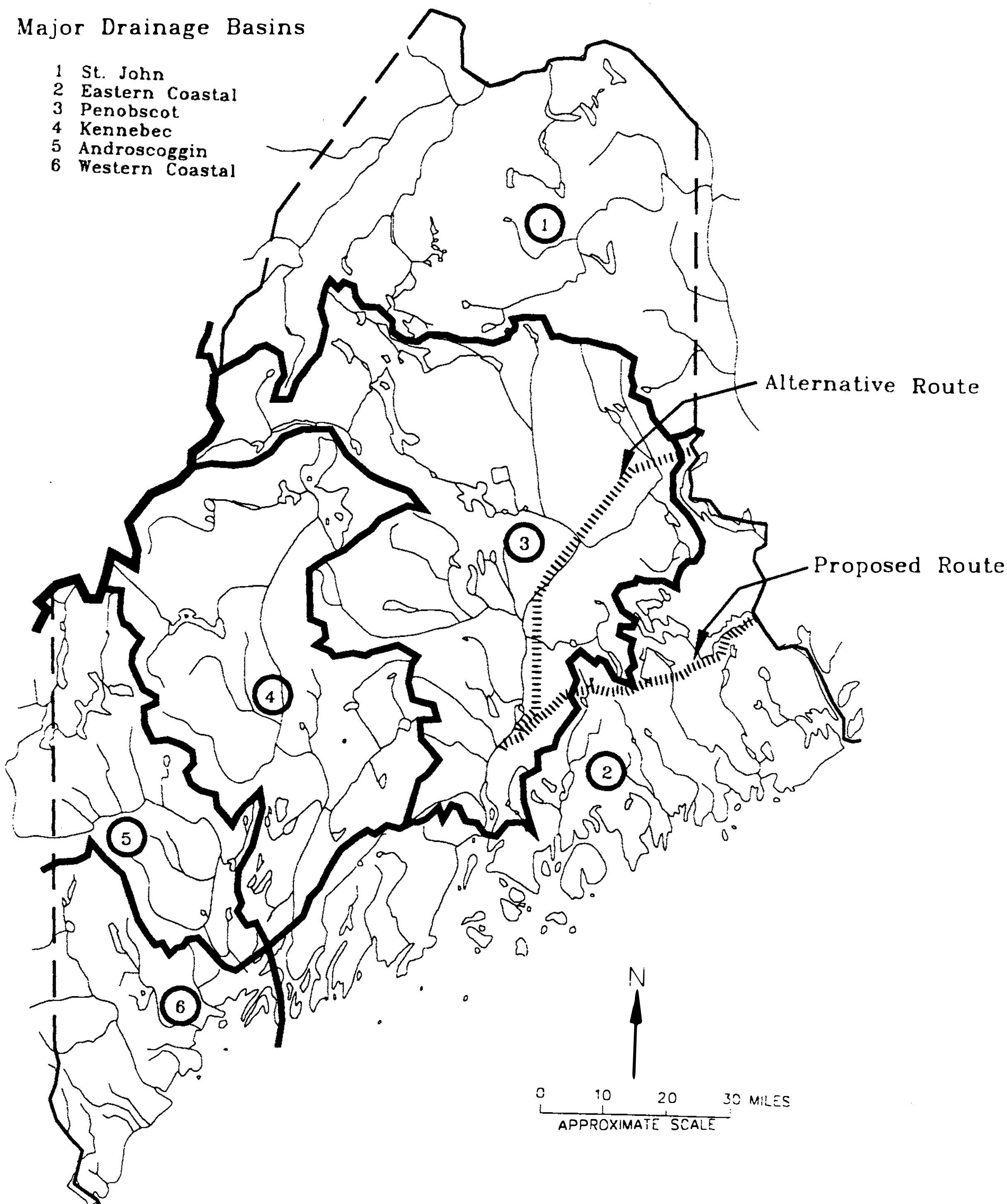

FIGURE 3.1 Major Drainage Basins in Maine (Source: Maine Department of Environmental Protection 1990)

the St. Croix and Narraguagus rivers at the proposed crossing sites are estimated to be about 85% and 10% of these recorded discharges, respectively. These values are based on the assumption that flows at the proposed river crossings would be directly proportional to the drainage area above the crossings.

The Maine Water Pollution Control Law of 1989 (Title 38, Chapter 3) authorized the Maine Department of Environmental Protection (MDEP) to control, abate, and prevent the pollution of the air, waters, and coastal flats and to prevent diminution of the highest and best use of the natural environment of the state. The Water Quality Control Board of MDEP has classified fresh surface water bodies into five categories according to water quality (Title 38, Article 4-A, Chapters 465 and 465-A, Appendix A). Class AA is the highest classification, followed by classes A, B and C. Class GPA is the sole classification for natural ponds and lakes.

The classification of the water bodies crossed by the proposed route is summarized in Table B.1 (Appendix B). Among the three major rivers crossed by the proposed route, the Machias River and Narraguagus River belong to class AA. The tributaries of those rivers, as well as the tributaries feeding Pocomoonshine Lake, are classified as A waters, accounting for about 55% of the number of water bodies crossed by the routes. Tributaries feeding the Union River received class B designations. The St. Croix River (the third major river crossed by the proposed route) at the point of crossing and the tributaries of the Penobscot River entering from the east and in the south of the Blackman Stream are classified as C waters (ER 1991). Class B and class C water bodies each account for 10% of all water bodies crossed by the proposed route, while class A waters account for 80%.

The Natural Resources Protection Act (NRPA) also has classified Maine's rivers into classes A, B, C, and D in terms of unique natural and recreational characteristics and on the basis of resource values of geologic/hydrologic features, critical ecological resources, scenery, history, degree of river development, fisheries, and recreational boating. The St. Croix, Machias, and Narraguagus rivers are designated as class A rivers, the highest classification in the program (ER 1991). Outstanding river segments designated under a special protection program of the NRPA are not crossed by the proposed route. No class B rivers are crossed by the route.

The proposed route would not cross any designated Wild and Scenic Rivers.

3.1.4.2 Groundwater

Groundwater occurs in the bedrock and unconsolidated deposits in the vicinity of the proposed route. The deposits include till, glaciofluvial deposits, and glaciomarine deposits. The glaciofluvial deposits are composed primarily of sand and gravel. They are the major source of groundwater in Washington, Hancock, and Penobscot counties. High yield and high hydraulic conductivity normally are encountered in the sand and gravel aquifers. A yield of more than 10 gal/min is common, and as much as 1,250 gal/min has been reported (Prescott 1963). High-yield aquifers are commonly located in the vicinity of rivers, streams, and other surface water bodies. The water quality of the aquifers is generally good. Major sand and gravel aquifers are associated with eskers. Their locations are shown in Figure 3.2.

Limited data indicate that the yield of groundwater in till, glaciomarine deposits, and bedrock in the vicinity of the proposed route is low, generally less than 10 gal/min (Caswell and Lanctot 1976, 1978; Prescott 1963). The heterogeneous nature of the till and the glaciomarine deposits may result in various yields in these materials. In granite, limestone, and metamorphic rocks, groundwater usually is present in secondary openings, such as fractures, cracks, bedding planes, and solution openings. Groundwater yield is higher in limestone, slate, and phyllite than in granite. The water table in the area is shallow, ranging from a few feet to 20 ft below land surface (Bartlett et al. 1989), and fluctuates from low in summer to high in late fall (Prescott 1963).

Only limited groundwater quality data are available for Maine. In nonforested areas, underground storage tanks and agricultural contaminants are two major sources of groundwater pollution (Maine Department of Environmental Protection 1990). For example, pesticides and nitrates are the main agricultural groundwater contaminants in the vicinity of blueberry barrens in Hancock and Washington counties.

A total of 36 water wells have been identified within 500 ft of the proposed route. All of these wells are in Penobscot County (15 in Brewer, 3 in Holden, and 18 in Eddington). Only one capped well is in the proposed right-of-way (ER 1991).

Significant sand and gravel aquifers are protected in Maine. As defined by the Maine State Legislature (38 MRSA Chapter, Section 482, 4-D), a significant sand and gravel aquifer is ". . . a porous formation of ice-contact and glacial outwash sand and gravel that contains significant recoverable quantities of water which is likely to provide drinking-water supplies." The sand and gravel aquifers traversed by the right-of-way of the proposed route are shown in Figure 3.2; they are estimated to total 6.3 linear miles and include a total area of 130 acres.

3.1.5 Biotic Resources

3.1.5.1 Terrestrial

Vegetation

The region traversed by the proposed route is within the Northern Hardwoods-Spruce Forest Region (Galvin 1979). This region is typified by forests dominated by hemlock (with some balsam fir and white spruce) and a mixture of such hardwood tree species as sugar maple, beech, and yellow birch (Galvin 1979). Typical woody understory plants include mountain and striped maples, alternate-leaved dogwood, bunchberry, and viburnum.

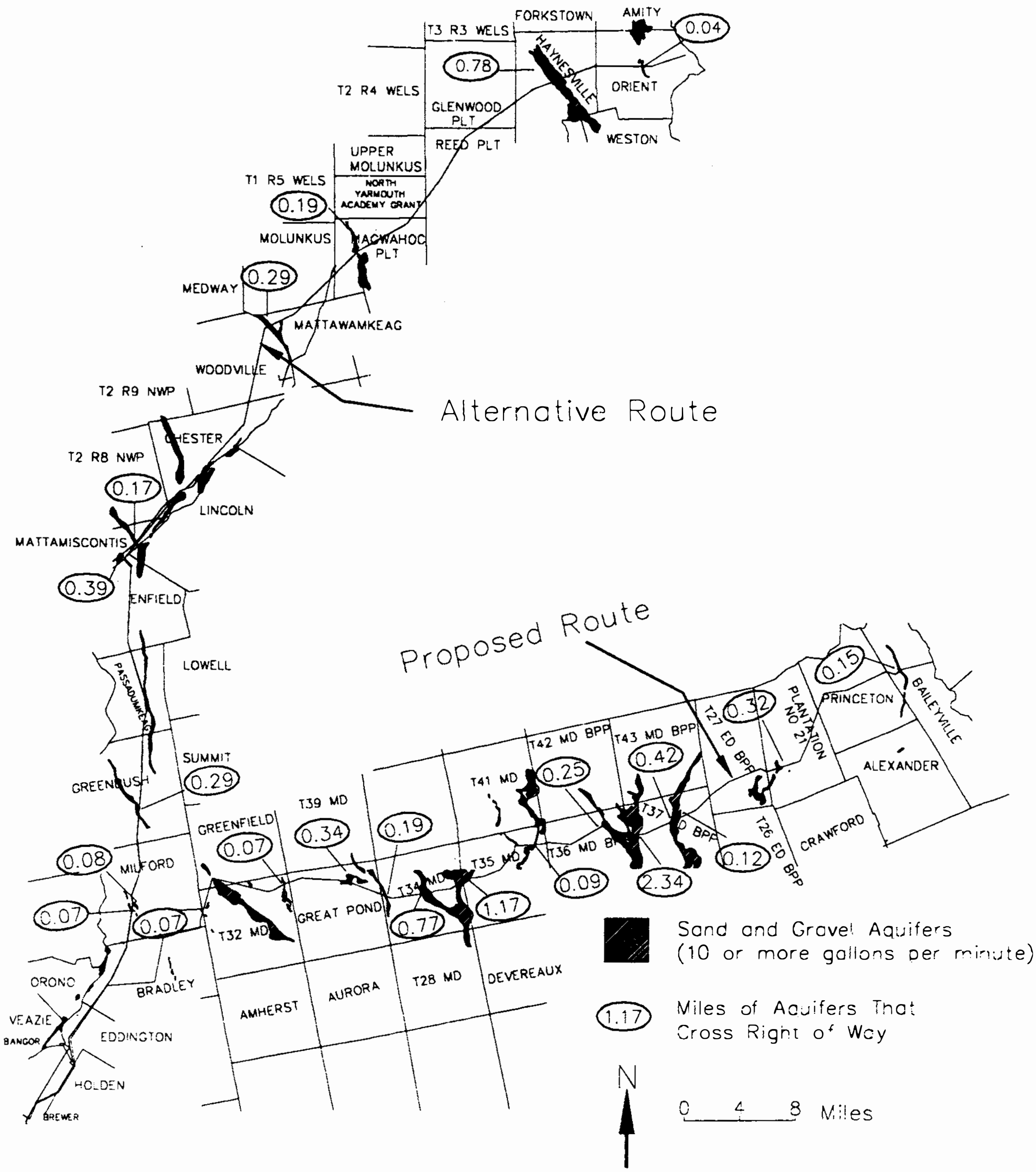

FIGURE 3.2 Locations of Major Sand and Gravel Aquifers (locations of aquifers coincide with the locations of eskers) (Sources: Based on data from Borns and Anderson 1982; Borns and Thompson 1981; Holland 1986a-e; Tolman 1981a,b.)

Common herbaceous plants are white baneberry, maidenhair fern, rue-anemone, twinflower, and trillium. Within this region, forest composition can vary, depending on disturbance history, silvicultural practices, soil type, slope, and aspect.

Nearly 90% of the proposed route is forested, consisting of two major forest types: mixed forest and coniferous forest (Table 3.4). The former includes such deciduous trees as paper birch, yellow birch, red maple, and beech and a conifer component consisting of hemlock, balsam fir, and white spruce. Typical understory and herbaceous plants include sheep laurel, fly-honeysuckle, wintergreen, creeping snowberry, trillium, asters, ferns, and dalibarda. The mixed forest is most common at the eastern and western ends of the proposed route. Coniferous forests (more common in the center of the route) are dominated by white and red pine, with a minor hardwood component (especially birches and poplars). Typical understory and herbaceous plants include sheep laurel, blueberry, huckleberry, sweet fern, and bracken fern (ER 1991).

Less common vegetation types along the route include deciduous hardwood forests, boreal spruce-fir forest, and small areas of successional old-field habitat. These old fields have developed on abandoned agricultural land and can be dominated in early successional stages by numerous herbaceous plants (including Queen Anne's lace, butterfly weed, bracken

TABLE 3.4 Acreage of Upland Vegetation Types along the Proposed Route

Vegetation Type	Number of Acres	Percentage of Route
Mixed forest	456	28.1
Coniferous forest (including boreal)	333	20.6
Clear-cut or regenerating forest	258	15.9
Deciduous forest	129	7.9
Open land (old-field and corridor)	27	1.6
Agricultural land (in current use)	14	0.9
Other habitats and land uses[a]	406	25.0
Total route	1,623	100

[a] Includes wetlands; surface waters; roads; and commercial, industrial, and residential properties.

Source: ER (1991).

fern, and goldenrod) and shrubs (e.g., serviceberry, blueberry, and pin cherry). As succession proceeds, these species are typically replaced by such trees as paper birch, trembling aspen, and black cherry. Finally, many of the species typical of the regional forest invade and become dominant.

Nearly 85% of the proposed route crosses managed forests ranging in age from recent clear-cuts, to young second- and third-growth stands, to older managed stands containing species typical of the mature regional forest. Consequently, on-going forestry practices have affected, and will continue to affect, the character of this landscape.

A relatively undisturbed deciduous hardwood forest (beech, sugar maple, birch) exists along the proposed route near Eagle Mountain. Parts of this forest have been harvested commercially. The route passes through a commercially managed second-growth area of the forest and near, but not through, the undisturbed forested areas. The rare (not protected) Allegheny vine has been reported in the vicinity of Eagle Mountain.

Wildlife

A high diversity of wildlife species is expected because of the variety of habitat types present along the proposed route (DeGraaf and Rudis 1986; ER 1991). Common mammals would include the white-tailed deer, moose, black bear, red squirrel, snowshoe hare, and Eastern chipmunk. Common furbearers to be expected include the beaver, river otter, muskrat, and striped skunk. Table C.1 (Appendix C) lists the mammal species that range within the project area.

Table C.3 (Appendix C) lists the bird species that range within the project area. Most raptors typical of eastern Maine (e.g., American kestrel, broad-winged hawk, and osprey) are likely to be present in the vicinity of the proposed route. Four osprey nests have been observed at the oxbow on the Narraguagus River south of the proposed route (ER 1991). Osprey have also been observed in the Penobscot and St. Croix river valleys (ER 1991). The barred owl and red-shouldered hawk typically inhabit wooded swamps (DeGraaf and Rudis 1986). Because this type of habitat occurs along the route (Section 3.1.5.3), these uncommon raptors could also occur. Common forest-dwelling migrants known to occur in the vicinity of the proposed right-of-way include the red-eyed vireo, ovenbird, veery, hermit thrush, and several species of warbler (BHE 1991b).

Birds known to be year-round residents in the area include the blue jay, black-capped chickadee, red-breasted nuthatch, eastern wood pewee, and ruby-crowned kinglet (BHE 1991b). Such birds as the tree swallow, song sparrow, house sparrow, and red-winged blackbird should also be common. Less common birds that could be present because of the availability of suitable habitat (DeGraaf and Rudis 1986) include the gray jay (coniferous and mixed forests and coniferous swamps), black-backed woodpecker (coniferous forests, logged areas, and swamps with large standing dead trees), and boreal chickadee (coniferous woods, swamps, and bogs).

The woodcock, an important migratory game bird, has been observed near wetlands (BHE 1991b), and excellent woodcock habitat has been noted near Bradley (BHE 1991a). Because of the lack of extensive boreal forest along the proposed route, spruce grouse are not expected to be common; however, a hen and chicks were seen in a 12-acre patch of boreal forest west of Huntley Brook in the immediate vicinity of the proposed route (BHE 1991b).

Amphibians and reptiles, such as the spring peeper, bullfrog, gray treefrog, common snapping turtle, Eastern smooth green snake, and garter snake, are likely to occur along the entire proposed route because of the presence of appropriate woodland and wetland habitats (DeGraaf and Rudis 1986). Table C.2 (Appendix C) lists the amphibian and reptile species that range within the project area.

Twelve areas that have the potential to function as deer yards (deer wintering areas) occur within 0.5 mi of the proposed route. Deer yards consist primarily of coniferous cover and are critical winter habitat for deer, providing both shelter and food. The proposed right-of-way intersects portions of six of these areas, covering about 21 acres in the right-of-way. The total acreage of these six areas (including the portions that extend beyond the proposed right-of-way) is about 303 acres. The other six areas total more than 97 acres. The total acreage of the 12 areas in the right-of-way and within 0.5 mi is about 400 acres. The individual sizes of these 12 areas range from slightly more than 2 acres to about 123 acres (ER 1991). None are state-designated deer wintering areas (Murphy 1992).

3.1.5.2 Aquatic

Only 27 indigenous species of freshwater fish, including landlocked Atlantic salmon, are found in eastern Maine. In addition, some freshwater game fish have been introduced (e.g., rainbow and brown trout and smallmouth and largemouth bass). Anadromous fish of eastern Maine include the Atlantic (sea-run) salmon, blueback herring, alewife, American shad, sea lamprey, and Atlantic sturgeon. However, sturgeons do not occur inland (BHE 1991b).

Maine has about 32,000 mi of streams (averaging about one stream mile per square mile of land). About 25,600 mi of these streams contain coldwater fisheries, with about 70% (more than 22,000 mi) of the streams considered brook trout habitat. Within the brook trout streams, about 2,300 brook trout occur per mile (1,300 brook trout [or 39.8 lb] per acre for all sizes) (Fenderson 1986).

About 92 streams in Maine support brown trout (760 stream miles, 4,635 acres), with an overall density of 581 fish per acre. Most brown trout stream habitat is shared with brook trout, but brown trout are also found in some streams too warm for brook trout (Pierce 1986).

Within the project area, about 130 permanent and intermittent streams would be crossed by the proposed route (Section 3.1.4.1). Most of these streams are known to contain, or potentially could contain, coldwater fisheries. Several of the streams contain either a warmwater fishery or a combination of warmwater and coldwater fisheries (ER 1991). Some of the streams that would be crossed by the proposed transmission line flow into or out of lakes or ponds that are located within a few thousand feet of the route centerline (Section 3.1.4.1). Most of these lakes and ponds contain warmwater fisheries.

Brook trout, which usually spawn from October to November (Andrews 1986), are the principal coldwater game fish in the project area. Essentially every perennial stream (except the St. Croix River) crossed by the proposed route contains brook trout. Lanpher Brook in Washington County may be the highest quality brook trout stream in the project area (ER 1991). The region containing the proposed route also has 16 brown trout streams (129 stream miles). Within the immediate vicinity of the route, brown trout fishing opportunities are limited to the Hancock County area (Pierce 1986).

The larger rivers in the project area and several of their tributaries are capable of supporting several anadromous fish species, such as Atlantic salmon and alewife. The alewife is the most numerous of the anadromous fish migrating up Maine's coastal streams and rivers (including the St. Croix River) and is an important food resource for bald eagles. Wild populations of Atlantic salmon originally were found in all of the watersheds crossed by the proposed project before the installation of dams on the St. Croix, Machias, Narraguagus, and Penobscot rivers. Potential spawning habitat still occurs in most streams crossed by the proposed route. However, the only streams containing spawning habitat requirements (i.e., loose gravel in swift current) are the Machias and Narraguagus rivers and Alligator, Sunkhaze, and Blackman streams. Other streams that potentially harbor Atlantic salmon include Fletcher Brook, Wiley Brook, tributaries of Sunkhaze Stream, Birch Stream and its tributaries, Titcomb Brook, Eaton Brook and its tributaries, Felts Brook and its tributaries, and the unnamed tributary to Fields Pond (BHE 1991b). Fish ladders have been installed at dams on the large rivers (such as the St. Croix) to allow migrating fish to pass. Most Atlantic sea-run salmon enter rivers in spring, but the actual spawning period can extend up to October or November (Everhart 1966).

The principal warmwater game fish in the area include smallmouth and largemouth bass, yellow perch, brown bullhead, white perch, burbot, and chain pickerel. Yellow perch and brown bullhead occur in all major river drainages. The yellow perch is a serious competitor with more desirable coldwater species (Bonney 1986). Burbot occurs in some of the larger rivers and small streams, although it is more typically found in large, deep lakes (Roy 1986). The white perch occurs primarily in lakes and ponds, but some live in the major rivers. Some of the smaller streams provide white perch fishing, although the fish probably come from nearby lakes (Smith 1986). The chain pickerel occurs in most habitat types in the southern half of Maine. Predation by chain pickerel is a problem affecting coldwater sport species (Brokaw 1986). Other warmwater species expected to occur in the area include pumpkinseed and redbreast sunfish, white sucker, longnose dace, creek chub, blacknose dace, common shiner, and northern redbelly dace (Roy 1986; Everhart 1966).

The following streams crossed by the proposed route contain warmwater game fish: St. Croix River (smallmouth bass and chain pickerel), Clifford Stream (smallmouth bass, white perch, turbot, and chain pickerel), Machias River (smallmouth bass and chain pickerel), unnamed tributary to Fifth Machias Lake (white perch, yellow perch, chain pickerel, and brown bullhead), stream from Pughole Pond to Burnt Land Lake (white perch, yellow perch, chain pickerel, and brown bullhead), stream from Green Lake to Campbell Lake (white perch and chain pickerel), Main Stream (smallmouth bass and chain pickerel), and Blackman Stream (smallmouth bass and chain pickerel) (ER 1991).

3.1.5.3 Wetlands

Wetlands are ecological systems where the water table is usually at or near the surface or where land is at least periodically covered by shallow water (Cowardin et al. 1979). A combination of low relief and abundant precipitation has led to the formation of many wetlands within the project area. About 374 acres of wetlands are within the proposed transmission line corridor. This acreage is about 23% of the route (258 delineated wetland segments totalling a linear distance of 19.76 mi). The proposed route also would cross 17 other very small wetlands (e.g., less than a few feet wide) that were not delineated. No intrusions of any of these very small wetlands are planned (BHE 1991a). Wetlands that would be crossed by the proposed line are principally marshes (vegetation dominated by grasses, reeds, rushes, sedges, or other nonwoody plants) or swamps (vegetation dominated by shrubs and trees). Detailed information on the wetlands is given in Section D.2.1 (Appendix D).

3.1.5.4 Threatened and Endangered Biota

Threatened and endangered and other protected plant and animal species that could occur along the proposed route are listed in Table C.4 (Appendix C). No federally listed threatened or endangered plant species are known to occur along this route (Beckett 1991), although the Orono sedge (a federal category 2 species) has been historically collected from the Penobscot River Valley in the general vicinity of the existing power line (BHE 1989). One state-listed plant species, a single plant of white adder's mouth (threatened), was observed along the proposed route (ER 1991). This species prefers calcareous soils and is generally found in white cedar swamps; however, the observation site in the right-of-way was on a slope with groundwater discharge.

The only federally listed animal species reported from the project area is the endangered bald eagle (ER 1991). A biological assessment for the bald eagle is provided in Section C.2 (Appendix C). Five federal candidate vertebrate species could occur in the project area: Atlantic salmon, northern goshawk, lynx, northern bog lemming, and small-footed myotis. The anadromous Atlantic salmon spawns in freshwater streams. The young remain in freshwater for two or three years and then descend to sea, spending one or more years there before returning for freshwater spawning runs. The salmon return to freshwaters from spring to early autumn, with spawning occurring in October to November (Scott and Crossman 1973). In the project area, the Machias and Narraguagus rivers provide essential spawning and nursery habitat. Other smaller streams within these watersheds and other rivers crossed by the proposed project may also provide salmon spawning and nursery habitat

(Beckett 1994). Habitat for the northern goshawk is the interior of remote, dense coniferous and mixed forests, special habitat requirements being extensive mixed woodlands with large trees for nesting. The lynx inhabits the interiors of extensive, unbroken forests that are isolated from human activity. Lynx favor swampy, boggy, or rocky areas. Habitat for the northern bog lemming includes sphagnum bogs, damp weedy meadows, mossy spruce woods, and hemlock and beech forests. The small-footed myotis occurs in or near woodlands in caves, mine tunnels, buildings, or rock crevices (DeGraaf and Rudis 1986). Three federal candidate invertebrate species are also known to occur in the project area: brook floater, dorcas copper butterfly, and tomah mayfly (Beckett 1991). Habitats for these species are larger streams and rivers, fields, and small temporary stream overflow pools, respectively.

The northern black racer, a state endangered snake species, could occur along the proposed route. It requires large tracts of mixed old-fields and woodlands. Although these habitat types are common in the area (Table 3.4), the range of the northern black racer apparently does not encompass the proposed route (DeGraaf and Rudis 1986). In addition to the small-footed myotis, six other bat species, all of indeterminate status (Table C.4, Appendix C), could reasonably be expected to occur in the area of the proposed right-of-way because of the presence of suitable summer habitat (hollow trees in deciduous or coniferous forest, depending upon the species of bat) (ER 1991). Several other wildlife species that are of indeterminate status or on the state watch list could also occur in the project area (Table C.4, Appendix C).

3.1.6 Socioeconomics

The principal political jurisdictions within the vicinity of the proposed route consist of counties, which are further subdivided into towns or into unorganized territories or townships. The proposed route crosses portions of three Maine counties: Hancock, Penobscot, and Washington. In the socioeconomic sections of this document, this three-county area is often referred to as the *region of influence.*[1]

3.1.6.1 Population

Populations of both Hancock and Penobscot counties have increased since 1970, and projections indicate that by 2010, the population in Hancock County should nearly double from its 1970 levels (Table E.1, Appendix E). The population of Washington County has remained nearly constant since 1970 and is expected to stay the same through 2010. Future populations in more rural areas of the region of influence are projected to decrease, while populations in small towns surrounding the more urban areas in Penobscot County are expected to increase.

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[1] The alternative route passes through Aroostook and Penobscot counties. This section contains information on Hancock, Penobscot, and Washington counties. Information pertaining to the affected environment for Aroostook County is presented in Section 3.2.6. To simplify the presentation, all tabular materials in Appendix E contain information on all four counties.

In terms of absolute numbers, Penobscot County, which includes the Bangor metropolitan area and is located in the western portion of the project area, has the largest number of people, while Hancock and Washington counties, located in the central and eastern portions of the project area, respectively, have the fewest people (Table E.1, Appendix E).

3.1.6.2 Economics and Employment

Employment in the state of Maine has increased by about one-third (28.8%) in the last decade, while unemployment has decreased about 15% (Table E.2, Appendix E). The pattern has been generally similar at the county level. In Hancock County, employment rose about 43%, while unemployment decreased about 20%. In Penobscot County, employment increased by just over 8%, while unemployment dropped by about 40%. Employment in Washington County has stayed nearly constant, with a decrease of 3.4%, and unemployment has dropped by about one-third (32.4%). For all of the counties, the lowest rates of unemployment over the 1980-1990 period occurred during the summers, reflecting the importance of seasonal employment in this area. The relatively slow rate of growth in employment relative to population growth is attributable to increased automation of businesses (McGonigle 1989).

For the state as a whole, the largest employer over the past decade has been manufacturing. This sector has accounted for an average of about 25% of total employment, although the percentage has decreased slightly in recent years. The services sector is second, accounting for about 20% of the total; this sector has increased slightly over the decade. Mining has accounted for the smallest proportion of the work force, at about 2-5% over the last 10 years. Construction, which has accounted for about 5% of employment, has grown slightly in the last decade. The employment distribution in Penobscot and Washington counties generally follows that of the state, although Washington County has had larger increases in construction in the last 10 years (Table E.3, Appendix E). In contrast, the largest employment sector in Hancock County is services (on average just over 25%); followed by retail trade (about 22%), which has increased slightly in the 1980s; and then manufacturing (about 18%).

Residents within the three-county region of influence are economically less well off than residents of the state as a whole, although per capita income increased in all three counties from 1979 to 1987 (Table E.4, Appendix E). Statewide per capita income increased from $5,766 in 1979 to $10,478 in 1987. In Hancock County it increased from $5,411 to $9,965, in Penobscot County from $5,593 to $9,876, and in Washington County from $4,581 to $8,126 (U.S. Bureau of the Census 1982, 1984, 1986, 1988).

3.1.6.3 Housing

The total number of housing units in the region of influence increased between 1980 and 1990 — from 25,062 to 30,396 in Hancock County, from 53,415 to 61,359 in Penobscot County, and from 18,149 to 19,124 in Washington County (Table E.5, Appendix E). Although the number of housing units increased, total vacancy rates remained relatively constant from 1980 to 1990, ranging from about 33% of total units for Hancock and Washington counties to approximately 10% of units in Penobscot County. Rental vacancy rates were generally somewhat lower than overall vacancy rates for the three counties.

While the rate of growth of population in the state as a whole is slowing, the number of new households is increasing twice as fast as the population as a result of more single people and increased divorce rates (McGonigle 1989). In fact, the average number of people per household in Maine decreased from about 3.3 in 1960 to 2.55 in 1990 (U.S. Bureau of the Census 1982, 1984, 1986, 1988).

Within the region of influence, the annual rate of housing growth from 1980 to 1987 was 804 new units in Penobscot County, 289 in Hancock County, and 87 in Washington County. One-third of the new housing constructed between 1980 and 1987 was in towns of 10,000 people or more. In this same period, an 8% rate of overbuilding of new housing units occurred (McGonigle 1989).

A slight decrease in the number of new housing units is projected for 1988-2010, with an annual average of 645 new houses expected in Penobscot County, 232 in Hancock, and 70 in Washington.

3.1.6.4 Environmental Justice

On February 11, 1994, Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was published in the Federal Register (59 FR 7629). The Order requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. Currently, no formal guidelines have been adopted to implement the Executive Order; however, EPA has published relevant studies and information on environmental justice and is leading an interagency task force to address the issues of environmental justice. DOE is a participating member of this task force. In July 1993, DOE distributed a memorandum stating the Department's commitment to environmental justice, providing information to better understand environmental justice issues, and requesting input on how DOE should consider environmental justice in its NEPA documents (*DOE Memorandum of July 22, 1993, from the Office of NEPA Oversight*).

An examination of census data, coupled with working experience of the Eastern Maine Development Corporation, indicated the proposed transmission line route would not pass through municipalities with significant communities of low-income or minority populations (Barbagallo 1994). The municipalities that would be traversed by the proposed transmission line would include Baileyville, Princeton, Great Pond, Milford, Bradley, Eddington, Holden, Brewer, Orrington, and several unorganized townships (Table 2.1, Section 2.1.3). Currently available maps show a total of only 98 dwellings within 600 ft of the proposed project centerline (Barbagallo 1994). This number represents only about 0.16%

of the 61,098 families within the three counties that would be traversed by the proposed transmission line (Table E.6, Appendix E). Specific socioeconomic data on the families that live in the 98 dwellings are not available. However, for the municipalities that would be traversed by the line; both the percentage of families below the poverty level and the percentage of population categorized as minorities are below their respective countywide average. Additionally, the median family income for each municipality is above its respective countywide average, except for Milford (Table E.6, Appendix E). (However, there are no dwellings within 3,000 ft of the proposed centerline in Milford.) Ninety-one of the 98 dwellings are currently located near the existing 345-kV transmission line and/or other smaller voltage lines (see Sections 2.1.3 and 2.3.7).

Penobscot Island (Penobscot Indian Reservation), located near Milford, is about 5 mi from the proposed route. It is the closest Native American property to the proposed project.

Bangor Hydro-Electric Co. is an equal employment opportunity company with an affirmative action plan. The plan pertains to the recruitment, hiring, training, promotion, transfer, and termination of personnel. The applicant's subcontractors are also subject to this plan.

3.1.7 Visual Resources

3.1.7.1 Visual Resources Study Area and Landscape Classification Approach

The visual resource analysis conducted for this project involves a two-step process of (1) inventorying the visual resources within the study area and along potential transmission line corridors and then (2) evaluating the visual impacts of the actual transmission line alignment, tower placement, and associated facilities (e.g., substations, access roads) within those corridors.

The visual resource inventory and evaluation criteria used by the applicant were based on definitions and standards stated in the December 1989 draft of the *Scenic Character Regulations* of the Maine Department of Environmental Protection (ER 1991). Much of the terminology and inventory and many of the evaluation procedures used in visual resource analysis are adapted from the visual management system developed by the U.S. Forest Service (1973, 1974).

A 6-mi-wide visual resources corridor (3 mi on either side of the proposed route centerline) was established as the study area to take into account foreground (0-0.25 mi) and middleground (0.25-3 mi) views. Landscape classifications were determined by the four major landscape elements: landforms, waterforms, vegetation, and cultural (man-made) modifications. The landscapes in the study area were categorized in terms of three visual quality classes: class A — distinctive, class B — scenic, and class C — common. Distinctive landscapes are areas of unusual or outstanding visual quality and often are of statewide or national significance; scenic landscapes are areas of high scenic quality; and common landscapes are areas with little or no visual variety. The landscape quality matrix used for the study area is presented in Table F.1 (Appendix F).

3.1.7.2 Landscape Descriptions

The proposed route extends through three distinct natural landscape regions: (1) the Eastern Bogs subregion of the Northern Forest region, (2) the Norumbega Hills region, and (3) the Foothills subregion of the Uplands region (Adamus 1978). The major natural landscape characteristics of these regions are listed in Table F.2 (Appendix F).

The landscape descriptions in this section are adapted from the ER (1991) and pertain to the route segments shown in Figure F.1 (Appendix F). These route segments correspond to major, identifiable natural and man-made features that occur along the proposed route. Maps and photographs (both aerial and ground) detailing the visual study area established by the applicant are presented in the ER (1991).

Segment 1 — St. Croix River Area: Except for the wooded bluff along the St. Croix River, this segment has flat to gently rolling topography and is dominated by the 560-ft-wide ponded area of the St. Croix River. The river is used for recreational purposes (e.g., fishing, boating, viewing wildlife). Vegetation consists of mixed coniferous forest with some clear-cuts.

Segment 2 — U.S. Route 1 Area: The terrain in this area is relatively flat to slightly rolling, with mixed softwood/hardwood growth and some recently harvested areas. No lakes or streams occur in the immediate area. Man-made modifications include existing transmission lines, gravel roads, and U.S. Route 1.

Segment 3 — Pocomoonshine Mountain / Lake Area: This area consists primarily of gently rolling hills and the prominent Pocomoonshine Mountain. The vegetation is mostly stands of mixed softwoods, with some deciduous woods located on the mountain and cedar swamps found along the streams and brooks. The proposed transmission line would extend across Dog Brook, Rocky Brook, Lewys Brook, and Allen Stream. A series of logging roads ring the base of the mountain, and several trails lead to an abandoned lookout tower on the summit.

Segment 4 — Clifford Lake / Stream Area: This segment contains mostly low to moderate rolling hills (40-80 ft high) with predominantly second growth conifers and some clear-cut areas. Several small perennial streams (e.g., Scott Brook, Clifford Stream, Big Wallamatogue Stream), as well as Clifford Lake occur in the area. The area contains several gravel roads that intersect Stud Mill Road.

Segment 5 — Machias River Area: The topography in this segment includes a ridge of rolling hills; the Machias River valley, characterized by low hills, eskers, and other glacial formations; and a series of low mountains (e.g., Fletcher Peak, Slewgundy Ridge, Knox

Mountain, Fletcher Peak) that rise about 400 ft above the surrounding terrain. The main waterform is Machias River, with a number of streams (e.g., Lanpher Brook), tributaries (e.g., Fletcher Brook), and lakes (e.g., Second and Fifth Machias lakes) in the area. Vegetation includes mixed second-growth forest, clear and strip cuts, and a dense growth of alders and shrub-scrub wetlands along much of the Machias River. The western bank of the river contains a stand of mature white pines. While the area is dominated by the Machias River, a popular canoeing route and recreational resource, it also contains a number of gravel haul roads, an equipment yard, and a dump.

Segment 6 — Upper/Lower Sabao Lake Area: This segment consists of a series of low mountains and ridges (e.g., Sabao Mountain and Horseshoe Ridge) interspersed with a number of lakes (e.g., Horseshoe, Campbell, and Burnt Land lakes). Vegetation is typically mixed coniferous forest with extensive deciduous woods located on Sabao Mountain and Horseshoe Ridge. Numerous areas have been clear-cut and strip-cut. Many of the lakes in this area are classified as important regional natural and recreational resources under the Maine Wildlands Lake Assessment Program. As part of that program, a determination has been made of the resource value of each lake for fisheries, wildlife, scenery, shoreline characteristics, botanical features, cultural features, and physical features. Recreational resources include a campsite, picnic area and canoe put-in on Burnt Land Lake, and several seasonal camps along Horseshoe and Green lakes.

Segment 7 — Narraguagus River/Deer Lake Area: The terrain in this area varies from broad valleys to moderately rolling hills with low eskers, kettleholes, and meandering streams. Jimmie's Mountain, a large glacially scoured hill that rises 300 ft above the surrounding landscape, is the most prominent landform. This area contains mixed forestland and wetlands with extensive clear-cuts. The most prominent waterform is the Narraguagus River, a free-flowing stream about 15-20 ft wide, which emerges from an extensive upstream bog. Deer Lake, which is part of the headwaters of the Narraguagus River, contains a campground and picnic area along its eastern shoreline. The campground, which is maintained by the Maine Forest Service, is the only campsite within the viewshed of the proposed project. A network of haul roads exists in the area.

Segment 8 — Alligator/Main Stream Area: This area is characterized primarily by relatively flat areas with meandering streams. However, Eagle Mountain rises more than 500 ft above the surrounding area. Vegetation in this segment includes coniferous areas, mixed hardwoods, and open bogs with areas that have been extensively clear-cut and strip harvested. Located in this segment are several roads, a canoe put-in along Alligator Stream, and three private seasonal camps along Main Stream.

Segment 9 — Crocker Pond Area: The topography in this area is flat with the exception of Horseback, a prominent 5-mi-long esker. The drainage conditions caused by the esker have formed a number of small streams, ponds, and wetlands in the area. Vegetation is primarily mixed growth coniferous forest with extensive clear-cuts. An extensive network of haul roads and all-terrain vehicle trails is located throughout the area.

Segment 10 — Maine Route 9 Area: The topography in this area ranges from flat to rolling hills, and vegetation ranges from second-growth deciduous woods and roadside shrub vegetation to pastureland. No major waterforms are located in the area. Extensive man-made modifications have occurred, including development of homes, streets, farmland, and transmission lines.

Segment 11 — Clewleyville Road/Eastern Avenue Area: The topography in this segment ranges from flat to rolling hills, and vegetation ranges from mixed softwoods, hardwoods, and wetland vegetation to open farm fields. Eaton Brook is the primary drainageway in the area. Numerous man-made modifications occur in the area, including roads, transmission lines, residences, commercial establishments, and farmland.

Segment 12 — U.S. Route 1A/Wiswell Road Area: The terrain in this area consists of flat to gently rolling hills with mixed vegetation, landscaped vegetation, and some farmland (hayfields and old-field growth). The only waterform is Felts Brooks and its wetland headwater area located north of Wiswell Road. This area has been greatly modified with homes, roads, transmission lines, and the construction of the I-395 interchange.

Segment 13 — Orrington Substation Area: The area surrounding the Orrington substation consists of low rolling hills with wetland vegetation. The substation site contains tall fences, microwave relay towers, transformers, transmission towers, and other electrical devices and facilities. A number of transmission lines emanate from the substation into the surrounding countryside.

3.1.8 Cultural Resources

3.1.8.1 Regional Prehistory and History

The prehistory and history of a region provide the requisite context for evaluation of its archaeological sites and historic structures. Evidence of early prehistoric settlement in the area of the proposed route is confined to isolated artifacts tentatively assigned to the Palaeoindian and Early Archaic periods (11,000-8,000 years ago) (Cox 1989). The Middle and Late Archaic periods (8,000-1,500 years ago) are represented by numerous sites along the Penobscot and Grand Falls rivers and in the Big Lake area (Sanger et al. 1977; Cox and Bourque 1986, 1988; Belcher 1988). The distribution and contents of these sites reflect a hunting and gathering economy that apparently persisted throughout the Woodland (or Ceramic) period, until the spread of Euro-American settlement approximately 200 years ago.

3.1.8.2 Archaeological Sites

The proposed route traverses a landscape of low to moderate relief characterized by low hills, glacial landforms (e.g., moraines, eskers), bogs, and shallow stream valleys. Coniferous, deciduous, and mixed forests cover most of the area. On the basis of its overall geographic and geologic setting (distance from coast, scarcity of rivers and lakes, absence of deep soils), the area was accorded a low potential for significant archaeological sites (Cox 1989). A review of existing records in 1988 revealed that no sites had been reported previously along the proposed route (Cox 1989).

Despite this low archaeological potential and lack of recorded sites, a field survey of the proposed route was conducted by the Maine State Museum during 1988-1990 to ensure an adequate inventory of potentially affected cultural resources (Cox 1989, 1990). The survey methodology reflected an approach used on other transmission line corridors in the region (e.g., Petersen et al. 1987; Baker 1989). The proposed route was subdivided into 674 sampling units, each consisting of a 656-ft long, 328-ft-wide segment of the route. Each sampling unit was evaluated for archaeological potential on the basis of slope, substrate type, proximity to water, and other landscape features. All 60 units thus determined to have a comparatively high archaeological potential were examined; in addition, a random sample of 12 units of low or moderate potential was examined.

The total number of units examined represented a 10.7% sample of the proposed route. All examined units were subjected to a pedestrian walkover, and 64 of these units were tested by shovel probes. These shovel probes (19.7 x 19.7 in.) were excavated to a mean depth of 11.8-15.7 in. (reflecting the shallow soils that cap till surfaces across most of the area), and excavated sediment was sieved through a 1/4-in. screen. A total of 650 shovel tests were conducted (Cox 1989, 1990).

Archaeological remains were encountered at three locations along the proposed route. At each of these locations, several test squares (19.7 × 19.7 in. each) were excavated to determine the size and contents of the site (90 total test squares). The most important of the three sites is located on the eastern bank of the Machias River. Test squares at that site yielded 2,136 artifacts (5 retouched items, 2 utilized flakes, and 2,129 unretouched flakes) buried in alluvial deposits of sandy silt and gravel. The characteristics of several retouched pieces permit assignment to the late Ceramic period (about 1,200-700 years ago) (Cox 1989). The Maine Historic Preservation Commission (equivalent to the State Historic Preservation Office) has determined that this site is eligible for nomination to the *National Register of Historic Places* (NRHP) on the basis of its potential contribution to knowledge of regional prehistory (Spiess 1990). The remaining two sites include a buried lithic scatter (comprising 73 unretouched flakes) on a ridge adjacent to Main Stream and an isolated artifact (tool fragment) recovered from the western bank of the St. Croix River. Neither site is eligible for the NRHP (Cox 1989; Spiess 1990).

3.1.8.3 Historic Structures

To date, no structures that meet eligibility criteria for nomination to the NRHP have been identified on or immediately adjacent to the proposed route.

3.2 ALTERNATIVE ROUTE

3.2.1 Atmospheric Environment

3.2.1.1 Weather and Climate

Weather and climatic conditions along the alternative route are generally similar to those described for the proposed route (Section 3.1.1.1). Minor differences occur along portions of the alternative route because it proceeds farther north than the proposed route. The eastern third of the alternative route is located in the climatological Northern Division of Maine; the remainder of the alternative route is in the Southern Interior Division, as defined by the National Oceanic and Atmospheric Administration (NOAA 1980).

In the more northerly portion of the alternative route, the following parameters could be expected to slightly decrease from the values experienced in the southern portion of the route: average annual temperature, number of days in excess of 90°F, the average length of the growing season, and total precipitation. Slight increases could be expected in both the number of days of subzero temperatures and the amount of snowfall. Additionally, localized ground-level snow accumulations are probably higher along most of the alternative route than along the proposed route because of the opening of the tree cover created by the right-of-way corridor for the existing 345-kV line.

3.2.1.2 Air Quality

Air quality conditions along the alternative route would closely match those discussed for the proposed route (Section 3.1.1.2).

3.2.2 Land Features

3.2.2.1 Physiography

Extensive wetlands are found along the alternative route, especially in the eastern and western parts. In Penobscot County, wetlands occur along the Penobscot River and its tributaries. Numerous patches of till are present in the high ground. In the Aroostook County, the terrain is characterized by moderate relief with broad ridges and shallow, sweeping valleys. A few eskers are present along major streams. The relief probably reflects the topography of underlying bedrock. Ground elevation ranges from 400 to 600 ft MSL. East of Glenwood, the proportion of wetlands increases substantially.

3.2.2.2 Geology

Sedimentary rocks dominate the area traversed by the alternative route. These rocks include calcareous sandstone, interbedded sandstone, impure limestone, and interbedded pelite and sandstone of Silurian and Devonian age. Near the eastern end of the route, interbedded pelite and sandstone of Ordovician-Cambrian age were uplifted by a reverse fault (Osberg et al. 1985). A few faults, mostly normal, have been identified. These trend in a generally northeastern direction. The bedrock is covered by Quaternary deposits.

More than 50% of the alternative route is located in the Penobscot River valley, which is characterized by fine-grained glaciomarine deposits, swamp deposits, eolian loess, and patches of glacial till (Borns and Thompson 1981; Borns 1981). Except for the glacial till, these deposits were laid down after the retreat of the last glacier about 13,000 years ago. Sand may be locally dominant. The till is commonly present on high grounds.

Northeast of Winn, the land surface is dominantly covered by till. Swamp deposits occur in the lowland or areas of previous drainage. The proportion of the swamp deposits increases to the northeast (Newman and Holland 1981, 1986; Newman 1980; Brewer 1980).

The alternative route crosses several major north-northwest trending eskers near Cardville, Passadumkeag, South Lincoln, Chester, Macwahoc, and Haynesville. These eskers are commonly associated with streams and brooks, such as Whitney Brook, Passadumkeag River, Mattamiscontis Stream, Medunkeunk Stream, Molunkus Stream, and Mattawamkeag River (Figure 3.2).

3.2.2.3 Geological Resources and Hazards

Eskers found in the area provide excellent sources of sand and gravel. The locations of the eskers are shown in Figure 3.1. Several peat deposits are located near the existing line. However, no significant peat resources are traversed by the alternative route in Penobscot or Aroostook counties (Cameron et al. 1984b,c).

Landslides have not been reported along the alternative route (Novak 1987). The seismic history and risk potential of the alternative route are generally the same as described for the proposed route (Section 3.1.2.3).

Relative to the Maine Critical Areas Program (Caldwell 1982), no geologically significant areas have been identified along the alternative route (Section 3.1.2.3).

3.2.2.4 Soils

The types of soil occurring along the alternative route are similar to those described for the proposed route (Section 3.1.2); however, the relative proportions may be different (as interpreted from available information on geology). The western side of the alternative route is dominated by fine-grained glaciomarine deposits and swamp deposits with patches of glacial till. In the uplands, glacial till and thin drift become dominant. Glaciofluvial deposits are commonly found along major river channels and tributaries. However, swamp deposits are well developed in flat, impounding areas of many river reaches.

Data from Soil Conservation Service maps (SCS 1962, 1964) indicate that the right-of-way for the alternative route crosses a total of about 1 mi (covering about 21 acres) of highly erodible soils. The alternative route also crosses about 350 acres of prime farmland.

3.2.3 Land Use

Major land use categories along the alternative route are the same as those described for the proposed route in Section 3.1.3. The areal extent for each land use category within the two-county study area (Penobscot and Aroostook counties) and the state of Maine is provided in Table A.1 (Appendix A).

3.2.3.1 Forestry

Forest-related activities strongly dominate land use throughout most of the state (Section 3.1.3.1). The total land area within the two-county study area is about 6.5 million acres, about 89% of which is classified as forestland. About 98% of the forestland qualifies as commercial timberland. The two principal forest types are (1) mixed forest of deciduous and coniferous species (yellow birch, white birch, red maple, and beech, along with hemlock, balsam fir, and white pine) and (2) boreal coniferous forest (red spruce, balsam fir, and white spruce interspersed with some tamarack, white pine, and red maple).

The alternative route extends through numerous areas that are periodically harvested for pulp and timber. Areas of both clear-cutting and selective cutting occur all along the alternative route, with recent cutting near Woodville and Chester. Most of Maine's timberland is in private ownership (Birch 1982). Timberland ownership for the two-county study area is listed in Table A.2 (Appendix A). Champion International, Inc., and Georgia Pacific Corp. are the major commercial forestry landowners along the alternative route.

3.2.3.2 Agriculture

As discussed in Section 3.1.3.2, only a small portion of land within the state is used for agriculture. About 6% of the land within the two-county study area is devoted to agricultural use. Very little agricultural land exists along the alternative route, which extends across only one hayfield and one pasture near the community of Chester. A few areas near Molunkus, Haynesville, and Seldon Road show historic evidence of agricultural use but are currently old-field growth reverting to forest. Commercial beehives are located near Glenwood Bog, and a Christmas tree farm is located along U.S. Route 2A between Maine Route 171 and Wytopitlock Stream. Table A.3 (Appendix A) summarizes agricultural use within the two-county study area.

3.2.3.3 Recreation

Most of the recreational resources and activities within the alternative route study area are associated with the natural and scenic features of the region and are similar to those discussed for the proposed route (Section 3.1.3.3). The alternative route extends between Monument Brook at the Canadian/U.S. border and the Penobscot River valley and includes the Mattawamkeag River valley. Recreational resources along the route include a park, a game management area, and three major canoeing streams. Major recreational facilities located along the alternative route are described in Table 3.5.

3.2.3.4 Residential, Commercial, and Industrial

Less than 1% of the land within the two-county study area is developed for residential, commercial, and industrial use (Table A.1, Appendix A). The city of Bangor has the largest amount of such development in the study area. Towns located in the vicinity of the alternative route and their respective populations are listed in Table E.1 (Appendix E). Residential areas occur along the alternative route northwest of Bancroft and in Lincoln. Industrial and commercial development is associated primarily with the timber and paper industry and is similar to the development discussed for the proposed route (Section 3.1.3.4).

3.2.3.5 Transportation and Utility Corridors

Major highways within the study area include several federal and state routes and county and local roads. Small airports in the area include Lincoln Regional Airport, DeWitt Field, and Brewer Airfield. All of these airports are more than a mile from the alternative route. The alternative route would essentially parallel the existing first 345-kV tie line that extends from the U.S./Canadian border near Orient to the Orrington substation south of Bangor. At several locations, the alternative route would diverge from the existing line for short distances to avoid large expanses of wetlands, populated areas, and other sensitive features. The last 12.2 mi of the alternative route would be the same as that described for the proposed route. Transmission line configurations that would share the right-of-way with the alternative route are shown in Figures 2.3 through 2.7. An oil pipeline parallels the alternative route for about 8 mi along U.S. Route 2A between Reed and Macwahoc.

3.2.4 Hydrologic Resources

3.2.4.1 Surface Water

All but the eastern extreme end of the alternative route is located in the Penobscot River drainage basin. The route passes extensive wetlands and makes a total of 59 crossings of perennial water bodies. Among these are two ponds located in the right-of-way. Three rivers — the Mattawamkeag, the Passadumkeag, and the Penobscot — 13 streams, and

TABLE 3.5 Recreational Resource Areas and Use along the Alternative Route

Resource Areas	Type and Relative Amount of Use
Monument Brook	Limited access to remote stream; some fishing
Mattawamkeag River	Mostly placid with some small rapids; primitive campsites; boat launch site; Mattawamkeag Wilderness Park, a county park located between two branches of the river, offering hiking, fishing, canoeing, swimming, camping, and picnicking
Wytopitlock Stream	Small scenic stream with some steep rapids, suitable for canoeing, especially at high water.
Macwahoc Stream	Mixed placid and fast water with some steep rapids
Molunkus Stream; floodplain forest	Primitive campsite; picnicking
Mattaseunk Lake and Stream	Boat launch site
Penobscot River	Fishing, boating, and canoeing
Mattamiscontis Stream and Penobscot River	Fishing, boating, and canoeing
Enfield Horseback	An esker (sharp-crested ridge) that rises steeply (up to 60 ft) above adjacent wetlands; used for study by the University of Maine
Passadumkeag River	Boat launch site, canoeing
Sunkhaze Stream and National Wildlife Refuge	Boat launches on northern and southern sides with relatively high use
Baker Brook access road	Amount of deer hunting high because of large deer populations near settled areas
Milford/Bradley woodlands	Amount of deer hunting high because of large deer populations near settled areas
Great Works Stream	3 camps; high hunting near Bradley, particularly deer
Peaked Mountain and trail	Highest use for hiking along the route
Eddington/Orrington woodlands	High hunting activity; high use for fishing, camping, and boating at Fields Pond

Sources: ER (1991); DeLorme Mapping Co. (1987).

36 named and unnamed brooks and their tributaries are crossed by the route. The Penobscot River and a few streams have multiple crossings (Table B.2, Appendix B). The route crosses Monument Brook in Orient Township at the international boundary between the United States and Canada.

The northeastern part of the route is within the Mattawamkeag subbasin of the Penobscot basin. The subbasin includes the Mattawamkeag River and several of its major tributaries, such as the Wytopitlock, Macwahoc, and Molunkus streams. The western part of the route is within the Penobscot River valley.

The recorded maximum discharge of the Mattawamkeag River measured near Mattawamkeag is 29,200 ft^3/s (recorded in 1936), while the 55-year average discharge is 2,494 ft^3/s (Bartlett et al. 1989).

Under the water quality classification of the Maine Water Pollution Control Law of 1989 (Title 38, Chapter 3), about 60% of the water bodies crossed by the alternative route are designated as class B (Table B.2, Appendix B); 30% are class C water bodies, including the Mattaseunk Stream, the Penobscot River, the Blackman Stream, and the minor streams to the south; and 10% are class A water bodies, including the Monument Brook, the Greenleaf Brook, the Sunkhaze Stream, the Great Work Stream, and their tributaries (Maine Water Pollution Control Law, Title 38, Chapter 3, 467).

Relative to the NRPA (which establishes classifications of areas relative to unique natural and recreational characteristics), the alternative route crosses no class A rivers. The class B rivers traversed include the Mattawamkeag River, the Wytopitlock Stream, the Macwahoc Stream, and the Molunkus Stream (Maine Department of Conservation 1982).

The alternative route would not cross any designated Wild and Scenic Rivers.

3.2.4.2 Groundwater

Sand and gravel aquifers occur in the Quaternary sand and gravel deposits usually associated with eskers or major stream or river channels (Tolman 1981c-g). Aquifer yields vary, but commonly exceed 10 gal/min. The aquifers provide the water supply for many towns in Aroostook and Penobscot counties. In the western portion of the alternative route, the bedrock of interbedded pelite and sandstone also provides groundwater (Caswell and Lanctot 1976). Because the aquifer may be hydrologically connected to the Penobscot River and its tributaries, the yield can be more than 10 gal/min.

Very little information has been published on groundwater quality in Maine. The limited information that is available indicates that nitrate and pesticides are commonly found in groundwater near potato fields in Aroostook County (Maine Department of Environmental Protection 1990).

The significant sand and gravel aquifers (as defined by the Maine State Legislature [38 MRSA Chapter, Section 482, 4-D]) traversed by the right-of-way of the alternative route are shown in Figure 3.2. The route is estimated to intersect about 2.3 linear miles of aquifers, covering an area of about 47 acres.

3.2.5 Biotic Resources

3.2.5.1 Terrestrial

Vegetation

The alternative route lies in the same forest region as the proposed route (Section 3.1.5.1), but because the alternative route follows a more northerly course, more boreal forest (white spruce and balsam fir) occurs along the alternative than along the proposed route (ER 1991). The predominant forest types along the alternative route are mixed deciduous forests on moderately sloping land, boreal forest on elevated (but somewhat poorly-drained) land, and coniferous forested wetland (Table 3.6) (ER 1991).

The deciduous forest generally has no single dominant tree species, but includes yellow birch, paper birch, red maple, and beech. Some conifers, such as hemlock, balsam fir, and white pine, also may be present, as are small scattered stands of white and red pine. The boreal forest type includes white spruce, red spruce, and balsam fir. As is true for the proposed route, the forested land along the alternative route is largely in private ownership, with almost half owned by the forestry industry. Consequently, much of the forested area is second growth, having been clear-cut in the past.

TABLE 3.6 Estimated Acreage of Vegetation Types within the Right-of-Way Corridor along the Alternative Route[a]

Vegetation Type	Number of Acres	Percentage of Route
Mixed forest	926	44.5
Coniferous forest	676	32.5
Deciduous forest	229	11.0
White and red pine	13	0.6
Other habitats and land uses	237	11.4

[a] Acreage estimated from maps of alternative route.

Sources: ER (1991); Murphy (1991).

Compared with the proposed route, a greater portion of the alternative route remains uncut, and a number of relatively undisturbed deciduous hardwood communities occur. These areas are located (1) along both banks of the Penobscot River in Woodville and Mattawamkeag, (2) on a hill overlooking Monument Brook in Orient, and (3) on Beech Hill in Molunkus (ER 1991). Much of the remainder of the route consists of second-growth spruce-fir and birch-aspen forest. Very few old fields occur along the alternative route; two such areas of early successional habitat occur near Molunkus and Haynesville (ER 1991).

Wildlife

Because of the number of habitat types available and the presence of large areas of unbroken forest, a high diversity of wildlife species would be expected along the alternative route (DeGraaf and Rudis 1986). Common wildlife species are similar to those found along the proposed route (Section 3.1.5.1; Tables C.1-C.3, Appendix C). Martens and fishers could be locally common because of the greater extent of continuous forest cover (especially coniferous and mixed) along the alternative route than along the proposed route (DeGraaf and Rudis 1986; Bissonette et al. 1991).

Most raptors typical of eastern Maine (e.g., kestrel, broad-winged hawk, and osprey) are likely to be present in the vicinity of the alternative route. Most bird species that occur along the proposed route should also be common here (Section 3.1.5.1; Table C.3, Appendix C). Other birds, such as the ruffed grouse and boreal chickadee, should also be common. Less common birds that could occur include the Canada jay and spruce grouse. The latter species has been observed in Reed, Glenwood, and Haynesville (ER 1991).

Because of the abundance of good deer browse (especially striped maple), deer are more numerous along the alternative route than along the proposed route (Gilman 1991). In addition, deer are confined to yards for longer periods because larger snowfalls occur along the alternative route than along the proposed route (see Section 3.1.5.1 for a discussion of deer yards) (Gilman 1991).

Active deer yards have been noted along the alternative route (ER 1991). Because they provide shelter and food, these areas of coniferous cover are critical winter habitat for deer. Extensive areas that would be suitable for deer wintering areas exist along the alternative route. However, systematic surveys of deer yards have not been completed along that route (Gilman 1991).

3.2.5.2 Aquatic

Aquatic biota within the streams and rivers crossed by the alternative route are similar to those described for the proposed route (Section 3.1.5.2). Brook trout, the principal coldwater game fish, occurs in most perennial streams crossed by the alternative route. The route does not cross any known brown trout streams (Pierce 1986).

Most segments of the larger streams crossed by the alternative route, especially those tributary to the Penobscot River, contain (or potentially could contain) anadromous fish (e.g., Atlantic salmon). Exceptions would be streams such as Eagle Stream, which is not passable for anadromous fish between its confluence with the Penobscot River and the location of the alternative route crossing (e.g., because of physical impasses such as falls rather than because of water quality degradation). Streams that could contain anadromous species at the points the alternative route crosses them are Monument Brook, Mattawamkeag River, Wytopitlock Stream, Macwahoc Stream, Molunkus Stream, Penobscot River, Medunkeunk Stream, Mattamiscontis River, Passadumkeag River, Olamon Stream, Sunkhaze Stream, Great Work Stream, Oliver Brook, Blackman Stream, Eaton Brook, and Felts Brook. Little Molunkus Stream may also contain landlocked salmon from Molunkus Lake.

Monument Brook and Mattaseunk Stream, as well as several of the other streams mentioned above, also contain warmwater fish species mentioned in Section 3.1.5.2.

3.2.5.3 Wetlands

About 40% (830 acres) of the right-of-way for the alternative route would consist of wetland habitat. More detailed information on the wetlands is provided in Section D.4.1 (Appendix D).

3.2.5.4 Threatened and Endangered Biota

Threatened, endangered, and other listed plant and animal species that could occur along the alternative route are listed in Table C.4 (Appendix C). Although no federally listed threatened or endangered plant species occur along this route, the federal candidate species Orono sedge may occur in the vicinity of the route. One state threatened plant species, the small yellow water-crowfoot, is known to occur in Glenwood along the alternative route.

The bald eagle (a federally listed endangered species) is also likely to occur along the alternative route (as well as along the proposed route). A biological assessment for the bald eagle is presented in Section C.2 (Appendix C). Other state threatened and endangered animal species that could occur along the alternative route would be similar to those along the proposed route (Section 3.1.5.4).

3.2.6 Socioeconomics

Socioeconomic conditions (including environmental justice) in most of the region of influence for the alternative route are similar to those in the three-county area described for the proposed route (Section 3.1.6). Penobscot Island (Penobscot Indian Reservation) is about 2.5 mi from the alternative route. This is equivalent to the distance of the existing line from Penobscot Island. The alternative route includes portions of Aroostook and Penobscot counties. The baseline conditions for Penobscot County are described in Section 3.1.6; the conditions for Aroostook County are summarized here.

The population of Aroostook County has been slowly decreasing since 1970 and is projected to continue this trend at least to the year 2010 (Table E.1, Appendix E). Employment in the county has increased 9%, and unemployment has decreased just over 30% during the past decade. Employment distribution in Aroostook County is similar to the state as a whole, with manufacturing being the largest employer, followed by services (Table E.3, Appendix E). Similar to the other counties within the region of influence, per capita income in Aroostook County increased from $4,807 in 1979 to $8,577 in 1987 (Table E.4, Appendix E).

The total number of housing units has increased in Aroostook County over the past decade, with 35,920 total units in 1980 and 38,421 units in 1990 (Table E.5, Appendix E). Over the period 1980-1987, the annual rate of housing growth was 234 units. A slight decrease in the number of new housing units is projected for the period through 2010, with an average of 188 new units expected each year.

Aroostook County housing vacancy rates remained relatively constant from 1980 to 1990, at about 20% of total units (Table E.5, Appendix E). However, while the county's overall rates have remained relatively constant, rental vacancy rates have varied considerably within individual towns in the county, ranging from 9% to 50%.

3.2.7 Visual Resources

3.2.7.1 Visual Resources Study Area and Landscape Classification Approach

The visual resource inventory and analysis process used to evaluate the alternative route is the same as that described for the proposed route in Section 3.1.7.1 and Table F.1 (Appendix F).

3.2.7.2 Landscape Descriptions for the Alternative Route

The alternative route extends through four distinct natural landscape regions: (1) the Eastern Bogs subregion of the Northern Forest region, (2) the Northern Lowlands subregion of the Northern Forest region, (3) the Norumbega Hills region, and (4) the Foothills subregion of the Uplands region (Adamus 1978). The major landscape characteristics of these regions are summarized in Table F.2 (Appendix F).

Landscape features along the alternative route were categorized in terms of landforms, waterforms, vegetation, and cultural modification. An existing 345-kV transmission line extends through all 13 corridor segments discussed below. The landscape descriptions in this section are adapted from the applicant's preliminary environmental report (BHE 1989) and correspond with the route segments shown in Figure F.1 (Appendix F).

Segment 1 — Monument Brook / U.S. Route 1 Area: This segment consists of mixed hardwood forest and boreal softwood forest with a black spruce bog and sedge meadow located near U.S. Route 1. The topography west of U.S. Route 1 is dominated by a series of eskers and small wetlands. The upland areas have been extensively logged. An extensive white cedar swamp occurs near Juniper Brook.

Segment 2 — Mattawamkeag River Area: The terrain in this segment consists of a broad river valley containing the meandering Mattawamkeag River, which contains many oxbows, offsets, and backwater areas with sedge meadows and alluvial woods. This area includes Haynesville, several local roads, and U.S. Route 2A. Much of this area is former agricultural land that has been abandoned and now consists of trees and shrubs.

Segment 3 — Glenwood Bog and Wetlands Area: This area is dominated by Glenwood Bog, a significant white cedar swamp that supports a rich diversity of flora, including several rare species of plants. A broad open meadow occurs near Alder Brook, and other wetlands include a black spruce swamp. U.S. Route 2A is also located in this area.

Segment 4 — Wytopitlock Stream Area: The relief of this segment is somewhat higher than in Segment 3, and the vegetation includes upland boreal softwood forests. The Wytopitlock Stream is a fairly large, swift stream. A Christmas tree farm and beehives are also located in this area.

Segment 5 — Reed Pond / Macwahoc Stream Area: This segment contains Beech Hill, and the vegetation on higher ground is northern mixed hardwoods. Water resources include Reed Pond, a small pond with a heath shrub margin, and Macwahoc Stream, a large, swift stream that flows over rock ledges.

Segment 6 — Molunkus Lake and Stream Area: The Molunkus Stream flows between high banks of alluvial deposits. The vegetation in the stream valley is lush bottomland forest where maidenhair fern grows in abundance. In areas of higher ground, the vegetation consists of mixed woods and old-field habitat. A number of wetlands (e.g., Martin Bog) also occur in this segment, as do Mattaseunk Lake and Stream. Several small communities (e.g., Macwahoc and Molunkus) and roads (U.S. Route 2 and local roadways) are also present.

Segment 7 — Penobscot River Valley Area: This portion of the Penobscot River valley contains the Mattaseunk dam and powerhouse. South of the dam, the vegetation consists of deciduous hardwoods and mixed forest. Timber recently has been harvested in some of the area. This segment contains both upland mixed forest and low-lying wetland and bog areas. A hayfield and some pastureland occur near Maine Route 116.

Segment 8 — Passadumkeag River / Sunkhaze Meadows Area: This area begins to take on a more developed appearance, with more roads and highways, rail lines, residences, and commercial development. However, various lakes, streams, and other natural features also occur in the area, such as Cold Stream Pond, Passadumkeag River, and Sunkhaze Meadows.

Segments 9 through 13 — The landscape descriptions for segments 9 through 13 (Crocker Pond, Maine Route 9, Clewleyville Road/Eastern Avenue, U.S. Route 1A/Wiswell Road, and Orrington substation area) are the same as for the proposed route and were described in Section 3.1.7.2.

3.2.8 Cultural Resources

The affected environment for the alternative route was assessed by (1) a review of file and map data at the Maine Historic Preservation Commission, (2) a search of available literature regarding known archaeological sites on or near the right-of-way, and (3) application of a predictive model of site distribution (Cox et al. 1991). A field survey of the alternative route has not been undertaken (except where it overlaps with the proposed route). One archaeological site is recorded at the location of the Passadumkeag River crossing (south bank); it yielded an artifact diagnostic of the Late Archaic period (Section 3.1.8.1). Historic records indicate that a small Penobscot village was present at the location of the Penobscot River crossing (west bank) in the early nineteenth century; however, the area has not been checked by an archaeologist (Cox et al. 1991).

Application of a predictive model for site distribution, on the basis of landscape features (e.g., slope, substrate type, proximity to water), indicates that the alternative route traverses 30 locations of medium to high archaeological potential. These locations chiefly correspond to stream, river, and pond crossings (Cox et al. 1991).

3.3 NO-ACTION ALTERNATIVE

The affected environment for the no-action alternative would be the same as described for the proposed (Stud Mill Road) and alternative (existing line) routes (Sections 3.1 and 3.2).

4 ENVIRONMENTAL CONSEQUENCES

4.1 PROPOSED ROUTE (STUD MILL ROUTE)

The proposed action includes numerous mitigating measures that are identified by category in Section 4.4.1. Each of the following discussions of environmental consequences of the proposed action assumes that all listed mitigating measures are adopted and effectively implemented.

4.1.1 Atmospheric Environment

4.1.1.1 Weather and Climate

The construction and operation of the proposed project would not notably alter the climate of the project area. Slight modifications to the microclimate would occur in areas where vegetation was cleared (Herrington and Heisler 1973). Removal of the forest canopy would expose shrub and ground strata to localized increases in solar radiation, daytime temperatures, ground-level wind speeds, and the amount of precipitation (including snow) reaching the ground.

4.1.1.2 Air Quality

The greatest impact to air quality would be from construction-related dust, vehicle emissions, and burning of slash. Impacts from vehicle emissions would be minor and transitory because of the mobility of the sources and short work schedule anticipated for any particular site. Any burning of slash would be done in accordance with appropriate federal, state, and local regulations. Compliance with state permit provisions would ensure that Maine ambient air quality standards were not violated.

The greatest project-related impact to air quality would be from fugitive dust generated during clearing and construction activities. Dust concentrations could be heavy in the immediate vicinity of construction activities but would decrease rapidly with distance. At 1,000 ft from these activities, the concentration of dust would have decreased to less than one-tenth of the initial value (Sullivan and Woodcock 1982). During construction of the line, contractors would be required to use dust-control measures to avoid significant impacts. Watering has been shown to be an effective and inexpensive method to reduce dust. For example, one study indicated that dust releases were lowered by as much as 95% from a haul road if the road was watered twice an hour (Maxwell et al. 1982). Under normal conditions of watering, the major impact should not extend more than about 300 ft from the dust source (DOE 1987). Additionally, the retention of shrub and ground-level vegetation to the fullest extent practicable would aid in reducing the amount or spread of construction-related dust.

Air quality impacts of gaseous emissions from diesel engines (e.g., sulfur dioxide and nitrogen oxides), would be minor and transitory because the sources are mobile. Thus, the emission of these gases by construction equipment would neither cause nor contribute to any violations of air quality standards. The amount of carbon monoxide and hydrocarbons released from diesel engines is also small and would not cause any violation of air quality standards.

Ordinarily, ozone is a secondary pollutant formed by the interaction of hydrocarbons, nitrogen oxides, and ultraviolet radiation within sunlight. In the case of high-voltage transmission lines, however, ozone is directly produced by conductor corona. Several field experiments have shown that ground-level ozone concentrations resulting from transmission line corona are usually indistinguishable from background concentrations (Sebo et al. 1976; Roach et al. 1978). Comber et al. (1982) estimated that an operating 1,050-kV AC line may increase ozone by 5 parts per billion (ppb) above background. In Maine, the state standard for ozone is 81 ppb (two consecutive hours), while the federal standard is 120 ppb (two full days). Therefore, operation of the proposed transmission system would not result in the production of ozone at deleterious levels.

In summary, local ambient air quality would only be slightly and temporarily impacted by fugitive dust emissions if mitigative measures are employed during construction. Release of gaseous pollutants would not result in significant impacts to local air quality.

4.1.2 Land Features

4.1.2.1 Physiography, Geology, Geological Resources, and Hazards

Construction, operation, and maintenance of the proposed project would have very minor to insignificant impacts on geologic conditions. Insignificant and localized terrain changes might result from the construction of access roads, the installation of pole structures, and the modification of the substation. Because sand and gravel would be mined for the construction of access roads, minor terrain alteration might occur in the area of sand and gravel pits. During the construction phase, the heavy equipment used to place transmission structures could potentially produce slope failure on steep slopes, such as river banks and eskers.

Earthquake activities of low to medium intensity would have very little or no effect on the transmission line. Although historical record shows that the general project area has minor seismic activity, this record does not preclude the occurrence of a major earthquake that could cause severe damage to the transmission line system.

No major mineral resources have been reported in the general project area, and it is unlikely that the proposed project would impede any mining potential in the future. Sand and gravel resources are ample in the general area, and, thus, use of sand and gravel for the proposed project would not strain the supplies of these materials for other local construction needs.

During construction of the line, additional information would be collected on soil and bedrock conditions through such processes as soil borings and excavation. That information would benefit the geologic community through personal communication, resulting in a better understanding of the geologic history and processes in Maine.

4.1.2.2 Soils

Removal of vegetation during construction could enhance and accelerate local soil erosion. Much of the erosion would occur in highly erodible soils and along the access roads. Highly erodible soils commonly are located on slopes in excess of 15 degrees, often in association with loamy or silty material. Highly erodible soils also are commonly found along river banks and in eskers. The area within the proposed route covered with highly erodible soil is estimated to be 14-15 acres. If precautions are taken, soil erosion would be substantially reduced (Section 4.4.1).

Along the access roads, lack of vegetation protection would promote erosion of fine particles from the road construction material. If these roads were not properly located, graded, and maintained, concentrated runoff could cause gully erosion. Less adverse impact would be expected for the light-duty access roads because they are scheduled to be used for less than one year. Upon completion of use, these light-duty roads would be regraded to the approximate original ground contours, seeded, and mulched (ER 1991). Heavy-duty access roads would pose a higher potential for soil erosion because (1) the heavy-duty roads would be permanent structures, and (2) surface runoff on the heavy-duty roads would be channeled into 4-ft-wide ditches (ER 1991), thus increasing the erosional power of the water.

Soil erosion caused by installation of structures and transmission lines is expected to be minor and temporary in much of the general area, provided that proper erosion-control measures are implemented. Such measures would include controlled clearing and use of sediment-control fences and hay bales in areas with moderate and high erosion potential (Section 4.4.1).

As indicated in Section 3.1.2.4, the proposed right-of-way crosses about 230 acres of prime farmland. However, the area actually affected would likely be substantially less than 230 acres. Since the transmission lines would be suspended by supporting structures (poles or towers), only the area around the footings or the foundations of the structures would be inaccessible for farming. For example, each steel lattice tower would occupy 0.03 acre (ER 1991), while the wood tangent poles would occupy even less area. If, on average, 14% of the total foundation area is on prime farmland, and if each structure occupies an average of 0.005 acre, a total area of about 0.4 acre of prime farmland would be affected by the foundations. Because of the small area involved, the impacts on prime farmland would be insignificant.

4.1.3 Land Use

The right-of-way for the proposed route would be 170 ft wide for 71.6 mi and 100 ft wide for 12.2 mi. The acreage (by land use and vegetation type) that would be affected by the proposed route is listed in Table 4.1. The line would cross 79 privately owned land parcels. Eleven of these parcels are used for commercial forestry and represent about 90% of the 1,623 acres of land required for the proposed project (ER 1991).

4.1.3.1 Forestry

The principal change in land use related to the proposed route would be that about 1,460 acres of commercial forestland (about 90% of the proposed route) would be converted to utility right-of-way and related use (ER 1991). The two major commercial forestry

TABLE 4.1 Existing Vegetation and Land Use Directly Impacted along the Proposed Route

Cover Type/Land Use	Acres	Percent of Right-of-Way
Conifers (>75%)	333	20.6
Mixed forest	456	28.1
Deciduous forest	129	7.9
Clear-cut/regeneration	258	15.9
Forested wetland	268	16.5
Nonforested wetlands	52	3.2
Cleared wetlands	55	3.4
Surface waters	5	0.3
Roads, ditches, grades, etc.	23	1.4
Agricultural land (in current use)	14	0.9
Other open land[a]	27	1.6
Commercial/residential/industrial	3	0.2
Total[b]	1,623	100

[a] Old fields, cleared land, existing power line.

[b] Estimated total acreage derived as follows: (71.6 mi × 170-ft right-of-way) + (12.2 mi × 100-ft right-of-way) 1,475 acres + 148 acres = 1,623 acres.

Source: ER (1991).

landowners affected would be Champion International and Georgia-Pacific. The line would span nearly 40 mi of property owned by Champion International and 20 mi of property owned by Georgia-Pacific.

Clearing of forest vegetation required for the proposed route would be accomplished by a combination of clear-cutting and selective cutting techniques (Section 2.1.5.2). Clear-cutting and selective tree cutting operations would occur on about 48% and 52% of the proposed route, respectively. Selective tree cutting procedures would be used to maintain natural vegetative buffer zones or screens at environmentally or visually sensitive areas, such as views from recreational rivers, deer wintering areas, and class I and class II wetlands. In some instances, selected tree and shrub species would be planted to establish appropriate buffer areas (ER 1991).

As part of land-clearing operations, much of the merchantable wood materials (e.g., sawlogs and pulpwood) would be salvaged by the clearing contractor (817 acres owned by Champion International, 411 acres owned by Georgia-Pacific, and 231 acres owned by nine other landowners) and used for commercial purposes (ER 1991). Tops of trees, cull material, and branches would be chipped and hauled to local power plants for fuel. Nonmerchantable logging slash (e.g., trees less than 2 in. in diameter), shrubs, and brush would be left in place (ER 1991). While the salvage of merchantable wood materials would help offset the immediate losses in local forest productivity, the cleared forestland would represent a long-term withdrawal from the forest resource base. However, only one cutting cycle would be lost for the duration of the project (estimated at 40 years). Some noncommercial forestry lands owned by the Maine Forest and Logging Museum and various landowners within the Penobscot Experimental Forest would also be affected by right-of-way clearing for the proposed project (ER 1991).

Given the vast areal extent of the forest resource base in the state (over 17 million acres), the amount of land taken out of forest production would be insignificant. For example, only 0.04% of the 3,400,000 acres of land managed by Champion International and Georgia-Pacific would be affected. Young fir or spruce trees within the proposed right-of-way could contribute to the "fir tip" industry (i.e., use of branch tips for wreaths and other Christmas decorations).

4.1.3.2 Agriculture

The proposed transmission line would extend across about 49 acres of agricultural land, over half of which is currently abandoned farmland. Existing transmission lines already extend across the majority of agricultural lands that would be affected by the proposed line. A few acres of cropland would be affected by the placement of transmission line towers; pasturelands would be essentially unaffected by transmission line structures. Because most of the agricultural acreage traversed by the proposed transmission line could continue to be used for raising crops or grazing livestock, the actual area withdrawn from agricultural production would be of minor consequence. Some short-term impacts to agricultural land could result from some parcels of land being temporarily unavailable for use during construction activities and from varying degrees of soil compaction along temporary access routes and construction sites. These impacts are not regarded as significant.

4.1.3.3 Recreation

In general, the majority of short-term physical impacts to recreational resources would result from clearing of vegetation, ground disturbance, noise, and other activities associated with construction of the proposed line. Most long-term effects would relate to visual disturbances and are discussed in Section 4.1.7. Specifically, the construction and operation of the proposed transmission line would affect three major recreational rivers — the St. Croix, Machias, and Narraguagus. These three rivers provide numerous recreational opportunities for boaters, canoeists, and fishermen.

The proposed line would extend across the Woodland Flowage segment of the St. Croix River. Although this segment of the river is south of a "class A" protected river stretch, recreationists would be adversely affected by views of the conductors and shield wires extending across the river. Recreationists canoeing and fishing along the Machias and Narraguagus rivers would be adversely affected by views of the transmission line extending across the river valleys and by the audible noise emanating from the conductors. These impacts would diminish the semiwilderness experience and sense of remoteness currently associated with the rivers in these areas.

Hikers, canoeists, hunters, and fishermen at various trail and stream viewpoints along the proposed route could also be adversely affected by views of the proposed transmission line. In particular, hikers and hunters would be affected by views of the line from several trail viewpoints on Pocomoonshine Mountain, diminishing the feeling of a remote, semisecluded area. Also, increased hunting pressure might occur in the Sunkhaze Stream area because of increased access along the proposed route. Nonvisual impacts to specific recreational uses and facilities located along the proposed route are listed in Table 4.2. Visual impacts relating to recreational use and facilities are discussed in Section 4.1.7.2. The proposed route would not affect any national or state parks or national trail systems.

In summary, development of the proposed transmission line would have both positive and negative effects on the opportunities for dispersed recreational activities in the study area. It is likely that at least some portions of the proposed route would be integrated with local trail and road systems and used for hiking, skiing, snowmobiling, and additional access to hunting and fishing areas. Therefore, the proposed route would enhance public access to some previously difficult or inaccessible areas. Alternatively, hunting, fishing, and trapping pressures could increase in some areas, and some private landowners might experience an increased level of intrusion on their property. Additionally, persons who may otherwise use several of the existing areas for a remote and undisturbed recreational experience may decide to go elsewhere. Those persons pursuing recreational activities in the immediate vicinity of

TABLE 4.2 Impacts to Recreational Use and Resources along the Proposed Route[a]

Resource	Impacts to Recreational Use and Resources
St. Croix River/Woodland Flowage	No impact on number of recreational opportunities
U.S. Route 1, other roads, woods, woodlands	Increases opportunities for access to this area; increases recreation in undeveloped areas, such as cross-country skiing, snowmobiling, all-terrain vehicle use, hunting, and some trapping
South Princeton Road woodlands	Eliminates some deer hunting and trapping opportunities while creating other trapping opportunities; increases access for cross-country skiing, snowmobiling, and all-terrain vehicle use
Vicinity of Pocomoonshine Lake	Increases access to this area
Allen Stream, Lewys Brook	Creates new access to this area; decreases remote recreational experience near Allen Stream; increases access for cross-country skiing, snowmobiling, and all-terrain vehicle use
Huntley Brook	Decreases remote recreational experience in this area; reduces trapping and hunting opportunities; creates access and opportunity for cross-country skiing, snowmobiling, and small game hunting
Big Lake	No impact on number of recreational opportunities
Clifford Lake and Stream	Increases access to this area and to adjacent woodlands
Monroe Lake, East and West Monroe ponds	Increases opportunities for land-based recreation
Machias River and Machias lakes	Increases access to this area
Fletcher Brook and associated woodlands	Increases access to this area; increases opportunities for land-based recreation
Burnt Land Lake	No impact on number of recreational opportunities
Sabao Lake	No impact on number of recreational opportunities
Green Lake, Campbell Lake	Creates some opportunities for land-based recreation
Deer Lake, Narraguagus River	Creates some opportunities for land-based recreation
Jimmies Mountain	Increases access to this area; creates some opportunities for land-based recreation
Alligator Lake and Stream	Increases access to Alligator Stream

TABLE 4.2 (Cont.)

Resource	Impacts to Recreational Use and Resources
Main Stream	Decreases remote recreational experience; increases access to this area and creates opportunities for land-based recreation
Great Pond	Minimal impacts to this area
Pickerel Pond	Minimal impacts to this area
Sunkhaze Stream and National Wildlife Refuge	Decreases remote recreational experience: increases access to this area and creates opportunities for land-based recreation
Baker Brook access road	Increases access to Baker Brook and Baker Brook access road
Milford/Bradley woodlands	Creates access to this area and opportunities for land-based recreation
Great Works Stream	Increases access to this area
Peaked Mountain and trail	No impact on number of recreational opportunities
Eddington/Orrington woodlands	Creates access to this area and opportunities for land-based recreation

[a] Visual impacts related to specific recreational uses and facilities are discussed in Section 4.1.7.2.

Source: ER (1991).

the proposed route would also be exposed to electromagnetic fields (EMF) associated with the transmission line. Section 4.1.9 assesses health and safety concerns relative to EMF exposure.

4.1.3.4 Residential, Commercial, and Industrial

A total of 98 houses, trailers, commercial structures, and camps (many adjacent to existing roads) are located within 600 ft to either side of the proposed route centerline. Three residences are located within the proposed route and would have to be removed. In addition, one residence is located within 400 ft of the substation fence line (ER 1991; Wainwright 1991).

The potential for affecting urban or built-up land uses would be limited to several areas adjacent to the proposed route. Additionally, 28 residences are located within 2,000 ft of the proposed staging areas (Wainwright 1991). Short-term impacts would include dust and noise emissions during project construction. The presence of the transmission line would cause visual impacts at some residential and commercial locations (Section 4.1.7) and increase the EMF exposure sources for some residents (Section 4.1.9).

4.1.3.5 Transportation and Utility Corridors

The route extends across 130 unimproved and improved private and public roads, including U.S. Routes 1 and 1A and Maine Route 9. Motorists adjacent to construction sites along the proposed route would be subjected to temporary increased levels of noise and fugitive dust. Additionally, construction-related vehicles could cause short-term interference with local traffic patterns on routes adjacent to and crossed by the proposed route. Movement of heavy vehicles and transport equipment could cause some damage to local roads.

The proposed transmission line would be constructed within 1.2 mi or more of Brewer and Princeton municipal airports. It is not anticipated that the proposed line would conflict with existing or planned operations at either airport. However, because several transmission line structures would extend above a slope of 100:1 from the end of a runway at both airports, a Notice of Proposed Construction was filed by the applicant to obtain project approval from the Federal Aviation Administration (ER 1991).

The proposed transmission line would intersect an existing 345-kV electrical transmission line near Bradley and extend parallel to that line for about 12 mi to the Orrington substation. Although extra precautions would have to be taken to ensure the safety of construction workers, no need to temporarily remove the existing transmission line from service is anticipated.

4.1.3.6 Special Uses

The proposed route would extend through the proposed Deepwoods Training Area, which might be developed and used for military training exercises by the Maine Army National Guard. A portion of this area, the Deepwoods Cantonment Site, would be traversed by the proposed route. Although the development of these proposed training areas has been suspended, it is anticipated that the construction and operation of the transmission line would not interfere with either of the proposed training exercise areas.

4.1.4 Hydrologic Resources

4.1.4.1 Surface Water

Potential impacts to local surface waters from the proposed line include degradation of water quality and alteration of flow regimes. During the construction phase, clearing of vegetation, placement of access roads, and movement of construction vehicles and equipment would promote the transport of disturbed soil to nearby waterways and increase sediment loads. Near water crossings of the line, the flow regime of surface waters might be impeded by the access roads built in nearby wetlands or creeks. The access roads might also disturb natural surface runoff and occupy floodplains. It is estimated that there would be 30 water crossings by light-duty (temporary) access roads and 9 crossings by heavy-duty (permanent) access roads (ER 1991). The intensity of the project-related impacts on surface water would depend on the slope of the land surface, construction design and practice, timing of construction, and physical properties of the underlying geologic material.

Erosion-control measures, such as the use of siltation fencing, hay bales, and geotextile fabric, will be implemented by BHE in areas where erosion is likely to occur and for all new light-duty and heavy-duty access roads (Section 4.4.1.2). Selective clearing will be applied to the buffer zones (either 100 ft or 250 ft wide) at perennial or intermittent streams (ER 1991). These measures would minimize the erosion impacts and the sediment load increases in surface water bodies.

The proposed Machias River construction staging area and the Route 178 staging area are less than 300 ft from the nearest water bodies, while the Pickerel Pond and the Huntley Brook staging areas are more than 1,000 ft from the nearest water bodies. Fuel and oil spills are possible during service and maintenance of equipment and vehicles, especially in the four staging areas. However, proposed precautions and containment facilities in the staging areas (Section 4.4.1.2) would minimize the potential threat of surface water contamination.

The use of herbicides for vegetation control in the right-of-way might have the potential to degrade water quality. This potential impact would be greatly reduced by controlled use of herbicides, including a ban on herbicide applications in stream, lake, or wetland buffers and within any wetlands (Section 4.4.1.3).

The removal of vegetation in the right-of-way would slightly increase local surface runoff. Because the right-of-way would occupy only a very small portion of the total area of the affected watersheds, major drainage patterns and streamflow regimes would not be affected.

In upland areas, both the refurbished and new access roads would promote soil erosion in the vicinity of the road bed, resulting in increased sediment loads in local brooks and streams. These impacts would be transient for the temporary access roads, but permanent for the permanent heavy-duty roads. Also, part of the surface runoff would be concentrated and diverted in the drainage channels along the permanent roads. Because erosion and sediment control measures would be implemented (Section 4.4.1.2), the impacts caused by the new permanent access roads would be minor and local.

The access roads would have very minor impact on the flow regime of brooks and streams. Installation of culverts, stone-lined and timber-mat fords, and log bridges would allow uninterrupted flow of surface water.

4.1.4.2 Groundwater

The use of herbicides and excavation for structure foundations would have the potential to adversely impact groundwater. The areas of major concern are where groundwater is recharged, water supply wells are located, and the water table is shallow. Once herbicides reached groundwater, they might not become degraded for months (Roberts 1990). The excavation for structure foundations might penetrate impermeable clay-rich layers and provide a conduit for groundwater to transfer between upper and lower aquifers.

The potential impacts would be minimized by prohibiting the application of herbicides in sensitive areas, such as where the sand and gravel aquifers are exposed and where water supply wells are located (Section 4.4). Also, the excavations for structure foundations should be backfilled with impermeable materials.

4.1.5 Biotic Resources

4.1.5.1 Terrestrial

Vegetation

Vegetation along the proposed route would be directly affected by clearing or selective cutting in the right-of-way (84 mi) and by construction of heavy-duty access roads (4.3 mi, 10.4 acres) and light-duty access roads (68.3 mi, 101.8 acres). The four staging areas that would be used as construction headquarters along the route would range in size from 4.5 to 8 acres and are presently cleared (ER 1991).

Heavy-duty access roads would be required only to areas where lattice steel structures are to be situated. All temporary roads and staging areas would be restored to their preconstruction state upon completion of the construction activities at each location. Consequently, initial clearing of trees (including cutting and disposal of trees and stumps) and subsequent maintenance of the right-of-way (e.g., by manual cutting and herbicide treatments) would be the major impacts to upland forests. The first 71.6 mi of new right-of-way would be 170 ft wide. The final 12.2 mi would require widening (clearing) of an existing right-of-way by an additional 100 ft (Section 2.1.3). Other minor impacts could include accidental killing of vegetation by spilling of oil or gasoline and by physical damage by machinery and vehicles.

About 48% of the right-of-way would be subjected to "normal" cutting, in which all trees greater than or equal to 2 in. in diameter would be cut and removed from the site. Smaller trees would be cut and left on the site. About 19% of the right-of-way has already been cut as a result of commercial forestry activities. At points where structures are to be located, all trees (regardless of size) would be chipped and removed. Areas 100 ft wide by 170 ft long would be cleared for wood and steel poles, and areas 140 ft wide by 200 ft long would be cleared for lattice steel towers.

The remaining 52% of the right-of-way would be selectively cut. Such areas would include protective 100-ft-wide buffer zones along surface water bodies, vegetated strips (at least 6 ft high, 170 ft wide, 200 ft long; two areas per span) across the right-of-way to discourage deer drives, and deer wintering areas (to be selectively cut in summer or early fall) (ER 1991).

Vegetation along the right-of-way would be managed in three ways. First, every four or five years, trees in buffer areas adjacent to water courses crossed by the transmission line would be removed if they were too close to the conductors. Second, trees along the right-of-way edge would be cleared or branches trimmed if they extended too far into the right-of-way. Finally, the right-of-way corridor itself would be maintained as necessary by cutting, trimming, and application of a herbicide. The herbicide would be used to control woody vegetation, and the type used and method of application would have to be approved by the U.S. Environmental Protection Agency and the Maine Board of Pesticides Control.

Because of these maintenance practices, the vegetation beneath the transmission line and in the adjacent habitat would remain in an early successional stage. The so-called edge effect created by forest cutting can create unique environmental conditions, vegetation structure, and vegetation composition in (1) the center of the clearing, (2) along the edges of the clearing, (3) in the edge itself, and (4) at some distance into the adjacent natural community (Forman and Godron 1986). As a result, the plant and animal composition in such managed areas can differ considerably from the adjacent unmanaged (or less intensively managed) areas. This difference can include the establishment in the managed areas of exotic organisms that could adversely affect community dynamics (Coblentz 1990; Soule 1990) and alter such ecosystem processes as productivity, nutrient cycling, and hydrology (Vitousek 1990).

Other possible adverse construction effects could include deposition on plants of dust and other particulates from the operation of vehicles and large machinery. This deposition could inhibit photosynthesis and, if chronic, result in plant mortality. In addition, soil compaction caused by heavy machinery could destroy the ground flora and indirectly damage (by reducing soil aeration and altering soil structure) roots of trees (even of trees outside the right-of-way whose roots extended into the right-of-way). However, because construction activities at any one point would be short-term, adverse impacts from dust and compaction should be negligible.

Because the proposed route is located largely within an area intensively managed for timber production, only two sensitive terrestrial areas exist along the proposed right-of-way. Portions of the St. Croix River are scenic waterways and have been designated as "outstanding river segments" under the Maine River Act of 1983. A 350-ft buffer zone would be maintained adjacent to the river and would serve, in part, to minimize erosion and damage to the river banks. Within this buffer zone, some selective cutting of commercially managed deciduous forest would occur, but no damage to the structure and function of the ecological system is expected. The other sensitive terrestrial area that might be affected is a deciduous hardwood forest near Eagle Mountain, which is described as being "well-developed and relatively undisturbed" (ER 1991). The rare Allegheny vine has been reported from the vicinity of Eagle Mountain and could occur along the proposed route. This species is not protected.

Wildlife

The primary effect on terrestrial wildlife would result from loss and alteration of more than 1,100 acres of habitat. Additional impacts to wildlife would be due to construction noise, human activity, and periodic right-of-way maintenance (including herbicide application) during the life of the transmission line.

Potential project impacts to wildlife species are listed in Appendix C (Table C.1 for mammals, Table C.2 for amphibians and reptiles, and Table C.3 for birds). A qualitative assessment of potential impacts was made on the basis of whether the proposed project would increase preferred habitat (beneficial impact), decrease preferred habitat (detrimental impact), or not notably alter preferred habitat (neither a net beneficial nor adverse impact).

Almost half of the mammal species would either not be affected or experience only a minor beneficial or adverse impact (Table C.1, Appendix C). Mammal species that would be most adversely affected by the project include those more dependent upon forested interiors (e.g., long-tailed shrew and lynx). However, because of current logging operations in the project area, forest interior species are uncommon to rare (if present at all) in the project area. Other mammal species that would be adversely impacted include those that are arboreal or otherwise dependent upon trees (e.g., several bat and squirrel species). Populations of some species (e.g., martins and fishers) could become isolated by the creation of dispersal barriers (rights-of-way and roads), thus limiting their foraging range (Merriam 1988; Bissonette et al. 1991). Mammal species most likely to benefit from the proposed project are those that prefer or require some open areas, edge habitat, and/or shrubs and small trees (e.g., woodchuck, meadow jumping mouse, coyote, red fox, long-tailed weasel, and moose).

Potential project impact to white-tailed deer is a primary consideration because of concerns about the effect that tree removal could have on deer wintering habitat. Current commercial timber management activities in the vicinity of the proposed route include clear-cutting, selective harvesting, and herbicide applications. Further habitat loss from forestry practices and impacts of right-of-way construction and maintenance on deer wintering areas could threaten deer populations, which have been declining in wildlife management units in eastern and northeastern Maine (Lavigne 1986). This decline in deer numbers has been attributed to (1) Maine's forests becoming dominated by increasingly older age-classes, thus providing less forage, (2) slow recovery of deer populations from several unusually severe winters, and (3) increased residential and commercial development (Lavigne 1986).

Deer typically return to the same wintering area each year (Tierson et al. 1985; Lavigne 1986); therefore, it is important to avoid destroying or disrupting deer yards. Deer yards in the vicinity of organized towns could be lost because of the lack of habitat protective zoning by the Land Use Regulation Commission; however, in other regions, such habitats are protected (Lavigne 1986). Succession of commercial clear-cut land could, with time, provide suitable sites for additional deer wintering areas. By the same token, increased slash and other edible woody debris from forest cutting could provide valuable deer browse during winter logging and transmission line construction activities. If increased numbers of deer are attracted to cleared areas, they could pose a threat to moose populations because deer can transmit "moose sickness" (a brain worm), which is frequently lethal to moose (Morris 1986).

Unlike commercial forest land that goes through cycles of cutting and reforestation, the right-of-way would be maintained in a permanent early successional state. Vegetation strips, which would be maintained at intervals along the right-of-way (two strips per span) to prevent deer drives, would have the added advantage of permitting other wildlife, such as bobcats, martens, and fishers, to cross open areas that they might otherwise avoid. Winter construction operations could provide wintering sites and forage for deer, although the benefit would depend on the local vegetation types and winter severity (Lavigne 1986). Herbicide would be applied sparingly and by low-pressure manual sprayers. Thus, any adverse toxicological threat to wildlife is unlikely.

Despite these potential negative impacts, right-of-way and edge communities have been shown in other instances to support a greater richness of small mammal species (e.g., Johnson et al. 1979). This condition is due in part to the open nature of such habitats and the presence of appropriate forage or prey. Thus, the creation and maintenance of such habitats can be considered to be favorable, not only for these small mammals, but also for some predators. Niering and Goodwin (1974) have shown that it is possible to create and maintain relatively stable shrublands in rights-of-way by using selective tree removal and herbicides, thereby managing rights-of-way for habitat diversity. Once shrub cover became established, it was stable for at least 20 years with little or no tree invasion. The maintenance of stable shrub systems would provide the dispersal corridors needed by some animal species and the habitat complexity required for many species of songbirds.

Overall, most amphibian and reptile species that range within the study area would either not be affected by the proposed project or only experience minor beneficial or detrimental impacts (Table C.2, Appendix C). Those species most likely to be adversely affected are the wood frog, northern ringneck snake, and maritime garter snake. (The latter species is unreported from the study area). Species most likely to benefit from the proposed project are the northern water snake and the eastern smooth green snake.

Potential project impacts to bird species are listed in Table C.3 (Appendix C). Openland habitat species (e.g., red-tailed hawk, American kestrel, and yellow warbler) would be expected to increase in numbers for as long as the right-of-way was clear of trees. As the right-of-way became more densely vegetated, bird species diversity would probably increase because of the availability of both edge and open habitats. Several forest species that might also use the right-of-way include the broad-winged hawk and ruffed grouse.

Other studies have demonstrated negative impacts of right-of-way creation and maintenance on bird communities (e.g., Kroodsma 1987). Songbird populations tend to be positively correlated to within-habitat diversity as measured by number of foliage layers (MacArthur and MacArthur 1961). Many recent studies have confirmed this relationship (Strelke and Dickson 1980; Ambuel and Temple 1983; Santillo et al. 1989; Gates 1991). Right-of-way maintenance (by either manual clearing or herbicide treatment) could reduce within-habitat diversity required for many species and thus could affect such forest interior bird species as ovenbirds, red-eyed vireo, rose-breasted grosbeak, and cavity-nesting birds (such as the hairy woodpecker, downy woodpecker, and black-capped chickadee) (Table C.3, Appendix C). All of these bird species have healthy populations (ER 1991), thus negative impacts from habitat alteration are likely to be small.

The projected increase in brown-headed cowbird populations following right-of-way construction (Table C.3, Appendix C) could adversely affect some bird species. This species is a brood parasite, laying its eggs in the nests of other species, especially of warblers, vireos, and sparrows (Robbins et al. 1966). Certain raptors, including the barred owl, northern goshawk, and red-shouldered hawk, could be adversely affected by loss of forest cover and habitat fragmentation (ER 1991). If habitat diversity can be maintained in treated areas, it might be possible to encourage greater bird species diversity (Derleth et al. 1989; Gates 1991).

Bird species that could potentially benefit from the creation and maintenance of successional vegetation in rights-of-way corridors include the American woodcock, osprey, and brown-headed cowbird (Table C.3, Appendix C). Cover, such as alder, would be left in buffer zones to provide habitat for the woodcock (ER 1991). At least one raptor, the osprey, could potentially benefit from right-of-way construction. Active osprey nests are often observed on wooden transmission line structures (e.g., near Blackman Stream along the existing 345-kV tie line). Structures located near larger streams, such as the Narraguagus River, would be candidate sites for osprey nesting along the proposed route (BHE 1991b). Other species potentially benefitting from the creation of open areas include the indigo bunting, ruby-throated hummingbird, purple finch, white-throated sparrow, chestnut-sided warbler, and American redstart (Table C.3, Appendix C).

Another potential impact to birds would be mortality due to collisions with conductors, shield wires, or structures, especially where transmission lines cross roads, rivers, fields, and other open areas. Meyer and Lee (1981) concluded that waterfowl (in Oregon and Washington) are especially susceptible to such collision impacts; however, they state that no adverse population or ecological results were obtained because all the species affected were common and because collisions occurred in less than 1% of all flight observations of ducks, gulls, and blackbirds. A similar conclusion was reached by Stout and Cornwell (1976), who suggested that less than 0.1% of all nonhunting waterfowl mortality nationwide was due to collisions with transmission lines. A few studies have examined the potential for collisions by raptors with transmission conductors and support wires. During a one-year examination of the foraging activities of raptors in a New Hampshire right-of-way corridor, Denoncour and

Olson (1984) did not find any mortality of hawks. However, collisions with power lines account for 25% or more of the known losses to whooping cranes (Morkill and Anderson 1991).

An informal study of a wetland near the Orrington substation has revealed no waterfowl mortality over several years, despite the fact that this wetland is crossed by 18 transmission lines (Spencer 1989). Nonetheless, it is inevitable that some mortality, however low, will occur as the result of collisions with conductors (Spencer 1989).

No electrocution of birds would occur from the proposed line because the distance between the conductors and between the conductors and the shield wires would be greater than the wingspread of the largest bird (i.e., bald eagle).

4.1.5.2 Aquatic

Construction of access roads over streams, installation of transmission line support structures (towers and poles) near stream banks, and clearing of the transmission line right-of-way would be the principal sources of project impacts to aquatic biota. The potential impacts would include (1) habitat destruction or modification resulting from instream construction, (2) downstream increases in turbidity and sedimentation resulting from erosion and stream sediment displacement at the construction site, and (3) changes in water temperatures resulting from removal of riparian vegetation. The severity of impacts would depend upon such factors as (1) season of construction, (2) stream size, (3) corridor width to be cleared, (4) construction procedures, and (5) quality of the existing habitat (Dehoney and Mancini 1984). Ponds and lakes would not be directly affected because none is crossed by the proposed route. A potential for minor indirect impacts to ponds and lakes could result from disturbances to streams that drain into such water bodies.

Only five support structures would be located within 100 ft of a perennial watercourse in order to accommodate spanning of adjacent wetlands or other critical areas. A total of 39 stream crossings by access roads would be required, with only 9 of these being permanent crossings (ER 1991).

In general, stream temperature alteration is reported to be one of the most significant impacts from clearing of riparian vegetation (Herrington and Heisler 1973). In order for a stream to support coldwater species, such as brook trout, the water temperature should not exceed about 68°F for more than short periods of time or distances. Removal of tall trees from stream banks can increase insolation of the stream and increase water temperature. Brook trout may avoid such areas. The normal reaction of fish exposed to stressful temperatures is to move along the temperature gradient until preferred temperatures are encountered. Fish could avoid elevated temperatures by swimming upstream or downstream to areas of groundwater inflow, to deep holes, or to shaded areas.

Results of several studies indicate that low-growing vegetation can effectively shade smaller streams (Brown 1979; Fredricksen 1971-1972). Therefore, leaving a vegetative buffer zone is generally effective in avoiding drastic stream temperature increases, as well as in providing cover for fish and increasing soil stability and silt detention. In some cases, tall grasses, forbs, low shrubs, and emergent plants can be as effective as tall trees in shading small streams (White and Byrnildson 1967). Case histories in New York have shown that impacts of rights-of-way on stream temperatures were negligible (Holewinski 1981). For transmission line stream crossings, only a small segment of the stream is thermally altered. For short stream reaches exposed by corridors where surrounding and overhanging vegetation has been removed, the normal longitudinal water temperature gradient rise may be about 5.4°F on clear, warm summer days. However, temperature decreases and stabilization usually occur within 200-300 ft after the stream reenters forested areas (Carvell and Johnston 1978). With maintenance of surrounding and overhanging vegetation in the riparian zone bordering small streams, the normal longitudinal temperature gradient remains unaltered. Larger streams are generally unaltered regardless of right-of-way exposure (Carvell and Johnston 1978).

For the proposed project, only a short linear distance of riparian vegetation would be cleared for the transmission line or access roads at any given stream crossing. Additionally, many of the streams are currently open (i.e., lack a canopy cover), including the St. Croix River, Joe Brook, Huntley Brook, Scott Brook, Machias River, Fletcher Brook, Lower Sabao Lake tributary, inlet to Burnt Land Lake, Narraguagus River, Alligator Stream (western crossing), Main Stream, Dead Stream, Wiley Brook, Sunkhaze Stream, Birch Stream, Little Birch Stream, Great Works Stream, Blackman Stream, Meadow Brook, Eaton Brook, and Felts Brook (BHE 1991b). Therefore, stream-warming impacts are not expected to occur in most of the streams crossed by the proposed route.

Some thinning of trees would be required at several streams that do have a shading canopy. As a result, the following streams could experience some degree of localized stream warming: Dog Brook, Lewys Brook, Clifford Stream, Big Wallamatogue Stream, Lanpher Brook, tributary to Fifth Machias Lake, Lake Brook, inlet of Campbell Lake, unnamed tributaries to the West Branch of the Narraguagus River, Alligator Stream (eastern crossing), Hinckley Brook, and Baker Brook. These streams would likely be affected for one to two years until overhanging vegetation, shrubs, or alders became established along their banks.

To minimize the potential for stream warming or siltation and sedimentation that could result from bank disturbance, the following mitigative steps would be employed at several of the above-named streams: (1) only trees required to be removed for safety reasons would be cut; (2) there would be no grubbing of soil or stumps; (3) if deciduous trees were cut, no herbicide treatments would be applied, and the stumps would be allowed to sprout; and (4) if coniferous trees were cut, they would be replaced with young conifers transplanted by hand from nearby sites. Only coniferous trees that are tolerant to clipping and pruning would be transplanted (e.g., hemlock, balsam fir, and northern white cedar). If appropriate, deciduous species such as red maple and yellow birch would be used. Transplanting would be done in spring or fall when success is most likely. These mitigative measures would be carried out in a manner that would not disturb the stream banks (Murphy 1991).

Martin et al. (1984) found differences in stream chemistry between recently clear-cut and nearly uncut watersheds to be generally small for a wide variety of soil and forest types in New England. The amount of change due to cutting was of the same magnitude as natural variations among streams draining similar watersheds. Such methods as clear-cutting less than the entire watershed, using patch and strip cuts, and leaving buffer strips along streams all appear to reduce the magnitude of changes to stream chemistry.

Some fish habitat may be temporarily to permanently altered or lost by the placement of new access roads across streams or by significant rehabilitation or modification of existing access roads. In such cases, fish that previously occupied that habitat would seek acceptable habitat elsewhere. However, the extent of such habitat impact would be very small (e.g., about the width of the access road times the length of the crossing — generally less than 0.02 acre/crossing). A number of the 39 required access road constructions would occur in small perennial or intermittent streams where impacts would be negligible.

Disturbance of instream habitat can have an immediate and localized impact on aquatic biota, but turbidity (and especially sedimentation) can result in greater and more widespread biological impacts. The destruction of protective vegetation and compaction of soil surface by timber harvesting procedures reduces soil permeability to water, thereby increasing erosive surface runoff and increasing concentrations of suspended solids in streams (Campbell and Doeg 1989). Sediment seldom reaches levels that are directly lethal to fish, but this sediment can interfere with spawning, cover, and food, and can adversely affect the food chain by blocking light. Because of their relative immobility, eggs and larvae of fish would be most adversely affected by increases in siltation and turbidity. Adult fish would likely vacate the area and avoid many of the impacts associated with stream crossing construction; however, instream construction activities could interfere with spawning migrations (Dehoney and Mancini 1984; Busdosh 1984), and increased siltation could disrupt fish reproduction by covering potential spawning grounds (Karr and Schloesser 1978). Disruption of fish activities such as spawning migrations would only be temporary because stream disturbances would likely last only a few days, while fish migration occurs over a period of days to weeks (Geen et al. 1966).

After construction activities were completed, fish could continue to be adversely affected as a result of improper design characteristics, such as improperly designed culverts. Installation of incorrectly designed or installed culverts and use of unsuitable (unstable) fill material could lead to complete washout of a stream-crossing embankment. Such events result in the most severe cases of erosion stemming from highway development and are responsible for the greatest percentage of fish passage problems (Dryden and Stein 1975). Improperly sized or installed culverts can eliminate fish species from a stream through blockage of migration (particularly upstream spawning runs), usually because of outfall barriers, excessive velocities within the culvert, insufficient water in the culvert, or lack of resting pools below the culvert (Dryden and Stein 1975; Yee and Roelofs 1980). Downstream of the blockage, spawning may be hampered by overcrowding — forcing fish to spawn in marginal areas, avoid the system, or not spawn at all (Dryden and Stein 1975). Additionally, improperly stabilized banks and improperly sized culverts may cause long-term erosion.

Brook trout exhibit a high tolerance to environmental variation (e.g., elevated temperature fluctuations, cold tolerance, pH, and turbidity), but they appear to be sensitive to changes in stream morphometry (e.g., cover, flow, mean depth, depth at bank) (Modde et al. 1986).

The most desirable culvert installation is one that causes no sudden increase in water velocity above, below, or within the culvert. Culverts are best located where the stream reach is of similar alignment above and below the culvert for several hundred feet. Also, the culvert gradient should be as close to zero as possible. When these conditions are not met, problems in fish passage may occur. One poorly installed culvert can affect the fish population of an entire small stream drainage (Yee and Roelofs 1980).

As discussed in Section 2.1.5.3, culverts would have the lowest priority among the five methods that could be used for the 30 temporary stream crossings. For the nine permanent crossings, log bridges would be given a higher priority than culverts. Because of the preferred choice of crossing methods and the measures that would be taken to minimize stream crossing effects (Section 4.4), impacts to aquatic biota would likely be short term and localized.

During operation of the transmission line, aquatic systems may be adversely affected by maintenance activities, primarily vegetation control. However, required vegetation control near stream crossings should be infrequent (occurring no more often than once every four to five years), and of a much lower activity level than would occur during construction. For example, instream disturbances would not be required during routine maintenance, and only selected trees might have to be removed or trimmed. Control of vegetation within streamside buffer zones would be accomplished by manual techniques. Therefore, erosion of stream banks from maintenance activities would be expected to be negligible. Accidental release of toxicants (e.g., gasoline, lubricants, and herbicides) would not be expected because heavy machinery would not be used near streams and no herbicides would be used within 250-ft buffer zones on each side of a stream.

Fisheries can be adversely affected by human activity that hinders revegetation (e.g., use of off-road vehicles) and thus prolongs erosion and related perturbations to streams (Galvin 1979). Instream disturbances also could occur from vehicles driving across streams made accessible from the right-of-way. However, such potential impacts should not increase dramatically as a result of the proposed project because public access via existing logging roads is already well established.

Increased access to streams from right-of-way openings could also increase fishing pressure. Increases in Maine's population, leisure time, income, and mechanized mobility of anglers over expanded forest road systems have elevated recreational fishing to a major industry and have exposed even the most remote fish populations to exploitation. These changes have created public demands that strain government's capacity to ensure continuation of bountiful fisheries resources (Fenderson 1986). A significant latent demand for brook trout angling may exist, and that demand might be expressed if opportunity (e.g., access) is increased (Andrews 1986). However, because the proposed route closely parallels Stud Mill Road and because ancillary logging roads off of Stud Mill Road come close to most streams crossed by the proposed route, adequate access now exists to most of the streams (BHE 1991b). Nevertheless, construction of the proposed route would add additional access points to many of the streams that the line would cross.

The likelihood of long-term impacts to aquatic ecosystems from construction and operation of the proposed transmission line facilities would be small. Although impacts resulting from construction (e.g., erosion and subsequent increases in turbidity and sedimentation, canopy removal) may occur, they would be localized, short-term, and reversible. Recovery (return to near biological and physical conditions that existed before construction) from instream disturbances is often estimated to occur within one year and as rapidly as six weeks (Dehoney and Mancini 1984). The potential for significant adverse impacts would be minimized if the mitigative measures committed to by BHE (Sections 4.4.1.4 and 4.4.1.5) are properly implemented.

4.1.5.3 Wetlands

In response to Executive Orders 11988 (Protection of Floodplains) and 11990 (Protection of Wetlands), DOE rules and regulations (10 CFR 1022) require that a floodplain/wetland assessment be prepared that describes the project; discusses the effects of the project on floodplains and wetlands; and identifies alternatives, including mitigating measures. Such an assessment is provided in Appendix D; the results are summarized here.

Although construction activities would avoid wetland areas where possible, all such areas could not be avoided. Therefore, some adverse impacts, mostly temporary, would occur during construction, stringing operations, and following construction. Impacts would include elimination or modification of wetland habitat by construction of access roads and line support structures and by clearing of vegetation to create conductor safety clearance zones. These impacts, discussed in more detail in Appendix D, would be minor and largely reversible. Long-term impacts to a minimum amount of wetlands would occur from structure placement and permanent access roads. Overall, there would be 6.3 mi (11.7 acres) of temporary access roads, 0.23 mi (0.56 acre) of permanent access roads, and 55 line-support structures located in wetlands.

4.1.5.4 Threatened and Endangered Biota

No federally listed plant species are known to occur along the proposed route, although small populations of one federal Category 2 species (Orono sedge) and one state threatened species (white adder's mouth) have been observed. Potential adverse impacts to rare plant species (Table C.4, Appendix C) would be minimized or eliminated by the implementation of mitigative measures aimed at threatened and endangered species (Section 4.4.1.5).

The bald eagle is the only federally listed animal species in the area. Potential project-related impacts to bald eagles could occur from disturbance, habitat destruction, and collisions with wires. Nest desertion would be the most significant effect that could occur from disturbance. However, this effect would not be expected because nesting sites do not occur along or adjacent to the proposed line (Todd 1993). The proposed line would be located within actively harvested commercial forest land. Therefore, no critical bald eagle habitats would be impacted by right-of-way clearing. Similar to other raptors, bald eagles are generally able to avoid collisions with wires unless preoccupied, distracted, or visually hindered by bad weather. "Clustering" or group-flight behavior (which can make eagles more susceptible to collisions) was not observed in the vicinity of the proposed line crossing of the St. Croix River (Northrop, Devine & Tarbell 1991). Nevertheless, the conductors and shield wires would span the river at heights that overlap the observed average range of bald eagle flights, so the potential would exist for collisions. However, colored aviation spheres would be placed on the shield wires to increase visibility. Overall, construction and operation of the proposed project are unlikely to adversely impact bald eagles. A biological assessment for the bald eagle is presented in Section C.2 (Appendix C).

Minimal to no adverse impacts to the five federal candidate vertebrate species would be expected. The St. Croix, Machias, and Narraguagus are the major rivers crossed by the proposed line that contain habitat for the Atlantic salmon (ER 1991; Beckett 1994). These rivers would not experience increases in turbidity, siltation, or insolation because there would be no instream support structures or access road crossings, equipment used to carry conductors or shield wires across the rivers, increases in canopy removal, or construction activities within regulated stream buffers (ER 1991). Several other streams that would be crossed by the proposed line are tributaries to the Machias, Narraguagus, or Penobscot rivers and, thus, may potentially be inhabitable by Atlantic salmon. These streams include Fletcher Brook, Wiley Brook, Sunkhaze Stream, Birch Stream, Titcomb Brook, Blackman Stream, Meadow Brook, an unnamed tributary to Eaton Brook, Eaton Brook, and Felts Brook. No impacts would occur to most of these streams for reasons similar to those stated for the river crossings. However, there would be temporary access roads and/or equipment crossings at Wiley Brook, Titcomb Brook, and the unnamed tributary of Eaton Brook. These roads and crossings would cause short-term increases in siltation, streambed erosion, and insolation. Resultant impacts to Atlantic salmon could include localized migration away from impacted areas and other short-term localized effects previously discussed in Section 4.1.5.2.

Due primarily to active forestry operations across much of the proposed project area, as well as more urbanized developments toward the western portion of the project area, preferred habitat (forest interiors) for the northern goshawk and lynx are not well established in the project area. Modification of habitat (e.g., cutting of trees) would contribute to reduced habitat suitability of the proposed project area for these two species. Although the presence of the small-footed myotis in the project area is not known, tree removal could contribute to loss of habitat for this species.

The proposed project should not adversely affect the northern bog lemming as long as no major reduction of soil moisture levels occurs. Restoration of wetland conditions along the existing line as part of wetland mitigation (Section D.3, Appendix D) would improve habitat conditions for the lemming.

Adverse impacts to the three federal candidate invertebrate species would not be expected because habitats in which the Brook floater mussel, "Tomah" mayfly, and Dorcas copper butterfly occur would not be degraded.

Potential impacts to most of the rare state vertebrate species (as listed in Table C.4, Appendix C) can be determined from information provided in Table C.1 (mammals) and Table C.2 (amphibians and reptiles) (Appendix C). Several of the species (such as most of the bats) could be adversely affected to some extent by modification of habitat (e.g., cutting of trees). However, two species (red bat and ribbon snake) could benefit from the creation of edge-type habitat. A few of the state's rare species are not listed in Table C.1 or C.2 (Appendix C) because their ranges apparently do not include the proposed route area (DeGraaf and Rudis 1986). These species include Tremblay's salamander, northern black racer, and northern brown snake.

4.1.6 Socioeconomics

This socioeconomic analysis examines potential changes in employment, population, and housing needs in the region of influence as a result of building the proposed transmission line. Because only a small work force (averaging about 60 people) would be needed for the project, impacts on capacities of public services such as schools, police, and fire protection are unlikely and, hence, were not included in this analysis. Public concerns were assessed by examining news releases and articles, citizens' letters, and minutes and transcripts of public meetings.

4.1.6.1 Employment and Economics

The estimated construction cost for the 84-mi portion of the transmission line from the international border to the Orrington substation would be about $45 million (ER 1991). The construction phase of the proposed project would provide minor employment benefits. The applicant estimates that an average of 60 workers, with a peak of 137 and a low of 3, would be needed to build the line (ER 1991). The peak numbers would be needed during the last quarter of the second year of construction. The approximate number of potentially available workers in the region of influence can be estimated by multiplying the total number of unemployed workers in the region by the percentage of the total work force represented by the construction field. Applying this procedure to 1989 data on work force distribution and unemployment indicates that about 100 construction workers would be available in each of the three counties constituting the region of influence. Approximately 100 additional workers would be available in Aroostook County, which is crossed by the alternative route. Hence, filling the transmission line construction employment positions with local applicants should not be difficult. After construction of the line, the long-term employment impacts would be negligible, with workers needed only for operation, inspection, and maintenance of transmission facilities and the right-of-way.

The loss of only one timber harvest over the life of the proposed project on 0.04% of the two largest company's land (Section 4.1.3.1) indicates that there would be no effects on logging jobs.

4.1.6.2 Population and Housing

The impact of project construction on the local population would be minimal. The maximum impact, on the basis of the applicant's estimate that 20% of the workers might come from outside the area of influence, would be the movement into the area of about 68 people (20% of 133 workers with families [2.55 average household size in Maine for 1990]) (McGonigle 1989). An increase of this small number of people over such a short time period would not have any appreciable impact on population or existing services, particularly since an available work force already exists within the three counties and since these people would be spread out in communities along the 84-mi length of the transmission line.

Even if the average of 60 workers needed for the construction project all had families and all needed to relocate into the area, about 153 people (average of 2.55 persons per household in 1990 in Maine) would need housing during construction. However, given the existing pool of workers, combined with a high vacancy rate in the rental market, housing shortages would be unlikely.

A total of 98 dwellings (e.g., houses, camps) are located within 600 ft to either side of the proposed route centerline. Most of these structures are in the western portion of the route in Eddington or Brewer. People living in these dwellings would be able to see the transmission line from their residences. Potential impacts on visual resources are discussed in Section 4.1.7. Property values would not likely be affected because most of these residences are in the portion of the corridor adjacent to existing power lines. Although the sample size was small, one investigation found no significant differences in property values before and after the addition of a power line to an existing right-of-way (Lamprey 1986). The proposed transmission line would increase EMF exposure sources for those residing near the line. This issue is discussed in Section 4.1.9.

Twenty-eight residences would be within 2,000 ft of the proposed construction staging areas. People in these areas might be affected by noise from trucks and possibly by traffic delays.

Because additional energy capacity made possible by the new line would be directed to a common pool (i.e., throughout the NEPOOL system), it is not possible to trace who might actually use the energy specifically imported with the proposed transmission line. Therefore, increased population growth resulting from additional energy volume from the proposed transmission line could not be distinguished from increased population growth resulting from the general energy capacity of the system.

4.1.6.3 Public Concerns

Informal meetings and public scoping meetings have been held for the proposed project. Opposition to the proposed line has come primarily from two or three concerned residents. Concerns raised at these meetings included need for power, property values, safety (electromagnetic fields and herbicides), land use (logging access and recreation), biotic resources (habitat loss and listed species), and water resources (water quality, stream warming, siltation/turbidity). It is likely that most of these concerns would be alleviated by implementation of the mitigative measures to which the applicant has agreed (Section 4.4.1).

4.1.6.4 Environmental Justice

Implementation of the proposed action is not expected to raise environmental justice issues because there are no low-income, minority, or Native American communities, and only a few dwellings, near the proposed project (Section 3.1.6.4).

Construction Impacts

Construction of the proposed transmission line would not have disproportionately high and adverse human health or environmental effects on low-income, minority, or Native American communities. All direct impacts are expected to occur within the proposed right-of-way or designated access roads and staging areas. The transmission line would not occur on any Native American Indian property (Section 3.1.6.4). No inhabited dwellings would be affected by construction activities.

Construction of the transmission line would not result in significant adverse impacts to streams or rivers (Section 4.1.4.1); therefore, impacts to fishery resources (including gamefish) are not expected (Section 4.1.5.2). Most wildlife species that are hunted or trapped would either benefit from, or not be adversely affected by, the establishment of the transmission line right-of-way (Section 4.1.5.1 and Appendix C).

As an equal employment opportunity company, BHE would provide equal opportunities of employment for persons with the required skills.

Operational Impacts

Operation of the proposed transmission line would not have disproportionately high or adverse human health or environmental effects on low-income, minority, or Native American communities.

The proposed transmission line would not occur near any Native American properties (Section 3.1.6.4). The transmission line would not pass through communities that are above respective county averages of low-income and minority community composition

(Section 3.1.6.4). Therefore, EMF exposure related to the operation of the proposed line (see Section 4.1.9) would not disproportionately expose these groups to an additional source of EMF.

4.1.7 Visual Resources

4.1.7.1 Visual Impact Analysis Criteria

The major objective of visual resource analysis for transmission line projects is to plan, design, place, and construct transmission line rights-of-way, towers, conductors, and other associated facilities to be in visual harmony with, or at least subordinate to, the surrounding landscape (U.S. Forest Service 1975). The methods for establishing the study area and evaluating the visual quality of the existing environment (on the basis of landscape types) for the proposed project are discussed in Section 3.1.7.

The applicant's methodology for assessing project visual effects involved evaluating impacts at more than 40 key viewpoints. These viewpoints consisted of lake/pond, mountain, river/stream, road crossing, and other views from which the proposed transmission line facilities could potentially be observed (ER 1991). Each viewpoint area was categorized and assessed in terms of landforms, vegetation, waterforms, and cultural modifications. Ground and aerial photographs were used to document existing conditions. Computer-generated photosimulations, plan views, line-of-sight cross sections, and freehand sketches were used to analyze impacts to visual resources along a 3-mi-wide corridor on either side of the project right-of-way. The level of impact was determined by (1) the visual contrast between the existing landscape and the project facilities, (2) the visual dominance of the project facilities over the landscape, (3) the overall landscape character, and (4) viewer expectations of the present and altered landscape.

4.1.7.2 Visual Impacts of Corridor Segments and Building Sites

Short-term visual impacts during the construction phase would consist of views of project personnel, construction equipment, and material staging areas. The development of staging areas would likely degrade the quality of the local landscape. However, upon the completion of project construction, staging areas would be restored to conditions similar to or better than those existing before construction.

The following discussion of long-term, project-related visual impacts corresponds with the major visual resources along the proposed route segments described in Section 3.1.7 and shown in Figure F.1 (Appendix F). Long-term visual impacts would result from the clearing of vegetation for the right-of-way and placement of transmission line structures and conductors. A new 170-ft-wide right-of-way would be required for 71.6 mi, extending from the U.S./Canadian border to the proposed intersection with an existing transmission line right-of-way near Bradley. An additional 100-ft-wide right-of-way would extend for 12.2 mi from the intersection with the existing line near Bradley to the Orrington substation. Because the Bradley to Orrington segment of the proposed transmission line would be adjacent to existing transmission line systems, visual impacts would be incremental.

Segment 1 — St. Croix River Area: The St. Croix River is used for recreation (e.g., boating, fishing, and wildlife observations) in the vicinity of the proposed route. The conductors would be highly visible to river recreationists (up to 1 mi away). Especially visible would be a series of orange warning balls attached to the shield wires to make them easily visible to light aircraft and to bald eagles. Portions of the tower structures would be visible at times, although a 250-ft buffer zone along the bank of the river should help limit their view. The proposed line would also be visible where it extends across Sprague Meadow Brook Road (where commercial forestland activities occur). These views would result in a moderate to high visual impact where the line crosses the St. Croix River and a low visual impact within the remainder of the segment.

Segment 2 — U.S. Route 1 Area: Although motorists traveling along U.S. Route 1 and South Princeton Road could view the proposed transmission line, viewer expectations would be low because of existing development and current human activities, thus resulting in low visual impact of the new line. In addition, vegetative buffers along the sides of both roadways would help limit views of the cleared right-of-way.

Segment 3 — Pocomoonshine Mountain/Lake Area: The proposed transmission line would extend across Dog Brook, Rocky Brook, Lewys Brook, and Allen Stream. Intermittent views of the transmission line could be seen by motorists using Stud Mill Road. The transmission line would result in a break in the tree canopy that could be viewed from two locations on Pocomoonshine Mountain — an open area on a mountain trail and a mountain ledge along a narrow opening in the forest. These views would result in low to moderate visual impacts to recreationists using the mountain trails.

Segment 4 — Clifford Lake/Stream Area: The conductors and transmission line towers would be visible from various locations along Stud Mill Road. Because the landscape in much of the area is considered common, viewer expectations would probably be low and visual impacts minor. However, the transmission line would be visible to motorists traveling near the intersection of Stud Mill and Clifford Stream roads, resulting in a moderate to high visual impact. In addition, recreational boating and fishing occur along Clifford Stream, and viewer expectations along the stream are expected to be high. A vegetative buffer zone would be preserved to limit views of the right-of-way from the stream area.

Segment 5 — Machias River Area: The Machias River is a popular canoeing route and is considered one of the most visually sensitive landscapes that would be traversed by the proposed line. The applicant's project design ensures that transmission line towers would be set back about 400 ft from the river (thus minimizing views of the towers and right-of-way); however, the conductors would be visible and would detract from the semiwilderness experience expected by recreationists. In addition, portions of the right-of-way and tops of the tower structures proposed along Second Lake Ridge would be visible to recreationists using First Machias Lake and Second Machias Lake. Finally, some tower structures that would be placed on Elwell Ridge would be visible from Fifth Machias Lake. Although this area contains a number of man-made modifications and is actively used for timbering operations, the visual impact to recreationists using the area would remain moderate to high.

Segment 6 — Upper/Lower Sabao Lake Area: The Burnt Land Lake area is a popular recreation site (e.g., fishing, swimming, camping, canoeing) and is considered an environmentally sensitive and visually significant landscape (ER 1991). Tower structures would be visible to recreationists using the lake and stream, resulting in a moderate to high visual impact. Tops of tower structures also would be visible from Horseshoe, Green, and Campbell lakes because the line would extend over the ridge at the base of Horseshoe Mountain. Because of the middleground viewing distances (3,500 to 8,000 ft), visual impacts would be moderately low.

Segment 7 — Narraguagus River/Deer Lake Area: Although a buffer zone would limit views of the transmission line right-of-way, the presence of conductors over the Narraguagus River would result in a moderate visual impact, detracting from the recreational experience of canoeists using the river. Boaters and recreationists along the northwestern portion of the Deer Lake shoreline would be moderately affected by views of the upper portions of several tower structures. Towers would also be visible from much of Haycock Pond. The transmission line also would be visible to motorists from various points along Stud Mill Road, especially to eastbound motorists viewing the line extending up and over Jimmie's Mountain.

Segment 8 — Alligator/Main Stream Area: Although BHE would maintain buffer zones along Alligator and Main streams, recreationists still would be able to view transmission line structures and conductors, detracting from the outdoor experience and resulting in a moderate visual impact.

Segment 9 — Crocker Pond Area: Motorists using Stud Mill Road would have views of the proposed transmission line for more than 3,000 ft in either direction. However, because of low viewer expectations due to past logging operations in the area, the visual impact of viewing the transmission lines is expected to be low. Moderate visual impacts would occur at Crocker Pond, where the combination of open water, high topographic relief from a nearby esker, and unbroken vegetation creates a visual setting of high quality.

Segment 10 — Maine Route 9 Area: Visual impacts would be moderately low for motorists viewing portions of the transmission line along Maine Route 9. However, visual impacts would be moderate to high for some local residents who currently enjoy open views of fields and hedgerows from their property.

Segment 11 — Clewleyville Road/Eastern Avenue Area: Although the transmission line could be viewed from various locations within this more populated segment of the proposed route, most visual impacts would be low to moderate because the proposed line would parallel an existing transmission line, resulting in only an incremental impact to most local residents. However, visual impacts would be high for two homes along Lambert Road, where the view of existing transmission lines is limited. Here, the clearing of vegetation would result in direct views of the existing and proposed transmission lines.

Segment 12 — U.S. Route 1A / Wiswell Road Area: Only low visual impacts to local residents and motorists would be anticipated in this segment because viewer expectations have already been diminished by existing development, such as transmission lines and the construction of I-395.

Segment 13 — Orrington Substation Area: The primary viewers in this area would be passing motorists and the residents across the road from the substation. Visual impacts would be low because of low viewer expectations due to views of the existing transmission line and substation facilities.

In summary, the conductors, shield wires, and tower structures (or portions thereof) would be visible from numerous locations along Stud Mill Road; associated timber haul roads; recreational streams, rivers, lakes, and camps; and several state and federal highways and local streets. The extent and level of visual impact would, in part, depend on weather conditions, the season of year, and the effects of future timber activities within the region on the visual environment. Overall, visual impacts from the proposed route would generally be low to moderate. However, in a few select areas (e.g., the St. Croix and Machias river areas), visual impacts would be moderately high.

4.1.8 Cultural Resources

The Maine Historic Preservation Commission has determined that construction of a 345-kV transmission line along the proposed route would not adversely affect any archaeological sites or historic structures that are eligible for the *National Register of Historic Places* (NRHP) (Shettleworth 1990). The proposed route traverses an area on the eastern bank of the Machias River containing an archaeological site that meets NRHP eligibility criteria (Section 3.1.8.2). However, the site is less than 165 ft from the river, and because the towers would be placed at least 490 ft from the river, impacts to this archaeological site would be avoided. Furthermore, the extensive testing undertaken by the Maine State Museum during 1989 (total excavated area of about 175 ft^2) represents adequate mitigation (i.e., data recovery) of any other impacts that could occur during construction or operation of the proposed 345-kV line (Cox 1989).

4.1.9 Health and Safety

Health and safety issues related to the operation and maintenance of transmission lines have routinely centered on the potential or perceived effects from induced current and/or spark discharges, electric and magnetic fields (EMF), air ions, audible noise, ozone production, and use of herbicides for control of vegetation. The following discussion details the health and safety concerns relevant to the proposed transmission line.[1]

4.1.9.1 Shock Hazards

The proposed transmission line would be designed to meet all requirements of the National Electric Safety Codes. Therefore, the potential hazard for induced electric shocks (both steady shocks and transient, or spark discharge, shocks) would be negligible. For example, transmission line clearances over roads and other accessways are required to be sufficiently high so that deleterious currents would not develop in vehicles under a line. Because of the known hazards of electrical shocks, fences and large metallic structures near transmission lines would be routinely grounded to neutralize induced currents (Lee and Reiner 1983).

4.1.9.2 Electric Field Effects

With the proposed line operating at 345 kV with any load, the calculated electric field at the northern or western edge of the right-of-way at midspan would vary from 0.23 kilovolts per meter (kV/m) to almost 1.2 kV/m (depending on whether there would be right-of-way sharing with existing lines). At the southern or eastern edge of the right-of-way, the field would be almost 1.2 kV/m for the entire route (Table 4.3). At the western edge of the right-of-way where the proposed line would share the right-of-way with existing transmission lines, the operation of the new line would leave the electric field virtually unchanged. At the eastern edge, the electric field would increase from 0.13 kV/m to about 1.2 kV/m. Electric fields across the right-of-way at various locations along the proposed transmission line route are shown in Figures 4.1 through 4.5. The electric field intensities would vary with location, and the maximum ground-level intensities would be encountered only in a small portion of the right-of-way (less than 5% — the point of maximum conductor sag) (ER 1991).

The AC electric field intensities for the proposed line would fall to below 1.0 kV/m within about 100 ft from the centerline of the right-of-way (where no line sharing exists or off the eastern side where line sharing would exist). Building walls provide about an 8:1 shielding of electric fields, although the magnitude of the electric field produced by house wiring is in the same range as that produced by transmission lines (Caola et al. 1983). Sheppard (1983) has identified 1.0 kV/m as a reasonable maximum level for protection of public health for long-term exposure to AC fields.

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[1] The geometry and operation of the wiring of substations are so complex that changes in EMF because of substation alterations associated with the proposed project would not be detectable at the substation fence lines. Therefore, the health and safety assessment related to EMF is limited to the operation of the proposed transmission line.

TABLE 4.3 Electric and Magnetic Field Levels Calculated for Proposed Bangor Hydro-New Brunswick and/or MEPCo 345-kV Transmission Lines, Each Operating at 500 MVA[a]

	Proposed[b]		Existing[b]	
Location	N-EROW	S-EROW	N-EROW	S-EROW
Electric Fields (kV/M)				
Forest	1.17	1.17	NA[c]	NA
Penobscot	0.30	1.15	0.30	0.14
Clewleyville	0.44	1.15	0.45	0.13
Eastern	1.16	1.16	1.17	0.13
Wiswell	0.23	1.15	0.23	0.14
MEPCo[d]	1.17	1.17	1.17	1.17
Magnetic Fields (mG)				
Forest	33.0	33.0	NA	NA
Penobscot	19.9	26.2	22.8	7.8
Clewleyville	17.6	26.7	22.3	7.3
Eastern	26.8	26.8	33.0	9.4
Wiswell	31.8	26.1	33.0	9.4
MEPCo[d]	33.0	33.0	33.0	33.0

[a] Values for Penobscot, Wiswell, Eastern, and Clewleyville calculated under assumption that the 345-kV MEPCo line is operating at 500 million volt-amperes (MVA).

[b] N-EROW = north edge of right-of-way; S-EROW = south edge of right-of-way.

[c] Not applicable.

[d] Refers to MEPCo right-of-way, exclusive of Penobscot, Wiswell, Eastern, and Clewleyville regions; MEPCo line operating at 500 MVA; assumes MEPCo geometry (including height, spacing, and sag) is the same as that of the proposed line (differences in conductor width between MEPCo and the proposed line do not affect the calculated values).

Source: ER (1991).

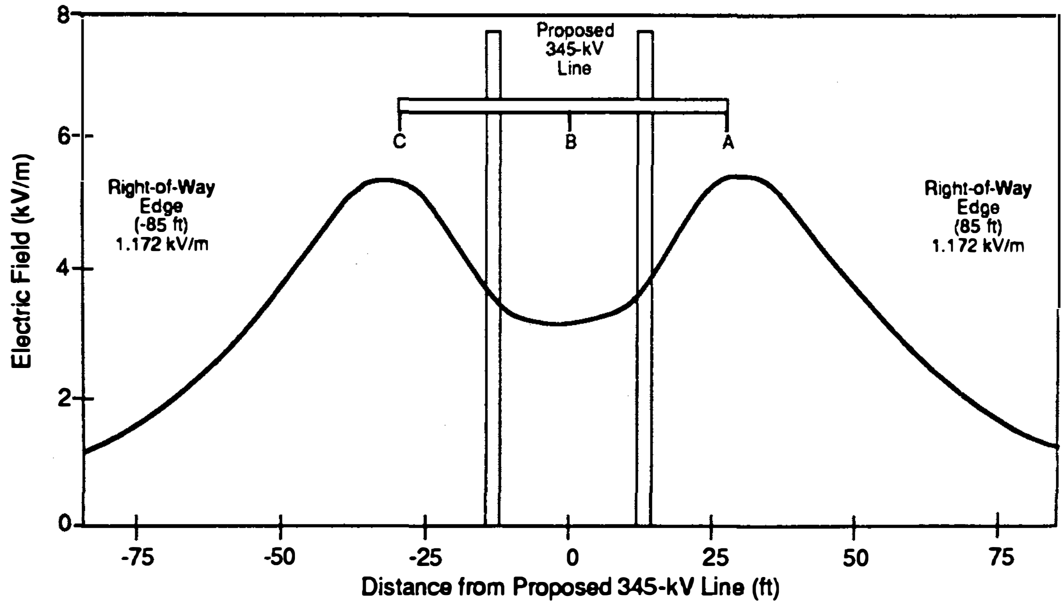


FIGURE 4.1 Calculated Electric Field across Proposed Transmission Line Right-of-Way in Areas Where No Other Lines Occur (H-frame configuration only) (Source: Modified from ER 1991)

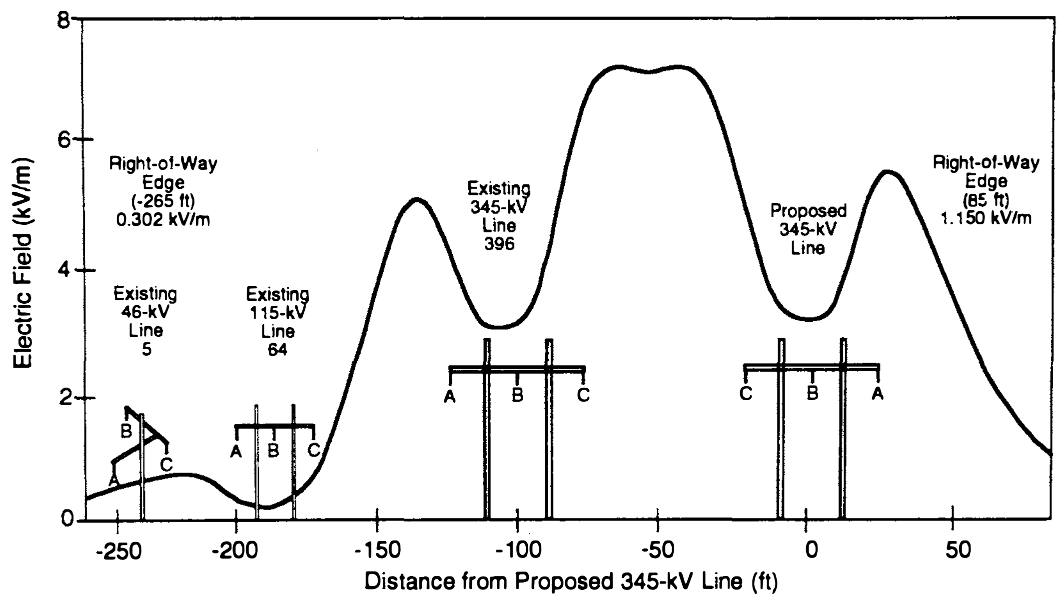


FIGURE 4.2 Calculated Electric Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 46-, 115-, and 345-kV Lines (H-frame configuration only) (Source: Modified from ER 1991)

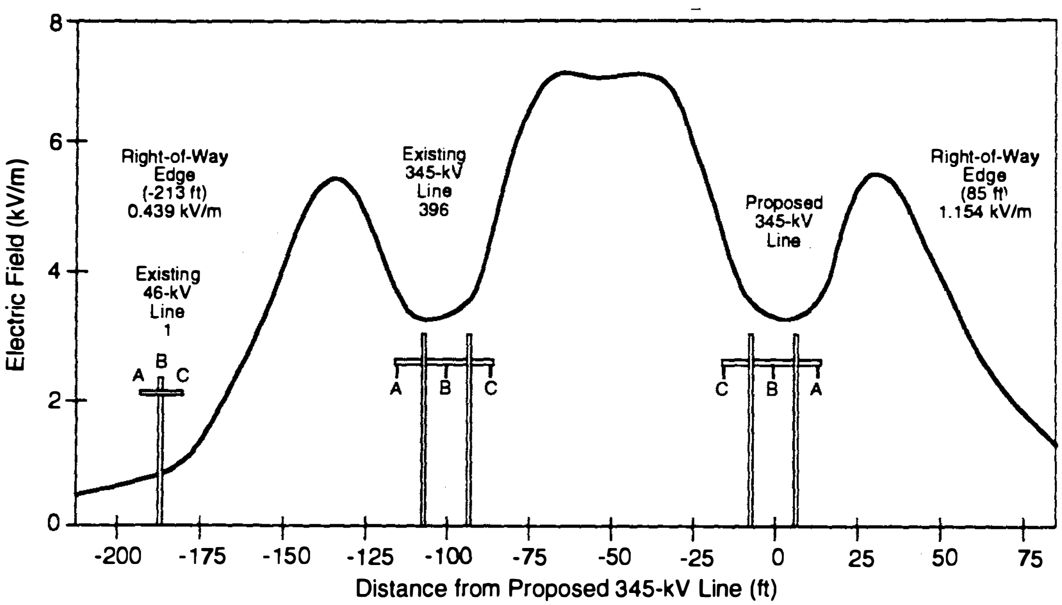


FIGURE 4.3 Calculated Electric Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 46- and 345-kV Lines (H-frame configuration only) (Source: Modified from ER 1991)

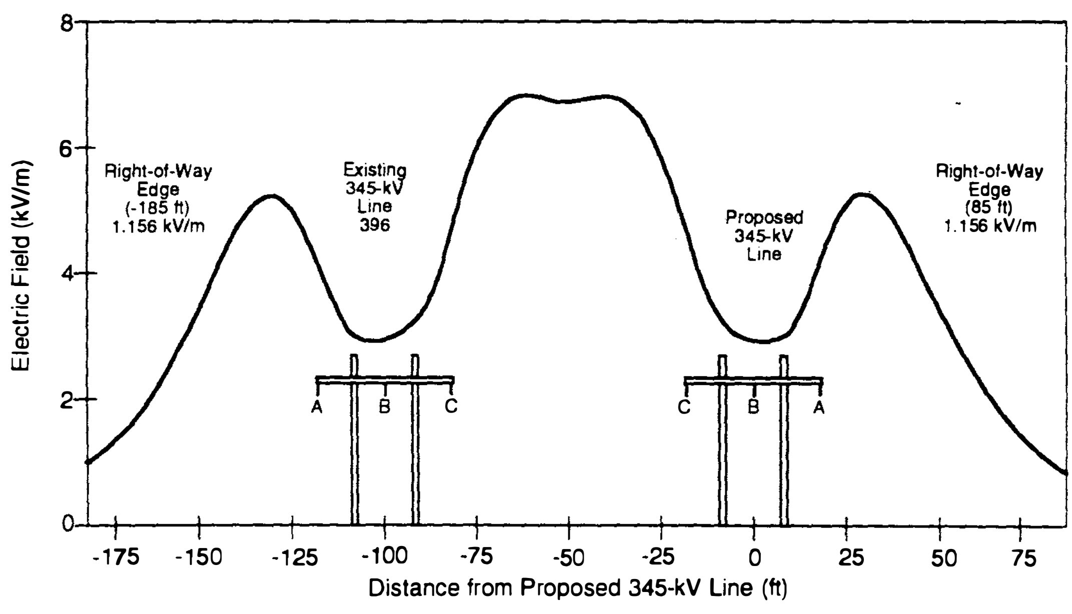


FIGURE 4.4 Calculated Electric Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 345-kV Line (H-frame configuration only) (Source: Modified from ER 1991)

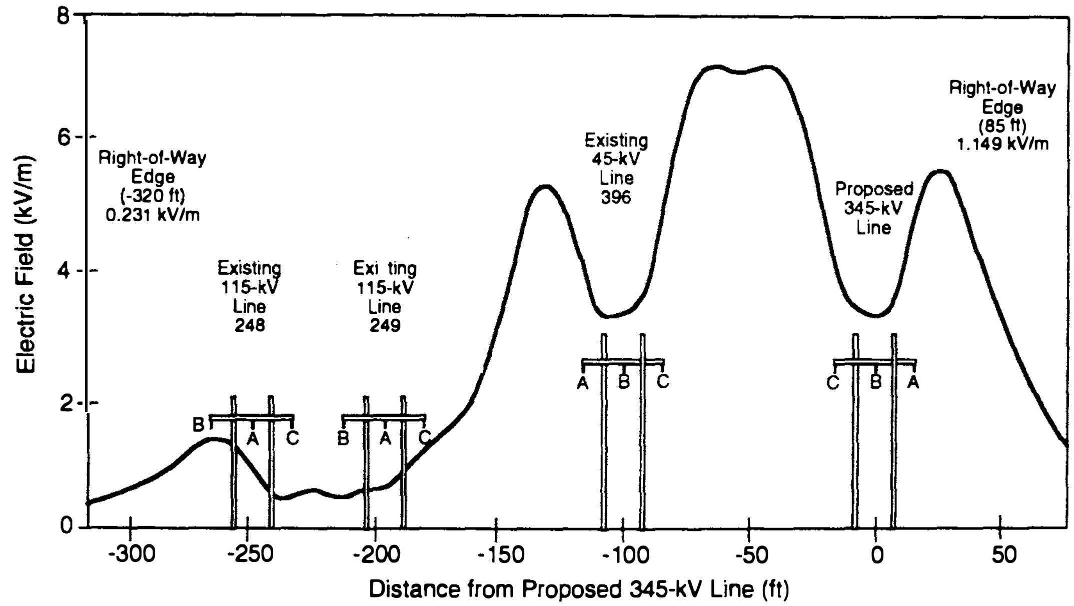


FIGURE 4.5 Calculated Electric Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 345-kV Line and Two 115-kV Lines (H-frame configuration only) (Source: Modified from ER 1991)

Field and laboratory animal studies have generally shown minimal or no impacts from power-frequency electric field strengths of 30 kV/m or less (Hauf 1974; Rupilius 1976; Amstutz and Miller 1980; Williams and Beiler 1979; Hennichs 1982; Wolpaw et al. 1989; Hackman and Graves 1981; Quinlan et al. 1985). Quantitative tests for stress (e.g., changes in behavior or brain wave patterns) were negative for people exposed to 20 kV/m (at 50 Hz) for five hours (Hauf 1982). However, Coelho et al. (1991) observed a stress response (e.g., social behavioral changes) in male baboons during exposure to a 30-kV/m electric field. Behavior returned to normal after exposure to the electric field ceased. Beyer et al. (1979) found no change in cortisol content of blood in humans exposed to 10-20 kV/m for 1.5 hours. Continuous exposure to the electric field in the proposed right-of-way is unlikely because it is improbable that humans would remain in the right-of-way for more than a few hours.

Although biological effects have been reported for elevated levels of electric field intensities associated with AC transmission lines, it is improbable that the fields associated with the proposed AC system would compromise human health and welfare. The World Health Organization (WHO) (1984) concluded that electric fields can alter cellular, physiological, and behavioral events in laboratory animals. While these results cannot be readily extrapolated to human health effects, they do imply that unnecessary exposure to electric fields should be avoided. However, it was concluded that no reason exists to limit access (resulting in intermittent exposures) to regions where the field strength is less than 10 kV/m, even though spark discharges or hair stimulation may occur to some individuals (WHO 1984). Little evidence exists of any significant biologic or health effects from electric fields at the strengths associated with transmission lines (Sagan 1992)

4.1.9.3 Magnetic Fields

The ambient 60-hertz (Hz) magnetic field is about 0.1 milligauss (mG). With the proposed line operating at 500 MW, the calculated magnetic field at the northern or western edge of the right-of-way would range from 18 to 33 mG (depending on whether there is right-of-way sharing with existing lines); while at the southern or eastern edge, the field would vary from 26 to 33 mG. These fields would diminish at lower loadings (Table 4.3). At the western edge where existing lines occur, the magnetic field would be expected to drop about 1-6 mG from existing levels because of phase relationships among the lines. At the eastern edge, the magnetic field would be expected to increase from the present 7-10 mG to about 27 mG. Magnetic fields up to 600 ft from the edge of the right-of-way (at 100-ft intervals) are listed in Table 4.4. Magnetic fields across the right-of-way at various locations along the proposed transmission line route are shown in Figures 4.6 through 4.10.

The calculated magnetic fields at the closest existing houses from operation of the proposed line are listed in Table 4.5. The two houses located 25 and 50 ft from the proposed centerline have been purchased by BHE and would not be occupied when the proposed line became operational. Thus, the closest inhabited house to the proposed line would be 100 ft from the centerline (Table 4.5, Case 3). The calculated magnetic field at this house would be 23.1 mG at 500 MW and 16.2 mG at 350 MW (ABC:CBA conductor phase arrangement). However, if the conductor phase arrangement would be CBA:CBA, the calculated magnetic fields would be 31.3 and 21.9 mG at 500 MW and 350 MW, respectively. If only the proposed line was operating at 700 MW, the calculated magnetic field at the house would be 39.7 mG. Currently, magnetic field levels at this location from operation of the existing 345 kV line are generally less than 10.0 mG for all operational load levels.

The next two closest houses would both be located 170 ft from the proposed centerline (Table 4.5, Cases 4 and 7). At 500 MW, the magnetic fields at these houses would be 10.9 and 7.1 mG, respectively (ABC:CBA phase arrangement). The magnetic fields at these houses would decrease at lower load levels and increase with alternative phase arrangement (CBA:CBA) or at higher load levels. Currently, magnetic field levels at these houses are generally less than 5 mG. Magnetic fields attributable to the proposed transmission line would greatly diminish with distance. For example, for houses located 200 ft from the centerline, the calculated magnetic field from a load level of 500 MW would be ≤6.1 mG (ABC:CBA phase arrangement) (Table 4.5). On the basis of information presented in Table 4.4, magnetic fields would fall below 2.0 mG by 200-300 ft from the edge of the right-of-way (285-385 ft from the centerline of the proposed line), depending upon right-of-way sharing with existing lines.

While electric fields are easily screened (with only a small amount of the field making it through the wall of a building or even through skin), magnetic fields travel through most matter without losing strength (Pool 1990). Background magnetic fields in homes range from 0.5 to 10.0 mG (Tell 1983; Stuchly 1986; Male at al. 1987; Wertheimer and

TABLE 4.4 Calculated Magnetic Field Levels at 100-600 ft from the Edge of the Right-of-Way for the Proposed Transmission Line at 500 and 700 MVA[a] Loading Factors

Distance from Right-of-Way Edge (ft)	Magnetic Fields (mG)					
	1 345-kV H-Frame		2 345-kV H-Frames		1 345-kV H-Frame/ 1 345-kV Steel Pole	
	700 MVA	500 MVA	700 MVA	500 MVA	700 MVA	500 MVA
Eastern edge						
600	0.74	0.53	0.18	0.13	0.73	0.52
500	1.01	0.72	0.28	0.20	0.98	0.70
400	1.47	1.05	0.47	0.33	1.38	0.99
300	2.34	1.67	0.88	0.63	2.10	1.50
200	4.27	3.05	1.57	1.40	3.59	2.56
100	10.16	7.26	4.34	4.28	7.52	5.37
Western edge						
100	10.16	7.26	4.34	4.28	10.14	7.24
200	4.27	3.05	1.57	1.40	4.37	3.12
300	2.34	1.67	0.88	0.63	2.43	1.74
400	1.47	1.05	0.47	0.33	1.56	1.10
500	1.01	0.72	0.28	0.20	1.08	0.77
600	0.74	0.53	0.18	0.13	0.79	0.57

TABLE 4.4 (Cont.)

Distance from Right-of-Way Edge (ft)	Magnetic Fields (mG)					
	2 345-kV H-Frames/ 1 115-kV Line/ 1 46-kV Line		2 345-kV H-Frames/ 1 46-kV Line		2 345-kV H-Frames/ 2 115-kV H-Frames	
	700 MVA	500 MVA	700 MVA	500 MVA	700 MVA	500 MVA
Eastern edge						
600	0.05	0.07	0.17	0.12	0.39	0.32
500	0.06	0.12	0.27	0.19	0.49	0.41
400	0.15	0.23	0.45	0.32	0.67	0.55
300	0.44	0.48	0.86	0.61	1.01	0.80
200	1.31	1.19	1.93	1.38	1.92	1.43
100	4.97	3.94	5.94	4.24	5.58	3.99
Western edge						
100	7.74	3.63	4.62	3.30	9.19	7.65
200	3.13	1.46	1.67	1.19	4.04	3.36
300	1.65	0.76	0.79	0.56	2.26	1.88
400	1.00	0.46	0.44	0.31	1.44	1.20
500	0.67	0.30	0.27	0.19	1.00	0.83
600	0.47	0.21	0.18	0.13	0.73	0.61

[a] MVA = million volt-amperes.

Sources: Broad (1991a,b).

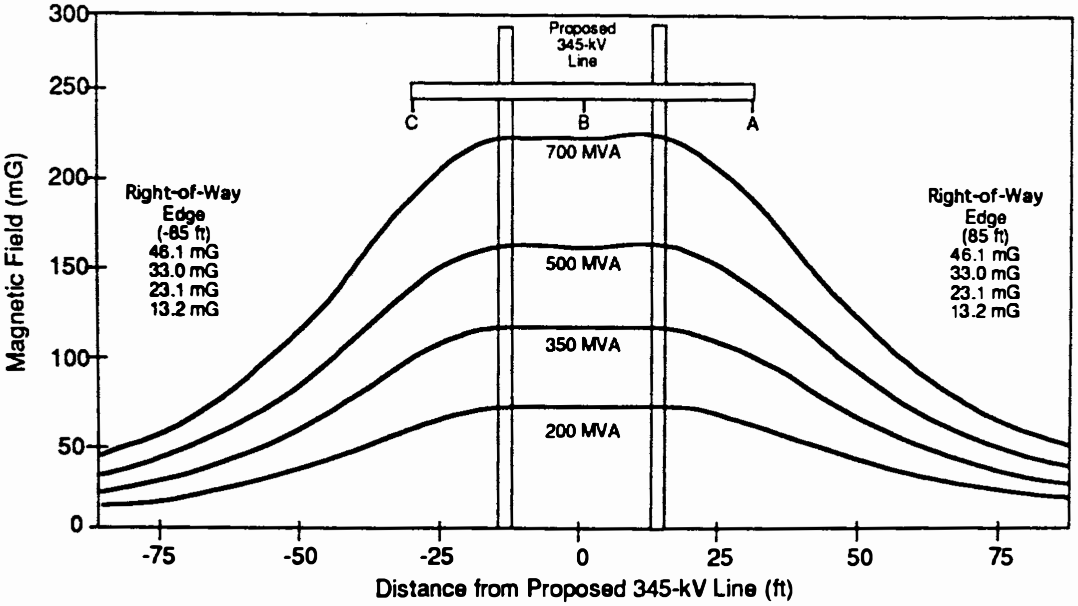


FIGURE 4.6 Calculated Magnetic Field across Proposed Transmission Line Right-of-Way in Areas Where No Other Lines Occur (H-frame configuration only) (Source: Modified from ER 1991)

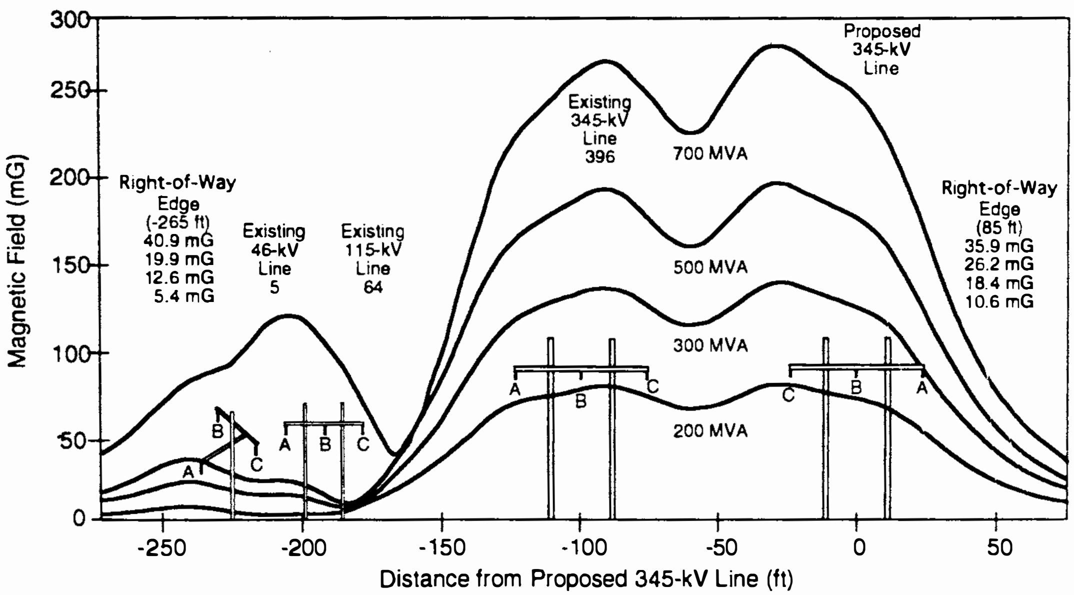


FIGURE 4.7 Calculated Magnetic Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 46-, 115-, and 345-kV Lines (H-frame configuration only) (Source: Modified from ER 1991)

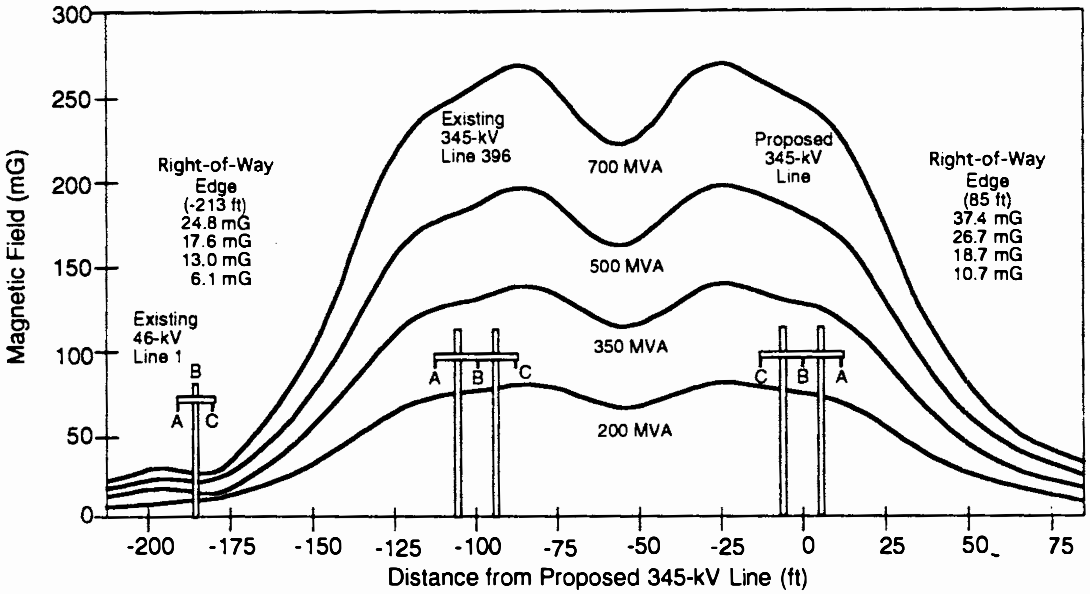


FIGURE 4.8 Calculated Magnetic Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 46- and 345-kV Lines (H-frame configuration only) (Source: Modified from ER 1991)

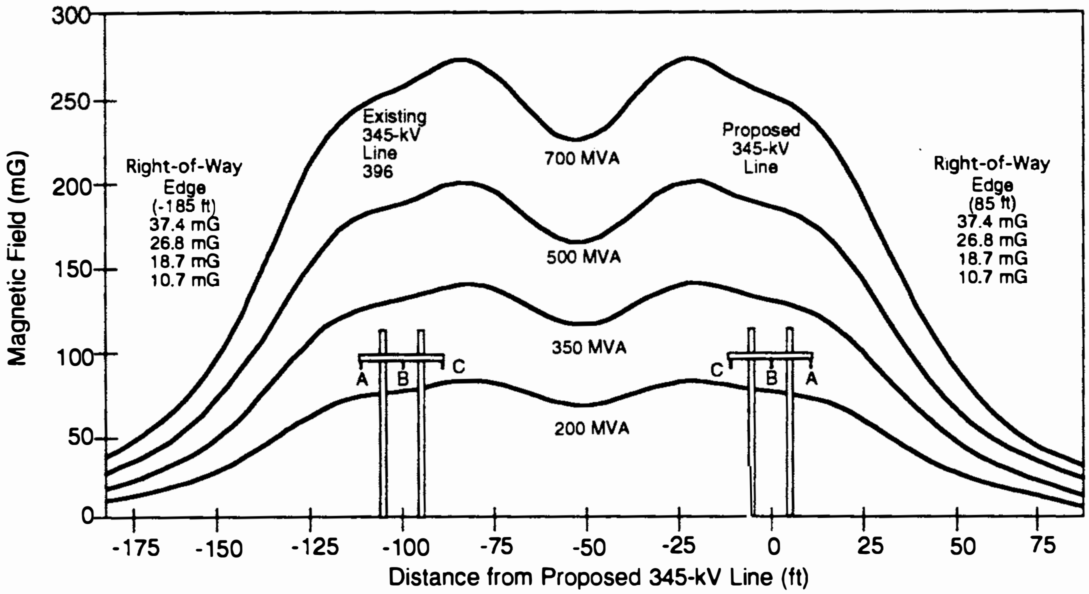


FIGURE 4.9 Calculated Magnetic Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 345-kV Line (H-frame configuration only) (Source: Modified from ER 1991)

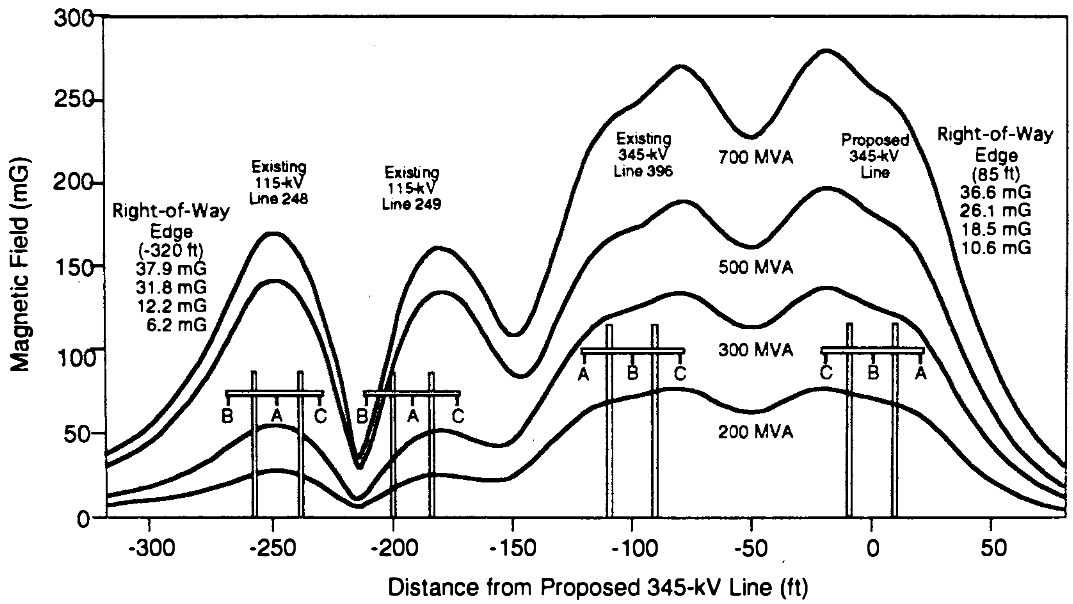


FIGURE 4.10 Calculated Magnetic Field across Proposed Transmission Line Right-of-Way in Areas Where Right-of-Way Is Shared with Existing 345-kV Line and Two 115-kV Lines (H-frame configuration only) (Source: Modified from ER 1991)

Leeper 1989). In addition to high-voltage transmission lines, other sources of residential magnetic field exposures include distribution lines, building wiring, and appliances (Mader and Peralta 1992).

Several epidemiological studies conducted over the past 20 years have investigated the potential link between exposure to magnetic fields and cancer. The results of these various investigations are summarized in Table 4.6. Individually, most of these studies can be challenged on one ground or another (including the no-risk studies). Some studies have shown a relationship between calculated magnetic fields and cancer (e.g., Feychting and Ahlbom 1992). In other studies, increased cancer risk was related to wiring configuration, whereas no clear associations between cancer and measured magnetic (or electric) fields were observed (e.g., London et al. 1991). However, as a group they have a consistency that is more difficult to ignore. The types of cancer generally linked to EMF exposure are usually leukemia, lymphoma, nervous system cancers, and malignant melanoma of the skin (Nair et al. 1989; Pool 1990).

The magnetic field exposures in most of the epidemiological studies are generally less than 3.0 mG. For example, the magnetic fields that central office telephone technicians were exposed to in a survey of male breast cancer was only 2.5 mG (Matanoski et al. 1991b), and magnetic fields for residential epidemiological studies are usually ≤3.0 mG (e.g., Savitz et al. 1988; Feychting and Ahlbom 1992). These values are lower than exposures that would exist at the edge of the proposed right-of-way (Figures 4.6 through 4.10) and at the closest residences from the proposed centerline (Table 4.5).

TABLE 4.5 Calculated Magnetic Field Levels at Houses Located Closest to the Proposed Transmission Line[a]

Case[b]	Proposed Line Supporting Structure[c]	Distance to House[d] (ft)	Magnetic Field at House[e] (mG): Phase — Alt. A[f] 350 MW	Phase — Alt. A[f] 500 MW	Phase — Alt. B[f] 350 MW	Phase — Alt. B[f] 500 MW	700 MW[g]
1	D/C steel poles (tangent-tangent)	50	27.0	38.5	12.6	18.0	37.5
2	D/C steel poles (dead end-tangent)	25	33.4	47.7	12.2	17.4	42.5
3	S/C H-frames (tangent-tangent)	100	21.9	31.3	16.2	23.1	39.7
4	S/C H-frames (tangent-tangent)	170	7.8	11.2	7.6	10.9	13.3
5	D/C steel poles (dead end-tangent)	200	5.2	7.5	2.1	3.0	6.8
6	D/C steel poles (tangent-tangent)	-200	16.1	23.0	17.0	24.2	9.9
7	S/C H-frames (tangent-tangent)	170	8.0	11.4	5.0	7.1	13.6
8	S/C H-frame — steel lattice (tangent-dead end)	200	6.7	9.5	4.3	6.1	11.6
9	S/C H-frames (tangent-tangent)	200	5.8	8.3	3.5	4.9	9.7

[a] Current calculated on a 0.9 power factor.

[b] For Cases 1, 2, and 5, the houses would be unoccupied when the proposed line becomes operational.

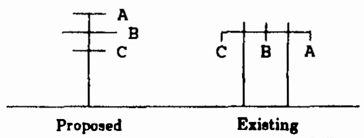
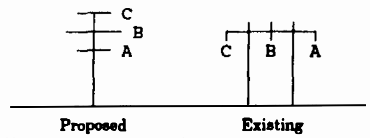
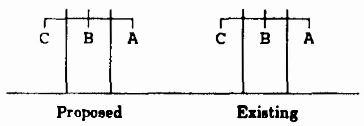
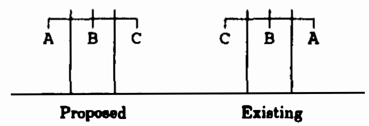
[c] Structure types that support conductors closest to house. D/C = double circuit; S/C - single circuit.

[d] House distance from center line of proposed line. All houses east of proposed line, except Case 6, which is west.

Footnotes continued on next page.

TABLE 4.5 (Cont.)

[e] Phase configuration alternatives (looking south):

Case	Phase — Alt. A	Phase — Alt. B
1, 2, 5 & 6		
3, 4, 7, 8 & 9		

[f] Both existing and proposed lines operating at the same load level.

[g] Only proposed line in operation.

Source: Broad (1992).

TABLE 4.6 Epidemiological Studies Related to Cancer Incidence and Exposure to Electromagnetic Fields

Subject	Risk	Reference
Residential Studies — Cancer		
Children living near high-current configurations	Increased leukemia	Wertheimer and Leeper (1979)
Children living near high-current configurations	No increased leukemia	Fulton et al. (1980)[a]
Adults living near high-current configurations	Increased cancer	Wertheimer and Leeper (1982)
Children living near high-voltage lines	No increased cancer	Myers et al. (1985)
Offspring of electrical workers	Increased neuroblastomas	Spitz and Johnson (1985)
Children living near high-voltage lines	No increased leukemia Increased nervous system tumors	Tomenius (1986)
Persons living near high-voltage lines	No increased cancer	McDowall (1986)
Adults living near high-current configurations	No increased cancer	Severson et al. (1988)
Offspring of electrical workers	Increased brain cancer	Wilkins and Koutras (1988)
Children living near high-current configurations	Increased cancer	Savitz et al. (1988)
Adults using electric blankets	No leukemogenic risk	Preston-Martin et al. (1988)
Children living near overhead lines and substations	Increased (nonsignificant) leukemia with decreasing distance from source	Coleman et al. (1989)
Children living near high-current configurations	Increased leukemia	London et al. (1991)
Postmenopausal women using electric blankets	No increased breast cancer	Vena et al. (1991)
Children and adults living near high-voltage power lines	Increased leukemia; no increased brain tumors	Feychting and Ahlbom (1992)

TABLE 4.6 (Cont.)

Subject	Risk	Reference
Occupational Studies — Cancer		
Telecommunication workers	No increased cancer	Wiklund et al. (1981)
Electricians and engineers	Increased central nervous system cancer	Preston-Martin et al. (1982)
Electrical occupations	Increased leukemia	Milham (1982, 1985b)
Electrical occupations	Increased leukemia	Wright et al. (1982)
Electrical occupations	Increased leukemia	McDowall (1983)
Electrical occupations	Increased leukemia	Coleman et al. (1983)
Electrical occupations	Slight excess cancer risk	Vagero and Olin (1983)
Electrical occupations	Increased eye melanoma	Swerdlow (1983)
Transportation and communications workers	Increased cancer	Howe and Lindsay (1983)
Chlorakali plant workers	No increased cancer	Barregard et al. (1985)
Electronic equipment assemblers, radio/TV repairmen	Increased leukemia	Pearce et al. (1985)
Electrical occupations	Increased brain tumors	Lin et al. (1985)
Amateur radio operators	Increased leukemia	Milham (1985a)
Underground coal miners	Increased leukemia	Gilman et al. (1985)
Telecommunication occupations	Increased malignant melanomas	Vagero et al. (1985)
Radio and telegraph operators, electrical engineers and linemen	Increased leukemia	Calle and Savitz (1985)
Electrical occupations	Increased malignant melanomas	Olin et al. (1985)
Electricians and welders	Increased leukemia	Stern et al. (1986)
Electrical occupations	Increased leukemia	Flodin et al. (1986)

TABLE 4.6 (Cont.)

Subject	Risk	Reference
Electric power linesmen and station operators	No excess leukemia or brain tumors; raised risk of urinary organ cancers	Tornqvist et al. (1986)
Workers exposed to EMF	Increased (nonsignificant) astrocytic brain tumors	Thomas et al. (1987)
Electrical occupation	Increased leukemia	Juutilainen et al. (1988)
Utility occupations	Increased brain cancer	Speers et al. (1988)
Telecommunication workers	Increased skin cancer	DeGuire et al. (1988)
Electricians	Increased (nonsignificant) cancer (neoplasms, esophagus, stomach, intestine/rectum, pancreas, larynx, brain, Hodgkins disease, leukemia)	Gurberan et al. (1989)
Electrical workers - general	Increased central nervous system cancer	Loomis and Savitz (1989)
Electricians and electrical and electronic technicians	Increased central nervous system cancer, plus increased leukemia	Loomis and Savitz (1989)
Electrical engineers	Increased brain cancer	Reif et al. (1989)
Workers exposed to EMF	Increased male breast cancer	Tynes and Andersen (1990)
Electricians, electrical engineers	Increased astrocytoma (nerve tissue tumor)	Preston-Martin et al. (1990)
Electricians, telephone linemen, electric power workers (males)	Increased breast cancer	Demers et al. (1991)
Utility electrical workers	No increased cancer	Sahl et al. (1991)
Telephone lineman	Increased (nonsignificant) leukemia with increasing exposure doses	Matanoski et al. (1991a)
Telephone company workers (males)	Increased male breast cancer	Matanoski et al. (1991b)

TABLE 4.6 (Cont.)

Subject	Risk	Reference
Electrical workers (general)	Increased leukemia and male breast, pleura, larynx, and bladder cancers; soft tissue sarcomas; no increase in brain tumors or in non-Hodgkins and Hodgkins lymphomas	Tynes et al. (1992)

[a] Reworking of data by Wertheimer and Leeper (1980) showed modest increased cancer at high current configuration.

Several other epidemiological studies related to EMF exposures have dealt with end points other than cancer. For example, increased suicide rates that have been related to proximity to overhead power lines (Reichmanis et al. 1979) and to increased magnetic field strength (Perry et al. 1981). However, such a relationship with suicide was not observed by McDowall (1986). The offspring of electric substation workers were found to have increased birth defects (Nordstrom et al. 1983). Electric blanket and heated waterbed use has been suspected to increase infertility, birth defects, gestation period, and fetal loss; while decreasing birth rates (Wertheimer and Leeper 1986). Increased fetal loss has also been related to use of ceiling cable heating (Wertheimer and Leeper 1989). However, study results of Dlugosz et al. (1992) suggest that use of electric blankets and heated waterbeds does not cause neural tube or oral cleft defects.

Nair et al. (1989) summarized the important experimental evidence concerning the potential association between EMF exposure and the increased occurrence of cancer:

1. Electromagnetic fields have not been shown to cause chromosomal damage and therefore are not probable cancer initiators.

2. Several experimental studies have indicated that the cell membrane is the site of interaction between EMF and the cell. The membrane site responsible for this action has also been shown to be a receptor for chemical cancer promoters.

3. EMF exposure has been shown to increase ornithine decarboxylase (ODC) activity. All known cancer promoters stimulate ODC activity. (However, many agents that promote ODC activity are not cancer promoters.)

4. EMF exposure has been shown to alter protein synthesis (in immunological and hormonal status) and metabolic competence via circadian shifts. Such changes can contribute to the progress of initiated cancers.

5. EMF exposure has been found to depress pineal melatonin levels in animals. Depression of this substance has been associated with cancer growth.

6. The function of gap junctions is disrupted by an EMF. Similar disruptions are produced by known chemical cancer promoters.

7. Epidemiological studies show a weak association between EMF exposure and both central nervous system cancers and leukemia.

A discussion of the experimental investigations of EMF effects (particularly at the cellular level) is beyond the scope of this EIS. More information on these studies can be obtained in recent EMF reviews by Nair et al. (1989) and Energetics, Inc. (1991).

4.1.9.4 Air Ion Effects

Air ion densities are not of concern for AC transmission lines. As the voltage on the conductor alternates polarity (at the rate of 60 times per second), charged molecules are alternately repulsed and attracted and thus remain near the conductor.

4.1.9.5 Audible Noise and Ozone Effects

The proposed transmission line has been designed with multiple conductor bundles to lower the conductor surface gradient and thus lower corona activity. At the edge of the right-of-way, audible noise would be at a level of 51 A-weighted decibels (dBA) during foul weather and 19 dBA during fair weather (ER 1991; Murphy 1991), well within the 55-dBA level recommended by the EPA for residential communities (see DOE 1979). Background levels of audible noise in rural areas typically are about 35-45 dBA during fair weather (EPA 1974). During heavy rain, background levels of audible noise would increase by 10-15 dBA. Thus, audible noise at the edge of the right-of-way would be expected to be below background during fair weather and at the upper end of ambient conditions during periods of heavy rain. Noise intensity decreases at the rate of 6 dB per doubling of distance (EPA 1974) (this value does not take into account the buffering of noise at ground level by woody vegetation).

Noise regulations issued by the Maine Department of Environmental Protection for protected locations (e.g., residential areas) include requirements that levels of audible noise not exceed 50 dBA at night and 60 dBA during the day. Operational hourly sound levels at the right-of-way edge would be less than these maximum allowable levels under both fair weather and wet conductor conditions. However, during heavy rain, the approximate noise level at the right-of-way edge would be 51 dBA. Residences would be sufficiently far from the centerline (no residences would be within 50 ft of the centerline, one residence would be within 51 to 100 ft, and four residences would be within 101 to 200 ft) that the noise level under all weather conditions would be below that allowed in protected areas (Murphy 1991, 1992). The greatest potential for noise-related impacts would be during wet weather when recreationists in remote areas passed directly under the conductors. Even then, the duration of audible noise would be minimal.

No adverse health effects are expected from ozone produced by the proposed transmission line (Section 4.1.1.2).

4.1.9.6 Effects on Cardiac Pacemakers

Both electric and magnetic fields have been found to introduce electromagnetic interference (EMI) that can alter the function of some older (no longer commercially available) cardiac pacemakers. Such pacemaker models could revert in electric fields of 2 kV/m or more (Moss and Carstensen 1985; Butrous et al. 1983). Jenkins and Woody (1978) found that the majority of pacemaker models exposed to 1,100-4,000 mG (average 2,100 mG) reverted to an asynchronous mode or exhibited abnormal pacing characteristics. However, pacemaker malfunctions produced by magnetic fields require field levels that are greater than those associated with high-voltage transmission lines.

Modern pacemakers function in a demand mode that sends stimulatory pulses to the heart only if the heart fails to exhibit intrinsic electrical activity. Pacemakers with the unipolar design (cathode lead in heart, pacemaker case is anode lead), rather than the bipolar design (both leads in heart), have been the models found in the past to be sensitive to EMI. However, manufacturers have successfully designed pacemakers to avoid such problems by incorporating features that automatically decrease the sensitivity of the amplifier circuit when EMI is sensed. Most pacemakers also contain noise detection circuitry that can discriminate electric fields with different frequencies and waveforms from those associated with the heart (WHO 1987).

Adverse conditions could occur in some older models when EMI is sensed and the pacemaker reverts to a fixed-rate pacing mode, which may be asynchronous with normal cardiac activity (WHO 1987). Griffin (1985) concluded that less than 2.5% of the individuals with pacemakers in the United States might be at risk from EMI. The percentage of individuals alive today with older pacemakers that could revert from EMI is undoubtedly significantly lower. Furthermore, the fraction of those individuals at risk who would be likely to encounter a source of EMI (including the proposed transmission line) during a period when their cardiac function was dependent upon their pacemaker is extremely small (WHO 1987).

Even when older pacemaker models susceptible to reversion were more prevalent, apparently no accidents resulted from exposure of a pacemaker patient to an AC transmission line (Scott-Walton et al. 1979; Lee et al. 1982; WHO 1984). The combination of circumstances that would lead to an accidental event is extremely rare (approaching zero, considering the small number of individuals who still have older models). People driving under a high-voltage transmission line are not at risk from pacemaker problems because the metal of the vehicle would serve as a shield from an external electric field (DOE 1979).

4.1.9.7 Summary of Electromagnetic Field Effects

Before the results of epidemiological investigations on the potential link between EMF exposure and cancer were reported, reviews of the EMF literature indicated that health and safety concerns were mostly related to secondary shocks, rather than EMF exposure per se. For instance, Michaelson (1979) concluded that electric fields up to 20 kV/m and magnetic fields up to 3,000 mG (individually or in combination) do not present any persistent threat to health. The scientific literature still tends to support the conclusion that electric fields associated with high-voltage transmission lines do not cause significant health risks. However, conclusions regarding magnetic fields are more ambiguous.

Exposures to magnetic or electric fields from the proposed line would be limited primarily to short-term exposures of people passing under the line (e.g., canoeists) or paralleling the line for a period (e.g., off-road motorists traveling within the right-of-way). Longer exposures may occur for individuals that live near the line, but the contribution from the line would be only one component of exposure. These individuals would also receive exposure from distribution lines, home wiring and appliances, and other sources. Because relatively few people live near transmission lines, other exposure sources (regardless of relative field strength) dominate exposure to the population as a whole in terms of time spent in electric and magnetic fields (Hester 1992). Thus, distribution lines, wall wiring, appliances, and light fixtures could play a far greater role than transmission lines relative to a public health problem from EMF exposure (Nair et al. 1989).

Possible measures of concern relative to EMF exposure include the intensity, duration, frequency, and/or orientation of electric and/or magnetic field exposure. A few epidemiological studies imply that magnetic field intensities of 2 to 3 mG may be sufficient to cause health concerns. However, to date there is no proven level of EMF intensity that causes health effects (Energetics, Inc. 1991). The DOE is aware that potential health effects from exposure to EMF is of public concern. In response to this concern, DOE has sponsored a number of studies to examine this topic. At present, no definitive evidence has been found supporting a conclusion of a health risk from EMF exposures. Several more years of research will be needed before questions about the possible health effects of EMF can be answered. Nevertheless, BHE management practices have included line routing decisions that have avoided hospitals, schools, and multiple-resident dwellings, and that have minimized the number of nearby single-family residences to the extent practicable.

4.1.9.8 Herbicide Use in Right-of-Way Management

Vegetation management within transmission rights-of-way is necessary to (1) keep trees from contacting transmission lines (thereby short-circuiting conductors and causing outages), (2) maintain unimpaired access to the right-of-way and support structures, and

(3) reduce the potential for safety hazards or damage to equipment (e.g., from fires) (DOE 1983). Right-of-way management practices for the proposed project would be similar to those currently used for existing BHE rights-of-way. Only selective basal applications of herbicides registered with the U.S. Environmental Protection Agency and the state of Maine would be used to retard the development of tall-growing vegetation that might compromise the integrity and safety of the transmission system. BHE plans to use Tordon 101R or an equivalent herbicide approved by the construction manager and the Maine Pesticide Control Board (BHE 1991b). The active ingredient in Tordon is picloram (4-amino-3,5,6-trichloropicolinic acid), which is used to control woody plants and most annual and perennial broadleaf weeds.

Herbicides would be applied only by means of selective basal spray application by workers using hand-held applicators; there would be no broadcast application. Selective basal herbicide application is an ecologically desirable means of encouraging the development of relatively stable shrublands, thereby decreasing the number of invading tree seedlings (Dreyer and Niering 1986). Areas near public water supplies, open waters, wetlands, springs, wells, homes, or roadsides would be managed by manual removal of undesirable vegetation.

Herbicides can be toxic to living organisms, and many herbicides are considered somewhat toxic to humans (Norris 1981; Gangstad 1982; DOE 1983, 1984). The risk to human health from herbicide application depends upon the acute and chronic toxicity of the compound, duration of the exposure, pathway of exposure, and concentration of the compound to which the individual is exposed. Workers can receive some exposure to herbicides (via ingestion, inhalation, and [primarily] dermal absorption). However, absorbed doses have been found to be below the no-observed-effects level (Lavy et al. 1987). Public exposure could result from ingestion of contaminated water and food and dermal absorption (e.g., from brushing against sprayed vegetation).

Alternatives to the use of herbicides for vegetative management include manual, mechanical, and biological control methods (DOE 1983). Manual and mechanical control are the most acceptable alternatives. These methods are more labor-intensive than use of herbicides and also expose workers to increased risk of injury from accidents in tool, equipment, and brush handling. Vegetation management by use of herbicides would reduce health and safety risks for workers, while slightly increasing the risks of toxic effects to the public and wildlife. However, herbicides would be applied to any given area of the proposed route only once every four to five years, thus limiting the opportunity for exposure of the public. Also, basal application methods would limit the potential for movement of herbicides away from the targeted vegetation.

Lawrence et al. (1988) determined the potential for toxic impacts to humans from exposure to selected herbicides by making dermal contact; drinking water; and consuming blueberries, venison, and brook trout. Potential impacts to white-tailed deer, red-tailed hawk, white-footed mouse, and brook trout were also assessed. This modeling study was done to support the safety of herbicide use for the proposed (but canceled) central Maine interconnection. That study concluded that the application of herbicides (including picloram) under specified application conditions and for specified uses would not pose a risk to humans or wildlife. Application of 0.12 lb/acre of active ingredient resulted in the following margins of safety to humans over the no-observed-effects level: blueberry consumption, 270 times; dermal contact, 2,000 times; drinking water, 55,000 times; venison consumption, 3,200 times; and brook trout consumption, 420,000 times. Safety factors above the no-effects-observed level for wildlife species were as follows: white-tailed deer, 1,100 times; red-tailed hawk, 2,000 times; white-footed mouse, 5,000 times; and brook trout, 140,000 times.

On the basis of the conservative assumption used by Lawrence et al. (1988), it is evident that even with an application rate well above the 0.12 lb/acre used in their assessment, no detrimental effects to man or wildlife would be expected from herbicide use. Similar safety levels were also found for dicamba and trichlopyr, two other herbicides often used for control of woody vegetation in rights-of-way.

In conclusion, the herbicides that would be used in the right-of-way generally have low degrees of toxicity to humans and animals, and their application according to label directions and in conjunction with appropriate mitigative measures would ensure their safe use. Extensive experience with herbicides has shown that these potentially hazardous materials can be used safely if appropriate precautions are implemented (Barnes 1975; Buffington 1974; Gangstad 1982; DOE 1983; Lawrence 1988).

4.1.10 Radio and Television Interference

A potential exists for radio and television (TV) interference from transmission line operation. The term "radio noise" is used to refer to any undesirable disturbance of the radio frequency spectrum, which ranges from 3 kilohertz (kHz) to 30,000 megahertz (MHz). Operational high-voltage transmission facilities contribute to radio noise that can interfere with radio and television reception, particularly the AM broadcast bands (535-1605 kHz) and the lower television broadcast bands (channels 2-6 at 54-88 MHz) (DOE 1984). The degraded reception is referred to as radio interference (RI) or television interference (TVI). The FM broadcast range from 88 MHz is unaffected by pulsative-type noise (LaForest 1982).

The RI and TVI associated with operational transmission lines result from corona discharge and gap sparking. The magnitude of corona-generated radio noise decreases with increasing frequency and is very low at frequencies above 10 MHz. Interference is generally noticed on AM broadcast bands when the receiver is located very close to a transmission line (e.g., in a car passing under the line). Some interference with weak AM broadcast radio stations may occur during fair weather within 100 ft of the right-of-way. High levels of static generally preclude useful AM radio reception during thunderstorms; FM broadcasts do not generally experience interference because (1) the magnitude of radio noise is quite small in the FM broadcast band (88-108 MHz), and (2) the interference rejection properties inherent in FM radio systems make them virtually immune to static-type disturbances. The radio and television interference related to gap sparking of transmission lines generally is caused by defective or loose fittings of line hardware and can be remedied by routine maintenance of those fittings.

Broadcast signal-to-noise ratio (SNR) for acceptable reception involving AC transmission systems is variously reported as 15 to 1, ranging up to 25 to 1. Accordingly, the AC line RI must be 23.5 to 28 dB below the broadcast signal strength for satisfactory reception (Bonneville Power Administration undated).

The intensity of radio noise from transmission line corona decreases with increasing distance from the line, as well as with increasing radio frequencies. Corona-generated radio frequency noise will be about 48 dB (250 times) lower at citizen band (CB) radio frequencies of 27 MHz than at a frequency of 1 MHz in the AM broadcast band. Assuming typical CB signal strengths, it is estimated that good CB communications can be obtained outside the transmission line right-of-way during fair weather conditions. During thunderstorms, atmospheric static would mask radio noise from the proposed transmission line (BHE 1991b).

Interference with TV reception is a visible interference in the received picture. The audio portion of a TV signal is an FM radio system that is not subject to static types of interference. Television interference is possible from corona activity, spark discharges associated with loose or damaged hardware, and from "ghost" images caused when TV signals reflect from large structures.

Corona-generated radio frequency noise is quite small in the very high frequency (VHF) range used for television transmission. Generally, if the AM radio reception near a particular line is acceptable, then TV interference would not be a problem (BHE 1991b). Ghosting is the only TV problem that may result from the proposed line.

The applicant has reported calculated RI levels at the edge of the proposed right-of-way. For a frequency of 1 MHz, the calculated RI is 68 dB or less during heavy rain, 60 dB or less during wet conductor conditions, and 43 dB or less during fair weather conditions. However, RI levels decrease rapidly with increasing distance from the line. At 100 ft from the edge of the right-of-way, the estimated RI level drops to 49 dB or less during heavy rain, 40 dB or less during wet conductor conditions, and 23 dB during fair weather conditions. Given a SNR equivalent of 20 dB for satisfactory radio reception and a 70-dB radio broadcast signal for the primary service area, AM radio reception at the edge of the right-of-way should be satisfactory, except when conductors are wet or heavy rain is occurring. At distances greater than 100 ft from the edge of the right-of-way, radio reception should be satisfactory during all weather conditions.

The level of interference associated with commercial television frequencies is considerably lower than that associated with the AM radio broadcast band. Thus, the incidence of TVI from the proposed line should be of minor consequence. The physical presence of transmission facilities may cause scattering or reflecting of primary television broadcast signals, thus resulting in the phenomenon referred to as ghosting (LaForest 1982). Ghosting can be alleviated by modifications of antennas.

4.2 ALTERNATIVE ROUTE (EXISTING-LINE ROUTE)

Impacts for the alternative route would be qualitatively similar to those for the proposed route. Therefore, the following sections refer to the appropriate discussions for the proposed route relative to general impact characterization and then discuss any impacts specific to the alternative route. If potential impacts would not be significantly different between the two routes, the section simply refers the reader to the appropriate discussion provided for the proposed route in Section 4.1.

Construction and operation in the alternative route would be subject to the same mitigative measures identified for the proposed route (Section 4.4.1). Therefore, the following discussions of environmental consequences assume the adoption and effective implementation of all listed mitigative measures.

4.2.1 Atmospheric Environment

4.2.1.1 Weather and Climate

Construction and operation of the proposed transmission line in the alternative route would not significantly affect the climate of the project area. Microclimatic changes would be similar to those that could occur along the proposed route (Section 4.1.1.1). However, construction in the alternative route would incrementally increase forest openings that have already been created by construction and maintenance of the various existing lines that would be paralleled by the alternative route. Such a change would have such localized effects as increasing the corridor width where ground-level snow accumulations could occur.

4.2.1.2 Air Quality

Impacts to air quality from construction along the alternative route would be of the same types and magnitudes as those discussed for the proposed route (Section 4.1.1.2).

4.2.2 Land Features

4.2.2.1 Physiography, Geology, Geological Resources, and Hazards

The alternative route would pose a similarly insignificant potential for geologic impacts as was projected for the proposed route (Section 4.1.2). Insignificant terrain changes would result from construction of the alternative route. No major peat deposits are traversed by the right-of-way (Cameron et al. 1984b,c), and the amount of sand and gravel used in the project would be very insignificant relative to the abundance of this resource in the area. The landslide potential along the right-of-way is very low. The only potential threat of the route is the possible destruction of a geologically significant esker, the Enfield Horseback (Borns

1979). That esker parallels a portion of the right-of-way and almost contacts the right-of-way at the crossing of the Passadumkeag River near Passadumkeag.

4.2.2.2 Soils

Soil erosion caused by installation of pole structures on the right-of-way would be locally minor if erosion-control measures and controlled clearings were implemented in areas with steep slopes. According to Soil Conservation Service data (SCS 1962, 1964), about one linear mile (covering about 21 acres) of highly erodible soil is traversed by the right-of-way of the alternative route. Because fewer ready-to-use access roads are available for the alternative route than for the proposed route, longer and more access roads would be required for the alternative. This requirement would result in more soil erosion potential than for the proposed route.

The area of prime farmland crossed by the alternative route is estimated to be about 350 acres, which is about 17% of the total acreage occupied by the route. The actual area affected, primarily the area occupied by foundations of supporting structures, would be substantially less than the 350 acres total. If the actual prime farmland affected by the foundations were 0.235% of the total prime farmland crossed by the right-of-way (the same ratio calculated for the proposed route in Section 4.1.2.2), a total area of about 0.8 acre of prime farmland would be affected by the foundations. Because of the small area involved, the impacts to prime farmland would be insignificant.

4.2.3 Land Use

The alternative route extends across 263 privately owned land parcels (Wainwright 1991). The acreage that would be affected by the 106-mi-long alternative route is listed (by use and vegetation type) in Table 4.7.

4.2.3.1 Forestry

The principal change in land use related to the alternative route would be the conversion of nearly 1,845 acres of forestland (about 89% of the alternative route). Champion International and Georgia Pacific are the major commercial forestry landowners that would be affected. The line would span about 8 mi of property owned by Champion International and 10 mi of property owned by Georgia Pacific (Champion International Corp. undated; Georgia Pacific Corp. 1990). Land-clearing operations and impacts are discussed in Section 4.1.7.1.

4.2.3.2 Agriculture

The alternative route extends through a hayfield and pastureland located near the community of Chester. Impacts to these agricultural areas are expected to be minimal.

TABLE 4.7 Estimated Amount of Existing Vegetation Directly Impacted by the Alternative Route

Cover Type	Acres	Percent of Right-of-Way
Conifers	676	32.5
Mixed forest	926	44.5
Deciduous forest	229	11.0
White and red pine	13	0.6
Nonforested wetlands	136	6.5
Residential/industrial	72	3.5
Agricultural	29	1.4
Total[a]	2,081	100

[a] Estimated total acreage derived as follows: (93.8 mi × 170 ft right-of-way) and (12.2 mi × 100 ft right-of-way) = 2,081 acres.

Sources: ER (1991); Murphy (1991).

4.2.3.3 Recreation

Short-term construction impacts to recreational resources would be similar to those described for the proposed route (Section 4.1.3.3). Many of the recreational impacts would be visual in nature and are discussed in Section 4.2.7. Impacts to specific recreational resources located along the alternative route are summarized in Table 4.8.

4.2.3.4 Residential, Commercial, and Industrial

The potential for affecting urban or built-up land uses would be limited to several areas adjacent to the alternative route right-of-way. Fifty-seven residences are located within 2,000 ft of the proposed staging area locations at Bradley along State Route 178, Maine Route 155 adjacent to the Maine Central Railroad in Enfield, Maine Route 157 in Mattawamkeag, and Lake Road in Glenwood (Wainwright 1991). A total of 150 houses, camps, and trailers, many adjacent to existing roads, are located within 600 ft to either side of the alternative route right-of-way centerline. The presence of the alternative route would result in visual impacts (Section 4.2.7) and an increase in EMF exposure (Section 4.2.9) at some residential and commercial locations.

TABLE 4.8 Impacts to Recreational Use and Resources along the Alternative Route[a]

Resource	Impacts to Recreational Use and Resources
Monument Brook	Increases access to this relatively remote area
Mattawamkeag River	Increases access to this area
Wytopitlock Stream	No impact on number of recreational opportunities
Macwahoc Stream	Increases access to this area
Molunkus Stream	Increases access to this area
Mattaseunk Lake and Stream	No impact on number of recreational opportunities
Penobscot River	No impact on number of recreational opportunities
Mattamiscontis Stream and Penobscot River	Increases access to this area
Passadumkeag River	Increases access to this area
Sunkhaze Stream and National Wildlife Refuge	Decreases remote recreational experience; increases access to this area and creates opportunities for land-based recreation
Baker Brook access road	Increases access to Baker Brook and Baker Brook access road
Milford/Bradley woodlands	Creates access to this area and opportunities for land-based recreation
Great Works Stream	Increases access to this area
Peaked Mountain and trail	No impacts on number of recreational opportunities
Eddington/Orrington woodlands	Creates access to this area and opportunities for land-based recreation

[a] Visual impacts related to specific recreational use and facilities are discussed in Section 4.2.7.

Source: ER (1991).

4.2.3.5 Transportation and Utility Uses

The alternative route extends across 25 unimproved and improved private and public roads, including U.S. Routes 1, 2A, 2, and 1A and Maine Routes 157, 116, 155, and 9. Short-term impacts to motorists would be the same as those described for the proposed route (Section 4.1.3.5). In the alternative route, the new transmission line would parallel an existing 345-kV transmission line for the majority of its length (except for several locations, totaling 34 mi, where the line would be diverted around large wetlands and other areas of concern). The line also would parallel an oil pipeline for about 8 mi along U.S. Route 2A between Reed and Macwahoc. Appropriate safety measures and construction practices should minimize the potential for any adverse impacts to the pipeline.

4.2.4 Hydrologic Resources

4.2.4.1 Surface Water

Installation of the line in the alternative route would result in surface-water impacts similar to those discussed for the proposed route (Section 4.1.4). The impacts would include potential degradation of water quality, increased surface runoff, altered drainage patterns, and river bank erosion. Because more and longer access roads would have to be constructed for the alternative route, the magnitude of adverse impacts would have the potential to be greater for this alternative than for the proposed route. Nevertheless, the impacts still would be minor and local, providing that the access roads were properly sited and designed and given the proposed mitigative measures discussed in Section 4.4.

4.2.4.2 Groundwater

The potential adverse impacts on groundwater for the alternative route could include groundwater contamination and alteration of shallow groundwater flow patterns. Because less sand and gravel aquifers are crossed by the alternative route than by the proposed route, potential groundwater water contamination caused by herbicides or spills would be less for the alternative route. However, because the transmission line would be longer and require more structures for the alternative route than for the proposed route, the potential disruption of shallow groundwater flow patterns would be greater for the alternative route.

4.2.5 Biotic Resources

4.2.5.1 Terrestrial

Vegetation

Most of the general environmental consequences discussed for the proposed route (Section 4.1.5) also apply to the alternative route. Construction of the new line in the alternative route (106 mi in Maine) would primarily require widening 72 mi of an existing transmission line (about 60 mi by 170 ft and 12 mi by 100 ft) and constructing 34 mi of new 170-ft-wide right-of-way in locations where the alternative route would diverge from the existing line. Construction of the transmission line in the alternative route would result in the modification of nearly 1,845 acres of forest, including forested wetlands (see Table 3.6). Tall trees and dead snags that pose a danger to the line would have to be removed. Snags can provide an important resource for insectivorous birds, such as woodpeckers, and if the snags are tall enough, they can provide roosting sites for raptors (as can tall live trees). Removal of these trees could affect foraging activities of these species. Because 72 mi of the right-of-way would be along an existing line, large expanses of contiguous habitat should remain.

Wildlife

Contiguous forest habitat along the alternative route could be fragmented in places, especially where the new line would diverge from the existing-line right-of-way. It is likely that many of the impacts associated with the proposed route (Section 4.1.5), including commercial forestry and wildlife management (Bissonette et al. 1991), also apply here. Impacts to wildlife, both beneficial and detrimental (see Tables C.1 through C.3, Appendix C), would be expected to be greater for the alternative route than for the proposed route because of the alternative's greater length.

4.2.5.2 Aquatic

Impacts to aquatic biota from construction and operation of the line in the alternative route would be similar to those discussed for the proposed route (Section 4.1.5.2). This similarity would especially be the case for the segments of the alternative route that would diverge from the existing-line route. Where new line would parallel and share right-of-way with the existing 345-kV tie line and other existing lines, the increase in overall right-of-way width could result in impacts that vary in magnitude from those for a right-of-way for a single transmission line. (The route segment between Blackman Stream and the Orrington substation would be identical for the proposed and alternative routes, and thus, potential impacts to aquatic biota would be the same.)

Thermal alterations to streams from vegetative clearing along the alternative route would be similar to those described in Section 4.1.5.2. The addition of 170 ft to the width of existing right-of-way between the international border and Blackman Stream (100 ft for the remainder of the line) could be expected to increase the potential for warming of smaller streams. However, such streams are currently crossed by the existing 345-kV tie line and (in some cases) other transmission lines and would have overhanging vegetation, shrubs, or small trees established along the banks. Therefore, clearing for right-of-way sharing would have about the same potential to thermally alter smaller streams as would clearing for a new corridor. Right-of-way clearing of streamside vegetation along larger streams that have little canopy cover would have a negligible effect on stream temperatures.

Detailed routing analyses have not been conducted for the alternative route (except for the 12.2-mi segment between Blackman Stream and the Orrington Substation that would be identical with the proposed route). However, the number of access road stream crossings required for the alternative would likely be higher than for the proposed route because of increased line length, lesser amount of available or usable access roads, and shorter span length between structures (Murphy 1991). Impacts to streams that would be crossed by access roads along the alternative and proposed routes (Section 4.1.5.2) would be comparable.

Construction of the new line in the alternative route would increase access throughout much of the existing corridor and add a new corridor in areas where the line diverged from the existing 345-kV line. The potential for instream disturbance from off-road vehicles and access for fishermen would increase.

The potential for significant adverse impacts to aquatic biota along the alternative route would be minimized by the implementation of mitigative measures committed to by BHE (Section 4.4.1.4).

4.2.5.3 Wetlands

The Orrington substation and the six proposed staging areas associated with the alternative route are located in upland sites. Therefore, activities required within these areas would not infringe upon wetlands. Only construction and maintenance of the transmission line are of potential concern relative to wetland impacts associated with the alternative route. Potential wetland impacts (e.g., elimination and wetland vegetation clearing) that would be associated with construction and operation of the alternative route are assessed in Section D.4.1 (Appendix D).

4.2.5.4 Threatened and Endangered Biota

Northern valerian and small yellow water-crowfoot are two rare plant species that could be affected if the transmission line were built in the alternative route. Both are known to occur along the route. The first is a candidate for federal listing, and the second is on the state threatened list. Right-of-way construction and maintenance could adversely affect individuals of these plants if they were not avoided during construction and if appropriate protective measures were not implemented.

Bald eagles were not observed along the alternative route, although they are known to occur in the region. Potential impacts to bald eagles at the crossings of the Penobscot River would be similar to those discussed for the proposed route crossing of the St. Croix River (Section 4.1.5.4). However, the likelihood of collision would be greater for the alternative route because there would be two crossings of the Penobscot River by the alternative route compared with only one crossing of the St. Croix River by the proposed route. A biological assessment for the bald eagle is presented in Section C.2 (Appendix C).

Potential impacts to other rare species (Table C.4, Appendix C) would be similar to those discussed for the proposed route (Section 4.1.5.4).

4.2.6 Socioeconomics

4.2.6.1 Employment and Economics

The cost of constructing the proposed transmission line in the alternative route (106 mi from the international border to the Orrington substation) would be about $53 million. This is more than $6 million greater than the estimated cost for construction in the proposed route.

Construction in the alternative route would provide minor short-term economic benefits through the employment of construction workers. The same number of construction workers, an average of 60, would be needed as for the proposed route. However, those workers would be needed for about 2.5 years for the alternative route, rather than the 2 years estimated by the applicant for the proposed route (Murphy 1991).

4.2.6.2 Population and Housing

As would be the case for the proposed route (Section 4.1.6.2), construction within the alternative route would have negligible impact on the regional population. Since the same numbers of workers would be needed for the alternative route as for the proposed route, the impact on housing would be approximately the same. As described in Section 4.1.6.2, adequate housing should be available for the workers.

A total of 150 houses are located within 600-ft to either side of the alternative route centerline, about 1.5 times as many as for the proposed route. Most dwellings are in the southwestern portion of the alternative route in the towns of Eddington, Brewer, and Holden. Potential health effects to people residing in these dwellings are discussed in Section 4.2.9. The construction areas would be closer to a larger population on this route than on the proposed route, with 57 residences located within 2,000 ft of the proposed staging areas for the alternative route (ER 1991).

4.2.6.3 Public Concerns

Public concerns for the alternative route are similar to those expressed for the proposed route (Section 4.1.6).

4.2.6.4 Environmental Justice

As for the proposed route (Section 4.1.6.4), environmental justice concerns would not be expected for the alternative route.

4.2.7 Visual Resources

The visual impact analysis criteria for the alternative route are the same as discussed in Section 4.1.7.1 for the proposed route, and the short-term visual impacts during the construction phase would be similar to those discussed in Section 4.1.7.2.

The following discussion of long-term, project-related visual impacts corresponds with the major visual resources described in Section 3.2.7 and shown in Figure F.1 (Appendix F). Long-term impacts would result from the clearing of right-of-way and the placement of new transmission line structures and conductors. Because much of the line would be placed adjacent to an existing transmission line system, most visual impacts would be incremental in nature.

Segment 1 — Monument Brook / U.S. Route 1 Area: Because of the relatively remote and wooded nature of the Monument Brook area, incremental visual impacts would be moderate in the vicinity of the stream crossing. Although motorists could view the alternative line along U.S. Route 1, viewer expectations would be low because of the presence of the existing line, thus resulting in a low visual impact.

Segment 2 — Mattawamkeag River Area: The presence of additional conductors over the Mattawamkeag River would result in an incremental visual impact, further detracting from the recreational experience of canoeists using the river. Visual impact would be low to moderate.

Segment 3 — Glenwood Bog and Wetlands Area: Much of the transmission line would extend across timber-harvested uplands that are surrounded by wetlands. Although the new transmission line would be placed on completely new right-of-way in this area to avoid Glenwood Bog and other wetland areas, visual impacts would be low because of few public viewpoints.

Segment 4 — Wytopitlock Stream Area: The presence of additional conductors over Wytopitlock Stream would result in an incremental visual impact, further detracting from recreational experiences of persons using the area. Visual impact would be low.

Segment 5 — Reed Pond / Macwahoc Stream Area: To avoid additional visual impacts near Reed Pond, the new line would be placed on completely new right-of-way and result in low to moderate visual impacts in the area and at the Macwahoc Stream crossing.

Segment 6 — Molunkus Lake and Stream Area: The new transmission line would be placed on entirely new right-of-way to avoid the Reed Pond area and would be located within several miles of the village of Macwahoc. Visual impacts in the vicinity of the U.S. Route 2 crossing would be low to moderate. In addition, visual impacts would be moderate where the line extended across the undeveloped shoreline of Molunkus Stream and low where it avoided Martin Bog southwest of Molunkus.

Segment 7 — Penobscot River Valley Area: A large number of viewing opportunities exist along the alternative route where existing lines extend across the Penobscot River and through the river valley. The presence of additional conductors, shield wires (with colored marker balls at the Penobscot River crossings), and structures would result in an incremental visual impact, further detracting from viewer expectations of the relatively undeveloped portions of the river valley. Visual impact would be low to moderate.

Segment 8 — Passadumkeag River Area: Although the area begins to have a more developed appearance, the new line would require entirely new right-of-way to avoid impacts to the Passadumkeag River area. However, since much of the new right-of-way could be seen only from a jeep trail and along the Maine Central Railroad line, visual impacts would be low.

Segments 9 through 13 — (Crocker Pond, State Route 9, Clewleyville Road / Eastern Avenue, U.S. Route 1A / Wiswell Road, and Orrington Substation Areas: These segments are the same as discussed for the proposed route, and the impacts would be as discussed in Section 4.1.7.2.

In summary, along the alternative route, the conductors, shield wires, and support structures (or portions thereof) would be visible from numerous locations along timber haul roads; recreational streams, rivers, lakes, and camps; and several state and federal highways and local streets. The extent and level of visual impact would, in part, depend on weather conditions, the season of year, and the effects of future timber activities within the region on the visual environment. Overall, the visual impact of the alternative route would be low. However, within a few areas, the visual impact would be moderate or moderate to high (i.e., portions of Segments 7, 9, 10, and 11).

4.2.8 Cultural Resources

A review of available information regarding known archaeological sites, combined with predictive mapping of archaeologically sensitive areas, indicates that construction of a 345-kV line along the alternative route could have adverse effects (disturbance or destruction) to one or more sites (Cox et al. 1991). Moreover, it appears likely that the affected sites would meet eligibility criteria for the NRHP. However, adverse effects to NRHP-eligible sites probably could be mitigated by avoidance or data recovery (i.e., excavation).

4.2.9 Health and Safety

Health and safety issues related to the operation and maintenance of the new transmission line along the alternative route would be similar to those discussed for the proposed route (Section 4.1.9). Differences would relate primarily to route location (thus affecting different populations) and to the fact that the alternative route would parallel an existing 345-kV line for about 68% of its 106-mi length, compared with 14.6% for the 83.8-mi proposed route. More people within the area of the alternative route could be faced with an increased likelihood of exposure to EMF, herbicides, noise, and other such potential hazards associated with transmission line operation and maintenance. In addition, about 34 mi of new corridor would be constructed where the alternative route would diverge from the existing corridor to avoid wetlands and other sensitive features. In those areas of divergence, people not now living near transmission lines could be exposed to potential effects of transmission line operation and maintenance.

Because the corridor would be identical for the last 12.2 mi of the proposed and alternative routes, potential effects would be the same in that segment.

The general discussions and conclusions presented in Section 4.1.9 for the proposed route also would essentially apply to the alternative route. Therefore, the following subsections discuss information more specific to the electric and magnetic fields and other operating and vegetation management characteristics of the alternative route.

4.2.9.1 Electric Shocks and Field Effects

The electric fields occurring along the 12.2-mi stretch of the alternative route closest to the Orrington Substation would be the same as those for the proposed route (Table 4.3 and Figures 4.2 through 4.5). Electric fields along about 60 mi of the alternative route from the International Crossing to Bradley would be similar to the values for the Eastern location of the proposed route (Table 4.3 and Figure 4.4) — about 1.2 kV/m at both edges of the right-of-way. Along the remaining 34 mi of the alternative route (various segments that would diverge from the existing line), conditions would be similar to the values for the forest location of the proposed route (Table 4.3 and Figure 4.1).

The maximum electric field value within the right-of-way where the new tie line would parallel the existing tie line would be about 6.9 kV/m. Electric field conditions for just the existing tie line are about 1.17 kV/m at the right-of-way edges and a maximum value of about 5.5 kV/m within the right-of-way. Similar electric fields would occur within the segments of the alternative route where it would diverge from the existing line. Although portions of the alternative route right-of-way would have higher electric fields than the proposed route, potential impacts from shocks would be similar, as discussed in

Section 4.1.9.1 (i.e., risk for a pathological shock would be negligible). Similarly, the discussion of electric field effects provided in Section 4.1.9.2 for the proposed route would apply to the alternative route.

4.2.9.2 Magnetic Fields

About 60 mi of the alternative route from the international crossing to the town of Bradley would have magnetic field values similar to those along that portion of the proposed route where the line would share the right-of-way only with the existing 345-kV line (Figure 4.9). The remaining 34 mi of this segment, where the alternative route would diverge from the existing line route, would have magnetic fields similar to the proposed route where it would occur within a new corridor (Figure 4.6). The magnetic fields for the final 12.2 mi of the alternative route leading to the Orrington substation would be identical to those of the proposed route for the same stretch of right-of-way (Figures 4.7 through 4.10).

Under normally expected operating conditions of 500 MW, the magnetic field at both edges of the right-of-way where the two 345-kV lines would be parallel would be about 27 mG, with a maximum of about 190 mG within the right-of-way (Figure 4.9). The magnetic field would sharply decrease away from the right-of-way (e.g., less than 4.3 mG at 100 ft from the right-of-way edge and less than 0.15 mG at 600 ft from the right-of-way edge) (Table 4.4). Magnetic fields for the existing 345-kV line with no right-of-way sharing and for the second tie line where it would diverge from the existing line would be 33 mG at the edge of the right-of-way, with a maximum of about 160 mG within the right-of-way (Figure 4.6). The magnetic fields at 100 ft and 600 ft from the edge of the right-of-way would be less than 7.3 mG and less than 0.55 mG, respectively (Table 4.4).

The addition of a new 345-kV tie line actually would decrease magnetic field exposures in some areas along the existing 345-kV tie-line corridor because of conductor phase interactions between the two tie lines (see Table 4.4). However, individuals passing under the lines or pursuing activities within the right-of-way would be more likely to encounter elevated magnetic fields because the additional transmission line would increase the corridor width of above-background magnetic field strengths.

Conclusions regarding exposure to magnetic fields from high-voltage transmission lines that were presented in Section 4.1.9.3 for the proposed route also would apply to the alternative route. The major conclusion drawn from that discussion was that the proposed 345-kV line generally would contribute only a small portion of the total magnetic field exposure that a person would receive.

People residing near transmission lines would be among those most likely to receive magnetic field exposures from those lines. The alternative route would potentially increase the magnetic field exposure to some of the people that occupy the 150 houses, camps, and trailers located within 600 ft of the centerline of the alternative route corridor (91 of these facilities occur within the 12.2 mi that would be identical for both routes).

4.2.9.3 Air Ion Effects

As discussed for the proposed route (Section 4.1.9.4), air ions are not a relevant concern for AC transmission lines.

4.2.9.4 Audible Noise and Ozone Effects

The discussion provided for audible noise and ozone production in Section 4.1.9.5 would also apply for the alternative route. At most, audible noise associated with the alternative route might occasionally cause a localized annoyance to recreationists passing under the line. Ozone production generated along the alternative route would be so slight as to be unmeasurable.

4.2.9.5 Effects of Cardiac Pacemakers

The discussion of effects on cardiac pacemakers provided in Section 4.1.9.6 would generally apply to the alternative route. The electric fields within the right-of-way for most of the alternative route would be somewhat higher than that for the majority of the proposed route (compare Figure 4.1 [conditions for most of proposed route] and Figure 4.4 [conditions for most of the alternative route]). In theory, the potential for pacemaker reversion would be somewhat higher for the alternative route. However, as for the proposed route, the combination of circumstances that would lead to an accidental event would be extremely rare.

4.2.9.6 Summary of Electromagnetic Field Effects

The summary presented in Section 4.1.9.7 for the proposed route would be applicable to the alternative route.

4.2.9.7 Herbicide Use in Right-of-Way Management

The conclusions reached in Section 4.1.9.8 that herbicide use, as proposed, would not affect humans or wildlife detrimentally would also apply for the alternative route. The right-of-way for the alternative route would encompass about 2,080 acres, compared with about 1,625 acres for the proposed route. About 40% of the alternative route would pass through wetlands versus 23% for the proposed route. Based on these two conditions, herbicide use would be similar for both routes because herbicides would not be used in wetlands (about 1,250 acres of nonwetland habitat for both routes). However, the shorter average span length for the alternative route (635 ft vs. 787 ft) would allow taller growing vegetation underneath the conductor security zone of the alternative route. Therefore, areas within which basal herbicide application would be allowed would probably be less frequently treated for the alternative route than for the proposed route.

4.2.10 Radio and Television Interference

Radio and television interference associated with the alternative route would be similar to that described for the proposed route (Section 4.1.10). The duration of static that might occur, especially for AM radio broadcasts, would be slightly longer in vehicles crossing under the new tie line where it paralleled the existing tie line (i.e., the time it would take a vehicle to travel up to an extra 170 ft). This increased time would be due to the combined presence of both operating lines within the right-of-way. Where the new line diverged from the existing tie line, a motorist crossing under the lines might experience two short-term periods of radio interference of near equal proportion.

4.3 NO-ACTION ALTERNATIVE

Under the no-action alternative, the presidential permit would not be issued and the proposed interconnection would not be constructed. Taking no action would be equivalent to maintaining the existing environment (as described in Section 3.1) and land use activities within the study area. The impacts associated with the construction, operation, and maintenance of the proposed transmission line (as described in Section 4.1) would not occur. However, the impacts associated with existing activities, such as timber harvesting, would continue. Without the proposed interconnection, the current level of transmission losses would continue, and the desired increase in power generating capacity and the power transaction and tie-line capacity reserve benefits would not be obtained.

In the absence of the proposed interconnection, BHE and other NEPOOL members might develop other sources of energy to meet projected increases in demand for electricity. These other sources could include purchase or exchange of power with cogenerators and electric utilities, conservation, use of combustion turbines, or construction of baseload generation stations. Further discussion of energy supply alternatives is provided in Section 2.2. The selection of other sources of energy would be based on reliability and economic considerations. Each of these other sources would have its own unique set of environmental impacts that would differ from those of the proposed interconnection. For example, combustion turbines or baseload generation stations would have air pollutant emissions that would not be associated with the proposed transmission line. Thus, while the no-action alternative would avoid the direct impacts of the proposed interconnection, it might also result in other impacts to different resources in different areas. These impacts would depend on the ultimate course of action taken to ensure electricity supplies in the NEPOOL region and cannot be characterized further at this time.

4.4 MITIGATION

4.4.1 Summary of Mitigation Committed to by the Applicant

The following subsections summarize many of the measures that BHE has agreed to perform in order to mitigate impacts from construction, operation, and maintenance of the proposed project facilities. Impacts to environmental resources have been minimized by planning at BHE by a team of individuals from varied disciplines. Unless otherwise noted, the information presented here is extracted from the ER (1991), BHE (1991b), and Murphy (1991, 1992). Along with the mitigative measures described in this section, a number of additional mitigative commitments are made in the U.S. Army Corps of Engineers permit (BHE 1991a) and the state permit (BHE 1991b) applications. While each of these mitigative measures may be minor, their overall combined contribution would significantly reduce impacts to the environmental resources of the area. The evaluations of environmental consequences of the project in Section 4.1 are based on the assumption that these mitigative measures will be carried out if the proposed action is undertaken.

4.4.1.1 Atmospheric Environment

Measures that BHE will implement to mitigate impacts to land and water resources (Sections 4.4.1.2 and 4.4.1.4) generally also will help to mitigate impacts to air quality. These impacts would include construction-related dust, vehicle emissions, and burning of slash, all of which would be temporary.

4.4.1.2 Land Features

Impacts related to unstable slopes will be largely mitigated through the use of careful siting of structures and access roads. The following are specific mitigative measures committed to by BHE:

- Right-of-way clearing and access road construction will be performed under the close daily supervision of BHE engineering and environmental inspectors to ensure that work is performed as specified within the conditions and specifications of all pertinent permits (e.g., state and Section 404 permits) and internal guidelines (e.g., *Bangor Hydro-Electric Company Erosion Control Guidelines for Construction and Maintenance Activities on the Proposed Second 345 kV Tie Line to New Brunswick*); and will be consistent with the latest version of the *Maine Environmental Quality Handbook for Construction — Best Management Practices*; and *Erosion Control on Logging Jobs* (Land Use Regulation Commission).

- Right-of-way access will utilize existing roads (improved and unimproved) wherever possible.

- Each selective clearing area will be flagged and appropriately designated in the field before clearing is begun.

- Precautions will be exercised to preclude spills and minimize any damage that may occur in staging areas.

- Fuel storage areas within staging areas will be provided with containment facilities as required by state and federal regulations.

- During construction (including expansion of the Orrington substation), appropriate erosion-control methods, such as the use of hay bales and siltation fences, will be employed in areas where erosion is likely to occur. Temporary erosion-control measures (such as siltation fencing) will be used along downslope boundaries of staging and laydown areas if gradients are sufficient to result in erosion.

- All erosion-control structures placed in areas of moderate to high erosion susceptibility will be maintained until vegetation is reestablished.

- The boundaries of each structure laydown area will be flagged to show limits of activity.

- Excavated soil will be used for final grading around structures, with the excess material mixed with the surrounding soil.

- Following construction, debris and unused materials will be removed, and staging areas will be returned to essentially the same condition that existed before construction started.

- All construction debris, including packing and transportation materials (e.g., wooden pallets and crates), will be disposed of by on-site burning or will be transported off-site to a commercial solid waste disposal facility approved by the Maine Department of Environmental Protection.

- Any burning of clearing residues (e.g., unusable slash and debris) will be conducted in accordance with appropriate fire permit rules and regulations.

- As appropriate in each particular location, permanent measures to prevent soil erosion will be installed during final cleanup operations.

- Solid waste will be burned on-site, hauled to a recycling facility, disposed of at a household refuse landfill, or hauled to an approved industrial waste landfill.

- Structure laydown areas will be seeded and mulched in locations where construction activities have exposed soils.

- Access roads will generally conform to the adjacent natural ground contours to the extent practicable.

- Immediately after construction, all new light-duty roads will be regraded to initial ground contours, seeded, and mulched.

- Feller/bunchers with rubber tires will be used to cut woody vegetation. The cut timber will be aligned in bunches, and skidders will be used to collect the bunches.

- Felled trees less than 2 in. in diameter will be left on the site to create ground litter and deter the formation of new drainage channels.

- No clearing will be done from March 15 to May 1, when the ground is normally saturated and prone to damage from the movement of heavy equipment.

- Much of the clearing will be done in the winter to minimize ground disturbance.

- A full range of four-wheel-drive and high-flotation construction vehicles and equipment will be used as required by the nature and condition of the terrain to minimize damage during hauling, erection of structures, and stringing of conductors and shield wires.

4.4.1.3 Land Use

Criteria adopted for routing the proposed transmission line would tend to limit land use impacts. For example, the proposed route is relatively direct, thus minimizing the overall length of the line. The route also has been selected so as to minimize the number of land owners within the proposed corridor. The following mitigative measures would be instituted:

- Herbicides will not be applied in portions of the right-of-way actively used for pasture, crop production, or cultivated field.

- River crossing points have been carefully selected so as to minimize potential disturbance to recreational users.

- The routing has been selected so as to allow continued use of aircraft landing strips within the immediate project area.

- Much of the merchantable wood materials (e.g., sawlogs and pulpwood) will be salvaged by the clearing contractor.

- Agricultural land disturbed during construction will be plowed and disked following construction activities.

- Where spreading of stumps and grubbings is done, it shall be conducted so that no materials enter type A or D clearing areas, watercourses, cultivated fields, or other areas where the material would affect land use (Murphy 1992).

4.4.1.4 Hydrologic Resources

Construction of the transmission line system and related access roads could increase soil erosion and stream channel siltation because of alteration of near-surface materials. However, careful location, construction, and maintenance of the transmission facilities and access roads could minimize these adverse impacts. For example, all structures will be located (to the maximum extent possible) up to 250 ft from surface waters crossed by or adjacent to the proposed line. Specific mitigative measures would include the following:

- The construction contractor will obtain permission from the owner of a water well before using the well for the supply of dust-control water. The contractor also will ensure that the capacity of the well is sufficient to supply the required volume of water without temporarily or permanently reducing the capacity of the well.

- Before cutting is begun in forested areas, hay-bale dikes or siltation fences will be placed along water bodies (including wetlands) and their buffers to the extent practicable.

- If any construction or soil disturbance occurs below the stream water level, the construction manager will direct the contractor to construct temporary stream diversions in accordance with best management practice specifications. Exemptions to this requirement will be reviewed and granted by the Maine Department of Environmental Protection on a site-specific basis (e.g., if the applicant can demonstrate that a stream diversion is unnecessary or impracticable based on flow, streambed, or bank characteristics, or by the absence of downstream fish spawning grounds) (Murphy 1992).

- Soil stabilization will be conducted within seven days where clearing, grubbing, or grading inadvertently occurs within 100 ft of a surface water body or wetland (Murphy 1992).

- Waterways will be crossed with the most appropriate method (e.g., log bridges, temporary or permanent culverts, cobble fords) on the basis of site-specific conditions of each waterway. However, bridges will be installed at all crossing locations where the gradient of a perennial watercourse exceeds 2% at the point of the crossing (Murphy 1992). The waterway crossings will be left for succeeding construction operations.

- In general, streams will not be crossed by equipment where access is available from either side.

- Pulling lines for the installation of shield wires and conductors will be carried across large streams and rivers during low flows or across the ice during the winter.

- Water for dust control will not be drawn from lakes or ponds to the extent that water elevations become lower than the normal low elevation. Similarly, water will not be drawn from flowing waters to the extent that flow rates become less than the normal minimum flow rate.

- Oil or oil-based products will not be used for dust suppression. The use of chlorides will be minimized. For example, the use of calcium chloride or other chloride-based dust-control products will be prohibited near streams and wetlands, except where prior approval is obtained from the construction manager.

4.4.1.5 Biotic Resources

The primary means by which impacts to biotic resources will be mitigated is careful routing and design of the transmission line to avoid significant habitats and sensitive species to the extent possible. An environmental supervisor will be present during construction within significant and unique natural areas and wetlands to ensure that impacts are held to a minimum.

Herbicide Use

Because herbicide use has the potential to affect both aquatic and terrestrial resources, BHE has committed to the following mitigative measures:

- No broadcast application of herbicides will be made during initial right-of-way clearing or subsequent right-of-way maintenance.

- Herbicides will be used only for application to stumps during initial right-of-way clearing and will be applied with a low-pressure, backpack-type applicator.

- Only herbicides approved by the Maine Pesticide Control Board (MPCB) will be used, and they will be applied only in the manner prescribed by the MPCB.

- No herbicides will be used within a surface water buffer zone.

- Within stream buffers, periodic vegetation management will not include the use of herbicides and will be limited to hand clearing operations.

Terrestrial

- Removal of vegetation (e.g., trees, shrubs, and brush) within stream buffers will be limited to the minimum amount necessary to accommodate transmission line security and operation.

- The growth of shrubs along streams will be encouraged.

- In areas where concerns exist regarding illegal deer drives, two 200-ft-long zones of vegetation will be left in place per span to act as areas of cover and to provide access across the right-of-way for species that prefer cover. Vegetation and stumps in these zones will be at least 6 ft high (but more than 20 ft below the point of maximum conductor sag).

- Construction clearing (with feller/bunchers or by hand) within deer wintering areas will only be done in late summer or early fall during dry conditions.

Aquatic

The mitigative measures listed in Sections 4.4.1.2 and 4.4.1.4 would also minimize impacts to aquatic biota. The following additional measures also have been committed to by the applicant:

- Native shrubs will be planted to maintain the stream buffer in locations where most trees within the buffer must be cut and where little undergrowth exists. Planting plans will take the local topography and aspects into account to maximize shading of surface waters.

- No slash or debris will be permitted within surface water buffer zones.

- Environmental inspectors will ensure that uncured concrete is kept away from water bodies.

Wetlands

The mitigative measures listed in Sections 4.4.1.2 and 4.4.1.4 would also minimize impacts to wetlands. As a mitigative measure, the materials used to construct temporary access roads would be removed from the wetlands. The applicant's mitigation plan to compensate for wetland impacts due to placement of access roads and transmission line structures is discussed in Section D.3 (Appendix D).

Threatened and Endangered Species

The following mitigative measures would be instituted:

- To ensure the protection of rare plant species known to occur within the immediate project area, such species will be accurately mapped and marked in the field before construction begins.

- Areas where rare plants have been identified in low numbers will be further searched before construction, and appropriate additional measures for protection (such as the mitigative measure described above) will be implemented in accordance with findings.

- Selective cutting near mile 20.7 of the proposed line will be conducted to maintain the partial shade required for the white adder's-mouth orchid.

- Orange spheres 20 in. in diameter will be placed on the shield wires at 100-ft intervals in a staggered arrangement across both shield wires over the St. Croix River, to make them more visible to bald eagles (and other birds) in flight. Marking of transmission lines in this manner has been shown to significantly reduce bird collisions with power lines (e.g., sandhill cranes [Morkill and Anderson 1991]).

4.4.1.6 Socioeconomics

In general, socioeconomic impacts are projected to be minor and short term. Therefore, no significant mitigative measures have been developed.

4.4.1.7 Visual Resources

The applicant has conducted a visual resource characterization study of the natural and man-made features along the proposed route (ER 1991). The following mitigative measures are based, in part, on the results of that study. Mitigation proposed by BHE for visual resource impacts consists of measures in the general categories of design and location of structures (including substation modifications) and right-of-way treatments (including construction laydown and staging areas). Mitigative measures committed to by BHE in these categories are described in this section.

Structure Design

Structures on either side of the Machias River will be a maximum of only 75 ft high to keep them in scale with the large pines commonly found along the river.

Structure Location

Specific mitigative measures will include the following:

- In many instances, the proposed alignment of the route has been moved substantially (several hundred yards or more) to make effective use of mature stands of evergreens in order to minimize exposure of recreationists to the line (e.g., to canoeists who could otherwise have several different viewpoints along the course of a meandering stream).

- Where possible, structures will be located at least 100 ft from unimproved roads and 200 ft from improved roads. The maximum amount of vegetation possible will be kept in the buffers between roads and structures.

- Most new structures will be located to align with existing structures in places where the proposed line parallels an existing line.

Right-of-Way Treatment

The applicant has committed to the following mitigative measures:

- At road crossings, a 100-ft length of right-of-way will be selectively cleared to interrupt the view of the right-of-way and structures.

- Native trees and shrubs will be planted at road crossings if most of the existing vegetation requires clearing. For example, fast-growing conifers will be planted in irregular groups to reinforce the vegetative buffer between Route 1 and the structure adjacent to it.

- Selective clearing will be conducted in visually sensitive areas. A buffer of 250 ft will be preserved at the crossings of the St. Croix, Machias, and Narraguagus rivers. Clearing will be limited to removal of those trees that would present a safety hazard to the transmission line. All clearing will be done by hand or with a feller buncher to minimize damage to existing vegetation.

- The applicant will work with affected landowners to devise site-specific plans to buffer residences from uninterrupted views. Such measures could include the planting of new trees and shrubs.

4.4.1.8 Cultural Resources

The applicant has conducted a literature/file search for previously recorded cultural resource sites along the proposed route and has conducted field surveys for archaeological sites (Cox 1989). The Maine State Historic Preservation Officer has determined that the proposed action would have no adverse effect upon any site or structure of archaeological, historic, or architectural significance (Shettleworth 1990), and no additional mitigation would be necessary.

4.4.1.9 Health and Safety

The applicant has committed to the following mitigative measures relative to health and safety:

- Colored ball markers will be placed on shield wires across the St. Croix River to increase visibility to aviators.
- The applicant will ground existing metallic fences located inside or crossing the right-of-way as an additional precaution against the possibility of induced currents. The applicant will also ground large metal buildings that are at or very near the edge of the right-of-way (CAI 1990).
- Excavated material removed from the Maxcys and South Gorham substation will be tested for the presence of polychlorinated biphenyls (PCBs) and disposed of in an appropriate manner.
- The applicant employs a full-time Environmental Compliance Specialist to conduct spill prevention and response activities and has published spill prevention control and countermeasure plans (e.g., for the Orrington substation).

4.4.1.10 Radio and Television Interference

Radio and television interference from operation of the proposed transmission line will be mitigated by one or more measures, including the following general measures:

- Mitigation typically involves reorientation, relocation, and/or replacement of receiver antennas.
- Television interference resulting from the physical presence of transmission facilities is usually remedied by changes of antenna systems.
- The line has been designed to minimize interference with the radio communication systems used by the timber companies, military operations, fire, police, and cellular phone companies.

- Interference due to gap sparking from loose or damaged hardware is mitigated by routine repair or replacement of the faulty transmission line hardware components.

4.4.2 Recommended Mitigation

The applicant has committed to a broad spectrum of mitigative measures that would minimize adverse environmental impacts resulting from the construction, operation, and maintenance of the proposed project. Additional measures that the DOE staff recommends be incorporated into BHE's mitigative program for the proposed project are described in this section.

4.4.2.1 Atmospheric Environment

Additional measures that should be considered to reduce excess fugitive dust and audible noise include the following:

- Construction and vehicular activities should be curtailed on dry, windy days in areas prone to excessive dust generation; or as an alternative, access roads in those situations should be watered, as necessary, to minimize the generation of fugitive dust.
- Vehicle speed should be controlled on unpaved access roads.
- Construction equipment should be properly maintained and operated.
- Shrub and ground-level vegetation should be retained, where practicable, to aid in reducing the amount of construction-related dust.

4.4.2.2 Land Features

Additional mitigative measures should include:

- Erosion gullies and depressions found on the right-of-way that carry water from heavy rains should be filled with brush from clearing operations (Ulrich 1976). This brush would trap sediments and eventually stabilize such areas.
- Where practicable, supportive structures should not be placed on eskers because of slope stability problems. Complete avoidance may not be possible because of conflicts with wetland avoidance and structure height and span length limitations.
- Geological significant sections of the horsebacks should not be mined for construction materials.

- Selective clearing should be considered on horsebacks to minimize the disturbance of the groundwater recharge zones and the destruction of the horsebacks by traffic.

4.4.2.3 Land Use

Specific mitigative measures relative to land use should include the following:

- If it becomes necessary to cross or parallel any gas, water, sewer, telephone, or other lines, this should be done so as to avoid impact to the existing lines and remain in compliance with all applicable regulations and codes. Such actions should be coordinated with the appropriate owner utilities.
- Construction vehicles and equipment should not be operated when unfavorable weather conditions (e.g., heavy rainfall) could result in unacceptably excessive erosion.
- Problems or damage to the right-of-way resulting from unauthorized vehicle use should be referred to the real estate department at BHE or local law enforcement officials for correction on a site-by-site basis.
- To maintain the remote recreational character of the Machias River, temporary access roads should be managed to preclude direct vehicle access to the river by the public (e.g., by posting signs forbidding public access or by blocking roads with large boulders) (Ten Broeck 1991).

4.4.2.4 Hydrologic Resources

The following mitigative measures should be instituted:

- Appropriate actions should be taken to assure that no unreasonable impacts to water quality occur due to public vehicular traffic within the right-of-way.
- Herbicides should not be used in areas where sand and gravel aquifers are exposed to the surface and where shallow aquifers are present.
- A contingency plan for fuel and oil spills should be prepared, especially for the construction staging areas.
- Properly sized culverts and breaks should be installed to allow free flow of water at waterway and wetland crossings. These features should be routinely inspected and maintained to ensure that surface drainage flows remain unaffected.

- After the poles are installed, the void surrounding them should be backfilled with impermeable natural material to avoid creating artificial groundwater conduits between upper and lower aquifers.

- Drainage along the access roads should be routinely inspected and maintained to ensure that excessive soil erosion does not occur.

4.4.2.5 Biotic Resources

Many of the committed and suggested mitigative measures to minimize impacts to land, forest, and hydrological resources would effectively reduce potential impacts to biotic resources. The following mitigative measures are designed more specifically to protect fish, wildlife, and their habitats and should be considered for implementation by BHE:

- To ensure compliance with the Migratory Bird Treaty Act and to provide additional protection for other bird species of concern (e.g., raptors), the following steps should be taken: (1) obtain a list from the Department of the Interior of migratory birds protected by the act; (2) determine if protected migratory birds (and raptors) or their nests exist in the areas to be cleared for the right-of-way (this would include consultation with appropriate state and local officials to identify any locations of migratory birds); and (3) if protected birds (including raptors) or their nests or eggs are present, consult with the Department of the Interior for the appropriate precautions to be taken. This consultation should be undertaken as far in advance of construction as practicable.

- Any required reseeding (Section 4.4.1.2) should be done according to local Soil Conservation Service specifications for seed mixtures.

- Debris resulting from periodic vegetation management should not be placed within the high-water mark of any water body. If tree tops and slash are not disposed of within about 25 ft of streams, the potential for formation of debris dams would be reduced (Lynch et al. 1985).

- Where practicable, wood debris that exists in streams before the construction of access roads should not be removed because such removal may reduce fish habitat.

- To decrease the potential of the corridor's becoming a barrier to movement or dispersal of wildlife, the following actions should be undertaken: (1) maintain strips of vegetation parallel to the corridor of increasing successional age away from the centerline (termed "feathering"), (2) maintain peninsulas of taller vegetation into the corridor, and (3) stagger vegetation control along the corridor to prevent establishment of extensive lengths of vegetation of uniform age and composition (Gates 1991).

- Construction and clearing operations in or immediately adjacent to streams (e.g., for access roads) should be restricted during salmonid nesting and spawning periods (especially in streams where nesting and spawning are expected to occur within or immediately downstream of the right-of-way). For brook trout (the major game species of concern) this period is during late summer to early fall.

- The potential of the area for use as a fish spawning site should be determined before disturbance of gravel stream bottoms. Areas where fish spawning sites are present should be avoided wherever practicable. Local fishery experts should be consulted in this matter.

- The potential for accidental herbicide spills can be reduced by careful driving and the use of strong, properly stored and secured leak-proof containers. Herbicide mixing sites should be located a safe distance from water bodies and wetlands and in areas with soils amendable to herbicide adsorption and breakdown (Willington 1987).

- The applicant should continue periodic contact with the U.S. Fish and Wildlife Service and the Maine Department of Inland Fisheries and Wildlife to monitor additions to listed species (e.g., threatened and endangered) (and new locations or habitats for previously listed species) that could be affected by vegetation management activities.

- In the event that a bald eagle collides with a conductor, shield wire, or support structure, the applicant should assume the financial cost of veterinary treatment and rehabilitation (including either euthanasia or life-time care if the injury sustained is permanent).

- If injury or death occurs to a bald eagle due to a collision with the transmission line, the applicant should meet with the U.S. Fish and Wildlife Service and the Endangered Species Office of the Maine Department of Inland Fisheries and Wildlife to determine if any remedial actions could be implemented to prevent additional line strikes.

- In the event that a bald eagle death is caused by the line, the applicant should assume the financial costs of (1) retrieving the bird and (2) conducting the required and standard necropsy and contaminants analyses (not to exceed $1,000 per bird). (Agreement to assume financial responsibility for dead or injured eagles would not provide the applicant with immunity from potential prosecution under the Endangered Species Act of 1973, as amended, or the Bald Eagle Act of 1940.)

- Herbicides should not be used during inclement weather (e.g., excessively windy or rainy days) or before heavy precipitation is expected.

- Herbicide residues in soil and water should be monitored when appropriately requested by land management agencies or landowners in order to identify patterns in herbicide persistence and mobility.

- Construction crews should receive environmental briefings as appropriate to alert them to specific areas of concern and to explain the reasons for such concern.

- Passive reminders (such as signs) to warn work crews to use only designated access roads or inform them that they are working in an environmentally sensitive area should be considered. Temporary physical barriers (such as fencing) to remind crews to avoid short cuts across streams or steep slopes also should be considered.

- Short snags and dead or dying trees should be left within the right-of-way whenever possible.

- Efforts should be made to curtail the development of monotypic stands of one or a few plant species within the right-of-way.

- The work force should be instructed (through meetings or distribution of pamphlets) on possible harassment and other adverse impacts to wildlife species during the construction period.

4.4.2.6 Socioeconomics

No additional mitigation measures would be necessary because of the minor socioeconomic impacts expected.

4.4.2.7 Visual Resources

Preconstruction meetings should be held with landowners to review and reaffirm all agreements made concerning right-of-way clearing, selective cutting, and planting. Postconstruction meetings and inspections should also be held to verify that all agreements were adequately implemented.

4.4.2.8 Cultural Resources

If archaeological remains are encountered during construction, the Maine Historic Preservation Commission should be contacted for clearance.

4.4.2.9 Health and Safety

The following additional mitigative measures relative to health and safety should be implemented:

- Engine-powered construction equipment should be equipped with exhaust mufflers in proper working condition. The mufflers should be checked frequently for proper operation and replaced if found to be defective.

- During construction and maintenance, efforts should be made to identify structures along the right-of-way that should be grounded or to notify owners if ungrounded structures are identified. If an individual seeks assistance or guidance concerning grounding, BHE should have the structure or equipment grounded for the owner if the structure exists at the time the transmission line is installed, or should provide information on grounding in the case of a new or proposed structure.

- Construction work within populated areas should be limited to daylight hours.

- Spark arresters should be used on cutting equipment. Fire suppression equipment should be accessible when vegetation management activities are conducted.

4.4.2.10 Radio and Television Interference

No additional mitigation measures beyond those committed to the applicant would be necessary.

4.5 ADVERSE EFFECTS THAT CANNOT BE AVOIDED IF THE PROJECT IS IMPLEMENTED

Construction, operation, and maintenance of the proposed 345-kV transmission line interconnection would result in some adverse impacts to the environment. Most of these could be eliminated, avoided, or reduced to minor and localized levels through implementation of appropriate mitigative measures. Those adverse impacts that could not be mitigated to insignificant levels or avoided altogether are identified below.

4.5.1 Atmospheric Environment

No serious air quality impacts are anticipated if the project is implemented. Localized, short-term impacts that would occur during the construction of the line include generation of dust and emission of combustion by-products and odors from the burning of wood debris and operation of vehicles and equipment. Alteration of the vegetation within the right-of-way would result in minor, long-term microclimatic changes in air temperature, solar radiation, wind velocities, and ground-level snow accumulations.

4.5.2 Land Features

Despite the implementation of mitigative control measures, some unavoidable increases in soil erosion and sedimentation within streams would result from construction activities, especially during thunderstorms. In addition, minor modification of natural topography, drainage patterns, and slopes would be unavoidable.

4.5.3 Land Use

Land use within the designated transmission line right-of-way would be controlled during the lifetime of the project and limited to those practices and activities compatible with the operation and maintenance of the line. Small areas around structures and access roads located in croplands would be unavailable for agricultural use. The overall area affected would be of minor consequence because few agricultural lands currently in use would be crossed by the route (only 14 acres, or 0.9%, of the proposed right-of-way).

About 1,450 acres of forest (including cleared/regenerating forest land) would be converted to and maintained as small tree, shrub, and grassland vegetation for the duration of the transmission line operation. This procedure would preclude one or two commercial timber cutting cycles within the corridor. Minor deposits of sand and gravel would become unavailable so as to preserve the structural and operational integrity of the line.

Development of the proposed transmission line would not displace or preclude use of any developed public recreational sites or facilities; however, recreational participants in the vicinity of the line could be exposed to views of the line that would detract from the quality of the recreational experience. The proposed route could increase access to areas that are currently somewhat inaccessible. However, recreational use of the transmission corridor by all-terrain vehicles (e.g., snowmobiles) would be minimized by vegetation management aimed at preventing illegal deer drives (type B cutting) (Section 2.1.5.2).

Despite planning efforts, project-related traffic and construction activities would variously interfere with public use of local transportation routes during the construction phase of the project.

4.5.4 Hydrologic Resources

Turbidity and suspended solids content of surface water bodies would be temporarily increased in the vicinity of the project area. Insignificant and temporary increases of herbicide concentrations could occur in surface and groundwater near the project area as a result of right-of-way clearing and maintenance. In areas near access roads, local surface runoff would be diverted.

4.5.5 Biotic Resources

About 1,185 acres of existing upland and wetland forest habitat would be cleared, but it is not anticipated that this would result in serious effects upon local wildlife populations. Although localized negative impacts could occur to a number of species, nearly as many other species could benefit from the clearing of the wooded habitat. Also, one habitat requirement for a species (e.g., breeding habitat) may be negatively affected, whereas another (e.g., feeding habitat) may increase (Tables C.1 through C.3, Appendix C).

Disturbance of streams and their associated biota would be an environmental impact of the proposed project and would occur primarily during construction activities. Impacts to aquatic biota would result from construction of stream crossings. Such impacts would be localized and transitory, provided that proper mitigative measures were implemented.

About 268 acres of forested wetlands occur within the proposed right-of-way, much of which would be modified to scrub/shrub wetlands. About 34 acres of wetland habitat would be disturbed for support foundations and access roads. However, there would only be 0.23 acres of permanent access roads would be in wetlands, and most of the acreage disturbed for tower construction (about 22 acres) would be restored. Required mitigation would restore more wetlands than would be lost, although it would take a number of years to functionally restore some wetlands, particularly forested wetlands.

4.5.6 Socioeconomics

The unavoidable socioeconomic impacts that would occur if the project were implemented would primarily involve changes in access to recreational opportunities.

4.5.7 Visual Resources

Visual resources would be adversely affected along various portions of the proposed route, especially at river crossings. However, some visual impacts would be limited to the construction phase of the project and others would be incremental in nature where the proposed transmission line would parallel the existing transmission line right-of-way.

4.5.8 Cultural Resources

No adverse impacts to cultural resources would occur that could not be avoided or mitigated.

4.5.9 Health and Safety

The potential would exist, albeit small, for serious injuries or fatalities to workers during construction of the line. Operation of the interconnection would add an additional source of public exposure to electromagnetic fields (EMF). However, this additional EMF exposure would be limited (in terms of both the number of people that would be exposed and the duration of exposure of any individual). Therefore, EMF exposure from the proposed line would only contribute a small amount of the total EMF exposure that individuals receive throughout their lives. The potential would exist for worker or public exposure to herbicides. However, with proper application the health risk would be negligible. The potential would also exist for contact with energized conductors by logging operators.

4.5.10 Radio and Television Interference

Operation of the interconnection could cause some localized interference with radio reception (particularly in the AM broadcast band) as vehicles passed under the transmission line.

4.6 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Resources that would be committed irreversibly or irretrievably during construction, operation, and maintenance of the interconnection include materials that could not be recovered or recycled and materials or resources that would be consumed or reduced to irrecoverable forms.

Gravel pits would be created to supply sand and gravel for the construction of access roads. Minor modification of landforms would be expected near the gravel pits, resulting in a minor and localized change of surface drainage. Use of sand, gravel, fuel, oil, concrete, steel, chemicals and other materials during construction, maintenance, and operation of the proposed transmission line would constitute an irreversible and irretrievable commitment of those resources. Resources, such as agriculturally productive soil, underlying sites occupied by transmission structures and access roads would be unavailable for use (and thus "committed") throughout the life of the project. The right-of-way could not be used for timber production during the life of the project.

Commitments of water resources would be insignificant during construction. Recovery by natural processes could occur within a very short time.

Wildlife habitat would be altered for the lifetime of the project. (On the other hand, wetland mitigation would create, restore, or enhance more wetland habitat than would be impacted.) In most cases, lost or modified habitat could be returned to original conditions after decommissioning of the line. Recovery could occur by natural succession or by revegetation programs. However, restoration of forested uplands and wetlands could take several decades.

Disturbance of cultural resource sites (particularly disturbance of previously undiscovered archaeological resources) could occur during construction. This disturbance could result in the permanent loss of data contained at the sites. Access to previously inaccessible areas could lead to vandalism of both known and undiscovered archaeological sites, rendering them irretrievable.

4.7 RELATIONSHIPS BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

This section summarizes the relationship between the proposed use of the environment for the construction and operation of the proposed transmission line interconnection and the actions that could be taken to maintain and enhance the long-term productivity of this same land and its resources.

Operation of the interconnection would result primarily in supplying electrical power needed to meet projected energy demands. The availability of the additional electricity would have a beneficial effect on the economy and should enhance continued growth and improvement of service within the NEPOOL service area.

Nearly 1,625 acres would be converted from present uses (mostly commercial timberland) to project-related uses (i.e., the creation of a transmission line right-of-way). Only a small amount of this total acreage would be permanently converted to project-related uses that would preclude other uses, such as wildlife habitat. In particular, about 10.5 acres would be occupied by permanent access roads.

Construction of the interconnection would result in varying losses and modifications of wetlands. However, in the long term, through mitigation more wetlands would be restored than eliminated. Short-term project-related use of renewable water resources would not effect the long-term availability of those resources.

The major short-term socioeconomic impact would be the employment of an average of 60 construction workers over a maximum of about 2 years. Long-term socioeconomic impacts would be negligible.

Any cultural resources disrupted or destroyed by the project in the short term could not be replaced.

Most adverse impacts to the environment would be short-term, or temporary, if the transmission line facilities were removed, rather than abandoned, and the area reclaimed at the end of the transmission line's useful life. Any preproject uses that could not be reestablished, such as archaeological sites, must be considered permanently lost.

4.8 CUMULATIVE IMPACTS

Cumulative impacts are those impacts to the environment that result from the incremental effect of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Implementation of the proposed transmission interconnection would result in only very small incremental (cumulative) environmental impacts within east-central Maine because most of the new transmission facility would be constructed within commercial timber areas (where impacts associated with harvesting of trees currently occur). Most of the proposed line (85.4%) would be in a new right-of-way with a width of 170 ft. This 71.6-mi-long stretch of right-of-way would add to various right-of-ways and timber clearings that currently exist in the east-central portion of Maine. The remaining 12.2 mi (14.6%) of the proposed transmission line would be adjacent to an existing right-of-way. This existing right-of-way would be widened by 100 ft. The following paragraphs summarize the notable cumulative impacts identified for the environmental resources within the area of the proposed interconnection.

The new transmission line would contribute to the continuing decline of remote recreational opportunities available within the region, especially along waterways. In addition, cumulative impacts to land use would consist of a very small reduction in the amount of land available for periodic timber harvesting.

Incremental impacts to wetlands have led to severe reductions in their quantity in the United States. Wetlands provide important wildlife habitats and are important for their floodplain values and because of the role they perform in maintaining the stability of hydrological and ecological systems. Construction of the proposed interconnection would initially add to the cumulative loss of wetlands in the project area (0.56 acre would be filled for permanent access roads and support structures). However, required wetland mitigation would restore about 10 acres of wetlands by the removal of fill and restoration of natural drainage patterns along the existing 345-kV transmission line. Alternate vegetation management would also be conducted for another 27 acres of wetlands along the alternative route to allow regrowth of buffer zones along streams and larger wetlands. Wetland mitigation would require a number of years to fully restore the functional values of the wetlands. However, in the long term, a net incremental increase in wetlands could occur because of the proposed project and associated mitigation.

The clearing of a new transmission line right-of-way and subsequent installation of the transmission line components would add to the continuing visual intrusion into the natural landscape with man-made features.

The proposed transmission line would add an additional source of exposure to electromagnetic fields (EMF). However, few people live within several hundred feet of the proposed right-of-way. Therefore, measurable exposures from the line would mostly be infrequent and of short-duration. In comparison with EMF exposures from the home and work environments, the contribution from the proposed transmission line would be minimal to negligible.

Noise generated by construction activities and traffic would incrementally add to noise generated from logging traffic and operations along Stud Mill Road. However, increases in construction-related noise would be temporary and have no long-term cumulative impacts. Noise generated from corona activity would generally be near ambient conditions. Corona-generated noise would occasionally be noticeable near the line. In conjunction with the visual intrusion of the line, noise from the transmission line could detract from remote recreational experiences.

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6 GLOSSARY

Alternating Current (AC) — An electrical current that reverses its direction at recurring intervals.

Anadromous Species — Fish species, such as salmon, that migrate from saltwater to freshwater to reproduce.

Applicant — Bangor Hydro-Electric Company, which is applying for Presidential Permit PP-89.

Aquifer — A water-bearing stratum of permeable rock, sand, or gravel.

Bus — A conductor or an assembly of conductors for collecting electric currents and distributing them to outgoing feeder lines.

Carrying Capacity — The maximum number of animals that can be supported by a given area of habitat.

Cogeneration — Production of electrical (or mechanical) energy and thermal energy from the same primary energy source.

Coldwater Fisheries — Fish assemblages characterized by trout, char, and/or whitefish. Water temperatures must be low enough to meet the thermal requirements for survival and spawning for natural populations to be maintained. If temperatures are too high, seasonal or annual nonsustaining coldwater fisheries could be maintained by stocking.

Construction Laydown Area — Work area required for each transmission line support structure to accommodate structure materials and construction equipment.

Cumulative Present Worth — The sum of a series of annual expenditures expressed in terms of a given year's buying power of money.

Cumulative Present Worth of Revenue Requirements — Cumulative present worth of the series of annual revenue requirements (see definition below) of a given project.

Danger Trees — Trees located outside or inside the right-of-way that pose a threat to the operation of the transmission line.

Decibel (dB) — Unit expressing the relative intensity of sounds on a scale from 0 for the average least-perceptible sound to about 130 for the average pain level.

Declining Species — A species whose populations are currently undergoing a prolonged, noncyclic decline in the state and, possibly, many other parts of its range, and that is either approaching rarity or is already very rare in the state. Such species are likely to become endangered or threatened in the state within the near future.

Endangered Species — A species classified as being in immediate danger of extinction throughout all or most of its range (federally listed); in danger of extinction in a state as a reproducing species; rare or very local throughout all or much of its range, or having a relatively restricted geographic range (state-listed).

Foliage Height Diversity (FHD) — Habitat complexity, or number of vegetation layers deemed necessary to maintain populations of songbirds.

Fossil Fuel — Fuel sources ultimately derived from living things. Major fossil fuels are coal, oil, and natural gas.

Hardwoods — General term for deciduous trees (angiosperms).

Hydrocarbons — Organic compounds often occurring in petroleum, natural gas, and coal.

Hydroelectric — Of or relating to production of electricity by water power.

Kilowatt-Hour (kWh) — Unit of work or energy equal to that expended by one kilowatt (1,000 watts) in one hour.

Mast — Nuts accumulated on the forest floor and used as food by wildlife.

Non-Point-Source Pollution — Pollution caused by a diffused or indirect source, such as a drainage field or runoff following a rain.

Particulates — Particles of material suspended in the atmosphere.

Polychlorinated Biphenyls (PCBs) — Highly stable organochlorine compounds used in numerous diverse products, such as lubricants, electrical equipment, paints, and plasticizers. These compounds remain persistent in the environment, are bioaccumulated, and can cause detrimental effects at low concentrations.

pH — A measure of acidity or alkalinity. A pH of 7 is neutral, lower values are more acidic, and higher values are more alkaline.

Photochemical Oxidants — Secondary gaseous pollutants created in the atmosphere from conversions and reactions of primary gaseous pollutants (such as sulfur oxides and nitrogen oxides). They include ozone and peroxyacetyl nitrate.

Point-Source Pollution — Pollution coming from a very specific source, such as an exhaust stack.

Rare Species — Populations and/or individuals of a species occurring in very low numbers relative to other similar taxa in the state, although common or regularly occurring throughout much of their range. They may occur in a restricted geographic region or occur sparsely over a wider area. Although rare, populations are apparently stable.

Region of Influence — That portion of the state of Maine that will likely be impacted by the proposed project. In this case, four counties are involved: Aroostook, Hancock, Penobscot, and Washington.

Revenue Requirements — The amount of money that must be recovered or generated in order to pay for the interest, depreciation, taxes, insurance, fuel costs, and all other variable expenses associated with the construction, operation, and maintenance of a project.

Secondary Contact Recreation — Recreational activities such as fishing or boating that do not generally involve continual direct contact with the water as do such water recreational activities as swimming.

Softwoods — General term for coniferous trees (gymnosperms).

Special Concern — A category used by Maine's Critical Areas Program to describe plant and animal species and natural communities in Maine that are not yet rare enough to be listed as threatened or endangered.

Special Concern Species — A species whose populations have been shown to be suffering a decline that could threaten the species in the area if allowed to continue unchecked, or a species that occurs in such small numbers or with such a restricted distribution or specialized habitat that it could easily become threatened.

Staging Area — Construction headquarters along the route where materials are received, stored, and shipped to the right-of-way.

Threatened Species — A species likely to become endangered in the future throughout all or most of its range (federally listed) or all of its range within the state (state-listed).

Warmwater Fisheries — Fish assemblages characterized by sunfish and bass (as well as by those species considered trash fish, such as carp, most suckers, and bullheads). Warmwater species generally inhabit waters with temperature ranges within which trout and other coldwater species cannot maintain self-sustaining populations.

Water Quality Guideline — A statement of a measurable value of a water quality parameter recommended to support a given general water use.

Water Quality Objective — A statement of a measurable value of a water quality parameter that has been established as necessary to support a given water use at a specified site.

Water Quality Standard — A legally enforceable requirement to maintain a specified measurable water quality value.

Watershed — The land area that drains into a given water system.

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Bangor, ME 04401

WDEA-AM
c/o News Director
68 State Street
Ellsworth, ME 04605

"Rock 100 FM" WKIT
c/o News Director
Wilson Street
Brewer, ME 04412

WKSQ-FM
c/o News Director
P.O. Box 9494
Buttermilk Road
Ellsworth, ME 04605

WLBZ-TV
c/o News Director
P.O. Box 934
Bangor, ME 04401

WLKN-FM
c/o News Director
P.O. Box 176
Lincoln, ME 04457

WMCS-AM
c/o News Director
12 Cooper Street
Machias, ME 04654

WPBC-FM
c/o News Director
27 State Street
Bangor, ME 04401

WQCB-FM
c/o News Director
49 Acme Road
Brewer, ME 04412

WSYY-AM
c/o News Director
P.O. Box 1240
Millinocket, ME 04462

WSYY-FM
c/o News Director
P.O. Box 240
Millinocket, ME 04462

WVII-TV
c/o News Director
371 Target Industrial Circle
Bangor, ME 04401

WWFX
c/o News Director
84 Main Street
Belmont, ME

WWMJ-FM
c/o News Director
68 State Street
Ellsworth, ME 04605

"Z-62" WZON-AM
c/o News Director
P.O. Box 921
861 Broadway
Bangor, ME 04401

APPENDIX A:

LAND USE DATA

TABLE A.1 Land Use Data for Counties Traversed by the Proposed and Alternative Routes and for State of Maine[a]

Land Use Category	Acreage				
	Washington	Hancock	Penobscot	Aroostook	State of Maine
Forest	1,514,500	838,100	1,941,400	3,811,200	17,607,400
Agriculture	34,400	13,400	82,900	339,200	998,400
Residential, commercial, and industrial	52,000	36,000	44,200	11,200	357,100
Right-of-way	-[b]	48,200	35,000	32,800	305,000
Wetland and noncensus water	53,900	48,100	80,000	73,400	392,000
Other[c]	-	-	11,500	33,800	176,900
Total land area	1,654,900	983,800	2,195,000	4,301,600	19,836,800

[a] Proposed-route study area consists of Washington, Hancock, and Penobscot counties; alternative-route study area includes Penobscot and Aroostook counties.

[b] No data.

[c] Includes mining, wasteland, recreation sites, and other nonforest categories.

Source: Brooks et al. (1986).

TABLE A.2 Area of Timberland by Ownership Class for Counties Traversed by the Proposed and Alternative Routes and for State of Maine[a]

	Acreage				
Ownership Class	Washington	Hancock	Penobscot	Aroostook	State of Maine
Private					
Forest industry	858,100	337,000	761,100	1,955,600	8,016,900
Farmer	94,200	64,600	132,800	273,400	1,306,500
Other[b]	456,100	333,200	865,000	1,375,100	7,046,700
Public					
Federal	11,200	500	3,700	5,600	64,800
State	22,500	22,000	22,900	82,700	354,200
Native American[c]	11,600	16,500	80,300	-[d]	157,100
County and municipal	500	2,500	6,900	76,000	114,000
Total	1,454,200	776,300	1,872,700	3,768,400	17,060,200

[a] Proposed-route study area consists of Washington, Hancock, and Penobscot counties; alternative-route study area includes Penobscot and Aroostook counties.

[b] Includes individual and corporate owners, undivided estates, partnerships, and trusts.

[c] Includes both fee and trust lands.

[d] No data.

Source: Birch (1982).

TABLE A.3 Agricultural Land Data for Counties Traversed by the Proposed and Alternative Routes and for State of Maine[a]

Parameter	Washington	Hancock	Penobscot	Aroostook	State of Maine
Number of farms	337	290	572	1,012	6,269
Land in farms (acres)	85,734	50,026	132,717	329,971	1,342,588
Percent of land in farms	5.2%	5.1%	6.0%	7.7%	6.8%
Total cropland (acres)	31,795	14,212	54,397	187,566	592,309
Harvested cropland (acres)	18,781	6,927	38,952	135,067	410,891
Cropland used only for pasture or grazing (acres)	1,597	1,247	9,271	10,800	87,487
Other cropland (acres)	11,417	6,038	6,174	41,699	93,931

[a] Proposed route study area consists of Washington, Hancock, and Penobscot counties; alternative-route study area includes Penobscot and Aroostook counties.

Sources: ER (1991, Table IV-18); U.S. Bureau of the Census (1989).

APPENDIX B:

HYDROLOGICAL DATA

TABLE B.1 Surface Water Bodies Crossed by the Proposed Route[a]

County/Township	Name of Water Body	Water Quality Classification[b]
Washington		
Baileyville	St. Croix River	C
Baileyville	Unnamed tributary to St. Croix River	A
Baileyville	Unnamed stream	A
Baileyville	Sprague Meadow Brook	A
Baileyville	Unnamed tributary to Sprague Meadow	A
Baileyville	Unnamed tributary to Sprague Meadow	A
Baileyville	Unnamed tributary to Sprague Meadow	A
Baileyville	Unnamed stream from Sawtelle Heath	A
Baileyville	Unnamed stream	A
Baileyville	Unnamed stream	A
Princeton	Unnamed stream	A
Princeton	Unnamed tributary to Dog Brook	A
Princeton	Unnamed stream	A
Princeton	Unnamed tributary to Dog Brook	A
Princeton	Dog Brook	A
Princeton	Tributary to Dog Brook	A
Princeton	Rocky Brook	A
Princeton	Lewys Brook	A
Princeton	Unnamed tributary to Allen Brook	A
Princeton	Allen Brook	A
Princeton	2nd unnamed tributary to Allen Brook	A
Princeton	3rd unnamed tributary to Allen Brook	A
Township No. 21	4th unnamed tributary to Allen Brook	A
Township No. 21	5th unnamed tributary to Allen Brook	A
Township No. 21	Unnamed stream	A
Township No. 21	Unnamed tributary to Joe Brook	A
Township No. 21	Joe Brook	A
Township No. 21	Unnamed tributary to Huntley Brook	A
Township No. 21	Unnamed tributary to Huntley Brook	A
Township No. 21	Unnamed tributary to Huntley Brook	A
Township No. 21	Unnamed stream	A
Township No. 21	Unnamed stream	A
Township No. 21	Huntley Brook	A
Township No. 21	Unnamed tributary to Huntley Brook	A
Township No. 21	Unnamed tributary to Huntley Brook	A
Township No. 21	Unnamed tributary to Huntley Brook	A
Township No. 21	Unnamed stream	A
Township No. 21	Unnamed tributary to Scott Brook	A
Township No. 21	Scott Brook	A
Township No. 21	Unnamed stream	A
T27ED	Clifford Stream	A
T27ED	Headwater of Little Wallamatogue Stream	A
T27ED	Big Wallamatogue Stream	A

TABLE B.1 (Cont.)

County/Township	Name of Water Body	Water Quality Classification[b]
Washington (Cont.)		
T27ED	Unnamed tributary to Big Wallamatogue Stream	A
T27ED	Unnamed tributary to South Brook	A
T37MD	Unnamed stream	A
T37MD	Unnamed stream	A
T37ED	Unnamed tributary to Little Musquash Stream	A
T37MD	2nd unnamed tributary to Little Musquash Stream	A
T37MD	Unnamed tributary to Little Musquash Stream	A
T37MD	Unnamed tributary to Lanpher Brook	A
T37MD	Lanpher Brook	A
T37MD	Unnamed stream	A
T37MD	Unnamed headwater of Dead Stream	A
T37MD	Machias River	AA
T36MD	Tributary to Fletcher Brook	A
T36MD	Fletcher Brook	A
T36MD	Unnamed stream	A
T36MD	Unnamed tributary to 5th Machias Lake	A
T36MD	Unnamed tributary to 5th Machias Lake	A
T36MD	Lake Brook	A
T36MD	Unnamed stream to Greenland Cove	A
T36MD	Unnamed stream to 5th Machias Lake	A
Hancock		
T35MD	Unnamed tributary to Lower Sabao Lake	A
T35MD	Unnamed stream	A
T35MD	Unnamed tributary to Lower Sabao Lake	A
T35MD	Unnamed stream	A
T35MD	Unnamed tributary to Lower Sabao Lake	A
T35MD	Stream from Pughole Pond to Burnt Land Lake	A
T35MD	Unnamed stream from Green Lake to Campbell Lake	A
T35MD	Thompson Brook	A
T35MD	Narraguagus River	AA
T34MD	Unnamed tributary to Narraguagus River	A
T34MD	Unnamed tributary to Narraguagus River	A
T34MD	Unnamed tributary to Narraguagus River	A
T34MD	Unnamed tributary to Eagle Stream	A
T34MD	Unnamed tributary to West Branch of Narraguagus River (2 crossings)	A
T34MD	Unnamed tributary to West Branch of Narraguagus River (5 crossings)	A
T34MD	Unnamed tributary to West Branch of Narraguagus River (2 crossings)	A
T34MD	Unnamed tributary to West Branch of Narraguagus River (3 crossings)	A
T34MD	Unnamed stream	A
T34MD	Alligator Stream	B

TABLE B.1 (Cont.)

County/Township	Name of Water Body	Water Quality Classification[b]
Hancock (Cont.)		
Great Pond	Unnamed tributary to Alligator Stream (Duds Pond Stream)	B
Great Pond	Unnamed tributary to Alligator Stream	B
Great Pond	Alligator Stream	B
Great Pond	Main Stream	B
Great Pond	Unnamed tributary to Hinckley Brook	B
Great Pond	Unnamed tributary to Hinckley Brook	B
Great Pond	Hinckley Brook	B
Great Pond	Unnamed stream	B
Great Pond	Unnamed stream	B
T32MD	Dead Stream	B
T32MD	Unnamed stream	B
T32MD	Unnamed tributary to Indian Brook	A
T32MD	Unnamed tributary to Wiley Brook	A
T32MD	Unnamed tributary to Wiley Brook	A
T32MD	Wiley Brook	A
Penobscot		
Greenfield	Unnamed tributary to Sunkhaze Stream	A
Greenfield	Sunkhaze Stream	A
T32MD	1st unnamed tributary to Birch Stream	A
T32MD	2nd unnamed tributary to Birch Stream	A
T32MD	Birch Stream	A
T32MD	Unnamed tributary to Birch Stream	A
Milford	Titcomb Brook	A
Milford	Unnamed stream	A
Milford	Unnamed stream	A
Bradley	Tributary to Little Birch Stream	A
Bradley	Unnamed tributary to Little Birch Stream	A
Bradley	Little Birch Stream	A
Bradley	Unnamed tributary to Baker Brook	A
Bradley	Baker Brook	A
Bradley	Unnamed tributary to Great Works Stream	A
Bradley	Great Works Stream	A
Bradley	Unnamed tributary to Boynton Brook	A
Bradley	Tributary to Boynton Brook	A
Bradley	Unnamed tributary to Boynton Brook	A
Bradley	Boynton Brook	A
Bradley	Unnamed stream	A
Bradley	Blackman Stream	C
Bradley	Unnamed tributary to Blackman Stream	C
Eddington	Meadow Brook	C
Eddington	Unnamed tributary to Eaton Brook	C
Holden	Unnamed stream	C

TABLE B.1 (Cont.)

County/Township	Name of Water Body	Water Quality Classification[b]
Penobscot (Cont.)		
Holden	Brook-unnamed tributary to Felts Brook	C
Holden	Felts Brook	C
Brewer	Felts Brook	C
Brewer	Felts Brook	C
Brewer	Unnamed tributary to Felts Brook	C

[a] Locations of water body crossings are shown in the ER (1991).

[b] As established by the Maine Department of Environmental Protection.

Source: Modified from ER (1991).

TABLE B.2 Surface Water Bodies Crossed by the Alternative Route[a]

County/Township	Name of Water Body	Water Quality Classification[b]
Aroostook		
Orient	Monument Brook	A
Orient	Greenleaf Brook	A
Orient	Skagrock Brook	B
Orient	Skagrock Brook	B
Orient	Bear Brook	B
Orient	Unnamed tributary to Skagrock Brook	B
Orient	Unnamed tributary to Skagrock Brook	B
Orient	Jimmy Brook	B
Haynesville	Dead Brook	B
Haynesville	Juniper Brook	B
Haynesville	Orr Brook	B
Haynesville	Mattawamkeag River	B
Haynesville	Unnamed tributary to Alder Brook	B
Glenwood Plantation	Unnamed tributary to Alder Brook	B
Glenwood Plantation	Unnamed tributary to Alder Brook	B
Glenwood Plantation	Unnamed tributary to Battle Brook	B
Glenwood Plantation	Smith Brook	B
Reed Plantation	Unnamed tributary to Finn Brook	B
Reed Plantation	Unnamed tributary to Finn Brook	B
Reed Plantation	Wytopitlock Stream	B
Reed Plantation	Unnamed brook to Reed Pond	B
Reed Plantation	Unnamed brook to Reed Pond	B
Macwahoc Plantation	Macwahoc Stream	B
Macwahoc Plantation	Unnamed tributary to Macwahoc Stream	B
Macwahoc Plantation	Arbo Brook	B
Macwahoc Plantation	Unnamed tributary to Arbo Brook	B
Macwahoc Plantation	Molunkus Stream	B
Macwahoc Plantation	Unnamed tributary to Little Molunkus Stream	B
Macwahoc Plantation	Little Molunkus Stream	B
Penobscot		
Mattawamkeag	Mattaseunk Stream	B
Mattawamkeag	Penobscot River	C
Woodville	Unnamed tributary to Eagle Stream	B
Woodville	Unnamed tributary to Eagle Stream	B
Woodville	Eagle Stream	B
Woodville	Medunkeunk Stream	B
Woodville	Medunkeunk Stream	B
T2R8NWP	Unnamed tributary to Penobscot River	B
Mattamiscontis	Mattamiscontis Stream	B
Mattamiscontis	Penobscot River	C
Mattamiscontis	Penobscot River	C
Enfield	Unnamed tributary to Barnes Brook	B

TABLE B.2 (Cont.)

County/Township	Name of Water Body	Water Quality Classification[b]
Penobscot (Cont.)		
Passadumkeag	Passadumkeag River	B
Greenbush	Olamon Stream	B
Greenbush	Unnamed tributary to Stevens Brook	B
Greenbush	Unnamed tributary to Stevens Brook	B
Milford	Unnamed tributary to Buzzy Brook	B
Milford	Sunkhaze Stream	A
Milford	Unnamed tributary to Sunkhaze Stream	A
Milford	Otter Stream	B
Milford	Otter Chain Pond	NC[c]
Bradley	Great Work Stream	A
Bradley	Boynton Brook	A
Bradley	Oliver Brook	A
Bradley	Blackman Stream	C
Bradley	Unnamed tributary to Blackman Stream	C
Eddington	Meadow Brook	C
Eddington	Meadow Brook	C
Eddington	Small man-made pond	NC[c]
Eddington	Unnamed tributary to Eaton Brook	C
Eddington	Unnamed tributary to Eaton Brook	C
Eddington	Unnamed tributary to Eaton Brook	C
Eddington	Unnamed tributary to Eaton Brook	C
Holden	Eaton Brook	C
Eddington	Unnamed tributary to Eaton Brook	C
Holden	Unnamed tributary to Felts Brook	C
Holden	Unnamed tributary to Felts Brook	C
Holden	Unnamed tributary to Felts Brook	C
Brewer	Felts Brook	C
Brewer	Felts Brook	C
Brewer	Felts Brook	C
Orrington	Unnamed tributary to Fields Pond	C

[a] Locations of water body crossings are shown in the ER (1991).

[b] As established by the Maine Department of Environmental Protection.

[c] Not classified.

Source: Modified from ER (1991).

APPENDIX C:

BIOTIC RESOURCES DATA AND ASSESSMENTS

APPENDIX C:

BIOTIC RESOURCES DATA AND ASSESSMENTS

This appendix contains tables of biotic resources data (Section C.1) and a biological assessment for the bald eagle (Section C.2, beginning on page C-29).

C.1 DATA TABLES

Tables presented here list information on the wildlife that could occur in the study area: mammals (Table C.1), amphibians and reptiles (Table C.2), birds (Table C.3), and threatened and endangered plant and animal species (Table C.4).

TABLE C.1 Mammal Species that Range within the Study Area

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Masked shrew	U to C	Damp woodlands with grass, rocks, logs, or stumps; bogs; other moist areas	–
Water shrew	U	Wet areas, especially grass-sedge marsh or shrub zones along ponds and streams in coniferous forests	+
Smoky shrew	U to C	Damp boulder-strewn upland woods with thick leaf mold; typically near streams with moss-covered banks; also clear-cuts in coniferous woodlands	0/+
Long-tailed shrew	R	Cold, deep coniferous forests, typically near moss-covered rocks and logs or woody talus slopes; also in deciduous or mixed forests	–
Pygmy shrew	R to C	Wet or mixed habitat, less often in dry areas close to water; damp litter, especially near rotten stumps and logs in wooded areas; prefers grassy openings in coniferous forests	–/0
Short-tailed shrew	C	Timbered and fairly open habitats; especially common along stream banks and in meadows with tall grasses or sedges, brush piles, and stone walls	0/+
Hairy-tailed mole	C	Open woods and meadows; prefers areas with vegetative cover and sufficient moisture; avoids heavy, wet soils	0/+
Star-nosed mole	U to C	Prefers low, wet ground near bodies of water, swamps, wet meadows; occasionally in wet spots in fields or low-lying woods	0/+
Little brown myotis	C	Males roost in valleys near streams and marshes; female roost sites include hollow trees	–/0
Keen's myotis	U to C	Nursery colonies in tree cavities; roost sites include crevices under loose bark	–

TABLE C.1 (Cont.)

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Silver-haired bat	R to U	Forested areas near lakes and streams; roosts in foliage of trees, tree cavities, and under loose bark	–
Big brown bat	C	Hollow trees in wooded areas	–
Red bat	R to U	Roosts in trees in wooded areas; most numerous along fencerows or forest edges	0/+
Hoary bat	R	Roosts in trees in wooded areas; prefers coniferous forests but also occurs in deciduous woods and woodland edges, hedgerows, and trees in city parks	–/0
Snowshoe hare	C	Woodlands with dense brushy understory, coniferous swamps, cut-over areas, burns; prefers second-growth aspen and birch in vicinity of conifers	+
Eastern chipmunk	C	Edges or interiors of deciduous woodlands with abundant cover or undergrowth, old logs, stone walls; also semiopen brushland with ample cover	0/+
Woodchuck	C	Woodland edges, open cultivated land, pastures, meadows, open brushy hillsides; seldom in forest interiors	+
Gray squirrel	U	Deciduous and mixed forests, especially those that produce mast; river bottomlands; woodlots in towns; city parks	–
Red squirrel	U to C	Forests, rural woodlots	–
Northern flying squirrel	U to C	Mature forests; favors cool, heavily wooded areas above 1,000 ft	–
Beaver	C	Small to large slowly flowing waterways usually bordered by woodland	0
Deer mouse	C	Interiors or edges of coniferous or mixed forests, along field borders, stone walls; uses recent forest clear-cuts	0/+

TABLE C.1 (Cont.)

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Southern red-backed vole	C	Cool moist forests among mossy rocks, logs, tree roots, or other cover; will use young clear-cuts	0/+
Meadow vole	A	Fields, pastures, orchards, marshes, meadows, borders of lakes and streams, open and wooded swamps, logs; less often in open woods and clear-cuts	0
Rock vole	R	Coniferous and mixed forests at higher elevations; favors cool, damp, moss-covered rocks and talus slopes in vicinity of streams	–/0
Muskrat	U to C	Marshes, shallow portions of lakes, ponds, swamps, sluggish streams, drainage ditches; most abundant in areas of cattails	0/+
Southern bog lemming	U	Marshes, open meadows, orchards, moist deciduous and mixed forests; favors sphagnum bogs and deciduous woodlands with a thick layer of loose duff; uses clear-cuts and other small forest openings with adequate ground cover	0
Northern bog lemming	R	Sphagnum bogs, damp weedy meadows, mossy spruce woods, hemlock and beech forests	–/0
Norway rat	A	Waterfronts, farms, cities, dumps, rural and suburban residences	0/+
House mouse	A	Buildings, fields, corncribs, and similar locations	+
Meadow jumping mouse	C	Moist, open grassy and brushy marshes and meadows; willow-alder thickets along water courses; swamps; transition areas between lowlands and wooded uplands; prefers areas with numerous shrubs and small trees	+

TABLE C.1 (Cont.)

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Woodland jumping mouse	C	Areas with herbaceous ground cover and low, woody plants in forests; frequently in brush and herbaceous vegetation bordering streams, lakes, and ponds; uses recent clear-cuts with herbaceous cover	0/+
Porcupine	U to C	Mixed or coniferous forests	–
Coyote	U to C	Edges of second growth forests, open brushy fields, fallow agricultural lands, forest openings created by fire or logging	+
Red fox	U to C	Mixture of forest and open areas preferred; forest edges used heavily	+
Black bear	C	Fairly remote forests and swamps; prefers mixed woodlands with a well-developed understory	–/+
Raccoon	C	Wooded areas interrupted by fields and water courses, not usually in dense forest, commonly encountered in wetlands near human habitation	+
Marten	U	Diversity of wooded habitats	–/0
Fisher	U to C	Extensive forests of mixed hardwoods and conifers, less frequently in more open stands or burned areas	–/0
Ermine	U to C	Wooded or open country with thickets, rock piles, or other heavy cover; often close to water courses	–/0
Long-tailed weasel	U to C	Open woods and woodland edges, grasslands, river bottomlands, fencerows; prefers to be near water	+
Mink	U to C	Stream banks, lakeshores, and marshes; prefers forested wetlands with abundant cover	0

TABLE C.1 (Cont.)

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Striped skunk	C	Semiopen county, woods, meadows, agricultural lands, suburban areas, trash dumps	+
River otter	U	Borders of streams, lakes, or other wetlands in forested areas	0
Lynx	R to U	Interiors of extensive, unbroken forests well removed from human activity	–
Bobcat	U to C	Mixed and hardwood forests; brushy and rocky woodlands broken by fields, old roads, farmlands; frequents cedar swamps and spruce thickets; favors areas with thick undergrowth	–/0
White-tailed deer	C	Forest edge, swamp borders, areas interspersed with fields and woodland openings	–/+
Moose	U to C	Second-growth boreal forests interrupted with semiopen areas and swamps or lakes	+

[a] A = abundant; C = common; R = rare; U = uncommon.

[b] Qualitative assessment based on conversion of existing habitats (primarily forested uplands and wetlands) to right-of-way habitats (primarily small tree, scrub shrub, and old-field habitats) and edge habitat:

+ = an overall increase in preferred habitat

0 = no major change in preferred habitat

– = an overall decrease in preferred habitat

A slash (e.g., 0/+) indicates that the impact is slight, except –/+ indicates one habitat requirement (e.g., summer habitat) would notably increase while another (e.g., winter habitat) would notably decrease.

Source: DeGraaf and Rudis (1986); Godin (1977) (relative abundance and habitat descriptions).

TABLE C.2 Amphibian and Reptile Species that Range within the Study Area

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Blue-spotted salamander	R	Woody, swampy, or moist areas	–/0
Spotted salamander	C	Moist woods, stream banks, beneath stones, logs, boards; prefers deciduous or mixed woods on rocky hillsides and shallow woodland ponds or marshy pools	–/0
Red-spotted newt	C	Terrestrial juveniles in moist areas, usually in woody habitats; adults in still or slow-moving waters with aquatic vegetation	–/0
Northern dusky salamander	C to A	Woodlands at margins of cool, running water	–/0
Redback salamander	A	Mixed deciduous or coniferous woods; inhabits decaying logs, stumps, under stones, bark, and moist leaf litter	–/0
Four-toed salamander	U to R	Wet woodlands (preferably with sphagnum moss), shallow woodland pools, tamarack bogs	–/0
Northern two-lined salamander	C to A	Floodplain bottoms, moist forest floors, along streams, boggy areas near springs and seeps, wet woodlands or pastures	–/0
Eastern American toad	C	Most habitats, usually moist upland woods	0
Northern spring peeper	C to A	Marshy or wet woods, second growth woodlots, sphagnum bogs, nonwooded lowlands, near ponds and swamps	–/0
Gray treefrog	C	Forested areas with small trees, shrubs, and bushes near or in shallow water	0/+
Bullfrog	C	Near shorelines of large bodies of water with emergent vegetation, lakes, rivers, oxbows	0

TABLE C.2 (Cont.)

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Green frog	C	Riparian habitats, margins of shallow permanent and semipermanent waters	0
Mink frog	R to C	Edges of lakes and ponds, cold springs, inlets where cold streams enter ponds, and stream edges; prefers open water with abundant lily pads	0
Wood frog	C	Terrestrial habitats in mesic woods, or xeric woods with moist microhabitats	–
Northern leopard frog	C	Wet open meadows and fields and wet woods during summer months	0/+
Pickerel frog	C	Water of lakes, ponds, clear streams, springs, sphagnum bogs, quarry pools, pastures, fields, woodlands	0
Common snapping turtle	C	Bottom dweller in any permanent and many semipermanent water bodies	0
Wood turtle	I to C	Slow-moving meandering streams with sandy bottoms and overhanging alders; fields, woods, and roadsides in summer	0
Eastern painted turtle	C to A	Quiet, shallow ponds, marshes, rivers, lake shores, wet meadows, bogs, slow-moving streams	0
Northern water snake	A	Aquatic and semiaquatic habitats; uncommon in deeply shaded woodland swamps and ponds	+
Northern redbelly snake	A	Moist woods, hillsides, sphagnum bogs, upland meadows, valleys; prefers woodlands	–/0
Eastern garter snake	A	All terrestrial habitats; most common and widespread snake	0

TABLE C.2 (Cont.)

Species	Relative Abundance[a]	Habitat	Potential Project Impact[b]
Maritime garter snake	Un	Mature hardwood stands, fir stands with mixed understory, along forest roads	–
Northern ribbon snake	R	Damp meadows, grassy marshes, sphagnum bogs, borders of ponds, lakes, and meandering streams	0/+
Northern ringreck snake	C	In moist shady woodlands with abundant hiding cover; stony woodland pastures; rock and stone walls; wood piles; debris; logs; boards	–
Eastern smooth green snake	C	Upland areas, grassy fields, meadows, open aspen stands, sphagnum bogs, marshes, vines and brambles, hardwood stands	+
Eastern milk snake	C	Various habitats, usually with bushy or woody cover; farmlands, woods, meadows, river bottoms, bogs, rocky hillsides, pine forests, second-growth pine, bog woods, hardwoods, aspen stands	–/0

[a] A = abundant; C = common; I = infrequent; R = rare; U = uncommon; Un = unreported.

[b] Qualitative assessment based on conversion of existing habitats (primarily forested uplands and wetlands) to right-of-way habitats (primarily small tree, scrub shrub, and old-field habitats) and edge habitat:

+ = an overall increase in preferred habitat

0 = no major change in preferred habitat

– = an overall decrease in preferred habitat

A slash (e.g., 0/+) indicates that the impact is slight.

Source: DeGraaf and Rudis (1986) (relative abundance and habitat descriptions).

TABLE C.3 Bird Species that Range within the Study Area

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Common loon	U to C	B	Lakes in open or densely forested areas	0
Pied-billed grebe	C	B	Ponds with heavy emergent vegetation, marshes	0
American bittern	C	B	Marshes, meadows, swamps, bogs, sluggish rivers and streams with some dense bordering vegetation	0/+
Least bittern	U to R	B	Wetlands, preferably with tall vegetation	0/+
Great blue heron	C	B	Shallow shores of ponds, lakes, streams, rivers, wet meadows, swamps, bogs, marshes; requires tall trees for nesting	0/+
Green-backed heron	U to C	B	Most aquatic and wetland habitats	0
Black-crowned night-heron	R	B	Varied aquatic and wetland habitats	0
Canada goose	U to C	B/W	Shores of ponds and lakes, grassy fields (breeding); ice-free water, agricultural fields (wintering)	0/+
Wood duck	U to C	B	Shallow water of ponds, lakes, and marshes with abundant vegetation; wooded swamps or open flooded lowland forests; requires trees with cavities for nesting	+
Green-winged teal	C	B	Ponds, lakes, sedge meadows, marshes near grasslands, dry hillsides with brushy thickets or adjacent open woodlands	+
American black duck	U to A	P/B	Marshy borders of water bodies; woody swamps, marshes, meadows (breeding); open marshes (wintering)	–/0 (B), 0/+ (W)
Mallard	U	P/B	Ponds, lakes, streams, rivers, marshes, wet meadows, swamps (breeding); ice-free ponds and rivers (wintering)	0

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Ring-necked duck	C	B	Flooded swamps, marshes, bogs, sloughs, beaver flowage near larger wooded lakes or rivers	0
Common goldeneye	U	B	Ponds, lakes, shallow rivers, floodplain forests and bogs, slowly flowing streams with weedy margins; requires larger trees with cavities	–
Hooded merganser	U	B	Heavily wooded ponds, lakes, rivers, streams, swamps; requires wooded areas with cavities	–
Common merganser	U to C	B	Clear ponds, lakes, and rivers with wooded shorelines; requires large trees with cavities	–
Red-breasted merganser	U	B	Most clear water bodies in forested areas; ground nester	0
Osprey	R to U	B	Near large bodies of water with abundant fish; requires elevated nest sites	+
Bald eagle	R	B	Forest and open areas, mountains, usually near large bodies of water with abundant fish; requires large living trees and isolation from humans	–
Northern harrier	U	B	Open country, marshes, swamps, bogs, wet meadows; requires open country with herbaceous or low woody vegetation	+
Sharp-shinned hawk	U	P/B	Open mixed or coniferous woodlands, clearings, edges; requires isolation from human disturbance	0/+
Cooper's hawk	R	B	Extensive deciduous or mixed woodlands that are dense or open; scattered woodlots interrupted with open fields; floodplain forests; wooded swamps	+
Northern goshawk	R to U	P/B	Interiors of remote, heavily wooded coniferous and mixed forests	–

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Red-shouldered hawk	U	B	Moist hardwood or mixed woodlands, swamps, bottomlands, wooded margins of marshes often close to agricultural fields	–/+
Broad-winged hawk	U to C	B	Dry forests; wooded hillsides, usually away from human habitations; prefers continuous woods and to nest along untraveled roads in woods	–/0
Red-tailed hawk	U	P/B	Deciduous and mixed woodlands interspersed with meadows, brushy pastures, bogs, and swampy areas	+
Rough-legged hawk	R	W	Restricted to open country, brushy fields, open meadows, marshes	0/+
American kestrel	C	B	Open areas with a few trees containing cavities, wet meadows, forest edges near open ground, orchards, farm buildings, cities	+
Spruce grouse	U	P	Tamarack swamps, cedar bogs and muskegs, lowlands bordering sluggish streams in coniferous forests; rarely uses open meadows or clearings	–
Ruffed grouse	U to C	P	Areas with dense woody cover overhead and fairly open herbaceous ground cover; frequents stands of aspen, birch or other hardwoods, alder thickets, recently logged areas next to shrubby wetlands, logging roads, small clearings, recently disturbed sites	+
Virginia rail	C	B	Marshes with abundant vegetation, especially sedges and cattails	0/+
Sora	C	B	Marshes, ponds, swamps, bogs, wet grassy meadows, sloughs; prefers sedges and cattails where mud and water are deep	0/+

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Killdeer	C	B	Heavily grazed meadows, edges of pasture ponds, dry uplands; often close to human habitations	+
Spotted sandpiper	U to C	B	Along edges of ponds, lakes, and rivers or far from water in dry fields, pastures, and weedy shoulders of roads; prefers open terrain	+
Upland sandpiper	U	B	Open pastures or grassy fields, alfalfa or clover hayfields, occasionally forest openings	0/+
Common snipe	C	B	Marshes with short vegetation, sedge bogs, alder and willow swamps, pond margins, lowlands associated with streams where soil is muddy and vegetation is sparse, wet meadows	0/+
American woodcock	C	B	Moist woodlands in early stages of succession, swamps, stream banks, bogs, rich bottomlands; often in thickets of alders, willows, or maples	+
Herring gull	C	B	Mainly on islands in lakes and rivers	0
Rock dove	A	P	Open country, especially near human habitations	+
Mourning dove	C	B	Open mixed woodlands and woodland edges, evergreen plantations, orchards, farmlands, suburbs, cities; avoids dense forests	+
Black-billed cuckoo	U	B	Brushy pastures, shrubby hedgerows at edges of fields, dry open upland woods and groves	+
Eastern screech-owl	R	P	Shade trees in towns, orchards, small woodlots, open woodlands; requires cavities in trees	–/+

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Great horned owl	U to C	P	Deep woods remote from populated areas, large streams, or woodland ponds; mixed countryside of forests and fields; requires large abandoned bird nests or large cavities	–/+
Barred owl	U	P	Low, wet, deep woods; heavily wooded swamps often near open country; requires large trees with cavities	–/+
Long-eared owl	U	P/B	Open or dense woodlands, wooded parks, sometimes small woodlots, swamps, evergreen plantations	–
Short-eared owl	U	B	Open grasslands, plains, marshes, dunes; requires extensive open grasslands with abundant rodents	0/+
Northern saw-whet owl	U	P	Various habitats, including woodlots, roadside shade trees, coniferous and deciduous forests; requires cavities in trees	–/0
Common nighthawk	R to C	B	Open areas such as plowed fields, barren areas with rocky soils, railroad rights-of-way, large woodland clearings, cities	+
Whip-poor-will	U to C	B	Dry, open, predominantly deciduous woodlands, often with small- to medium-sized trees of pine, oak, and birch; less often in mature forests	0/+
Chimney swift	A	B	Vicinity of buildings in cities and farms	0
Ruby-throated hummingbird	C	B	Mixed woodlands, shade trees in residential areas, orchards; often near streams and wooded swamps	+
Belted kingfisher	C	B	Banks near water bodies; requires perches near water	–/0

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Yellow-bellied sapsucker	C	B	Mixed forests, especially near water and small clearings; woodlots; occasionally orchards	–
Downy woodpecker	C	P	Interiors and edges of open mixed woodlots and forests, orchards, shade trees in cities and suburbs	–
Hairy woodpecker	C	P	Open woodlands with mature living and dead trees, swamps; prefers bottomlands with large trees	–
Three-toed woodpecker	R	P	Coniferous forest, especially with large stands of dead trees; logged areas and swamps with scattered dead trees	–
Black-backed woodpecker	U	P	Coniferous forest, especially where burned or logged and swampy conditions predominate; also large tracts of balsam fir killed by spruce budworm	–
Northern flicker	C	B	Open woods, woodland edges, suburbs, farm woodlots, clear-cuts in dense forests, fields, meadows; requires medium to large dead or dying trees	–/+
Pileated woodpecker	U	P	Extensive second growth and mature forests; often in lowlands near rivers and swamps; woodlots near farms and residential areas	–
Olive-sided flycatcher	U to R	B	Coniferous (spruce) forest near edge and clearings, often along wooded streams and borders of bogs and muskegs, burned over areas with a few dead trees for perching	0/+
Eastern wood-pewee	C	B	Forest interiors and edges, bottomlands, uplands, farm woodlots, roadsides, parks	0/+
Alder flycatcher	C	B	Low, damp thickets bordering bogs, swamps, and marshes; often in alders, willows, sumacs, and viburnums; prefers open areas	+

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Least flycatcher	C	B	Deciduous forest edges, woodlands, burns and clearings, open shrublands, orchards, well-planted residential areas, edges of country roads, overgrown pastures	+
Eastern phoebe	C	B	Woodland cliffs, ravines, agricultural and residential areas, often near streams	0/+
Great crested flycatcher	C	B	Woodland edges, swamps, old orchards, woodland clearings, sometimes along sides of ravines and deep forests; requires cavity trees	–/+
Eastern kingbird	C	B	Frequents orchards, pastures, shrubby borders, forest edges, along fields and highways, near streams with shrubby banks, swamps or marshes with dead stumps and snags	+
Horned lark	C	P	Plowed fields and large open areas with closely cropped grasses, golf courses, athletic fields, cemeteries, airports; prefers areas with minimum of vegetation	0/+
Tree swallow	A	B	Farmlands, river bottomlands, beaver ponds, wooded swamps, marshes with dead standing trees; requires cavity trees	–/+
Bank swallow	U to C	B	Riverbanks, gravel pits, road cuts, hardwood sawdust piles, clay banks; prefers areas with grassland or cultivated fields at low elevations and near water	0/+
Cliff swallow	U to R	B	Farmlands, villages, cliffs, bridges, dams, water areas, open forests	0/+
Barn swallow	C	B	Farmlands, rural and suburban areas	0/+
Gray jay	U to R	P	Coniferous forests and nearby deciduous or mixed woodlands, coniferous and mountain swamps	–

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Blue jay	C	P	Woodlands, wooded islands, farms, cities, suburbs, parks, gardens	0
American crow	C	P	Interiors and edges of open forests and woodlots	0
Common raven	C	P	Remote mountain forests; prefers open woodlands, clearings; avoids extensive, dense forests; requires cliffs or tall trees	0/+
Black-capped chickadee	C	P	Woodlands, frequents both heavily forested and residential areas	–/0
Boreal chickadee	C	P	Coniferous woods, swamps, bogs; requires decaying trees	–
Red-breasted nuthatch	C	P/B	Coniferous forests, sometimes mixed woodlands; requires cavities in trees	–
White-breasted nuthatch	C	P	Mixed or deciduous woodlands with large trees, villages; requires cavities in trees	–
Brown creeper	U to C	B	Dense woodlands, swamps; requires standing dead trees with loose bark	–
House wren	U	B	Near human dwellings with adequate woody vegetation, woodland edges, farmlands, open forests and clearings, suburban gardens, orchards, swampy woodlands; requires cavities in trees	–/+
Winter wren	C	B	Usually in or near dense undergrowth of damp coniferous forests, in thickets near woodland streams, banks of marshy ditches, piles of slash, boreal bogs	0/+
Sedge wren	R	B	Sedge meadows, shallow sedge marshes with scattered shrubs and little or no standing water	0
Marsh wren	C	B	Large marshes with abundant tall herbaceous vegetation, shores of sluggish rivers, inland ponds	0

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Golden-crowned kinglet	U to C	B	Mostly dense coniferous (spruce) forests; also pine, fir, hemlock and tamarack woods, and cedar bogs	–
Ruby-crowned kinglet	U to C	B	Coniferous forests in pure or mixed stands of spruce, fir, tamarack, or pine; forest edges; open stands; bogs	–/0
Eastern bluebird	R to U	B	Savannahs, open woods, swamps, farmlands, sparsely inhabited residential areas, roadside fence lines, woodland edges beside fields and meadows, clearings	+
Veery	C	B	Low, moist deciduous woods, bottomland forests, swamps, damp ravines; prefers thickets in early deciduous second-growth and open woods with fairly dense undergrowth of ferns, shrubs, and trees	–
Swainson's thrush	C	B	Spruce-fir forests, especially in low damp areas near water; prefers interiors to edges	–
Hermit thrush	C	B	Lowlands in swamps and damp forests; uplands in dry, brushy clearings in coniferous or mixed forests; also woodland edges and brushy pastures	0/+
American robin	A	P/B	Open woodlands, woodland edges, clearings, fields, orchards, shade trees in residential areas	+
Gray catbird	C	B	Dense thickets of shrubs, briars, vines along woodland borders; lowland tangles near streams, ponds, and swamps; shrubbery around buildings; forest clearings with brushy edges	+
Northern mockingbird	R	P	Woodland edges; pastures with fruit-bearing shrubs, small trees, or groves of large trees	+

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Cedar waxwing	U to C	B	Open woodlands, orchards, shade trees; semiopen country, commonly in agricultural areas and near water; avoids dense forests	–/0
Northern shrike	R	W	Semiopen country with short grasses and scattered trees or shrubs for perches; fences and utility wires also used	+
European starling	A	P	Farms, cities, orchards, gardens, parks; prefers rural areas with pastures, cultivated fields, and hayfields	+
Solitary vireo	C	B	Coniferous or mixed woodlands, especially those with openings in canopy and a dense understory; prefers mountain elevations	–
Yellow-throated vireo	R	B	Tall deciduous trees in woodlands with partially opened canopy, seldom in dense or coniferous forests; frequents roadsides, stream borders, orchards, woodland borders, swampy woods	–/0
Warbling vireo	U to C	B	Open mixed or deciduous woodlands, roadsides, village shade trees, bottomlands with mature trees, orchards	–
Philadelphia vireo	U	B	Forests, woodland edges, clearings, burned-over areas with young deciduous trees, neglected farmlands, large to small trees and tall shrubs interspersed with clearings, thickets along streams	+
Red-eyed vireo	A	B	Open deciduous and second-growth woodlands with thick undergrowth of saplings; frequents residential areas with abundant shade trees	–

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Tennessee warbler	C	B	Associated with openings in deciduous or mixed woodlands with grasses, dense shrubs, and scattered clumps of young deciduous trees; often in boggy areas	+
Nashville warbler	C	B	Moist open deciduous woods; overgrown pastures and fields; swampy areas; woodland edges; clearings with young second-growth vegetation, particularly young trees 10-12 ft tall	+
Northern parula	C	B	Wooded bogs, swamps; prefers conifers in areas where bearded lichen grows	–
Yellow warbler	C	B	Farmlands, orchards, roadsides, along streams and lakes; prefers scattered small trees or dense shrubbery	+
Chestnut-sided warbler	C	B	Second-growth woodland edges and abandoned fields, along brushy brooks and hillsides, roadside thickets, woodland clearings and burns	+
Black-throated blue warbler	C	B	In or near mixed and deciduous forests with heavy undergrowth or at edges of woodland clearings; generally in moist places	–/0
Yellow-rumped warbler	C	B	Coniferous woods or young coniferous growth near the edge of woods; sometimes in mixed woods	–/0
Black-throated green warbler	C	B	Deep coniferous woods or swampy woods where spruces are thickly draped with bearded lichen	–
Palm warbler	U	B	Sphagnum bogs and wet muskegs, open barrens, dry spruce forest	–/0
Bay-breasted warbler	R to C	B	Coniferous or mixed forests, especially in young trees along ponds, streams, bogs, forest clearings; prefers coniferous trees 6-10 ft tall	+

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Blackpoll warbler	C	B	Among low coniferous trees at high elevations, swampy groves, stunted spruce and fir; favors small growth	0/+
Black-and-white warbler	C	B	Mature or second-growth deciduous or mixed woodlands	–
American redstart	C	B	Orchards, saplings bordering pastures, second-growth deciduous woodlands, shade trees and shrubbery about dwellings, thickets bordering ponds and streams	0/+
Ovenbird	C	B	Usually in closed-canopy, mature deciduous or mixed woods; often among pines; prefers open forests with little underbrush and an abundance of fallen leaves, logs, and rocks	–
Northern waterthrush	U to C	B	Wooded swamps and bogs, less frequently along woodland brooks or streams and swampy wooded shores of ponds or lakes	+
Mourning warbler	U to C	B	Dense underbrush on the margins of a lowland swamp or bog; brushy hillsides; forest clearings grown up to brambles, shrubs, and saplings	+
Common yellowthroat	C	B	Wet brushy meadows and pastures, open swampy thickets on the margins of damp woods and woodland streams or ponds, in cattail beds of marshes, and dense tangles near water	+
Wilson's warbler	U	B	Swampy, brushy land such as tamarack bogs or swampy runs, willow and alder swales	+
Canada warbler	C	B	Various habitats from lowlands to uplands; prefers shrubby undergrowth in cool, moist, mature woodlands, streamside thickets, cedar bogs, weedy ravines; less often in dry forest edges with young trees	–/0

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Scarlet tanager	C	B	Mature deciduous and mixed woodlands, roadside shade trees	–
Rose-breasted grosbeak	C	B	Edges of moist, deciduous second-growth woods; wooded borders of swamps and streams; thickets; suburban trees; old orchards	+
Indigo bunting	C	B	Edges of woods, old burns, open brushy fields, roadside thickets, brushy ravines	+
Rufous-sided towhee	C	B	Woodland edges and dry open interiors and clearings, hedgerows, roadside thickets, brushy hillsides, pastures	+
Chipping sparrow	C	B	Suburban areas, farms, orchards, open mixed woodlands, forest clearings, woodland edges, borders of lakes and streams	+
Vesper sparrow	U	B	Short-grass meadows, pastures, hayfields, cultivated grain fields, dry open uplands, burned and cut-over areas in forests, country roadsides	+
Savannah sparrow	U to C	B	Grassy swales, hayfields, meadows	+
Song sparrow	A	B	Brushy fields, swamps, forest edges, roadsides, hedgerows, farms, suburbs, cities, shores of ponds and streams	+
Swamp sparrow	U to C	B	Marshes; swamps; bogs; sloughs with shrubs, rank grasses, sedges, or reeds; low swampy shores of lakes and streambanks	0/+
White-throated sparrow	C	B	Forest edges, brushy clearings, open stunted tree growth, bog borders, cut-over and open second-growth woodlands	+
Dark-eyed junco	U to C	P/B	Coniferous and mixed forests, forest edges, stream borders, woodland clearings, sides of logging roads	+

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Lapland longspur	U	W	Cultivated fields, open weedy meadows, sunny waste places with sparse vegetation	0/+
Snow bunting	U to C	W	Lakeshores, cultivated fields, windswept grasslands	0
Bobolink	U to C	B	Hayfields, meadows, marshes, fallow fields	0/+
Red-winged blackbird	A	B	Marshes, swamps, wet meadows, ponds, dry fields; prefers wetlands with extensive growth of cattails, bulrushes, sedges, and reeds	0/+
Eastern meadowlark	U	P/B	Open farmlands (especially pastures, hayfields, and grassy meadows); may use areas with widely scattered shrubs and may favor moist lowland	0/+
Rusty blackbird	U to C	B	Swamps, tree-bordered marshes, beaver ponds, muskegs, bogs, and stream borders with alder and willow thickets; rarely in fields	0/+
Common grackle	A	B	Farmlands, suburbs, marshes, swamps, meadows	0/+
Brown-headed cowbird	C	B	Open woodlands, forest edges, agricultural lands, suburban areas	+
Northern oriole	C	B	Suburban and roadside shade trees, groves, orchards, parks, deciduous woodland edges, along streams and lakes	–/0
Pine grosbeak	U	W	Spruce-fir forests typically at high elevations, usually at edges of open areas in forests and along forest borders	0/+
Purple finch	C	P/B	Edges of coniferous forest, evergreen plantations, ornamental conifers in residential areas, parks, open mixed woodlands; winters largely in deciduous woodlands	–

TABLE C.3 (Cont.)

Species	Relative Abundance[a]	Status[b]	Habitat	Potential Project Impact[c]
Red crossbill	R	P	Coniferous forests	–
White-winged crossbill	U	P	Coniferous forests	–
Common redpoll	U	W	Near alders and birches, snow-covered weedy fields	0/+
Hoary redpoll	R	W	Old fields, pastures, birch or alder swamps	+
Pine siskin	R to A	P	Coniferous forests, alder thickets, weed patches adjacent to forests	0/+
American goldfinch	C	P/B	Open weedy fields, pastures with scattered trees near villages and farms, forest edges, open swamps	+
Evening grosbeak	C	P	Coniferous forests (breeding), coniferous and deciduous woodlands (winter)	–
House sparrow	A	P	Urban and suburban areas, farms, parks; avoids heavily forest areas	+

[a] A = abundant; C = common; R = rare; U = uncommon.

[b] B = resident during breeding season; P = permanent resident; P/B = project area near transition between permanent and breeding resident range; W = resident during winter.

[c] Qualitative assessment based on conversion of existing habitats (primarily forested uplands and wetlands) to right-of-way habitats (primarily small tree, scrub shrub, and old-field habitats) and edge habitat:

+ = an overall increase in preferred habitat

0 = no major change in preferred habitat

– = an overall decrease in preferred habitat

A slash (e.g., 0/+) indicates that the impact is slight, except –/+ indicates one habitat requirement (e.g., feeding habitat) would notably increase while another (e.g., breeding habitat) would notably decrease.

Source: DeGraaf and Rudis (1986) (relative abundance, status, and habitat descriptions).

TABLE C.4 Status of Threatened and Endangered Plant and Animal Species that Could Occur in the Project Area

Species	Status[a] Federal	Status[a] State
Plants		
Calypso (*Calypso bulbosa*)	NL	WL
New England violet (*Viola novae-angliae*)	C3C	C
Orono sedge (*Carex oronensis*)	C2	C
Purple pyrola (*Pyrola asarifolia*)	NL	WL
Showy lady's slipper (*Cypripedium reginae*)	NL	C
Small yellow water-crowfoot (*Ranunculus gmelinii*)	NL	T
Swamp birch (*Betula pumila*)	NL	WL
Variegated scouring rush (*Equisetum variegatum*)	NL	C
White adder's mouth (*Malaxis brachypoda*)	NL	T
Invertebrates		
Brook floater mussel (*Alasmidonta varicosa*)	C2	NL
"Tomah" mayfly (*Siphlonisca aerodromia*)	C2	NL
Dorcas copper butterfly (*Lycaena dorcas claytoni*)	C2	NL
Fish		
Atlantic salmon (*Salmo salar*)	C2[b]	NL
Birds		
Bald eagle (*Haliaeetus leucocephalus*)	E	E
Northern goshawk (*Accipiter gentillis*)	C2	NL
Mammals		
Long-tailed shrew (*Sorex dispar*)	NL	WL
Lynx (*Lynx canadensis*)	C2	I
Northern bog lemming (*Synaptomys borealis*)	C2	T
Southern bog lemming (*Synaptomys cooperi*)	NL	I
Southern flying squirrel (*Glaucomys volans*)	NL	I
Yellow-nosed rock vole (*Microtus chrotorrhinus*)	NL	I
Big brown bat (*Eptesicus fuscus*)	NL	I
Hoary bat (*Lasiurus cinereus*)	NL	I
Keen's myotis (*Myotis keenii*)	NL	I
Little brown myotis (*Myotis lucifugus*)	NL	I
Red bat (*Lasiurus borealis*)	NL	I
Silver-haired bat (*Lasionycteris noctivagens*)	NL	I
Small-footed myotis (*Myotis leibii*)	C2	I

TABLE C.4 (Cont.)

Species	Status[a] Federal	State
Amphibians and Reptiles		
Tremblay's salamander (*Ambystoma tremlayi*)	NL	I
Northern black racer (*Coluber constrictor*)	NL	E
Northern brown snake (*Storeria dekayi*)	NL	I
Ribbon snake (*Thamnophis sauritus*)	NL	C
Wood turtle (*Clemmys insculpta*)	NL	I

[a] C = Special Concern, C2 = federal candidate for listing; C3C = withdrawn from consideration as a candidate species; E = endangered, Maine Natural Heritage Program (MNHP); I = indeterminate Maine Department of Inland Fisheries and Wildlife (MDIFW) (state listed species for which more data are needed to assess their status); NL = not listed; R = rare MDIFW (not a legal designation); T = threatened; WL = Watch List MNHP and MDIFW.

[b] This species is currently the subject of a petition to list it as endangered with critical habitat.

Sources: Maine Department of Inland Fisheries and Wildlife (1988) (animals); Beckett (1991, 1993, 1994) (plants and animals); Maine Natural Heritage Program (1991) (plants); ER (1991) (plants and animals); BHE (1991b) (plants and animals).

C.2 BIOLOGICAL ASSESSMENT FOR THE BALD EAGLE

This section discusses the presence of and assesses potential project-related impacts to the bald eagle (*Haliaeetus leucocephalus*) in the vicinities of the proposed route and the alternative route for the proposed transmission line.

C.2.1 Project Purpose and Description

The New Brunswick Power Commission of Canada proposes to sell to the New England Power Pool (NEPOOL) 600 megawatts (MW) of firm capacity from existing and new coal-fired electric generation facilities under construction in Canada. However, without the construction of a new transmission line, only 300 MW of this capacity could be imported over an existing 345-kilovolt (kV) tie line between New Brunswick and the NEPOOL system. Therefore, the Bangor Hydro-Electric Company (BHE) proposes to construct a second 345-kV alternating current (AC) transmission tie line interconnection to Canada. The project would also require modifications within the Orrington substation to accommodate the new line, and modifications to two other substations for system reliability throughout the NEPOOL system.

Two routes are being evaluated for the transmission line: (1) the proposed (Stud Mill Road) route, and (2) the alternative (existing-line) route. The proposed route would cross the St. Croix River at a point in the Woodland Flowage about 4 mi north of the Woodland Dam (ER 1991) (Figure C.1). At this point, the flowage is about 550 ft wide. The proposed route is referred to as the Stud Mill Road route because much of the line would be located near the Stud Mill Road. The first 71.6 mi of the proposed line (starting at the crossing of the St. Croix River near Baileyville, Maine) would be a new 170-ft-wide right-of-way. The remaining 12.2 mi of the proposed route would share right-of-way with the existing 345-kV interconnection and other smaller voltage lines (Section 2.1.3).

The 106-mi-alternative route would generally parallel the existing 345-kV transmission line, which crosses Monument Brook at the international border at Orient, Maine. However, because of the presence of sensitive environmental areas, the alternative route would diverge from the existing-line right-of-way at several locations, resulting in about 34 mi of new right-of-way. The alternative route would cross the Penobscot River at two locations: (1) below the Mattaseunk Dam near the Aroostook-Penobscot county border, and (2) above Mohawk Island between the towns of Lincoln and West Einfield.

The two routes are shown in Figure 2.1; a more detailed depiction of the proposed route is provided in Figure 1.1. Details on project purpose and description are provided in Sections 1 and 2 of this EIS.

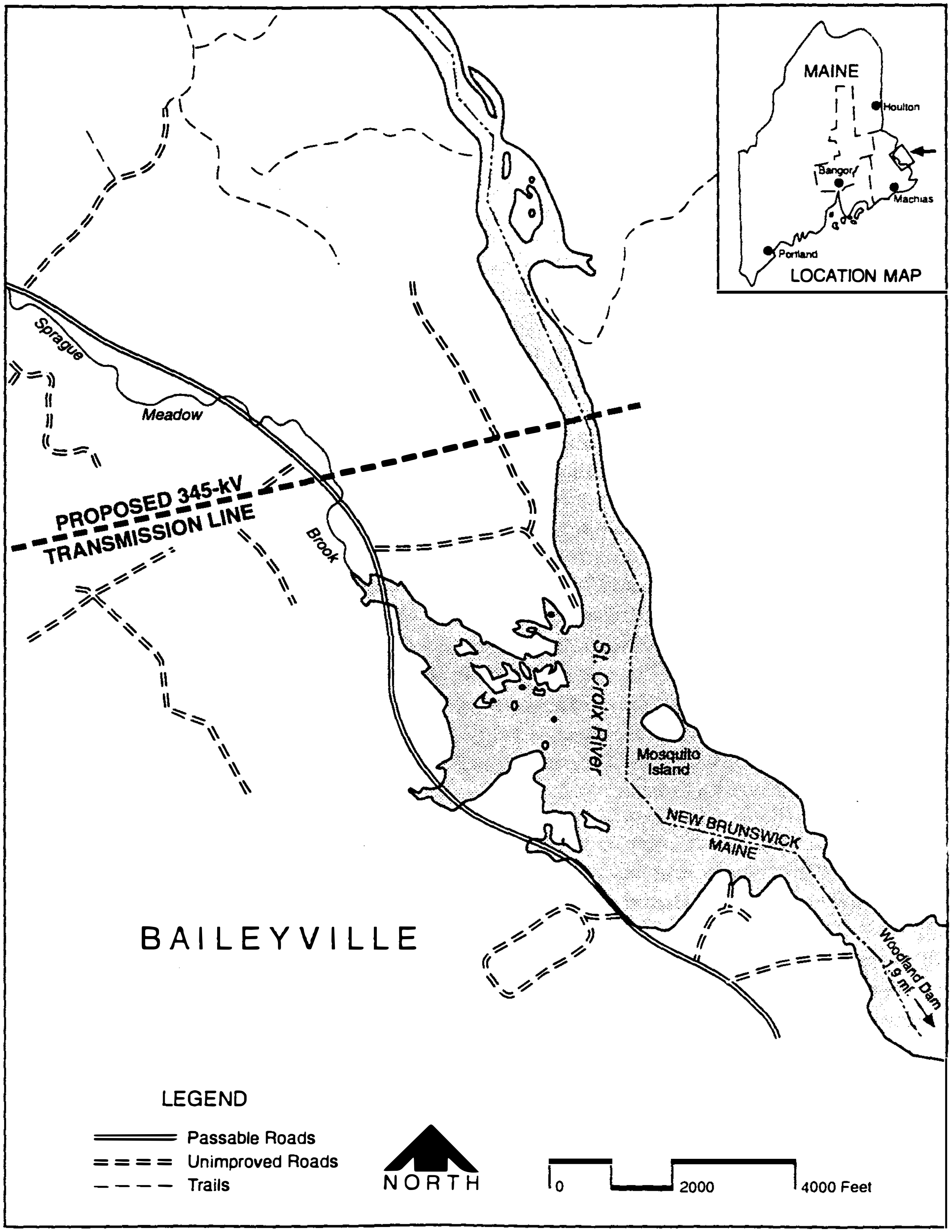

FIGURE C.1 Proposed Transmission Line Route Crossing of the St. Croix River (Source: Adapted from Northrop, Devine & Tarbell 1991)

C.2.2 Background and Status of the Bald Eagle in the Project Study Area

The bald eagle, which is endangered in Maine, occurs in the vicinities of both the proposed and alternative transmission line routes. This raptor inhabits much of North America from the Arctic to the Gulf of Mexico. Populations of this once-common species declined beginning in the mid-1800s because of such factors as habitat loss and fragmentation, hunting, and (after World War II) contamination of prey with pesticides (Hlohowskyj and Dunn 1992).

Bald eagle nests are usually located within 0.5 mi of water and in one of the tallest trees in a forest stand. They also use perch and roost trees, which are also typically the tallest trees in a forest stand. The perch trees are usually located within 165 ft of water (Stalmaster 1987). Isolation from human disturbance may be an additional habitat need (DeGraaf and Rudis 1986). Bald eagles do not normally build a nest closer than 0.6 mi to another occupied nest, and an eagle's normal territory size is about 0.4-0.8 mi^2 (Stalmaster 1987). Bald eagles feed on fish, waterfowl, and mammals. During winter, eagles tend to congregate below dams, because waters in these areas often remain ice free, thus providing the eagles access to fish throughout the winter (Stalmaster 1987).

C.2.2.1 Proposed Route

Two bald eagle nesting territories are located in the vicinity of Grand Falls Flowage; both territories are more than 5 mi north of the crossing site for the proposed transmission line route. Another nesting territory may be located several miles downstream from the Woodland Dam (Northrop, Devine & Tarbell 1991). The closest known nests to the proposed route are on the Pocomoonshine Lake and along the Penobscot River, both about 1 mi from the right-of-way (ER 1991). The closest known bald eagle nest to the proposed St. Croix River crossing is several miles north (Northrop, Devine & Tarbell 1991). The 1993 nesting and production surveys for Maine's bald eagle population did not result in the discovery of any new nests along or adjacent to the proposed transmission line route (Todd 1993). However, breeding and juvenile eagles occur along the entire length of the St. Croix River (ER 1991; Northrop, Devine & Tarbell 1991). Juvenile eagles often congregate in spring and early summer following runs of alewives and blueback herring up coastal rivers (ER 1991). Bald eagles are frequently found near dams, which tend to localize concentrations of fish and significantly improve fishing opportunities for the eagles (Stalmaster 1987). The habitat requirements of bald eagles are met in many places along the proposed route, and it is likely that eagles forage elsewhere in the vicinity of the proposed route.

C.2.2.2 Alternative Route

The closest known nest to the alternative route is 1 mi from the right-of-way near the town of Chester (ER 1991). The closest nest to the right-of-way along the Penobscot River is on the southern side of Lawrence Island above the Mattaseunk Dam, about 2.5 mi west of the existing line (ER 1991). Eagles are known to nest and forage along the Penobscot River; however, eagles have not been observed during recent surveys near the points at which the transmission line would cross the river (ER 1991; Northrop, Devine & Tarbell 1991). Given the number of rivers, streams, and lakes along the alternative route, it is conceivable that eagles nest and forage elsewhere along the line.

C.2.3 Impacts

C.2.3.1 Proposed Route

The potential impacts of transmission lines on bald eagles include (1) disturbance of important habitat, such as nest sites; and (2) mortality from collisions with the lines and towers (Kroodsma 1978). If human activity is particularly disruptive, adult eagles may abandon their nests (Stalmaster 1987). Collision with utility lines is generally a random, infrequent, and inconsequential mortality factor for raptor populations (Olendorff and Lehman 1986). However, loss of individuals of a rare species could be of significant concern.

Most bald eagles use old forests for nesting and other activities (Stalmaster 1987). The proposed route primarily crosses commercial forest lands that are cut on about a 40-year cycle (Section 4.1.3.1). Transmission line construction activities could disturb bald eagles, but such impacts are expected to be minimal (localized and temporary). Grubb and King (1991) assessed the effects of human disturbance on breeding bald eagles and reported the following median distances that evoked response from human disturbance: 980 ft resulted in an "awareness" or alert response, 490 ft resulted in a short-distance flight, and 330 ft caused departure from the immediate area of human activity. Grubb and King (1991) suggested that vehicles be excluded within at least 1,500 ft and restricted within 2,800 ft of breeding eagles. Because the nearest known bald eagle nests are about 1 mi from the proposed route, no construction-related disturbance effects are expected. Several of the types of pedestrian activities shown to affect eagle behavior (e.g., hunting and fishing) (Grubb and King 1991) are typical activities that occur in the project vicinity. Development of the proposed route would increase human access within the project area for these recreational activities but would not increase access to areas where eagles are known to nest or to areas along the St. Croix River where eagles feed.

Eagles would not be electrocuted by the transmission line because the distance between the conductors and between the conductors and shield wires would be greater than the wingspread of the bald eagle.

Although collisions with transmission line wires are a potential risk to eagles and other birds, raptors are generally able to avoid such obstacles because of their (1) keen eyesight, (2) ability to soar or use relatively slow, flapping flight, (3) good maneuverability while in flight, (4) conditioning to the presence of obstacles, and (5) tendency not to fly in groups. However, when raptors are preoccupied or distracted (e.g., when defending territory or pursuing prey), the potential for line strikes increases. Bad weather can also limit the visibility of wires to raptors (Olendorff and Lehman 1986).

Young eagles along the St. Croix River have been observed to exhibit "clustering" behavior. The effect that this flight behavior could have on the potential for collisions with the proposed transmission line is of concern to the Maine Department of Inland Fish and Wildlife (Northrop, Devine & Tarbell 1991). Eagles within a cluster may be more susceptible to collisions because of distractions from other eagles or by pursuing prey. To address this concern, consultants to BHE undertook a study to determine (1) if bald eagles cluster in the vicinity of the proposed crossing; (2) if bald eagles exhibit inattentive flight behavior that could increase the likelihood for collisions; and (3) if clustering occurs, whether such clustering is at a greater frequency at any given height above the river (Northrop, Devine & Tarbell 1991). At and near the St. Croix crossing point of the proposal line, 129 eagle sightings were reported during 192 observer-hours in 1990 and 31 sightings were reported during 88 observer-hours in 1991 (Northrop, Devine & Tarbell 1991). At the proposed crossing point, 55 and 10 eagle sightings were made in 1990 and 1991, respectively. Flight height averaged 78 ft in 1990 and 96 ft in 1991. Eagle clustering was observed at Grand Falls Dam and at areas along the St. Croix River where currents are fast; however, clustering was not observed in the vicinity of the proposed crossing (Northrop, Devine & Tarbell 1991).

The lack of clustering at the proposed crossing site suggests that the potential would be low for eagle collisions with the transmission line wires because of inattentive behavior. However, 19 of 34 (56%) of eagle flights across the centerline of the proposed transmission line route during 1990 were at elevations within which the conductors and shield wires would occur (Northrop, Devine & Tarbell 1991). The shield wires are often implicated in bird losses along high-voltage transmission lines because birds will fly over the more visible conductor bundles but collide with the less visible shield wires (Thompson 1978). Faanes (1987) reported that 102 of 109 bird deaths from transmission line collisions were due to the overhead shield wires rather than the conductors.

Under normal conditions of electric load and air temperature, the conductors would be 58 ft above the river, but could sag to 50 ft under extraordinary conditions (ER 1991). At the low point of the sag in the middle of the flowage, the shield wires would be about 40 ft above the conductors (ER 1991), or 98 ft above the river under normal conditions. The range in wire heights (58-98 ft for conductors and shield wires, respectively) would therefore overlap with the average range in bald eagle flight height (78-96 ft). Thus, the possibility exists for bald eagles to collide with the proposed transmission line. Northrop, Devine & Tarbell (1991) noted the results of other studies in which eagles have been observed to increase their flight height over conductors and shield wires and concluded that bald eagles have sufficiently keen vision to avoid wires marked with colored aviation spheres.

C.2.3.2 Alternative Route

Because the closest known bald eagle nests are 1 mi or more from the alternative route, it is unlikely that eagles would be adversely affected by construction and maintenance of the right-of-way, although the noise of heavy machinery might be temporarily disruptive. Because design specifications for the transmission line would be similar for both the proposed and alternative routes, no potential would exist for bald eagles to be electrocuted.

Collisions by bald eagles with conductors or shield wires is possible at river crossings, particularly those across the Penobscot River. Results from a study along the St. Croix River (which would be crossed by the proposed route) suggest that such collisions are unlikely (Northrop, Devine & Tarbell 1991; see also previous discussion in Section C.3.1). In other parts of northern New England, collision of raptors with power line conductors has been indicated to be a minor source of mortality and has not adversely affected population levels (Denoncour and Olson 1984). Faanes (1987) concluded that none of the mortality observed at any particular site was considered biologically significant. However, the cumulative effect of mortality from collisions with power lines may be important, particularly for rare or endangered species (Faanes 1987). Thus, the addition of two more transmission line crossings over the Penobscot River for the alternative route would (in theory) be more detrimental for eagles that use the Penobscot River than would one crossing of the St. Croix River by the proposed route for eagles that use that river.

C.2.4 Mitigation

Mitigative measures for the project are detailed in Section 4.4. These measures would provide a high degree of effectiveness in minimizing the potential for adverse environmental effects associated with the construction, operation, and maintenance of the tie line and associated right-of-way. General mitigative measures that BHE has agreed to perform that would indirectly minimize the potential effects to bald eagles include the following:

- An environmental supervisor will be present during construction within significant and unique natural areas to ensure that impacts are held to a minimum,

- No herbicides will be used within surface water buffer zones.

A specific mitigative measures that BHE has agreed to perform that would directly minimize the potential effects on bald eagles is to place colored spheres on the shield wires over the St. Croix River to make the wires more visible to bald eagles in flight. Marking transmission lines in this manner has been shown to significantly reduce bird collisions with power lines (e.g., sandhill cranes) and is also the most cost-effective and logistically feasible method to reduce collisions (Morkill and Anderson 1991). If the alternative route were used, similar measures would be taken at both crossings of the Penobscot River. The applicant has installed marker balls on one of its transmission lines that crosses the Penobscot River near the Veazie Dam and has not observed any eagle collisions with the wires (Northrop, Devine & Tarbell 1991). The DOE staff recommends that the following mitigative measures also be incorporated into BHE's mitigative program for the proposed project as means to minimize potential effects on bald eagles:

- The applicant should continue periodic contact with the U.S. Fish and Wildlife Service and the Maine Department of Inland Fisheries and Wildlife concerning new locations for eagle nesting that may have been identified. Then steps should be taken by BHE to ensure that vegetation management and line maintenance activities did not physically damage nests or harass eagles.

- The work force should be instructed through meetings or distribution of pamphlets on possible harassment and other adverse effects that could occur to bald eagles from construction or maintenance activities.

- Engine-powered construction equipment should be equipped with exhaust mufflers in proper working condition in order to minimize the potential for noise harassment to bald eagles.

- If practical, BHE should place spiral vibration dampers on the shield wires (at least along the mid-span region of the river crossing). These devices would increase the visibility of the wires, while also controlling wire vibration and reducing line wear (Faanes 1987).

- In the event that a bald eagle collides with a conductor, shield wire, or support structure, the applicant should assume the financial cost of veterinary treatment and rehabilitation (including either euthanasia or life-time care if the injury sustained is permanent).

- If injury or death occurs to a bald eagle due to a collision with the transmission line, the applicant should meet with the U.S. Fish and Wildlife Service and the Endangered Species Office of the Maine Department of Inland Fisheries and Wildlife to determine if any remedial actions could be implemented to prevent additional line strikes.

- In the event that a bald eagle death is caused by the line, the applicant should assume the financial costs of (1) retrieving the bird and (2) conducting the required and standard necropsy and contaminants analyses (not to exceed $1,000 per bird). (Agreement to assume financial responsibility for dead or injured eagles would not provide the applicant with immunity from potential prosecution under the Endangered Species Act of 1973, as amended, or the Bald Eagle Act of 1940.)

C.2.5 Statement of Findings

The proposed transmission line has been designed so as to minimize the likelihood of eagle collisions (e.g., by keeping conductor and shield wire heights as low as possible and by using colored aviation balls on shield wires) (Northrop, Devine & Tarbell 1991). Kroodsma (1978) offered similar suggestions in an assessment of a 354-kV transmission line in Wisconsin. Thus, the potential for adverse effects to the bald eagle has been minimized.

The only other feasible mitigative measure would be to not have shield wires on the line. However, this measure would not be practical because of reduced reliability of the transmission line. Additionally, observations indicate that when there are no shield wires, birds appear to cross a line at lower altitudes nearer the conductor, which could increase the incidence of collisions with conductors (Beaulaurier et al. 1984).

APPENDIX D:

WETLAND AND FLOODPLAIN ASSESSMENT

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D.1 PROJECT PURPOSE AND DESCRIPTION

The New Brunswick Power Commission of Canada proposes to sell to the New England Power Pool (NEPOOL) 600 megawatts (MW) of firm capacity from existing and new coal-fired generation facilities under construction. To obtain all of this capacity, it would be necessary to construct new facilities to transmit this energy. Otherwise, only 300 MW of this additional capacity could be imported over the existing 345-kilovolt (kV) tie line to New Brunswick. The new facilities, as proposed by the Bangor Hydro-Electric Company (BHE) (the applicant), would consist principally of an 83.8-mi-long, 345-kV alternating current (AC) transmission tie line from the U.S.-Canadian border at Baileyville, Maine, to an existing substation at Orrington, Maine (Figure 1.1). This project would also require modifications within the Orrington substation to accommodate the new line and modifications to two other substations for system reliability throughout the NEPOOL system. Specifics on project purpose and description are provided in Sections 1 and 2 of this EIS.

D.2 WETLAND AND FLOODPLAIN EFFECTS — PROPOSED ROUTE

D.2.1 Wetlands

D.2.1.1 Wetland Descriptions

The wetlands within the proposed corridor are primarily palustrine[1] and include emergent, open water, scrub/shrub, and forested wetlands. Additionally, riverine[2] wetlands are common where perennial and intermittent streams occur along the route. Lacustrine[3] habitats are not crossed by the route. The locations of the wetland units associated with the proposed and alternative routes are shown in Figures D.1 through D.3.

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[1] Palustrine: area dominated by trees, shrubs, persistent emergents, emergent mosses , or lichens, and/or less than 20 acres; lacks active-wave-formed or bedrock shoreline, and water depth in deepest part of basin is less than 6.6 ft at low water (may be located at edge of lake, river, or river floodplain) (Cowardin et al. 1979).

[2] Riverine: contained within a channel with periodically or continuously moving water (Cowardin et al. 1979).

[3] Lacustrine: deepwater areas situated in a topographic depression or dammed river channel; vegetation areal cover less than 30% and total area more than 20 acres (area less than 20 acres can be lacustrine if portion of boundary is active-wave-formed or bedrock shoreline, or if water is more than 6.6 ft deep in deepest part of basin at low water) (Cowardin et al. 1979).

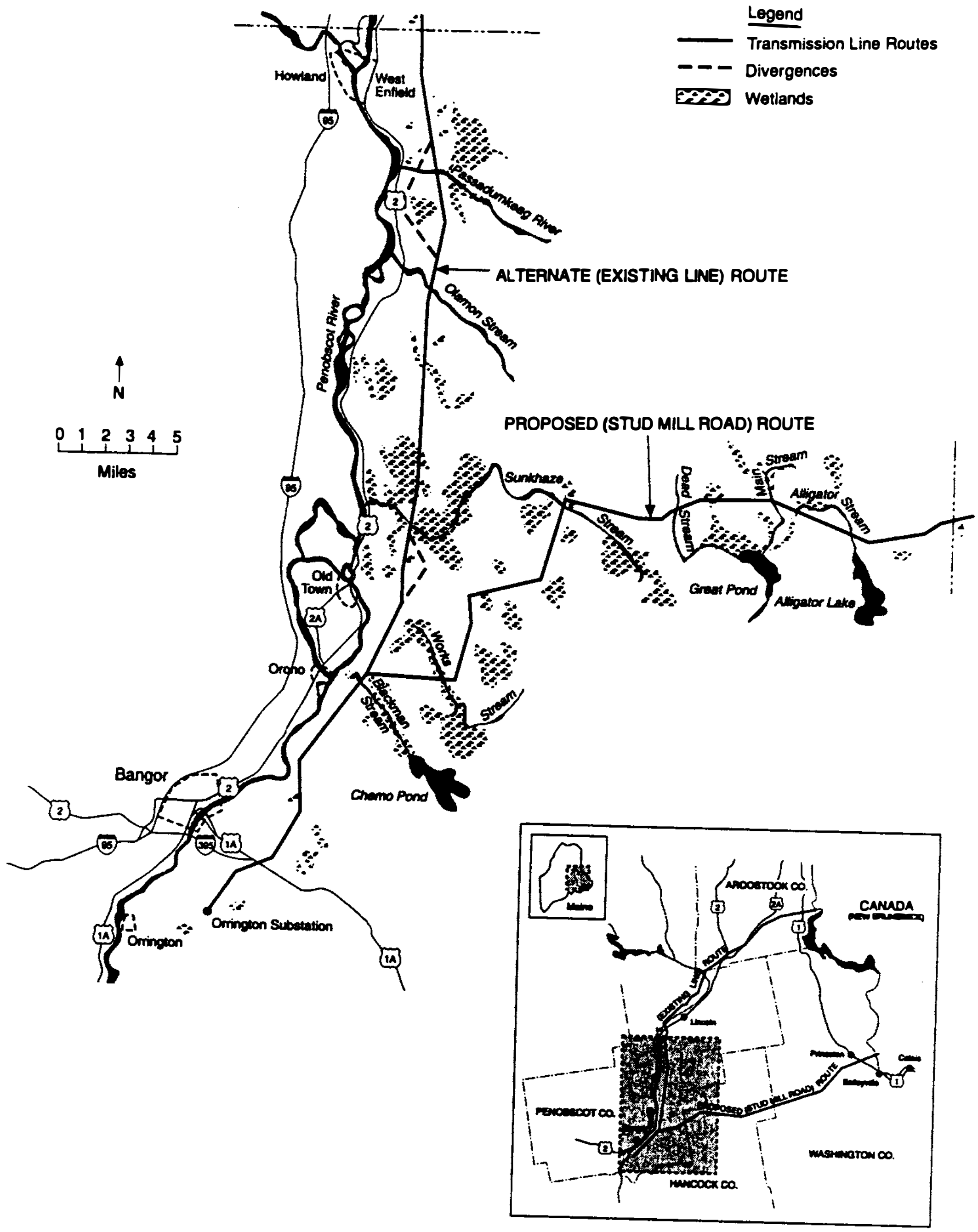

FIGURE D.1 Major Wetland Units Associated with the Western Portions of the Proposed and Alternative Transmission Line Routes (Source: Murphy 1991)

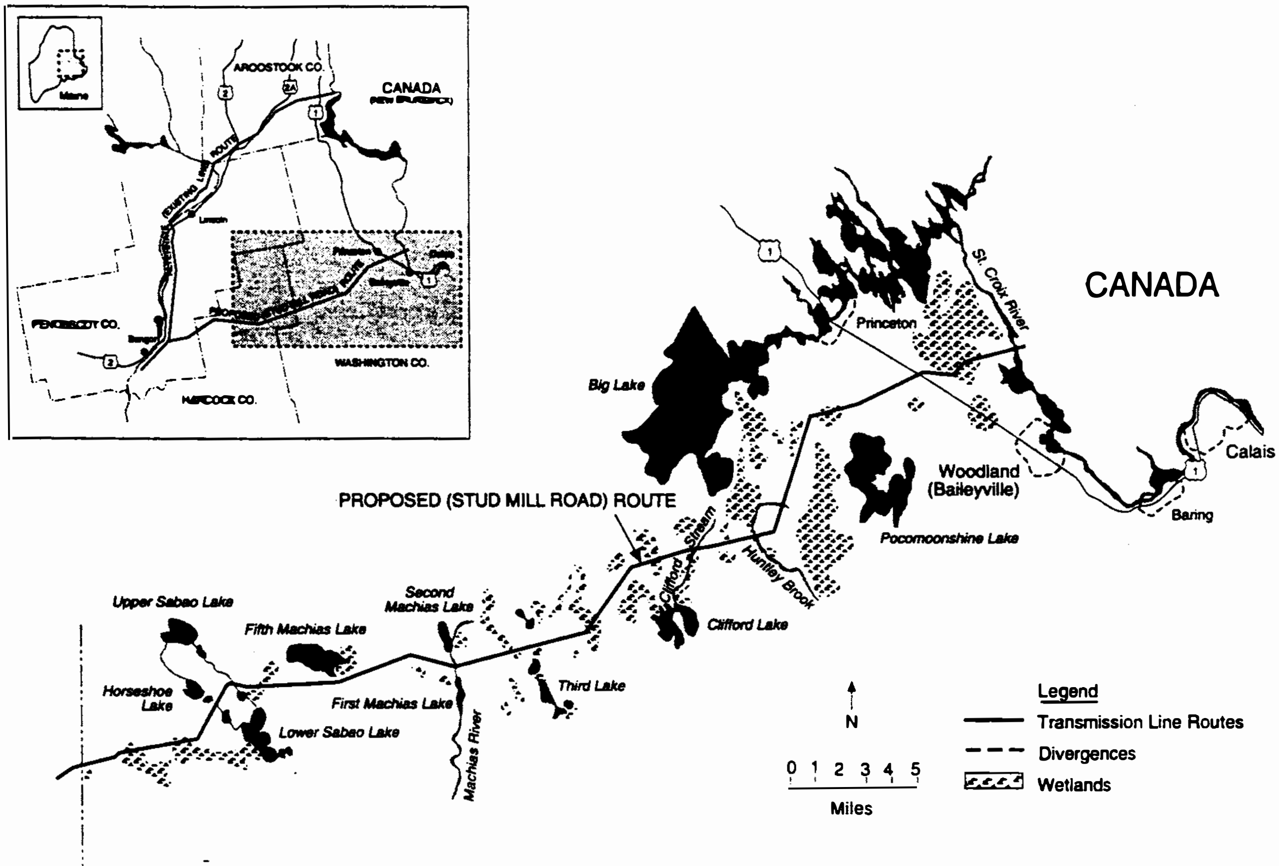

FIGURE D.2 Major Wetland Units Associated with the Eastern Portion of the Proposed Transmission Line Route (Source: Murphy 1991)

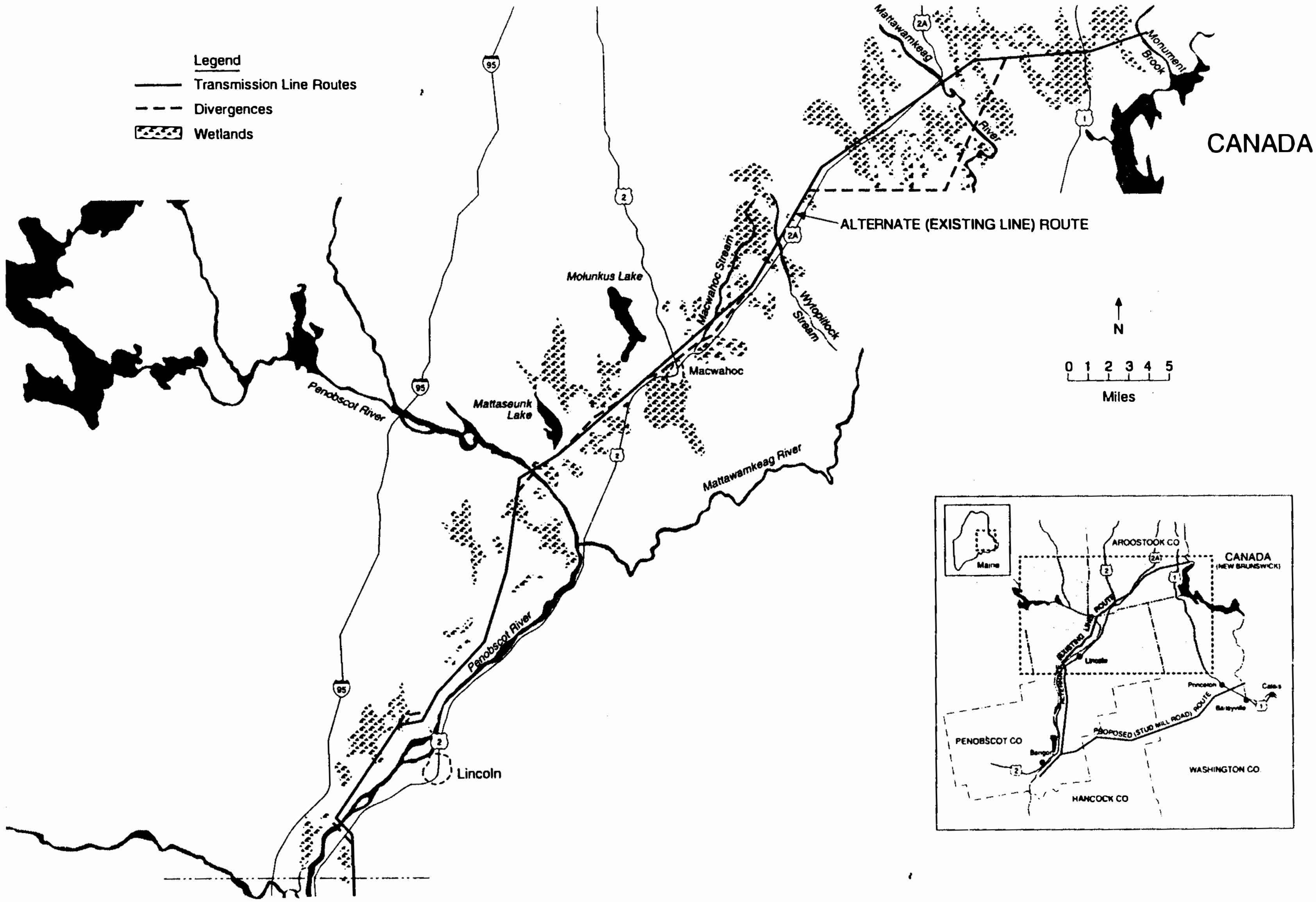

FIGURE D.3 Major Wetland Units Associated with the Eastern Portion of the Alternative Transmission Line Route (Source: Murphy 1991)

In general, palustrine emergent and open-water wetlands (e.g., marshes, wet meadows, and beaver ponds) contain zone gradations of plant species as follows (from shallow to deeper water): (1) emergent plants (e.g., reeds, cattails, bulrushes, sawgrasses, sedges, and arrowheads); (2) floating leafy plants (e.g., lilies, smartweeds, spatterdocks, and some pondweeds); and (3) submerged plants (e.g., waterweeds, some pondweeds, muskgrasses, milfoils, coontails, bladderworts, horworts, and buttercups) (Darnell 1976).

The emergent and open-water wetlands contain a diverse and productive fauna, including a number of aquatic and terrestrial invertebrates, fish, amphibians, and reptiles. These wetlands also provide important habitat for birds and mammals (Darnell 1976; Godin 1977; DeGraaf and Rudis 1986). The proposed route would cross few areas that would be classified solely as emergent wetlands because most of the emergent wetlands in the study area often intergrade with scrub/shrub wetlands.

Scrub/shrub wetlands are dominated by woody vegetation less than 20 ft tall, including true shrubs, young trees, and trees and shrubs that are small or stunted because of environmental conditions (Cowardin et al. 1979). Dominant woody species include alder, willow, blueberry, sumac, winterberry, steeplebush, mountain holly, viburnum, red osier dogwood, spirea, bog rosemary, bog laurel, leatherleaf, and young trees of such species as red maple and black spruce. Sensitive fern and sedges are among the predominant herbaceous species in scrub/shrub wetlands, with sphagnum moss predominating in peat bogs (Cowardin et al. 1979; ER 1991). The three general types of scrub/shrub wetlands that occur in the study area are inland fresh meadows, scrub/shrub wetlands associated with larger streams, and peatland bogs. The proposed transmission line would cross about 52 acres of scrub/shrub wetlands.

Forested wetlands are dominated by living or dead trees that are at least 20 ft tall. Tree species in the palustrine forested wetlands along the proposed route are primarily conifers (mostly black spruce, northern white cedar, and tamarack, with red spruce and balsam fir common in more acidic sites). Shrub and herbaceous layers are dominated by the species common to the scrub/shrub wetlands. The presence of forested wetlands dominated by dead trees results from construction of man-made impoundments and beaver ponds, fire, pollution, or insect infestation (e.g., spruce budworm outbreaks) (Cowardin et al. 1979). The line would cross about 268 acres of forested wetlands.

The most common woody species encountered within the wetlands along the proposed route include balsam fir, black spruce, red spruce, white pine, white cedar, hemlock, quaking aspen, speckled alder, paper birch, white birch, red maple, and sheep laurel. Commonly encountered herbaceous species include sphagnum moss, cinnamon fern, bracken fern, raspberry, and meadow sweet. Various grass, sedge, rush, blueberry, and aster species are also common, but no single species predominates (BHE 1991a).

Animals encountered in scrub/shrub and forested wetlands are similar to those found in emergent wetlands, but include more diverse bird and mammal assemblages because of increased habitat and food resources provided by understory and canopy vegetation. Waterfowl and shorebirds that occur in the emergent wetlands also frequent swampy wetlands. Waterfowl species observed along the route include black duck, wood duck, ring-necked duck, green-winged teal, hooded merganser, common loon, and double-crested cormorant (Spencer 1989). Also present in forested wetlands are such species as arboreal songbirds, birds of prey, and woodpeckers. Large mammals, such as white-tailed deer and moose, occur in forested wetlands along with many smaller mammals, such as mice, voles, squirrels, shrews, weasels, otters, lemmings, and bats (Godin 1977; DeGraaf and Rudis 1986). The mammals, amphibians, reptiles, and birds that could occur within the wetlands along the proposed route are listed in Tables C.1 through C.3 (Appendix C).

The state of Maine categorizes wetlands into three classes. Class I wetlands (1) are coastal marshes, (2) are located within 250 ft of a great pond (a standing body of water larger than 10 acres), (3) contain threatened or endangered plant species, or (4) contain significant wildlife habitat (e.g., deer yards, bald eagle nests). Class II wetlands are (1) located within 250 ft of a coastal wetland, river, stream, or brook; (2) open marsh-type wetlands; or (3) boggy wetlands. Class III wetlands are wetlands that do not passes any of the requirements of class I or II wetlands (e.g., wet meadows or wooded swamps not contiguous to any water bodies). Only four of the 258 delineated wetlands crossed by the proposed route are class I wetlands. The rest are class 2 (109) and class 3 (145) wetlands.

D.2.1.2 Wetland Impacts

The Orrington substation and four proposed staging areas associated with the proposed route are in upland sites. Therefore, project activities required at these areas would not infringe upon wetlands. Only construction and maintenance of the transmission line are of potential concern relative to wetland impacts. Although wetland areas would be avoided to the extent possible during construction, they could not be completely avoided. Therefore, some adverse impacts, primarily temporary ones, would occur during construction. These impacts would be minor and largely reversible. Long-term impacts would occur to a minimum amount of wetlands from placement of structures and access roads. In total, 263 wetland segments would be affected by the construction of access roads and/or installation of support structures.[4] Forty-five of these segments would have permanent access roads, support structures, or both in them. The remainder would only be temporarily affected by light-duty access roads (BHE 1991a,b).

Installation of the support structures would require both temporary and permanent access roads within wetlands, as summarized in Table D.1. Overall, there would be 6.3 mi (11.7 acres) of temporary access roads in wetlands out of the total of 68.3 mi (101.8 acres) of

[4] Figures depicting these wetlands would add excessive length to the EIS and thus are not included in this document. Anyone wishing to view maps of these wetland segments can consult the Department of the Army, Corps of Engineers Permit Application for the project (BHE 1991a), which has detailed figures showing all intrusions by access roads and support structures that would occur within wetlands. Additionally, the permit provides detailed written descriptions of the wetlands. The information and analyses presented in this EIS are adequate on a stand-alone basis for a wetland assessment.

temporary access roads. Similarly, 0.23 mi (0.56 acre) of permanent access roads would be required within wetlands out of the project total of 4.3 mi (10.4 acres).

Fifty-five (10.5%) of the line-support structures would be located in wetlands, and three of these would be steel lattice structures. On the basis of a work area of 140 by 200 ft for steel lattice structures and 100 by 170 ft for other structures, it is conservatively estimated that about 22.4 acres of wetlands would be subject to temporary impacts from structure construction. However, actual disturbance would be somewhat less because construction work could be done in adjacent uplands in several instances. This situation would be most likely for four of the structures that would have only one of their poles located within wetlands. An additional 48 structures would be located within 100 ft of wetlands.

Wetland habitat would also be affected by clearing of vegetation for line construction and for establishment of conductor safety clearance zones (Table D.1). The potential effects of proposed construction activities could include disruption of drainage patterns, erosion and siltation, habitat destruction, changes in water temperature, increased public access, wildlife displacement, water-level modification, and addition of pollutants. Fluctuations in water level can also be detrimental to vegetation located adjacent to wetlands (Boelter and Clare 1974).

Even short-term alterations in the flooding cycle in wetlands can be expected to have substantial and long-lasting effects on wetland vegetation. Draining has a more immediate and longer lasting effect than short-term flooding. Several years of flooding may be necessary before composition of wetland vegetation is affected (Thibodeau and Nickerson 1985). Thus, use of temporary access roads in wetlands should not pose significant impacts if appropriate actions are undertaken to restore the area.

TABLE D.1 Access Road and Clearing Requirements within Wetlands for the Proposed Route

	Acreage Requirements by Wetland Class			
Category	Class I	Class II	Class III	Total
Permanent fill (access roads)	0.00	0.49	0.07	0.56
Temporary fill (access roads)	0.35	5.67	5.70	11.72
Clearing	12.44	200.28	149.34	362.06
Total	12.79	206.44	155.11	374.34

Source: BHE (1991b); Murphy (1992).

Impacts would be somewhat greater for forested wetlands than for other types of wetlands because the loss of tree canopy in such areas would locally alter plant communities and affect wildlife. Hole-nesting waterfowl, such as wood ducks and hooded mergansers, could be adversely affected by clearing, but impacts are expected to be minimal because of infrequent use of the study area by waterfowl (Spencer 1989). Many resident bird species occupy coniferous forest wetlands during winter. Also, white-tailed deer, which take advantage of the cover provided by coniferous forest wetlands in winter, could be affected by a loss of canopy if the available deer wintering area in the region is being used to near capacity.

Impacts are expected to be less for scrub/shrub wetlands than for forested wetlands because the scrub/shrub vegetation is low and would not have to be cut except within structure construction work areas or within access road locations. Also, many of the scrub/shrub wetlands are located within stream buffers and would be spanned by the line.

Because of their narrow width, riverine wetlands generally would be spanned. Impacts to such wetlands would occur primarily as a result of removal of tall trees, thus increasing the amount of sunlight reaching the wetland area. Removal of mature trees would allow a more vigorous growth of ferns, grasses, and other plants along the banks of the stream, and possibly in the stream as well.

Because the area of wetlands that would be affected by the project would be small, the overall impacts to wetland habitat would not be of sufficient magnitude to affect the viability of any plant or animal species. Additionally, the wetlands that would be affected are not unique or rare in the area. Impacts to wetland habitat would also be minimized because the majority of wetlands would be spanned; thus, construction activities (e.g., structure placement) would be minimized within wetlands.

Construction in several sensitive wetlands and in wetlands with excessively soft or moist soils would be conducted in winter when frozen ground or snow could support equipment without disturbing the soil surface. The only special preparations required for winter construction would be the cutting of any rushes, shrubs, or small trees within the minimum width required for access roads. Access to 15 structures located in six wetlands would require winter construction. The construction contractor could elect to conduct additional wetland construction in winter, which would further minimize the potential for long-term wetland impacts (ER 1991). In one study, construction of a 345-kV transmission line through a cattail marsh in Massachusetts was not found to cause changes to vegetation (Thibodeau and Nickerson 1984). Construction was conducted in winter, and equipment was driven across the frozen wetland without any observed alterations to the substrate. Grigal (1985) observed a low shrub bog to return to preconstruction conditions by the second growing season following winter construction. In contrast, vegetation in a shrub bog wetland had still not fully recovered 10 years after construction that was not undertaken in winter (Nickerson et al. 1989). Thus, relative effects of construction would depend upon the season and type of wetland, as well as upon construction methods and mitigative measures employed.

Some minor adverse impacts to wildlife could result from vegetation clearing and management within and adjacent to wetlands. For example, clearing operations could (1) reduce mast (fallen nuts) used by black duck, wood duck, and green-winged teal; (2) remove some cover for ground-nesting waterfowl; and (3) eliminate mature trees with cavities used for nesting by wood ducks and mergansers. However, some beneficial impacts to wildlife could result from increased shrub cover. Tables C.1 and C.2 (Appendix C) provide an evaluation of project impacts that would result to mammal and bird species that could occur in the project area.

The amount of spoil that would be removed to set support structures is estimated to be 1.6 yd^3 for each pole that does not require select backfill and 6.1 yd^3 per pole that does require select backfill. Spoil would be spread adjacent to the wetland structure sites only when it is determined that significant damage would be done to the wetland by the process of removing the spoil to an upland location (BHE 1991a). With installation of adequate cross drainage, constructing access roads in wetlands should have little impact other than to eliminate biota from the roadbed.

Following construction, impacts to wetlands could result from maintenance of access roads, increased public access, and periodic maintenance of the line or underlying right-of-way vegetation. The applicant has proposed a long-term vegetation management plan to allow the maximum growth of shrubs and young trees, up to a height consistent with safety — generally about 8 ft tall at the centerpoint of a span (point of maximum conductor sag), and taller near the edges of the corridor and toward the support structures. This plan would be implemented in all wetland areas and in buffer zones along wetland edges. Increased vegetative cover would improve water quality, water storage, wildlife habitat, and (where applicable) shading of adjacent streams (Murphy 1992). Therefore, impacts to wildlife in the wetlands are not expected to be significant. No areas along the proposed route have been identified as migratory waterfowl resting or staging areas. However, some waterfowl breeding does occur in the wetlands along the proposed corridor. Therefore, some waterfowl collisions with conductors and shield wires could be expected over the lifetime of the project. However, this would be expected to have little or no effect on waterfowl populations of the area (Spencer 1989). A more thorough discussion of bird collisions with wires is presented in Section 4.1.5.1.

D.2.2 Floodplains

D.2.2.1 Floodplains Descriptions

Floodplain data are available only for the populated area along the valleys of the Penobscot River and its major tributaries (Federal Emergency Management Agency 1978-1988). In Penobscot County, the right-of-way crosses about 22 acres of floodplain. However, only very limited information on floodplains is available for Hancock and

Washington counties, and the amount of floodplain crossed by the right-of-way in these counties cannot be determined from available data.

D.2.2.2 Floodplain Impacts

The potential impact of the proposed transmission line on floodplains is primarily related to the displacement of floodplain volume by transmission line structures, access roads, and the unused excavated material disposed of within the limits of the floodplains. The displacement of floodplain volume could reduce the flood storage capacity of the affected floodplains.

The potential displacement of floodplain volume by transmission line structures is relatively small compared with the potential displacement volume caused by the access roads and unused excavated material. If a flood was 1 ft deep in every area where line structures would be installed (or about 10% of the foundation depth for wooden structures and 5% of the foundation depth for the steel structures), the displacement volume would be less than 7% of the volume displaced by the unused excavated material (or about 2.4% of the total displacement volume by the unused excavated material and the access roads). Therefore, the floodplain displacement by the transmission line structures would be too slight to be considered here, and there would be no impacts to human lives or property.

In Penobscot County, the planned light-duty access roads would extend through 0.8 mi of floodplain. These roads would be 12 ft wide and have up to a 6-in. center crown (ER 1991). The potential displacement of floodplain volume by the light-duty access roads would be about 12,700 ft^3. The planned heavy-duty access roads would cross about 0.35 mi of floodplains in Penobscot County. A 6-in. gravel bed would be added on a 20-ft wide corridor before a 6-in. center crown was placed on a 12-ft wide road. These roads would displace about 24,000 ft^3 of floodplain volume. Therefore, the total potential displacement of floodplain volume by access roads in Penobscot County is estimated to be 36,700 ft^3 (0.84 acre-feet). If the ratio of the occurrence of access roads within floodplains and the length of the right-of-way is the same in Penobscot, Hancock, and Washington counties, then the displaced floodplain volume in the latter two counties would be 102,800 ft^3 (or 2.36 acre-feet).

To make a conservative estimate of floodplain displacement from excavation and installation of transmission line structures, it was assumed that all transmission structures would be located in the floodplain and all unused excavated material would remain in the floodplains. Twenty-two steel lattice structures, 4 steel pole structures, and 537 wood pole structures would be installed in the right-of-way. The steel lattice structures would have four foundations, each 5 ft in diameter and approximately 22 ft deep (ER 1991). The unused material excavated from these foundation holes would total about 38,000 ft^3. If the average diameter of a pole in the wood pole and steel pole structures was 1.75 ft, the average embedded depth was 10.5 ft, and there were on average 2.5 poles in each structure, then the unused excavated material generated would total 34,160 ft^3.

On the basis of these assumptions, the potential displacement of floodplain volume could total 211,700 ft^3 (4.9 acre-feet). Because the floodplains that would be crossed extend to a large area beyond the access roads, the volume displaced would be an insignificant portion of the total floodplain area. In addition, because most of the land traversed by the project in Hancock and Washington counties would continue to be committed for forestland use, the impact of the transmission line on the floodplains in land development would be insignificant.

D.2.3 Mitigation[5]

In addition to avoiding wetlands where possible, the applicant would use proper construction and maintenance procedures to minimize potential impacts (e.g., installation of adequate cross drainage for access roads constructed within wetlands). Numerous mitigative measures would be implemented to further reduce the risk of significant adverse environmental consequences. Mitigative measures committed to by BHE are listed in Section 4.4.1, and additional measures that should be considered are listed in Section 4.4.2.

For the proposed project, all construction and maintenance work in wetlands would be carried out in accordance with conditions of the U.S. Army Corps of Engineers' Section 404 permit, as well as with applicable state and local regulations. Thus, wetland fills that are permitted may be compensated for by the creation of new wetlands, by enhancement of existing wetlands, or by the restoration of wetlands that have been previously degraded or eliminated by drainage or fill. Restoring functions of degraded wetlands is recommended as the primary choice among these three mitigation strategies (Kruczynski 1989). In addition to these mitigative measures, BHE has prepared a mitigation action plan to provide wetland compensation at a ratio well above a "no net loss" or 1:1 ratio. The following paragraphs summarizing the applicant's planned wetland mitigation are based on the detailed description provided in the ER (1991) and Murphy (1992).

Construction of the proposed transmission line would necessitate the permanent fill of slightly more than 0.5 acre (1,208 linear feet) of wetlands spread out among six wetland units. Additionally, about 11.7 acres (33,584 linear feet) of wetlands would receive temporary fill (Table D.1). Total wetland fill for lattice steel structures would be about 128 yd^3 of reinforced concrete; select backfill for wood structures would be about 96 yd^3 (ER 1991). Compensation for these impacts is proposed through the restoration of wetlands that were affected by the construction of the existing 345-kV transmission tie line. During construction of the existing 345-kV line, placement of fill and improper installation of culverts impeded drainage and created small impoundments that flooded and killed trees. Some of those impoundments have created viable wildlife habitat. However, in areas subject to wide variations in water levels, the originally forested wetlands have been degraded. Other impacts along the existing route have resulted in the loss of tree and shrub cover within some

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5 Because impacts to floodplains would be insignificant (Section D.2.2.2), mitigative measures specifically designed to reduce floodplain impacts would not be required.

wetlands. Along streams or at abrupt wetland boundaries, this has caused the loss of protective cover for wildlife movements.

The applicant proposes to restore impacted areas along the existing line to the standards of those wetlands that occur along the proposed route. Two courses of action would be taken. The first would be the repair of waterways through the removal of fill and restoration of natural drainage patterns within selected wetland areas where improper use or installation of culverts has led to the inundation and subsequent degradation of forested wetlands. Restoration would involve the removal of undersized culverts and/or sufficient dredging to allow entering streams to flow without backing up. Equipment would not be placed in the stream channels to remove the culverts. Where waterway crossings would still be required, culverts and fill would be rebuilt with stone-lined fords at the grade of the original stream bottom. Where waterway crossings are no longer required, the impeding roadbed would be removed, and dredged material would be disposed of on upland sites within the existing power line corridor. This material would be graded and seeded to minimize erosion. Erosion and sedimentation control measures (e.g., hay bales and siltation fences) would be installed during restoration activities. Also, swales would be cut into roadways on each side of fords to divert runoff into vegetative buffer strips rather than into waterways. Stabilization methods (e.g., vegetative streambank stabilization, seeding and mulching, and installation of sedimentation barriers) would be used in conjunction with stone-lined ford installation (Murphy 1992).

Eight areas totalling 10 acres are proposed for such restoration: (1) north of Hill Street in Eddington (1 acre), (2) Blood Brook in Chester (1 acre), (3) Arbo Brook in Macwahoc (1 acre), (4) near Glenwood Bog in Glenwood (1 acre), and (5) four tributaries of Skagrock Brook in Orient (6 acres combined). Once original drainages and water levels were restored, an emergent/shrub wetland community would become established. This community would be followed by a forested wetland community (over a period of decades). These forested wetlands would not be equivalent to the original forested wetlands but should approximate them in species composition and structure (Murphy 1992).

The second course of action would be to implement a vegetation management plan within selected wetland areas along the existing line. The management plan would be similar to the one proposed for the wetlands along the proposed route. This procedure would allow for the regrowth of buffer zones along streams and larger wetlands (i.e., rectify impacts to wildlife habitat). The boundaries of streamside wetlands would be identified in the field, and a 100-ft buffer zone would be established beyond these wetland edges. Within these buffer zones, natural regrowth of trees and shrubs would be allowed to occur within the limits of the wire security zone. No ground disturbance would occur in wetlands where vegetation management plans would be initiated. Thus, no seeding or erosion-control plans would be required. However, seeding of existing bare soils would be considered. When right-of-way maintenance was required, selective clearing techniques would be used (e.g., hand clearing with chain saws or feller bunchers) to minimize damage to vegetation not requiring clearing. Cleared material would not be allowed to enter waterways. Additionally, no herbicides would be used within the buffer zones. Vegetation management would help to restore wildlife corridors, provide increased structural (vertical) diversity, increase nesting and perch sites for birds (and other wildlife), improve shading of some surface waters, and improve water quality and/or storage (Murphy 1992). This action is proposed for 13 of the larger streams and several of the major wetlands along the existing line. Altogether, a total of 26.5 acres would be involved (Table D.2).

Upon initiation of restoration, the different wetlands would display distinctive recovery rates. Some would recuperate within a year (e.g., cattail marshes), while others, such as bogs and forested wetlands, would take a number of years to recover. Mitigative measures would be monitored for three years at the sites where drainage patterns would be corrected. Monitoring would involve site visits (field inspection and photography) and preparation of progress reports. Baseline monitoring for comparative purposes would be done in late summer (following bird nesting) before the start of restoration. Monitoring would not be done where vegetation would simply be allowed to regrow, because several years would be required before the effect of this mitigative strategy would be evident (Murphy 1992).

D.3 WETLAND AND FLOODPLAIN EFFECTS — ALTERNATIVE ROUTE

D.3.1 Wetlands

D.3.1.1 Wetlands Descriptions

Approximately 830 acres of wetlands occur within the right-of-way of the alternative route. This acreage represents about 40% of the route (Murphy 1991). The major wetland units associated with the alternative route are shown in Figures D.1 and D.3. The wetlands within the alternative route corridor are similar to those described for the proposed route (Section D.2.1). Several of the divergences from the existing right-of-way have been incorporated into the layout of the alternative route to avoid areas of extensive wetlands (e.g., Glenwood Bog and Thousand Acre Bog) to the extent practicable. Without these divergences, the acreage of wetlands occurring within the alternate route right-of-way would be even more extensive.

As with the proposed route, forested wetlands are the predominant wetland type along the alternative route. Because previously forested wetlands under the existing line are maintained in an emergent or scrub/shrub condition, the forested wetlands within the alternative route right-of-way would closely approximate forest edge habitat.

D.3.1.2 Wetland Impacts

The general impacts to wetlands discussed in Section D.2.1 for the proposed route would apply to the alternative route. The primary impacts would occur from modification of

TABLE D.2 Streams and Wetlands for which Alternative Vegetation Management Is Proposed[a]

Area	Township	Approximate Acreage[b]
Great Works Stream	Bradley	1
Otter Chain Ponds (2 areas)	Milford	2
Sunkhaze Stream	Milford	5
Olamon	Greenbush	1
Passadumkeag Stream/ Thousand Acre Bog	Passadumkeag	10
Mattamiscontis Stream[c]	Mattamiscontis	1
Mattaseunk Stream	Mattawamkeag	1
Molunkus Stream/ Little Molunkus Stream	Macwahoc	2
Macwahoc Stream	Macwahoc	1
Wytopitlock Stream	Reed	1
Mattawamkeag River	Haynesville	1
Monument Brook	Orient	0.5
Total		26.5

[a] Trees and shrubs that would not compromise the integrity of the transmission line would be allowed to develop within the wetlands.

[b] Values are estimates based on a buffer zone width of 100 ft on each side of the stream/wetland. At Sunkhaze Stream and Passadumkeag River, the wetlands are of such extent that acreages are greater.

[c] Banks along Mattamiscontis Stream are very steep; in addition, gravel is being extracted in the area. Allowing greater vegetative cover will lessen the potential of erosion into that stream.

Source: Modified from ER (1991).

wetlands (particularly forested wetlands), from clearing operations, and from temporary to long-term elimination of wetland acreage by the construction of access roads and line-support structures. Approximately 42.4 mi (40%) of the 106-mi alternative route right-of-way would traverse wetlands. On the basis of required widths (100 ft for the 12.2 mi between Bradley and the Orrington substation and 170 ft for the remaining 93.8 mi of the line), about 830 acres of right-of-way for the alternative route would be located within wetlands. This acreage could be considered the maximum area of wetland vegetation clearing that would be expected.

Detailed engineering designs for the alternative route have not been developed. Although preliminary routing considerations have accounted for corridor divergences to avoid extensive wetland areas, only a conservative assessment can be made of the extent of wetland impact that could result from the construction of the alternative route. An exception to this is for the 12.2-mi stretch between Bradley and the Orrington substation that would be identical for both the proposed and alternative routes. Detailed information on structure placements and access roads is available for this area.

The 12.2-mi segment leading to the Orrington substation would require 1.5 mi (3.1 acres) of temporary and 400 ft (0.2 acre) of permanent access roads in wetlands. These values are small percentages of the 14.6 total miles of access roads (14.1 mi temporary and 0.5 mi permanent) that would be required within this segment (ER 1991). Within the remaining 93.8 mi of the alternative route, about 94.2 mi of temporary access roads and 8.2 mi of permanent access roads would be needed. If 40% of the alternative route traversed wetlands (Murphy 1991), an additional 37.7 mi of temporary access roads and 3.3 mi of permanent access roads could be in wetlands. If the average road width were 16 ft for temporary access roads and 20 ft for permanent access roads, an additional 73.6 acres of temporary access roads and 8.1 acres of permanent access roads could be within wetlands. Therefore, a maximum of 76.7 acres of temporary access roads and 8.3 acres of permanent access roads for the alternative route could be in wetlands. For the proposed route, only 11.7 acres of temporary and 0.23 acre of permanent access roads would be in wetlands.

Wetlands along the alternative route also could be affected by construction of line-support structures. Within the 12.2-mi segment between Bradley and the Orrington substation, 18 of the 96 structures required would be located within wetlands. Construction disturbance (on the basis of the size of structure laydown areas) within wetlands for this segment would total about 2.4 acres (0.6 acres per structure for lattice steel towers and 0.4 acres per structure for all other structures). For the remaining 93.8 mi of the alternative route, an estimated 24 steel lattice towers and 841 wood and steel pole structures would be required (Murphy 1991). It can be conservatively estimated that about 40% of the structures along the alternative route would be in wetlands. On this basis, about 10 lattice steel towers and 336 other structure types would be constructed within wetlands. Construction of these structures would disturb about 140.4 wetland acres. About 60 of the structures in wetlands would have to be constructed in the winter to minimize impacts (Murphy 1991).

In summary, constructing of line-support structures in wetlands could disturb 143 acres along the alternative route. For the proposed route, construction of the 55 structures located in wetlands would disturb about 22.4 acres of wetlands.

The above estimates of wetland acreage subject to impacts are thought to be conservative. Comprehensive right-of-way routing and access road and structure placement designs have not been conducted for the alternative route to the extent done for the proposed route. Although 18.7% of the proposed route traverses wetlands, only 9.8% of the line-support structures would be located within wetlands. Similarly, only 6.5 mi (7.7%) of the access roads required for the proposed route would be located in wetlands (Section 4.1.5.3). Routing refinements for the alternative route could also be expected to lessen the amount of impact to wetlands. Judicious planning for the proposed route essentially halved the potential amount of wetland disturbance based on the percentage of wetlands traversed by the route. If similar reductions occurred for the alternative route, wetland impacts would still be more extensive for the alternative route than for the proposed route.

D.3.2 Floodplains

D.3.2.1 Floodplain Descriptions

Most of the floodplains identified along the alternative route are located in the populated areas along the valleys of the Penobscot River and its major tributaries. In Penobscot County, the right-of-way for the alternative route would cross about 4.3 linear miles of floodplains, encompassing an area of 52 acres. Because of the scarcity of data, the amount of floodplains that would be crossed by the alternative route in Aroostook County cannot be determined.

D.3.2.2 Floodplain Impacts

Because the alternative route would be longer than the proposed route, more access roads and structures would be required (Section D.4.1.2). Also, extensive wetlands are located in the eastern part of the alternative route. Therefore, the displacement of floodplain volume would be expected to be greater for the alternative route than for the proposed route. However, exact displacement volumes cannot be determined because the length and location of access roads have not been established.

D.3.3 Mitigation

Wetland mitigation that would be required for the alternative route would probably be similar to that discussed for the proposed route (Section D.2.3). The proposed mitigation plan would restore about 10 acres and modify the current vegetation management of an additional 26.5 acres along the alternative route. Depending on wetland compensation ratios that would be required for a U.S. Army Corps of Engineers Section 404 permit, the amount of proposed mitigation discussed in Section D.2.3 may not be adequate to compensate for wetland impacts that would be caused by construction of the alternative route. Additional areas within which to create, restore, or enhance wetlands would have to be identified, particularly along the existing-line route.

D.4 STATEMENT OF FINDINGS

DOE finds that no practicable alternative to locating a portion of this proposed action in floodplains and wetlands is available. The proposed action would conform with all applicable state or local floodplain protection standards. All work that would be conducted in wetlands would conform to standards set forth in the Army Corps of Engineers Permit Application (BHE 1991a) and conform to all state and federal standards (Murphy 1992).

APPENDIX E:

SOCIOECONOMIC DATA

TABLE E.1 Population Trends and Projections in Counties and Selected Towns[a] in the Region of Influence

County/Town	1970	1980	1990	2000[b]	2010[b]
Aroostook	94,078	91,344	86,936	81,000	75,000
Amity	-[c]	168	186	-	-
Glenwood Plantation	-	7	8	-	-
Haynesville	-	169	243	-	-
Macwahoc Plantation	-	126	114	-	-
Orient	-	97	157	-	-
Reed Plantation	-	274	296	-	-
Weston	-	155	207	-	-
Hancock	34,590	41,781	46,948	55,000	61,000
Amherst	-	203	226	-	-
Aurora	-	110	82	-	-
Great Pond	-	45	59	-	-
Penobscot	125,076	137,015	146,601	145,000	147,000
Bangor	-	31,643	-	-	-
Brewer	-	9,017	-	-	-
Bradley	-	1,149	1,136	-	-
Chester	-	434	442	-	-
Eddington	-	1,769	1,947	-	-
Enfield	-	1,397	1,476	-	-
Greenbush	-	1,064	1,309	-	-
Greenfield	-	194	267	-	-
Holden	-	2,554	2,952	-	-
Lincoln	-	5,066	5,587	-	-
Lowell	-	194	267	-	-
Mattawamkeag	-	1,000	830	-	-
Medway	-	1,871	1,922	-	-
Milford	-	2,160	2,884	-	-
Passadumkeag	-	430	428	-	-
Veazie	-	1,610	1,633	-	-
Woodville	-	226	215	-	-
Washington	29,859	34,963	35,308	35,000	34,000
Alexander	168	385	478	-	-
Baileyville	2,167	2,188	2,031	-	-
Crawford	74	86	89	-	-
Plantation No. 21	83	127	-	-	-
Princeton	956	994	973	-	-

[a] The towns of Forksville, Molunkus, and Upper Molunkus in Aroostook County; and Drono, Mattamiscontis, and Summit in Penobscot County are not listed here because no data were available.

[b] Projected data for 2000 and 2010.

[c] No data available.

Sources: U.S. Bureau of the Census (1988, 1990a); McGonigle (1989); Washington County Regional Planning Commission (1990).

TABLE E.2 Average Employment in the Region of Influence

County/Parameter	Civilian Labor Force (number of people)		
	1980	1985	1990
Aroostook			
Total civilian labor force	37,770	37,440	39,720
Unemployed	3,930	3,060	2,730
Resident employed	33,840	34,380	36,990
Hancock			
Total civilian labor force	19,570	21,750	27,190
Unemployed	1,600	1,230	1,330
Resident employed	17,970	20,520	25,860
Penobscot			
Total civilian labor force	65,830	62,920	69,540
Unemployed	5,260	3,610	3,740
Resident employed	60,570	59,310	65,810
Washington			
Total civilian labor force	16,200	13,240	15,100
Unemployed	1,850	1,120	1,250
Resident employed	14,350	12,120	13,860
State of Maine			
Total civilian labor force	507,000	553,000	635,000
Unemployed	39,000	30,000	33,000
Resident employed	468,000	523,000	603,000

Source: Maine Department of Labor (1990).

TABLE E.3 Average Employment by Sector in the Region of Influence[a]

County/Sector	1981 Number	1981 Percent	1985 Number	1985 Percent	1989 Number	1989 Percent
Aroostook	24,256	100	25,989	100	28,534	100
Agriculture, Forestry, and Fishing	885	3.65	813	3.13	882	3.09
Mining	24	0.10	12	0.05	7	0.02
Construction	758	3.13	1,109	4.27	1,232	4.32
Manufacturing	6,424	26.48	6,595	25.38	6,235	21.85
Transportation and Public Utility	1,060	4.37	1,079	4.15	1,568	5.50
Wholesale Trade	1,194	4.92	1,110	4.27	1,183	4.15
Retail Trade	4,376	18.04	4,873	18.75	5,920	20.75
Finance, Insurance, and Real Estate	934	3.85	999	3.84	959	3.36
Services	4,158	17.14	4,769	18.35	5,787	20.28
State Government	763	3.15	832	3.20	888	3.11
Local Government	3,681	15.18	3,798	14.61	3,873	13.57
Hancock	12,324	100	14,608	100	17,802	100
Agriculture, Forestry, and Fishing	128	1.04	144	0.99	221	1.24
Mining	0	0	0	0	11	0.06
Construction	865	7.02	1,335	9.14	1,612	9.06
Manufacturing	2,445	19.84	2,832	19.39	3,026	17.00
Transportation and Public Utility	431	3.50	493	3.37	653	3.67
Wholesale Trade	365	2.96	445	3.05	350	1.97
Retail Trade	2,632	21.36	3,274	22.41	4,522	25.40
Finance, Insurance, and Real Estate	433	3.51	481	3.29	598	3.36
Services	3,137	25.45	3,677	25.17	4,704	26.42
State Government	485	3.94	477	3.27	384	2.16
Local Government	1,404	11.39	1,450	9.93	1,721	9.67

TABLE E.3 (Cont.)

County/Sector	1981 Number	1981 Percent	1985 Number	1985 Percent	1989 Number	1989 Percent
Penobscot	51,159	100	55,027	100	62,958	100
Agriculture, Forestry, and Fishing	269	0.53	289	0.53	37	0.06
Mining	49	0.10	17	0.03	-[b]	-
Construction	1,374	2.69	2,124	3.86	2,925	4.65
Manufacturing	14,075	27.51	13,596	24.71	12,170	19.33
Transportation and Public Utility	2,539	4.96	2,990	5.43	3,716	5.90
Wholesale Trade	2,434	4.76	2,652	4.82	3,239	5.14
Retail Trade	9,259	18.10	10,922	19.85	13,717	21.79
Finance, Insurance, and Real Estate	1,750	3.42	1,871	3.40	2,146	3.41
Services	9,319	18.22	10,385	18.87	13,048	20.72
State Government	4,474	8.75	4,508	8.19	5,175	8.22
Local Government	5,618	10.98	5,673	10.31	6,449	10.24
Washington	8,474	100	8,725	100	10,682	100
Agriculture, Forestry, and Fishing	202	2.38	231	2.65	307	2.87
Mining	17	0.20	0	0	0	0
Construction	334	3.94	545	6.25	920	8.61
Manufacturing	2,680	31.63	2,306	26.43	2,203	20.62
Transportation and Public Utility	336	3.97	415	4.76	594	5.56
Wholesale Trade	250	2.95	304	3.48	385	3.60
Retail Trade	1,430	16.88	14,80	16.96	2,066	19.34
Finance, Insurance, and Real Estate	197	2.32	190	2.18	260	2.43
Services	1,416	16.71	1,540	17.65	1,923	18.00
State Government	236	2.78	276	3.16	332	3.11
Local Government	1,377	16.25	1,438	16.48	1,692	15.84

[a] The values listed in this table are lower than the "resident employed" values in Table E.2 because not all employment is broken down by sector.

[b] No data available.

Source: Maine Department of Labor (1990).

TABLE E.4 Estimated Per Capita Income for Counties and Selected Towns[a] in the Region of Influence

County/Town	1979	1981	1983	1985	1987
Aroostook	4,809	5,763	6,562	7,556	8,577
Amity	3,893	4,744	5,433	6,221	7,063
Glenwood Plantation	4,809	5,763	6,562	7,556	8,577
Haynesville	3,939	4,745	5,417	6,222	7,064
Macwahoc Plantation	3,935	4,826	5,536	6,329	7,185
Orient	4,809	5,763	6,562	7,556	8,577
Reed Plantation	3,524	4,246	4,848	5,567	6,322
Weston	5,485	6,583	7,508	8,632	9,802
Hancock	5,411	6,516	7,192	8,456	9,965
Amherst	4,210	5,186	5,716	6,663	7,846
Aurora	4,353	5,398	5,956	6,926	8,137
Great Pond	5,411	6,516	7,192	8,456	9,965
Penobscot	5,593	6,596	7,480	8,567	9,876
Bangor	6,185	7,226	8,419	9,494	11,152
Brewer	6,590	7,746	8,723	10,084	11,600
Bradley	5,752	6,719	7,315	9,014	10,210
Chester	3,924	4,611	5,222	5,993	6,923
Eddington	5,535	6,595	7,324	8,727	10,338
Enfield	5,384	6,329	6,974	7,947	8,638
Greenbush	4,746	5,287	5,994	6,660	7,749
Greenfield	3,861	4,575	5,194	5,948	6,857
Holden	5,836	6,893	7,919	8,991	10,625
Lincoln	5,225	6,274	6,882	7,849	9,108
Lowell	5,114	6,042	6,853	7,855	9,062
Mattawamkeag	5,194	6,460	7,268	8,341	9,599
Medway	5,520	6,581	7,157	8,653	9,300
Milford	5,494	6,674	7,391	8,605	9,683
Passadumkeag	4,242	5,195	5,503	6,700	8,081
Veazie	7,058	8,260	9,359	10,685	12,337
Woodville	5,007	5,846	6,607	7,596	8,787
Washington	4,581	5,332	5,885	6,929	8,126
Alexander	4,433	4,762	5,659	6,491	7,292
Baileyville	6,631	7,800	8,604	10,159	11,461
Crawford	4,581	5,332	5,885	4,581	8,126
Princeton	5,265	5,989	6,625	7,834	9,334
State of Maine	5,766	6,895	7,830	9,042	10,478

[a] The towns of Forksville, Molunkus, and Upper Molunkus in Aroostook County; Drono, Mattamiscontis, and Summit in Penobscot County; and Plantation No. 21 in Washington County are not listed here because no data were available.

Sources: U.S. Bureau of the Census (1982, 1984, 1986, 1988).

TABLE E.5 1980 and 1990 Housing Vacancy Rates in the Region of Influence

	1980			1990		
Country/Town	Total Housing Units (No.)	Total Vacancy Rate (%)	Rental Vacancy Rate (%)	Total Housing Units (No.)	Total Vacancy Rate (%)	Rental Vacancy Rate (%)
Aroostook	35,920	18.3	8.6	38,421	18.4	7.2
Amity	76	21.1	30.8	81	14.8	0
Glenwood Plantation	20	75	50	38	89.5	0
Haynesville	87	42.5	0	141	42.6	50
Macwahoc Plantation	68	36.8	20	66	36.4	9.1
Orient	231	85.3	16.7	251	76.9	16.7
Reed Plantation	101	18.8	0	132	19.7	0
Weston	207	72.9	0	231	66.7	7.1
Hancock	25,062	38.4	6.7	30,396	36.7	8.5
Amherst	123	37.4	0	133	36.8	11.1
Aurora	95	56.8	0	101	68.3	0
Great Pond	55	67.3	20	66	66.7	0
Penobscot	53,415	13.9	8.1	61,359	11.9	7.2
Bangor	12,792	8	8.8	14,366	6.8	7.5
Bradley	481	17.3	7.8	516	14.5	2.3
Brewer	3,534	8	12.2	3,780	4.3	5.2
Chester	143	14.7	0	159	6.9	5.9
Eddington	664	11.7	17	843	12.2	8
Enfield	724	39.4	4.1	750	29.5	7.1
Greenbush	424	16.7	7.7	525	15.2	1.7
Greenfield	144	56.9	12.5	187	47.1	0
Holden	1,106	17.4	15.2	1,332	14.9	11
Lincoln	2,317	23.8	11	2,569	18.4	9.8
Lowell	120	46.7	0	144	36.8	0

TABLE E.5 (Cont.)

Country/Town	1980 Total Housing Units (No.)	1980 Total Vacancy Rate (%)	1980 Rental Vacancy Rate (%)	1990 Total Housing Units (No.)	1990 Total Vacancy Rate (%)	1990 Rental Vacancy Rate (%)
Penobscot (Cont.)						
Mattawamkeag	354	11.3	15	347	8.9	12.7
Medway	594	7.9	16	676	5.8	8.7
Milford	805	8.8	7.7	1,126	6	5.9
Orono	2,349	7.5	3.7	2,687	8.7	6.7
Passadumkeag	158	13.9	14.3	183	17.5	11.1
Summit	16	75	0	-[a]	-	-
Veazie	642	8.3	11.3	692	4.8	9.1
Woodville	78	11.5	0	75	4	0
Washington	18,149	32.7	9.3	19,124	29.8	10.2
Alexander	269	49.4	8.3	326	50.6	4.5
Baileyville	911	19.9	9.5	894	14.3	6.2
Crawford	69	44.9	0	92	59.8	0
Plantation No. 21	156	72.4	60	-	-	-
Princeton	431	20.4	8.3	467	20.1	5.4
State Totals	501,093	21.1	7.1	587,045	20.7	8.4

[a] Town did not exist in 1990.

Source: U.S. Bureau of the Census (1990b).

TABLE E.6 Low-Income and Minority Populations in the Project Area[a]

Location	Total Number of Families	Median Family Income ($)	Percent of Families below Poverty	Total Population	Percent of Population Categorized as Minorities[b]
Washington County	9,781	23,822	14.76	35,308	4.76
Baileyville	583	33,177	0.51	2,031	1.53
Princeton	275	27,604	10.18	973	1.75
Hancock County	12,897	29,939	6.63	46,948	1.43
Great Pond	19	32,083	0	59	5.08
Penobscot County	38,420	31,584	9.46	146,601	2.35
Milford	784	31,000	7.65	2,884	1.49
Bradley	318	32,833	3.46	1,136	1.85
Eddington	583	32,545	4.29	1,947	0.51
Holden	864	38,438	6.94	2,952	1.02
Brewer	2,555	32,262	8.57	9,021	1.37
Orrington	1,045	37,377	4.31	3,309	0.91

[a] Data are based on 1990 census.

[b] Minorities = total population - non-Hispanic white population.

Source: Barbagallo (1994).

APPENDIX F:

VISUAL RESOURCES DATA

TABLE F.1 Landscape Quality Matrix

Feature	Distinctive	Scenic	Common
Landform	Eskers, hills, and ridges or other noted geological features providing distant views; high relative relief greater than 200 ft; steep slopes; sharp exposed bedrock outcrops.	Low, rounded hills and gently rolling terrain; relative relief of 100-200 ft.	Nearly flat to gently sloping terrain; relative relief less than 100 ft.
Waterform	Major river courses, cascades or falls, large placid lakes or reservoirs; shoreline development absent or sympathetic to water element.	Secondary rivers and meandering streams, moderate-sized lakes, ponds, and impoundments; low-density shoreline development.	Narrow, slow moving or intermittent streams and creeks, small farm ponds and similar minor water features; high-density shoreline development.
Vegetation	Stands of dense forest, seen as masses of varying color and texture; mosaic of natural and pastoral vegetation; stands of old timber growth greater than 60 ft in height.	Mixed stands of forest and secondary growth seen as interspersed vegetation pattern; some timber greater than 60 ft in height. Only occasional evidence of logging activities.	Stands of scrubland or unbroken woodland; large agricultural or urban land uses; extensive timbered areas; secondary growth common; most timber under 60 ft in height.
Cultural modifications	Designated historical districts, scenic areas or scenic rivers, and public park and recreation areas; areas where man's impression is sympathetic to the landscape; farmsteads; little contemporary development.	Small- to moderate-sized communities supporting some business, light industry, and commercial development occurring in a semirural setting; some historic buildings or districts; occasional elements such as quarries, utility lines, or landfills, but inconspicuous such that visual integrity is not lost.	Large areas of urbanization, industrialization, suburban sprawl, or highway strip development dominating the landscape; major "eyesores" that destroy visual integrity.

Source: DOE (1987).

TABLE F.2 Major Natural Landscape Characteristics along the Proposed and Alternative Transmission Line Routes

Natural Landscape Region	Landform	Vegetation	Waterform
Northern Forest			
Eastern Bogs subregion	Low to moderate topographical relief	Spruce-fir forest with mixed northern hardwoods (maple and beech) in cut or burnt areas	Abundance of freshwater, wetlands, lakes, and ponds
Northern Lowlands subregion	Flat to gently rolling hills	Spruce-fir forest with maple, beech, and birch	Moderate number of small lakes and ponds; extensive bogs
Norumbega Hills	Very hilly, rounded monadnocks; average elevation between 500 and 1,000 ft	Spruce-fir forest with northern hardwoods in higher elevations	Extensive freshwater wetlands, lakes
Uplands (Foothills subregion)	Very hilly; average elevation between 100 and 500 ft	Diverse vegetation, transition hardwoods including hemlock, maple, beech, and birch	Some streams or ponds

Source: ER (1991); Adamus (1978).

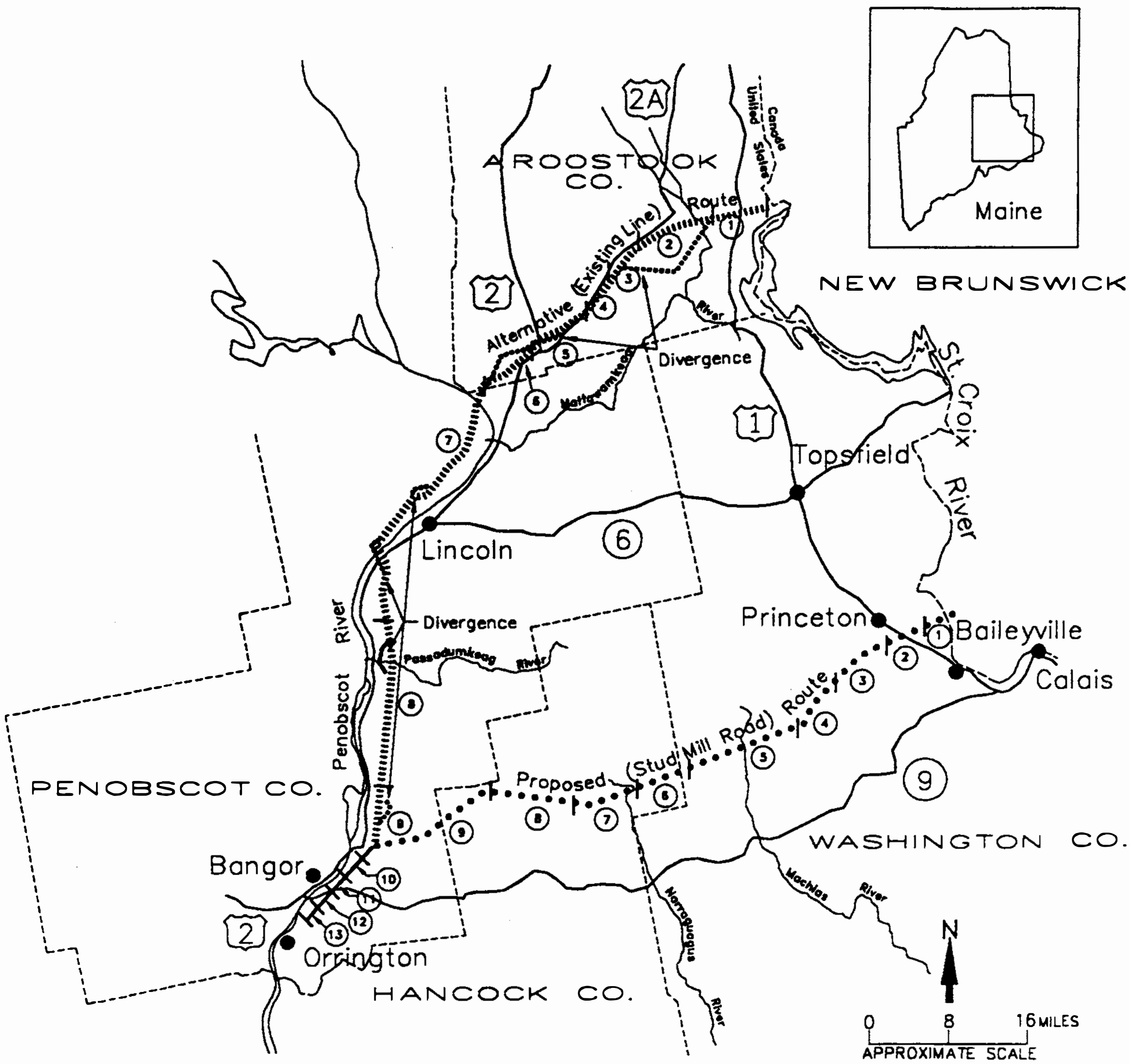

FIGURE F.1 Corridor Segments for the Proposed and Alternative Routes (Circled numbers along transmission line routes refer to corridor segments mentioned in visual resource discussions in the main text.)

APPENDIX G:

LETTERS OF CONSULTATION

EASTERN MAINE DEVELOPMENT CORPORATION

One Cumberland Place Suite 300
P. O. Box 2579 Bangor, Maine 04402-2579 (207) 942-6389

October 12, 1994

Bangor Hydro-Electric Company
33 State Street
Bangor, ME 04401

To Whom It May Concern:

The proposed Second 345kV Tie Line to New Brunswick does not appear to have any potential impact on minority or low-income residents in the impacted communities. The communities impacted by this proposal include: Baileyville, Princeton, Great Pond, Milford, Bradley, Eddington, Holden, Brewer, Orrington and several unorganized territories. According to the most recent maps available, there are only 98 dwellings within 600 feet of the proposed line -- the majority of which are in Brewer and Eddington.

According to Census data and our experience, within the impacted communities there are no significant concentrations of low income or minority populations. Please see the attached table indicating the percentage of minority residents and income levels in the impacted communities. Given that the line will pass through primarily uninhabited territories and relatively few households will be impacted, the impact of this proposed project on low income and minority populations is therefore minimal.

Please do not hesitate to call if you have any further questions or require additional documentation.

Sincerely,

Julia Barbagallo
Community Development Specialist

EXHIBIT G.1 October 12, 1994, Letter of Consultation Regarding Low-Income and Minority Components of Impacted Communities

Low-Income and Minority Populations In Project Area
Bangor Hydro-Electric Company Second 345kV Tie Line to New Brunswick
Source: 1990 Census - STF 1A and 3A

	Total Number of Families	Median Family Income	Percent of Families Below Poverty	Total Population	Percent of Population Categorized as Minorities*
Baileyville	583	$33177	0.51	2031	1.53
Princeton	275	$27604	10.18	973	1.75
Washington County	**9781**	**$23822**	**14.76**	**35308**	**4.76**
Great Pond	19	$32083	0.00	59	5.08
Hancock County	12897	$29939	6.63	46948	1.43
Milford	784	$31000	7.65	2884	1.49
Bradley	318	$32833	3.46	1136	1.85
Eddington	583	$32545	4.29	1947	0.51
Holden	864	$38438	6.94	2952	1.02
Brewer	2555	$32262	8.57	9021	1.37
Orrington	1045	$37377	4.31	3309	0.91
Penobscot County	**38420**	**$31584**	**9.46**	**146601**	**2.35**

*Minorities = Total Population - Non-Hispanic White Population

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

November 8, 1990

Ihor Hlohowskyj
Environmental Assessment and
Information Sciences Division
Argonne National Laboratory
9700 South Cass Ave.
Argonne, Illinois 60439

Dear Dr. Hhlohowskyj:

This responds to your letter dated October 17, 1990 for information on the presence of Federally listed and proposed endangered or threatened species in the vicinity of the three alternative transmission lines interconnecting the Bangor Hydro-Electric Company facilities with the New Brunswick Power Commission.

Information on the transmission line right-of-way provided with your request was not specific enough for us to identify potential conflicts with Federally listed threatened or endangered species. According to the Maine Natural Heritage Program, the following list of Federal candidate and listed species are known to occur in the general vicinity of the transmission lines:

Figure	Species	Common Name	Status
Fig. 1	Carex oronensis	Sedge	Candidate
	Alasmidonta varicosa	Brook floater	Candidate
	Viola novae-angliae	New England violet	Candidate
Fig. 2	Carex oronensis	Sedge	Candidate
	Lycaena dorcas claytoni	Dorcas Copper Butterfly	Candidate
	Siphlonisca aerodromia	Tomah Mayfly	Candidate
Fig. 3	Haliaeetus leucocephalus (Princeton)	Bald eagle	Endangered

Many of the species identified above are candidate species. While Federal candidate species are not afforded protection under the Endangered Species Act, the U.S. Fish and Wildlife Service encourages their consideration in environmental planning. If unnecessary impacts to candidate species can be avoided, the likelihood that they will require the protection of the Act in the future is reduced.

A list of Federally designated endangered and threatened species in Maine is included for your information. We suggest that you contact Francie Smith of the Maine Natural Heritage Program at State House Station 130, Augusta, Maine 04333, (207)289-6800 and Steve Timpano, MDIFW, 284 State St., Augusta, Maine 04333, (207)289-5258 for information on state listed species and other wildlife resources that may be present.

EXHIBIT G.2 November 8, 1990, Letter of Consultation Regarding Threatened and Endangered Species

When project plans have been refined, please contact this office and we will review them for specific locations of listed and/or candidate species. Thank you for your cooperation and please contact Susi von Oettingen of this office at (603) 225-1411 if we can be of further assistance.

Sincerely yours,

Gordon E. Beckett
Supervisor
New England Field Offices

EXHIBIT G.2 (Cont.)

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
400 RALPH PILL MARKETPLACE
22 BRIDGE STREET
CONCORD, NEW HAMPSHIRE 03301-4901

February 7, 1991

Ihor Hlohowskyj, PhD.
Argonne National Laboratory, Department of Energy
Environmental Assmt. and Information Sciences Div.
9700 South Cass Ave
Argonne, Illinois 60439

Dear Dr. Hlohowskyj:

This acknowledges receipt of the additional information provided with your January 2, 1991 letter, regarding routing of a proposed transmission line connecting Bangor Hydro-Electric Company facilities in Maine with those of the Brunswick power Commission, Canada. Specifically, this letter addresses the presence of candidate and Federally listed endangered species and the obligations of the Department of Energy (DOE) relative to Section 7 of the Endangered Species Act of 1973.

In reply to your October 17, 1990 request, this office identified the bald eagle (Haliaeetus leucocephalus) as the only Federally listed endangered species known to be present within the project area. Bald eagles are closely tied to aquatic environments, both freshwater and marine. Eagles nest along water, feed largely on fish and waterfowl, and are known to use the St. Croix and Penobscot Rivers for nesting, feeding and as movement corridors. For purposes of project review and Section 7 consultation, bald eagles can be considered present in both the Existing Line Route alternative and the Stud Mill Route alternative. Also, as identified in our earlier correspondence, the following Federal candidate species may occur in the project alignments:

Existing Line Route

Carex oronensis	Orono Sedge	Federal Category 2 Candidate
Alasmidonta varicosa	Brook Floater Mussel	Recommended for Cat. 2 Status

Stud Mill Route

Siphlonisca aerodromia	Mayfly	Recommended for Cat. Status

While Federal candidate species are not afforded protection under the Endangered Species Act, the U. S. Fish and Wildlife Service (FWS) encourages their consideration in environmental planning. If unnecessary impacts to candidate species can be avoided, the likelihood that they will require the protection of the Act in the future is reduced. Mr. Steve Timpano of the Maine Department of Inland Fisheries and Wildlife (MDIFW), 284 State Street,

EXHIBIT G.3 February 7, 1991, Letter of Consultation Regarding Threatened and Endangered Species

Augusta, Maine 04333 tel., 207/289-3286 and Mr. John Albright of the Maine Natural Heritage Program, State House Station 130, Augusta, Maine 04333, tel., 207/289-6800 can be contacted for additional site specific information regarding the occurrence of these candidate plants and animals.

The Endangered Species Act (the Act), places responsibility to determine whether an activity will adversely affect a listed species on the Federal agency proposing, funding or authorizing that activity (see Interagency Cooperating Regulations, 50 CFR part 402, enclosed). For projects that are considered "major construction activities" significantly affecting the quality of the human environment, these regulations provide very specific guidelines for the Section 7 consultation process. Agencies must request a list of threatened or endangered species for the project area, which DOE has done. If listed species are identified in the project area, the agency or its designated agent, must prepare a Biological Assessment (see page 19960 of the regulations). The Biological Assessment does not need to be a stand alone document, rather it is often included as a section of the Environmental Impact Statement. The assessment is a report which documents the review of the potential effects of the project on the listed species present and is used to determine whether formal Section 7 consultation is necessary. Accordingly, it should reach one of two possible conclusions, the project may affect the species and therefore initiation of formal Section 7 consultation should be requested; or, the project is not likely to adversely affect a listed species, and if FWS concurs, no further consultation is necessary. A Biological Assessment becomes an integral part of the administrative record for a project that "may affect" a listed species.

Information usually contained in a Biological Assessment includes the following:

- — identification and description of the action being considered,
- — identification and description of the specific area that may be affected by the action,
- — identification of the listed species that may be affected by the action,
- — identification and description of the manner in which the action may affect any listed species and an analysis of any cumulative effects,
- — relevant reports including other environmental impact statements, environmental assessments or biological assessments,
- — any other relevant information available on the action, the affected species and the environmental baseline.

The Service believes that the primary issues with regard to the bald eagle are (1) the potential for adverse affects to nesting birds and (2) mortality of eagles from collisions with powerlines, tower structures and guy wires. It is our understanding that representatives for Bangor-Hydro have met with MDIFW personnel regarding the alternative alignments and the presence of eagle nests. We assume that the two routes currently proposed have taken known eagle nest sites into consideration. However, as of March 1, 1991, an additional 32 eagle nest sites in Maine will be added to the list of essential eagle nesting habitats protected by state regulation. Therefore, the assessment should document that the two proposed routes have been <u>recently</u> examined for potential nest site conflicts. Bald eagles nest along

EXHIBIT G.3 (Cont.)

both the Penobscot and St. Croix rivers. Eagles also move along these riparian corridors and concentrate in certain portions of the rivers due to local food abundance. The possibility exists for mortality to eagles from collisions with the lines and structures. In relation to this concern, the assessment should discuss the location of river crossings, avoidance of nests and eagle concentration areas, and color marking lines and guy wires to increase their visibility under low light conditions and all other feasible means of avoiding eagle collisions.

The transmission (distribution and subtransmission) lines may also be an electrocution hazard to eagles and other large birds if insufficient distance between lines and poles allows phase to phase or ground to phase contact (Steenhof 1978, Management of Wintering Bald Eagles, US DOI, 59 pp.). While it is unlikely that eagles would attempt to construct a nest on a tower, ospreys or hawks might. Engineering and design solutions are available that eliminate the electrocution hazard to eagles and other large birds and their use should be addressed in the assessment.

Our Interagency Cooperation Regulations implementing Section 7 of the Act, require that the "best scientific and commercial data available" be provided for an adequate review of the effects that an action may have upon listed species. This review should consider all direct and indirect effects of the action, as well as any identifiable interrelated or interdependent actions which may affect the bald eagle. The fact that nesting bald eagles in Maine are already experiencing increased disturbance pressure from human activities is an example of an indirect effect that may result from the increased access that follows the construction of transmission lines and their associated access roads.

The bald eagle is the only Federally listed species under the jurisdiction of the U. S. Fish and Wildlife Service that may be affected by the proposed action. No critical habitat pursuant to the Federal Endangered Species Act of 1973, has been officially designated for the bald eagle in Maine.

More that one Federal agency is likely to have some regulatory authority for different aspects of this project, such as the Corps of Engineers and Section 404 of the Clean Water Act permits for wetland fills and stream crossings. Therefore, it is our assumption that the DOE, as the agency responsible for preparing the environmental impact statement, is assuming lead agency responsibility for the Endangered Species consultation. It is our recommendation that DOE or its agent correspond with biologists of the U.S. Fish and Wildlife Service and the Maine Department of Inland Fisheries and Wildlife for additional assistance in drafting the assessment.

For questions regarding this response and for further consultation on endangered species, please contact Michael Amaral or Susanna von Oettingen at 603-225-1411.

Sincerely yours,

Gordon E. Beckett

Gordon E. Beckett
Supervisor
New England Field Offices

EXHIBIT G.3 (Cont.)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Offices
400 Ralph Pill Marketplace
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4901

March 12, 1993

Mr. William S. Vinikour
Environmental Assessment and Information
Sciences Division
Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

Dear Mr. Vinikour:

This responds to your February 8, 1993 letter requesting updated information relative to endangered species occurrence in the area of the proposed Bangor Hydro-Electric Company's second 345-KV transmission line to New Brunswick, Canada.

Most of the information provided to Dr. Hlohowskyj in our February 7, 1991 letter remains valid. The endangered bald eagle (*Haliaeetus leucocephalus*) is the only Federally listed species known to occur in the project area. The Maine Department of Inland Fisheries and Wildlife, Endangered Wildlife Project Office in Bangor (MDIFW), documented 13 new eagle nesting locations in Maine in 1992 (total is now 140, up from 127 pairs in 1991). Alan Hutchinson or Charlie Todd of MDIFW should be contacted to verify that no new eagle nests were found within or near the proposed utility corridor rights-of-way. Also, 1993 nesting surveys will be initiated soon, and it would be prudent to remain in contact with MDIFW to obtain the most current nest site information available.

There have been changes to the status of two species identified in our earlier letter as "Recommended for Category 2 [candidate] status. Both the Brook floater mussel (*Alasmidonta varicosa*) and "Tomah" mayfly (*Siphlonisca aerodromia*) have been officially designated Category 2 candidate status (Federal Register, vol. 56, no. 225, November 21, 1991, enclosed). While Federal candidate species are not afforded protection under the Endangered Species Act, the U.S. Fish and Wildlife Service encourages their consideration in environmental planning. If unnecessary impacts to candidate species can be avoided, the likelihood that they will require the protection of the Act in the future is reduced.

Our February 7, 1991 letter identifies the need to prepare a biological assessment pursuant to Section 7(c) of the Endangered Species Act. That letter also provided guidance on what is usually contained in an assessment. We would appreciate notification of your intent to complete a biological assessment. While they are often incorporated within an environmental impact statement, at your discretion, a biological assessment can be a separate document.

EXHIBIT G.4 March 12, 1993, Letter of Consultation Regarding Threatened and Endangered Species

Questions regarding this response or preparation of the biological assessment can be directed to Michael Amaral, Endangered Species Specialist, at 603-225-1411.

Sincerely yours,

for Gordon E. Beckett
Supervisor
New England Field Offices

Enclosure

EXHIBIT G.4 (Cont.)

John R. McKernan, Jr.
Governor

William J. Vail
Commissioner

DEPARTMENT OF INLAND FISHERIES AND WILDLIFE

Telephone (207) 289-3371

Wildlife Resource Assessment Section
650 State Street
Bangor, ME 04401-5654
Telephone (207) 941-4468
FAX (207) 941-4443

September 27, 1993

Bill Vinikour
Argonne National Laboratory
9700 South Cass Avenue
Building 900
Argonne, IL 60439

Dear Bill:

The 1993 nesting and production surveys for Maine's bald eagles population were completed in July. No new nest locations were discovered along or adjacent to the second 345-KV transmission line corridor proposed by Bangor Hydro Electric Co. into New Brunswick. These surveys focus at traditional nest sites, alternate nest locations, and potential habitats as evidenced by eagle sightings or nesting rumors. A thorough search for nesting eagles along the proposed corridor was last conducted in 1991.

There are 2 invertebrate species possibly in the project area for which we are seeking additional information. The brook floater mussel (Alasmidonta varicosa) and Tomah mayfly (Siphlonisca aerodromia) are both designated as "Category 2" candidate species by the U.S. Fish and Wildlife Service. The status of each is currently under review in Maine.

Please advise if I can be of further assistance.

Sincerely,

Charlie Todd

Charles S. Todd
Wildlife Biologist
Endangered Species Group

CST/llm

cc: Hutchinson
Schaeffer
Timpano

State House Station 41, Augusta, Maine 04333 — *Offices Located at* 284 State Street

EXHIBIT G.5 September 27, 1993, Letter of Consultation Regarding Threatened and Endangered Species

MAINE HISTORIC PRESERVATION COMMISSION
55 Capitol Street
State House Station 65
Augusta, Maine 04333

Earle G. Shettleworth, Jr.
Director

Telephone:
207-289-2133

August 7, 1990

Ms. Lisa Hilli
Northrop, Devine and Tarbell
175 Exchange Street
Bangor, Me. 04401

Re: Bangor Hydro-Electric 345 kV Tie Line, Phase I Archaeological Survey

Dear Ms. Hilli:

We received Dr. Steven Cox's report from you on July 20, 1990, although it is dated December 15, 1989. The following constitute Maine Historic Preservation Commission comments on the report, and recommendations for completion of archaeological work on the project.

We note that four powerline segments have not received archaeological testing because of route changes subsequent to the initial archaeological survey work (segments 125A, 35A, 320A), and because of lack of landowner permission (segment 671). The sampling approach and fieldwork methods employed by Dr. Cox for Phase I survey of the powerline, however, are exemplary. Completion of Phase I archaeological survey on the four segments mentioned above using the same methods will constitute an acceptable Phase I archaeological field survey.

Beyond the fact that Phase I work on these 4 segments of powerline are still outstanding, there are several minor problems with Steve Cox's report. Because a report on the four unsurveyed segments must be filed in the future, and because of the problems with the current submission which we discuss below, it would be best to consider the report a draft submission which can be revised to reflect completion of Phase I (and possibly Phase II) archaeological survey in the near future.

One minor problem is a mistaken UTM coordinate for site 75.2, (corrected site form enclosed) as far as we can tell. A more serious problem is misnumbering of the archaeological site on the Machias River as site 94.32. Site number 94.32 was assigned to a petroglyph location on Grand Lake stream in September 1988. Subsequently, a report on the petroglyph site was published (Bulletin of the Maine Archaeological Site, Spring 1989). Therefore, the site numbered 94.32 in Steve Cox's report must be renumbered 94.33. Henceforth, we will refer to it as 94.33.

We note that Phase I archaeological survey to date has identified three archaeological sites along the powerline corridor:

EXHIBIT G.6 August 7, 1990, Letter of Consultation Regarding Cultural Resources

sites 75.2, 94.33, and 96.5. The Phase I testing of sites 75.2 and 96.5 was adequate to provide convincing evidence that they do not contain significant information, and hence are not eligible for nomination to the National Register of Historic Places. Therefore, Bangor Hydroelectric's management responsibility for these two sites ends with the Phase I report, and they need be given no further consideration.

Site 94.33 is another matter. We believe that Dr. Cox's recommendation (p39) that the site is eligible for the National Register, but that all significant data have been recovered from it, is premature. (As an aside, the recommendation is logically incorrect. A site cannot retain eligibility to the National Register under Criterion D if all significant data have been recovered from it. Once a site has been completely excavated, it is no longer eligible.) The site evidently consists of one or more small concentrations of stone tools and other debris. Steve Cox's team excavated the majority of one such concentration. As I read the data in his maps and report, however, there is a 10 meter stretch of untested riverbank between the concentration he excavated and a single piece of debitage in a testpit to the north. It seems that one or more other concentrations of debris in the 2-4 meter diameter size range might be "hidden" in the untested stretch of riverbank, or within a few meters of the positive testpit north of the concentration. Moreover, based upon the data presented in the report, one corner of the known artifact concentration at 94.33 has not been completely excavated.

If it can be demonstrated that there are no other concentrations of stone tools, and if the known concentration is completely excavated, then site 94.33 will no longer contain significant data and will need no further consideration or management. For this reason we recommend a small (Phase II) season of excavation on the site.

If any significance remains at site 94.33, it in part relates to prehistoric use of the Machias River as a canoe route. Other sites (94.31 and 94.30) lie approximately 1 kilometer upstream and downstream from 94.33. Although Bangor Hydro is NOT responsible for any work at sites outside the powerline corridor, the significance of 94.33 (if any) must be considered in a broader context during the analysis and reporting stage.

Again, let me state that Dr. Cox's Phase I archaeological work on the project so far is exemplary, and completion of the archaeological studies seems to be possible in the near future.

Sincerely,

Dr. Arthur E. Spiess
Archaeologist

cc: Steve Cox

EXHIBIT G.6 (Cont.)

MAINE HISTORIC PRESERVATION COMMISSION
55 Capitol Street
State House Station 65
Augusta, Maine 04333

Earle G. Shettleworth, Jr.
Director

Telephone:
207-289-2133

September 7, 1990

Ms. Lisa Hilli
Northrop, Devine and Tarbell
175 Exchange Street
Bangor, Me. 04401

Re: Bangor Hydroelectric 345 kV tie line, Archaeological survey

Dear Ms. Hilli:

Dr. Arthur Spiess of my staff has reviewed revisions to the Phase I archaeological report which Dr. Steven Cox recently delivered to this office. These revisions respond satisfactorily to Dr. Spiess' comments of August 7. We find that the report is now acceptable, and the Phase I archaeological survey for the powerline corridor is complete. Archaeological site 94.33 contains no further significant data, and the other two sites discovered on the survey are not significant.

As Dr. Cox notes in the report, there has not been any archaeological survey of possible access and construction road routes. A provision will have to be made for archaeological survey of any new access and construction roads, especially near water crossings. With the exception of the possible need for archaeological survey of access and construction roads, I find that this project will have no effect upon any structure or site of historic, architectural, or archaeological significance as defined by the National Historic Preservation Act of 1966.

Sincerely,

Earle G. Shettleworth, Jr.
State Historic Preservation Officer

EXHIBIT G.7 September 7, 1990, Letter of Consultation Regarding Cultural Resources

MAINE HISTORIC PRESERVATION COMMISSION
55 Capitol Street
State House Station 65
Augusta, Maine 04333

Earle G. Shettleworth, Jr.
Director

Telephone:
207-289-2133

JUN 14 1991

June 11, 1991

Michael J. Murphy, P.E., Branch Manager
Northrop, Devine & Tarbell, Incorporated
1 Cumberland Place, Suite 204
Bangor, Maine 04401

Dear Mr. Murphy:

In response to your recent request, I have reviewed the modifications to the Bangor Hydro 345 kV Tie Line as shown on maps accompanying your letter of May 21, 1991.

I find that there are no properties in the project area of historic, architectural, or archaeological significance as defined by the National Historic Preservation Act of 1966.

If I can be of further assistance concerning this matter, please do not hesitate to let me know.

Sincerely,

Earle G. Shettleworth, Jr.
State Historic Preservation Officer

EGS/slm

EXHIBIT G.8 June 11, 1991, Letter of Consultation Regarding Cultural Resources

APPENDIX H:

REFERENCES

APPENDIX H:

REFERENCES

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Wright, W.E., et al., 1982, *Leukaemia in Workers Exposed to Electrical and Magnetic Fields,* Lancet, *2*(8308):1160-1161.

Yee, C.S., and T.D. Roelofs, 1980, *Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; 4: Planning Forest Roads to Protect Salmonid Habitat,* General Technical Report PNW-109, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Ore.

APPENDIX I:

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND RESPONSES

APPENDIX I:

COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND RESPONSES

I.1 PUBLIC HEARING COMMENTS AND RESPONSES

This section presents the comments that were received at the three public hearings held on the Bangor Hydro-Electric Company's proposed second 345-kV transmission tie line to New Brunswick. The hearings were held on January 10 and 11, 1994, in Bradley and Woodland, Maine. The only speaker presenting comments during the hearings was Mr. Bruce King, who spoke at the January 10 hearing in Bradley, Maine. Summaries of Mr. King's comments and corresponding DOE responses are presented below. Complete copies of the hearing transcripts are available for review in DOE's office in Washington, D.C., and in Bangor Hydro-Electric Company's office in Bangor, Maine. Transcripts can also be purchased directly from Brown, Keene & Halteman, P.O. Box 1538, Bangor, Maine 04402-1538.

Comment Summary	Response
1. In addition to the environmental issues, does the EIS also take into account the socioeconomic issues?	Socioeconomics are primarily addressed in Sections 3.1.6, 3.2.6, 4.1.6, and 4.2.6. Appendix E presents socioeconomic data used in support of the impact analysis.
2. Would the proposed project displace other projects?	The proposed project would not displace any other planned electrical-generating or importing project. Land within the proposed right-of-way would be excluded from commercial forestry uses, but this loss is viewed as insignificant (see Section 4.1.3.1).
3. Would the proposed project affect other Bangor Hydro-Electric Company projects (e.g., Basin Mills hydroelectric project)?	Other projects planned by Bangor Hydro-Electric Company would not be affected by the proposed project.

I.2 WRITTEN COMMENTS AND RESPONSES

This section reproduces (from the best available copies) the comment letters received during the review period for the Draft Environmental Impact Statement (DEIS) and presents corresponding DOE responses. Attachments to the letters have been reproduced only if they presented, or were to be considered, comments. In general, the letters have been arranged chronologically in order of receipt. Each letter responded to by DOE has been assigned a letter code, and for each letter, consecutive numbers have been used to designate individual comments and the corresponding DOE responses. The letters and responses are placed side by side on facing pages to the extent possible so the specific response to a given comment can be easily located. The following index lists the letters and the corresponding codes in the order they appear in the appendix:

Town of Baileyville

27 Broadway Street
P.O. Box 370
Woodland, ME 04694

207-427-3442
FAX 207-427-6200

January 21, 1994

Anthony J. Como
United States Department of Energy
Fossil Energy (FE-52)
Office of Fuels Programs
Room 3B-087
1000 Independence Avenue
S.W. Washington, DC 20585

Dear Mr. Como:

FDJ-1

On behalf of the Town Council of the Town of Baileyville, I want to express my support for the proposed construction and operation of Bangor Hydro Electric Company's second 345-KV transmission tie line to New Brunswick. A portion of this line would cross through the Town of Baileyville and result in significant tax benefits for our community.

We have reviewed the draft environmental impact statement and attended the public hearing held here on January 11th.

We appreciate receiving a copy of the draft environmental impact statement and ask that you keep us posted of any further developments. All correspondence should be sent to P.O. Box 370, Woodland, Maine, 04694.

Thank you for your time and effort.

Sincerely,

Frank D. Jones
Chairman
Baileyville Town Council

FDJ/ejr

Response to FDJ-1: Thank you for the statements. No response required.

Washington County Soil and Water Conservation District
P.O. Box 121 - Machias, Maine 04654 - (207) 255-3995

March 15, 1994

Office of Fuels Programs
ATTN: Xavier Puslowski
Office of Asst. Sec. for Fossil Energy
U.S. Department of Energy
1000 Independence Avenue S.W.
Washington D.C.

Dear Mr. Puslowski:

Thank you for sending the draft copy of the Environmental Impact Statement for the proposed Bangor-Hydro Electric Transmission Line in eastern Maine.

NBa-1 Enclosed are copies of comments which the District submitted to the Maine Department of Environmental Protection. I have taken the liberty of highlighting portions which may be of interest to you.

Hancock County's Conservation District also made some recommendations.

Sincerely,

N. Bennett

Nancy Bennett, Chair

nb/n
Encs.

Response to NBa-1: Although the comments raised in the attachment to your letter were directed to the Maine Department of Environmental Protection, where appropriate they have been adopted as comments on the DEIS. Responses to those comments are found on the following pages.

WASHINGTON COUNTY SOIL AND WATER CONSERVATION DISTRICT
49 COURT STREET AND FEDERAL BUILDING
P.O. BOX 121
MACHIAS, ME 04654
(207) 255-4659

TO: Stacie Beyer, Project Analyst
Board of Environmental Protection
106 Hogan Road
Bangor, ME 04401

FROM: Washington County Soil and Water Conservation District

SUBJECT: Proposed Bangor Hydro Electric 345V Transmission Line # L-17131-29-A-N

We have previously requested that a public hearing on this proposal be held and we have given reasons for that request. After studying staff memo and department recommendation that a hearing not be held, we wish to again point out that this proposal is to impact every major watershed in Washington and Hancock Counties as well as the Penobscot Watershed. In addition, many minor watersheds will be impacted. It is inconceivable to us that such a proposal would not go to a public hearing. We should not need to point out that the surface and ground waters within these watersheds belong to the people of our state. Therefore, any citizen could and should show concern about impacts on these waters, regardless of where they live.

The applicant has submitted inaccurate and incomplete data to date. They have not addressed the concerns raised by our comments. Additionally, Department staff have not requested that the applicant address these concerns.

The departments discussion on whether to hold a hearing is very incomplete, biased, and disappointing. Conspicuous by its absence are several major issues raised by us in our comments and at the public meeting. These comments and concerns; i.e. lack of surface water protection plan, ground water protection plan, stream crossing specifications and other technical data necessary to show that this proposal, if permitted, will not unreasonably impact our natural resources should be addresses by the applicant.

Should the Board decide not to hold a hearing on this proposal, we request that the board direct the applicant to address concerns raised during the review process prior to any further action by the Board on the permit.

No response necessary

TO: SWCD Washington County

* FROM: DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF LAND QUALITY CONTROL, 106 Hogan Road Bangor, Maine 04401

DATE: July 29, 1991

SUBJECT: REQUEST FOR PROJECT REVIEW

This constitutes a request for your agency's review of the project identified below and your submission of comments in accordance with our Memorandum of Agreement on Project Reviews.

Questions concerning this project should be directed to the DEP Project Manager, Stacie Beyer, at ~~289-2111~~. 941-4570

The deadline for agency comments is August 26, 1991.

PROJECT		APPLICANT	
NUMBER:	1-17131-29-A-N	NAME:	Bangor Hydro
NAME:	345 KV Transmission line	CONTACT:	Michael Murphy
LOCATION:	Orrington → New Brunswick		Northrop, Devine, + Tarbell 942-0999

After a thorough review of the above project, as presented to us, and consideration of our agency's standards, programs and responsibilities, the following comments are submitted to the Department of Enviromental Protection.

This package contains the promised "addendum" to the application as well as response to some review comments already received. SRB

PLEASE SEE ATTACHED COMMENTS

☑ Check if requesting copy of draft Findings of Fact and Order.

(Comments must be signed and dated in order to be accepted by this Department.)
(If additional space is needed, please attach another sheet.)

SIGNATURE: Clancy Bennett DATE: 9/10/91

* TL

No response necessary

Washington County Soil and Water Conservation District
P.O. Box 121 - Machias, Maine 04654 - (207) 255-3995

NBa-2 1. A more comprehensive environmental impact study of the route and alternatives should be required.

BHE's superficial, incomplete, and inaccurate investigation of environment, recreational, aesthetic, historical/archaeological and engineering considerations for the Stud Mill Road Route is woefully inadequate to provide the information necessary to make intelligent decisions on this project in regard to the Natural Resources Protection Act and the Site Location of Developmental Law.

NBa-3 2. We recommend that the Department of Environmental Protection and the Land Use Regulation Commission hold joint public hearings on this proposal.

3. Responses to previous comments dated February 1, 1991, are woefully inadequate due to being incomplete and inaccurate.

Example: Page 56 "The impact of...application" a search of Volume 2 segment by segment finds no mention of ground water nor precautions which will be taken to protect it especially over sand and gravel aquifers. No mention of alternative methods of maintenance of right of way was found in this section either. Therefore, the comment on surface waters and ground waters is put in the form of the following questions:

NBa-4 A. What specific construction techniques in addition to erosion and sediment control will be used to protect the surface waters and ground water?

NBa-5 B. What specific equipment maintenance techniques will be used during construction and ROW maintenance operations that will safeguard both surface water and ground water?

NBa-6 C. What calculations have been done to select the appropriate culvert size for each culvert location? This information is critical to protection surface waters and fisheries resources. Without this information other erosion and sedimentation measures may contribute to siltation, phosphorus loading, and other degradation of surface waters.

NBa-7 D. We recommend as a condition if this project proceeds that no chemicals be used to suppress vegetation on the ROW.

NBa-8 4. The revised wetlands maps are more accurate and extremely helpful. Degradation of these wetlands must be minimized by getting all structures and roads out of them and using mechanical hand held equipment to maintain ROW vegetation where appropriate. We recommend a 300 ft. riparian zone upland of each wetland area.

NBa-9 5. The alternative analysis provided in Exhibit 36 and in the Environmental Report is inadequate and therefore, does not convince us that this project

Response to NBa-2: Your comments are noted. No response necessary.

Response to NBa-3: Your comment is noted. Because this was a state or regional governmental issue, no response is required for the EIS.

Response to NBa-4: Please refer to Sections 2.1, 4.1.4, and 4.4.1 for discussions on construction techniques and mitigative measures that would be implemented to protect surface waters and groundwaters.

Response to NBa-5: Equipment maintenance techniques to protect surface and groundwater resources were addressed within Bangor Hydro-Electric Company's state permit application. These techniques include providing containment facilities for fuel storage; providing temporary erosion control measures at staging areas; properly disposing of used oil and filters, waste fuels and lubricants, and associated containers; not storing fuels underground; and storing fuels aboveground in approved containers and at locations approved by the construction manager. The contractor's proposal to store fuels aboveground must be submitted to the construction manager for approval and must be accompanied by a spill protection, containment, and countermeasure plan. The plan must meet the requirements and specifications of, and be approved by, the Maine Department of Environmental Protection.

Response to NBa-6: Design criteria for culverts are detailed in Bangor Hydro-Electric Company's state permit application. Culverts would be sized to handle at least a 2-year frequency storm for temporary stream crossings and at least a 10-year frequency storm for permanent stream crossings. As discussed in Section 2.1.5.3, culverts would not be the preferred type of waterway crossing.

Response to NBa-7: Your concerns are noted. Please refer to Sections 4.1.9.8 and 4.4.1.5 for a discussion of proposed herbicide use.

Response to NBa-8: Your concerns are noted. To the extent practicable, wetlands were avoided during the selection process for the proposed route, support structures, and access roads. However, because about 23% of the proposed route passes through wetlands, complete avoidance of wetlands would not be possible. Please refer to Appendix D for the assessment of wetland impacts and mitigation.

Washington County Soil and Water Conservation District
P.O. Box 121 - Machias, Maine 04654 - (207) 255-3995

NBa-9 (cont.)

is needed, necessary, or in the best interests of the people of Maine.

NBa-10

6. The lost jobs referred to in our comments include such things as lost guiding opportunity for bear, deer, moose, and other hunting activities along the area which will become the ROW and Field trips of birders, students and other recreational users which now use this area on a regular basis. Will access be restricted to the ROW area?

NBa-11

7. The wildlife and fisheries assessment is not in sufficient detail to determine what impacts are likely to occur, therefore, a more comprehensive 2 year study of the area should be done.

NBa-12

8. Our comment about magnetic and electrical force fields is restated below. The studies of Dr. Wendall Winters, Dr. Marjorie Speers, Dr. H.D. Brown and S.K. Chattopadhyay and other epidemiological studies indicate a relationship between occupational exposure to electromagnetic fields and cancers of many types. The evidence and data are overwhelming on this issue and therefore some buffer zones and other warnings or restrictions are advisable.

NBa-13 What specific restrictions of access to traditional hunting and fishing areas are planned?

NBa-14 How will these be enforced in this rural area?

NBa-15 Will greater access because of this project allow greater harassment of wildlife?

NBa-16 What effect will this have on deer wintering areas and potential deer wintering areas?

NBa-17

9. What impact will this project have on campers, hunters, fishermen, trappers, snowmobilers, ATC riders, and canoeists?

Since we could find no response to this previous comment, we are repeating it here.

NBa-18

10. The archaeological sites which were disturbed to study for this project hopefully will be restored and copies of the report made available to the public. We find this method of digging up more than 50% of a site to study for a proposed project totally unacceptable procedures. Additionally there are several Indian trails which will be crossed by the ROW. No mention of these are contained in the study. Will continued access be allowed? What safety precautions should be taken by these who use the trails in the future? Are additional digs planned?

Response to NBa-9: Your concerns are noted. The DOE does not determine the route of a proposed transmission line. The utility, consistent with relevant state siting requirements, determines the route of a proposed transmission line. The DOE, pursuant to Executive Order 10485, as amended by Executive Order 12038, is responsible for electric reliability of the system and the environmental impacts of the action proposed by the utility. In the environmental review, the National Environmental Policy Act (NEPA) requires consideration of all reasonable alternatives to the proposed project. This consideration may include evaluation of alternative transmission routes that would provide the same desired effect as the proposed route. The DOE will either grant or deny a Presidential permit to build a transmission line after the evaluation of all reasonable alternatives to the proposed line.

Response to NBa-10: There would not be any access restrictions within the right-of-way (above and beyond those that may currently exist for any given portion of the project area).

Response to NBa-11: Your concerns are noted. The wildlife and fisheries assessment presented in the EIS is rather extensive (see Sections 3.1.5, 3.2.5, 4.1.5, 4.2.5, 4.4, and 4.5.5 and Appendixes C and D). We are confident that additional ecological studies of the project area would not significantly alter the assessment provided in the EIS.

Response to NBa-12: Section 4.1.9 of the EIS contains an extensive review of the EMF exposure health issue, including results of epidemiological studies, comparisons of source exposures to magnetic fields, potential mechanisms by which magnetic fields could affect health, prudent avoidance recommendations, and routing considerations to minimize residential exposures. Bangor Hydro-Electric Company's management practices for the proposed project have included routing decisions that have avoided hospitals, schools, and multiple-resident dwellings and that have minimized the number of nearby single-family residences to the extent practicable. Most of the proposed line would extend through commercial forest lands. Thus, individual exposures to EMF from the line in these areas would be infrequent and of short duration. The EMF strengths at the edge of the right-of-way where the proposed line would be closer to residential properties would be at or below strengths that now occur for the existing transmission lines (see Table 4.3, Section 4.1.9). Your concerns regarding buffer zones or other warnings are noted. However, until more definitive evidence on the EMF health issue is obtained in the next few years, establishment

See comments NBa-13 through NBa-18 on page I-16.

Response to NBa-12 (Cont.) of buffer zones or access restrictions is unwarranted (especially in light of more prominent EMF sources that the public would be continuously exposed to in and around their homes, workplaces, and towns). A toll-free public information telephone line has been established to answer EMF-related questions and direct callers to further sources of information. The EMF "Infoline" number is 1-800-363-2383 (in Washington, D.C., call 484-1803).

Response to NBa-13: No restrictions in access to traditional hunting and fishing areas would occur because of the proposed project.

Response to NBa-14: No enforcement of access restrictions to hunting and fishing areas would be required.

Response to NBa-15: In general, the entire project area already has ready access because of commercial forestry operations (including associated logging roads) and ongoing recreational activities. Therefore, increased harassment of wildlife from the proposed project would not be expected. Vegetation management (see Section 2.1.5.2) would include measures to prevent illegal deer drives.

Response to NBa-16: In general, no impacts to deer wintering areas would occur. Some loss to existing (or potential) deer wintering areas might occur; however, areas suitable for additional deer winter areas could be provided (Section 4.1.5.1). Also, any clearing in deer wintering areas would be conducted in late summer or early fall during dry conditions (Section 4.4.1.5).

Response to NBa-17: Impacts to recreationists are addressed in Section 4.1.3.3.

Response to NBa-18: The Maine Historic Preservation Commission has determined that construction of the proposed transmission line would not affect any archaeological sites (see Section 4.1.8). Copies of reports (or information on where to obtain copies) regarding archaeological surveys of the proposed project route can be obtained from Bangor Hydro-Electric Company in Bangor, Maine. No additional diggings associated with the proposed project are planned.

Washington County Soil and Water Conservation District
P.O. Box 121 - Machias, Maine 04654 - (207) 255-3995

NBa-19 11. Appropriate mitigation techniques include the location as well as replacement in like kind. All mitigation should be as close to the location of loss as possible. Each mitigation site needs individual evaluation for the parameters lost and then planned to more than compensate for the loss.

12. We would be happy to accept an invitation to hold an additional technical review session to discuss the above issues and other aspects of this project if it would be helpful to the applicants, DEP staff, and LURC staff.

Bruce Bennett
Chair, Board of Supervisors

Response to NBa-19: The DOE staff assumes that this comment refers to wetlands. A detailed discussion of wetland mitigation is provided in Section D.2.3 (Appendix D). Wetland mitigation close to the location of wetland loss is often preferred. However, the applicant's plan to restore wetlands along the existing route would allow mitigation to occur far and above a one-to-one compensation value.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
New England Field Offices
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4986

February 15, 1994

Anthony Como, Director
Office of Coal, Electricity, Fuels
Programs and Fossil Energy
Department of Energy
Washington D.C. 20585

Dear Mr. Como:

This responds to your December 10, 1993 letter and the Department of Energy's draft Environmental Impact Statement (publication number DOE/DEIS-0166) regarding the construction and operation of the proposed Bangor Hydro-Electric Company's second 345-kv transmission tie line to New Brunswick, Canada. Specifically, this letter addresses the obligations of the Department of Energy (DOE) relative to Section 7 of the Endangered Species Act and the effects of the project on the endangered bald eagle (*Haliaeetus leucocephalus*).

The bald eagle is the only Federally listed species under the jurisdiction of the U.S. Fish and Wildlife Service that is known to occur in the project area. No critical habitat pursuant to the Federal Endangered Species Act of 1973 (ESA) has been officially designated for the bald eagle in Maine.

Informal Section 7 consultation on the subject project began in October 17, 1990. Copies of this office's response to DOE's request for a list of threatened and endangered species, as well as two subsequent letters dated February 7, 1991 and March 12, 1993, are appended within the draft environmental impact statement (DEIS, Exhibits G.1-3).

Appendix C of the DEIS contains a list of biotic resource data and the biological assessment for project related impacts on the endangered bald eagle. Although the biological assessment was not accompanied by a cover letter summarizing its findings, it is implicit within the assessment that the DOE finds that the design and mitigative measures developed for the proposed transmission line minimize the potential for adverse effects to the bald eagle.

Effects on the Bald Eagle

In previous written comments (specifically our February 9, 1991 letter) we identified the following areas of concern that warrant evaluation in the biological assessment relative to project effects on the bald eagle:

- The potential for adverse effects to nesting birds.
- Mortality (or injury) to eagles from electrocution.

No response necessary

-2-

Mortality (or injury) to eagles from collisions with powerlines, tower structures, and guy wires.

The biological assessment addresses potential effects on nesting bald eagles in two respects, location of the line to avoid nest sites and the potential for construction activities to disturb nesting eagles. Both the proposed and alternative transmission line routes were carefully reviewed to ensure that the proposed right-of-ways did not occur in close proximity (within a mile) of known eagle nest sites. Due to the distance of the right-of-ways from all known active nesting sites, we concur that no construction-related disturbance effects are anticipated. Similarly, no effect to bald eagles is anticipated from the long-term habitat changes that will result from construction and operation of the line.

Transmission lines may be an electrocution hazard to eagles and other large birds if insufficient distance between lines and poles allows phase to phase or ground to phase contact (Steenhof 1978, Management of Wintering Bald Eagles, US DOI, 59 pp.). However, the design of the proposed transmission line eliminates this possibility as the distance between the conductors, and between the conductors and shield wires amply exceed the wingspan of bald eagles (DEIS for Construction and Operation of the Proposed Bangor Hydro-Electric Company's Second 345-KV Transmission Tie Line to New Brunswick, 1993, page C-32).

An additional potential adverse effect could result from toxicological contamination of the bald eagle's food chain from application of herbicides. However, as stated in the DEIS, only state-registered herbicides will be used, they will be used sparingly, and applied only by low-pressure hand or manual sprayers. Furthermore, no herbicides will be used within a 250-foot buffer zone on each side of streams (page 4-19). Accordingly, any adverse toxicological threats to bald eagles is very unlikely.

The most significant potential hazard to bald eagles is the possibility for collisions with the transmission lines, shield wires, towers and their supporting guy wires, particularly at the St. Croix River crossing. Typically, the narrow gauge shield wires above the conductors pose the greatest collision hazard to birds in flight. While an alternative design that would eliminate the use of the overhead shield wires at the St. Croix crossing was addressed in the assessment and determined to be not feasible, we question whether or not crossing the St. Croix via underwater cable was seriously considered. This option would completely eliminate the collision hazard for eagles and the many other bird species moving along the river corridor.

GEB-1

As stated in the biological assessment, the study of bald eagle activity along the St. Croix River by Northrop, Devine and Tarbell document significant numbers of bald eagles moving up and down river at the location of the proposed crossing. Moreover, more than half of the eagle flights across the centerline of the proposed transmission line route observed in 1990 (19 of 34) were at an elevation at which the conductors and shield lines would occur.

Response to GEB-1: DOE agrees that an underground crossing of the St. Croix River would eliminate the collision hazard for eagles and other birds moving along the river. However, underground construction would severely degrade the river. Additionally, potential leakage from oil-filled cables used to cool underground lines could contaminate the river, and any necessary repair of the line could cause further physical disturbances to the river. Bangor Hydro-Electric Company also eliminated undergrounding as an alternative because of economic considerations. Costs would have been about 10 times greater for undergrounding than for conventional methods of transmission line installation.

Evaluating whether or not an obstruction across a frequently used eagle flight path is likely to result in collision, however, is problematic. Eagles are not considered particularly susceptible to collisions with manmade structures. Due to their keen vision, slow, deliberate flight behavior, and good maneuverability while in flight, bald eagles routinely and easily avoid obstacles in their path. Another important factor limiting the vulnerability of eagles to collision hazards is that, when migrating, eagles are diurnal. Nonetheless, over the lifetime of this project, some unquantifiable potential exists for eagles to strike and become injured or killed by the proposed transmission line, particularly at the St. Croix River crossing.

Based on a review of available information, we believe that the potential for collision with the transmission line over the St. Croix will be negligible if the shield wires are marked as recommended by both the Northrop, Devine and Tarbell (1991) report and page C-34 of the biological assessment. The markers should be orange-colored and spherical in shape (20 inches in diameter) and placed at 100-foot intervals in a staggered arrangement across both shield wires to maximize their visibility and detection by eagles moving up and down the river corridor. Collision with the towers along the St. Croix is unlikely given that they are to be set back approximately 370 feet and 300 feet from the river edge on the U.S. and Canadian sides, respectively (Northrop, Devine and Tarbell report 1991, Figure 6, page 13). **Provided the towers are located as described above, the lines are marked according to the above statement, and the four measures to minimize effects on eagles identified on pages C-34 and 35 become conditions of DOE's Presidential Permit-89 to Bangor Hydro-Electric, we concur that the project as newly described is not likely to adversely affect the bald eagle.**

GEB-2

Atlantic Salmon

Atlantic salmon (*Salmo salar*) in five downeast Maine rivers (Denny's, Machias, East Machias, Narraguagus and Pleasant) are designated a category 2 candidate species for possible future addition to the endangered species list (Federal Register November 21, 1991). On October 1, 1993, the Service received a formal petition pursuant to Section 4(b)(3)(A) of the Endangered Species Act to list the Atlantic salmon as endangered and to designate critical habitat. On January 10, 1994, the Service published a Notice of Petition Finding that stated the petition contained substantial information warranting a full review of the status of the species (enclosed). Under formalized time frames for the review of species that are petitioned for listing, the Service must publish a finding of whether or not the Atlantic salmon warrants listing as a threatened or endangered species by October 1, 1994.

GEB-3

Since the proposed transmission line route crosses the Machias and Narraguagus rivers (both provide essential spawning and nursery habitat for Atlantic salmon), as well as numerous smaller streams within the watersheds of these and other potential salmon rivers, it is advisable to formalize mitigative measures committed to by the applicant to avoid adverse effects to the habitat these waters provide for Atlantic salmon. These measures, identified in Section 4.4 (pages 4-64 to 4-78) should become conditions of Presidential Permit PP-89. Although as a candidate species, Atlantic salmon are not now afforded any substantive protection under the Endangered Species Act, it would be both timely and prudent to ensure that any adverse effects to this species are avoided — in the event that a decision to list the salmon occurs prior to the initiation of construction activities.

Response to GEB-2: Your suggestions have been added to the mitigation requirements (see Section 4.4.1.5).

Response to GEB-3: Mitigative measures identified in Section 4.4 would become conditions of the Presidential Permit. Also note that Section 4.1.5 has been modified to include an assessment of potential impacts to Atlantic salmon.

GEB-4 The Atlantic Sea Run Salmon Commission is the organization with the biological expertise and management responsibility for Atlantic salmon in Maine. The Program Coordinator and staff of the Atlantic Sea Run Salmon Commission (Commission) should be provided a copy of the DEIS (and mitigation measures) and ample time to review them. Provided that the Program Coordinator for the Commission finds that the proposed mitigation will eliminate adverse effects to the salmon and its habitat, we concur that the project will have no effect on this species. Accordingly, in the event that the Atlantic salmon is determined to be a threatened or endangered species, no further section 7 consultation will be required.

Other Comments

GEB-5 Factual corrections and additions relative to Federal status of species in Table C.4 (Page C-27): Status of Threatened and Endangered Plant and Animal Species That Could Occur in the Project Area, are as follows:

Plants	Federal Status	
New England violet (*Viola novae-angliae*)	C-3C[1]	Correction
Northern valerian (*Valeriana uliginosa*)	None	Correction
Orono sedge (*Carex oronensis*)	C-2	√
Invertebrates		
Brook floater mussel (*Alasmidonta varicosa*)	C-2	√
"Tomah" mayfly (*Siphlonisca aerodromia*)	C-2	√
Dorcas-copper butterfly (*Lycaena dorcas claytoni*)	C-2	√
Fish		
Atlantic salmon (*Salmo salar*)	C-2[2]	Add
Birds		
Bald eagle (*Haliaeetus leucocephalus*)	E	√
Northern goshawk (*Accipiter gentillis*)	C-2	Add
Mammals		
Lynx (*Lynx canadensis*)	C-2	Correction
Northern bog lemming (*Synaptomys borealis*)	C-2	Correction
Small-footed myotis (*Myotis leibii*)	C-2	Correction

We commend the DOE for developing a comprehensive and well written DEIS. We also commend Bangor Hydro-Electric Company for undertaking the bald eagle study conducted by Northrop, Devine and Tarbell along the St. Croix River and for their foresight in the design of the many mitigation measures that greatly lessen the project's adverse effect on wildlife and the environment.

---

[1] Withdrawn from consideration as a candidate species.

[2] This species currently the subject of a petition to list as endangered with critical habitat.

Response to GEB-4: At your request, a copy of the DEIS was sent to Atlantic Sea Run Salmon Commission. However, no comments on the DEIS were received from the commission. Project routing plans for the major stream crossings, coupled with mitigative measures committed to by the applicant (Section 4.4.1), would effectively prevent any significant impacts to Atlantic salmon. Also refer to revised Section 4.1.5.4 that now addresses the Atlantic salmon.

Response to GEB-5: Table C.4 has been corrected on the basis of your comments. Changes have also been made to the text in Sections 3.1.5.4 and 4.1.5.4 in response to your comments.

Informal section 7 (ESA) consultation on this project should continue
relative to the outcome of DOE discussions with the applicant, Bangor Hydro-
Electric, and the recommendations contained herein. We would appreciate
GEB-6 notification that the Program Coordinator of the Atlantic Sea Run Salmon
Commission has been provided a copy of the DEIS and would like to receive a
copy of their comments when they are available. Finally, we would
GEB-7 appreciate written notification of your intent to proceed with issuance of
Presidential Permit PP-89.

While it is the consensus of Bangor Hydro-Electric, their consultants
Northop, Devine and Tarbell, and this office that the proposed transmission
line, if properly marked, will not adversely affect the bald eagle, there is
one additional, discretionary measure that could be taken by BH-E to further
demonstrate their commitment to bald eagle conservation. In the unlikely
event that over the lifetime of this project one or more bald eagles do
collide with the line or associated structures, we recommend that Bangor
GEB-8 Hydro-Electric assume the financial cost of veterinary treatment and
rehabilitation of these birds. Since avian line strikes usually entail wing
injuries, rehabilitation can sometimes take several months, or if the injury
is permanent, the bird must be euthanized or cared for for the remainder of
its life, a period of many years.

We envision that agreement by BH-E to assume this financial responsibility
could involve a sum of several hundred dollars to the low thousands per
injured eagle (not to exceed $5,000.00 per eagle). In the unlikely event
that an eagle injury or mortality occurs, we would recommend that BH-E meet
GEB-9 with us and representatives of the Endangered Species Project Office of the
Maine Department of Inland Fisheries and Wildlife (Bangor) to determine if
any physical remedial actions can be implemented to prevent further line
strikes. In the unlikely event of an eagle mortality caused by the line, we
recommend that BH-E assume only the cost (if any) of retrieving the eagle
GEB-10 and to conduct the required and standard necropsy and contaminants analyses
(not to exceed $1000.00 per bird).[3]

Please refer questions regarding this letter and further endangered species consultation to Michael Amaral of this office (tel. 603/225-1411).

Sincerely yours,

Gordon E. Beckett
Supervisor
New England Field Offices

Enclosure

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[3] Since the bald eagle is protected by both the Endangered Species Act of 1973, as amended, and the Bald Eagle Protection Act of 1940, agreement to assume financial responsibility for injured or dead eagles does not provide immunity from potential prosecution under these statutes.

Response to GEB-6: See response to comment GEB-4.

Response to GEB-7: A Federal Register notice will be issued regarding the decision on issuance of Presidential Permit PP-89. In addition, a separate copy of the Record of Decision will be mailed to Mr. Beckett when completed.

Response to GEB-8: Your suggestions have been added as recommended mitigation (see Sections 4.4.2.5 and C.2.4).

Response to GEB-9: Your suggestions have been added as recommended mitigation (see Sections 4.4.2.5 and C.2.4).

Response to GEB-10: Your suggestions have been added as recommended mitigation (see Sections 4.4.2.5 and C.2.4).

February 10, 1994

Office of Fuels Programs
ATTN: Xavier Puslowski
Office of Asst. Sec. for Fossil Energy
U. S. Department of Energy
1000 Independence Avenue S.W.

Dear Mr. Puslowski:

As a long-time resident of Washington County, I would like to comment on Bangor Hydro-Electric's proposed power line which would pass through Penobscot, Hancock, and Washington Counties. Most of the line would be in Washington County.

After a conversation with Bill Cohen today, I am requesting a copy of the Environmental Impact Statement (draft) from your office.

NBb-1 Public input meetings were held last month in outlying towns along the proposed route. Other county residents who might have attended, find midwinter with bad weather and poor road conditions make travel difficult. I suggest that Bangor Hydro hold meetings in June in Machias and Ellsworth, county seats of Washington and Hancock Counties.

NBb-2 A previous effort to locate this power line in a more populated area of Maine, received considerable coverage in the media and was strongly opposed. Bangor Hydro quietly pursued a new location in a more remote area. Washington County is sparsely populated and is an economically depressed county. The power line would be of little, if any, benefit to the residents here.

As chair of the Washington County Soil and Water Conservation District, it is disturbing to know that once again large companies and powerful interests are taking advantage of this county and its wealth of natural resources. We do not have the population nor the political clout to address these projects.

I would appreciate any information or comments you may have and will gladly pass them along to the rest of the Board in the District.

Sincerely,

Nancy Bennett

nb/n

25 Water Street
Machias, ME 04654

Response to NBb-1: The January public hearing dates were selected by the U.S. Department of Energy (DOE). It is DOE's policy to hold public hearings on each of its draft environmental impact statements (DEISs) soon after the availability of the DEIS is announced in the Federal Register. The Federal Register notice for the DEIS on Bangor Hydro-Electric Company's proposed project was published on December 23, 1993. That notice initiated the 45-day public comment period on the DEIS, and it was prudent for DOE to hold its public hearings during that comment period. Although it is possible that not all residents who may have wanted to attend the hearings could do so, they did have the opportunity to send in written comments. All comments received, written or oral, have been given individual and equal consideration.

Response to NBb-2: Chapter 2 of the EIS describes factors involved in the routing decisions for the proposed project. The proposed route was chosen on the basis of a practical point for a second transmission line to come in from New Brunswick, coupled with the goal of minimizing both environmental impacts and the number of residences that the line would be located near. Bangor Hydro-Electric Company held several town meetings on the proposed project in the early stages of project planning and routing. Also, DOE held public scoping meetings on the proposed project (see Section 2.1.2) to solicit concerns and suggestions from property owners; local residents; and local, state, and federal agencies. The benefits that Washington County residents (who reside within the New England Power Pool [NEPOOL]) would derive from the line are those discussed in Section 1.2.

March 31

Dear Mr. Como,

I have read the draft EIS for Bangor Hydro Electric's proposed transmission line from New Brunswick.

NA-1 I am concerned that the discovery of archaeological remains of a hunting and gathering economy has not been shown to the Indian nations in Maine as I did not see any reference to communication with the Indians.

As you know NEPA requires early notification of Indian tribes when there is possible impact.

Would you please forward to me the communications you have had with the Indians.

Thank you -

Nancy Allen
Box 909 RR 1
Surry, ME. 04684

207-667-2016

Response to NA-1: During the routing assessment stage for the proposed project, the applicant conducted the necessary investigations concerning potential impacts to historic and archaeological resources. Surveys of the proposed route revealed only one site (Machias River) that appeared to meet the eligibility criteria for the National Register of Historic Places (Section 3.1.8.2). No corridor construction is planned near the Machias River. Thus, there would be no impact to the site as a result of the proposed project. The Maine Historic Preservation Commission has determined that construction of the proposed line would not adversely effect any archaeological sites that are eligible for the National Register of Historic Places (Section 4.1.8). Because there would be no impacts to archaeological resources (including those that may be associated with American Indians native to Maine), there was no need to notify Indian tribes of Maine of potential impacts to their cultural resources.

NICOLS FOX
P.O. BOX 300
BASS HARBOR, MAINE 04653
TEL 207-244-5542

April 11, 1994

Anthony Cuomo
Office of Fuels Programs
Office of Fossil Energy
US Dept. of Energy
1000 Independence Ave. SW
Wash. D.C. 20585

Mr Cuomo:

NA-2 I would like for this article to be accepted as comment in the proposed Bangor Hydro-Electric Company's Second 345-kV Transmission Line to New Brunswick.

Thank you.

Sincerely,
Nicols Fox

Response to NF-1: Your article "Indecent Exposure" (*Lear's*, August 1993 issue) has been included as an attachment to your comment letter. The major issues and concerns expressed in the article include the potential link between electromagnetic field (EMF) exposure (both residential and occupational) and health concerns (with particular concern about cancer) and magnetic fields associated with electrical wiring and household appliances. Section 4.1.9 of the EIS contains an extensive review of the EMF exposure health issue, including results of epidemiological studies, comparisons of source exposures to magnetic fields, potential mechanisms by which magnetic fields could affect health, prudent avoidance recommendations, and routing considerations to minimize residential exposures. Section 4.1.9.7 summarizes DOE's current position on the EMF topic.

LEAR'S AUGUST 1993

INDECENT EXPOSURE

Experts don't agree on whether electromagnetic fields cause cancer, but a lot of people aren't waiting around for a verdict. They're putting down the hair dryer, unplugging the electric blanket, moving the clock radio farther from the bed. Here's why

I think I bought the first gauss meter in my neighborhood.

A gauss meter measures the electromagnetic fields produced whenever an electric current flows through a wire, whether in a power line or in an electric appliance. These are invisible fields that pass through lead, cement, earth—virtually anything except a few metal alloys—and they're all around us.

Gauss meters come in different sizes and shapes, but mine is in two parts. I hold the sensing device, a box about 4 1/2 inches by 2 3/4 inches by 1 inch in one hand, and in the other I hold the meter, watching the needle move up and down. They aren't cheap. Mine cost $340, from ExpanTest Inc., a company in Portland, Maine, that designs and sells them. I was that curious. For the past 20 years or so, studies here and there have linked electromagnetic fields—commonly called EMFs—with health problems ranging from headaches and depression to several forms of cancer and leukemia. Recently, these studies have begun to proliferate. Gauss meters are likely to proliferate, too.

Once you start measuring things, it's hard to stop. Ordinary electric lights don't even move the meter at reading range. When my new computer is on, it registers as much as 30 milligauss (mG) on my meter when measured from the back. But from the front, where I'm sitting, it measures only about .3 mG. My TV measures 30 mG at six inches, but only 1.5 mG at three feet. The clock beside my bed makes a 2-mG blip every time it ticks.

What these numbers mean is a subject of controversy. Federal regulating agencies and the Electric Power Research Institute (EPRI) both downplay a connection between EMFs and cancer, despite a number of studies indicating otherwise. A Swedish study using sophisticated assessments of past exposure confirmed a link between EMFs and childhood leukemia. Swedish regulators are considering a standard for new power lines, new transformers, and new homes near power lines that would limit acceptable exposure for individuals to 2 mG, with peak exposure around 10 mG. A 33,000-volt power line running over your head could dish out a steady 9 mG.

My dishwasher, when it's running, registers 50 mG. My coffee grinder measures a surprising 35 mG. I don't have a microwave, but my trendy Italian toaster sends up 4 mG from a distance of 12 inches. My hair dryer is the stunner: 300 mG. And it's aimed right at my head. ➤

By Nicols Fox Photographs by Robin Broadbent

A friend of mine was given an electric razor for Christmas. A few weeks later he noticed the arthritis in his hand acting up. Then he thought of EMFs and the razor. He asked me to check it out with my gauss meter. The razor measured off the scale—more than 1,000 mG. The uncle who gave it to him, who's used an electric razor all his life, has cancer—lymphoma, to be exact, one of several cancers associated with EMFs. My friend got rid of his razor. And his electric blanket, and his electric stove, which he replaced with a gas stove. They call this prudent avoidance—the kind of action you take when you're not quite sure, but you want to manage your risks.

The telephone linemen working outside my house have also begun thinking about risk management. One of them took my gauss meter up in the cherry picker to check EMFs near the lines where he works. He measured a steady 10 mG exposure. When he came down, he told me he'd had testicular cancer—a testicle had been removed. He'd gotten sick about 8 years ago, after working on the lines for nearly 20 years. This is only an anecdote.

The debate over EMFs, which has reputable scientists lined up on both sides, has moved out of the laboratories and the scientific journals and into the public domain, even into pop culture. Eddie Murphy's film *The Distinguished Gentleman* had an EMF plot line; on TV, last season's *Civil Wars* had one, too. Lawsuits are multiplying, house prices are falling, corporations are moving offices or equipment to protect workers. The construction of high-voltage transmission lines in several states has been either delayed or prevented. Insurance companies, utility companies, and appliance manufacturers are tense, fully aware that a proven association between EMFs and illness could have enormous economic consequences. Given growing public concern, even the threat of a link is leaving a wake.

Nancy Wertheimer is the mother of electromagnetic fields. She's the epidemiologist who first noticed the little black boxes on the tops of utility poles in Denver, Colorado, in 1977, and drew a connection between the EMFs the lines produce and childhood-leukemia cases she was studying. It wasn't the boxes, or transformers, that were the problem, but the configuration of wires they signaled.

She and a physicist friend, Ed Leeper, followed that discovery with a study called "Electrical Wiring Configurations and Childhood Cancer" in *The American Journal of Epidemiology* in March 1979. The first paragraph read:

> Electrical power came into use many years before environmental impact studies were common, and today our domestic power lines are taken for granted and generally assumed to be harmless. However, this assumption has never been adequately tested. . . . In 1976–1977 we did a field study in the greater Denver area which suggested that, in fact, the homes of children who developed cancer were found unduly often near electric lines carrying high currents.

Wertheimer would see her study picked apart by scientists, utility companies, and other critics, who faulted both her methods and her conclusions. Lacking grant money, she had funded it herself, and even that drew fire. Leading the attack was EPRI. Its clients, the electric-utility companies, had a lot at stake. Critics said her research was "almost impossible to evaluate," "unscientific," and based on "questionable statistical calculations."

"She underwent years of attacks by an old-boy network who didn't think a woman could have done this," says Paul Brodeur, a *New Yorker* staff writer who sounded some of the first and loudest alarms about EMFs in a series of articles in the magazine between 1989 and 1992.

Wertheimer is more charitable than Brodeur. Most criticism, she feels, came from honest doubts. "When we found the link, we said it was crazy," she says, "and I was sure it was going to go away. After a while we couldn't get rid of it—so we published it. We were as skeptical as anyone."

Some subsequent studies failed to duplicate the link, but several others confirmed what Wertheimer found. In 1984, David Savitz, an epidemiologist at the University of North Carolina, Chapel Hill, went back to Denver, used new cancer cases, spent more money to ensure a blind study, and, in 1988, came up with a relationship between childhood cancer and wire configurations that was similar to Wertheimer's. In 1991, Stephanie J. London, of the University of Southern California School of Medicine in Los Angeles, using a standard of measurement devised by Wertheimer and Leeper to predict exposure, found that children exposed to power lines were more than twice as likely to have childhood leukemia. Most recently her findings were confirmed in a Swedish study conducted by doctors Anders Ahlbom and Maria Feychting. Released in September 1992, the study found that children living near transmission lines where they received 3 mG of exposure were nearly four times as likely to get leukemia. It appeared that the closer the children lived to the transmission lines, the more likely they were to get sick.

Following the release of the Swedish study, Sweden's National Board for Industrial and Technical Development announced that it would "act on the assumption that there is a connection between exposure to power-frequency magnetic fields and cancer, in particular childhood cancer"—making Sweden, according to a watchdog newsletter called *Microwave News* that has monitored the subject for more than a decade, the first country to officially recognize an EMF-cancer link.

One of the biggest problems in doing epidemiological studies on electromagnetic fields is that it's difficult to find an unexposed group to use as a control. For example, even when you ask whether or not people use an electric blanket, the chances are that those who don't are exposed to EMFs in many other ways—from power lines, wiring, and appliances in their homes. As Wertheimer says, it's not like comparing someone who smokes with someone who doesn't. It's like comparing someone who smokes two and a half packs a day with someone who smokes two. Which means that the data aren't going to be nice and clear, like the link between cigarettes and lung cancer—and everyone knows how long it took for that hypothesis to be accepted.

Confounding, too, is the fact that although there are some strong clues, no one has quite figured out the mechanism of magnetic fields—that is, how they do what they seem to be doing. Scientists demand to know *how* something happens before they're comfortable saying it *does* happen, but that very insistence might cause unreasonable delays in reducing EMF exposure. As the Swedish study's Ahlbom recently said. "Even for cigarettes—while we know there is a lot of chemical exposure—we really don't know what it is about cigarette smoke that causes cancer."

Wertheimer thinks that rather than causing cancer, EMFs enhance its progression. One theory is that they affect the pineal gland's production of melatonin, a substance that seems to help cells defend themselves against cancer. So it just might come down to our immune systems. That would explain why, in all the various studies, there isn't an association with just one type of cancer, but with several.

Microwave News's Louis Slesin, who monitors the press for EMF stories, notes that studies finding no link get "a lot of press," while the recent Swedish study failed to generate much interest at all. Nothing on the front page or in the science pages of *The New York Times* or *The Washington Post*, for example.

"The media think this is some kind of black magic," says Slesin, irritated by the "junk science" label pinned on EMF research. Of the hundred or so studies on EMFs and cancer, the vast majority show a link, he says, and most were published in peer-reviewed journals—generally seen as evidence of professional credibility.

Skeptics exist in abundance. A 1992 report of the British National Radiological Protection Board concluded that the EMF cancer literature "provided no firm evidence of the existence of a carcinogenic hazard" from extremely low frequency electromagnetic fields. Despite Paul Brodeur's 35-year tenure at *The New Yorker*, his book *Currents of Death* was greeted with "general scoffing," says writer Peter Blumberg, who surveyed the media's response to Brodeur's research in *The Washington Journalism Review* in 1991. When *New York Times* science reporter William Broad reviewed the book, he compared Brodeur's thesis with that of someone who believes in space aliens.

While EPRI publicly says it reserves judgment on EMFs, its own journal tells how to "manage occupational exposure" and reconfigure power lines to reduce emissions. Robert S. Briggs, president and CEO of my local company, Bangor Hydro-Electric in Maine, says flatly, "No one has established that there is any harm caused by EMFs." But BHE's spokesperson admitted that the company had tested some of its own generating facilities and substations, had talked to its workers about EMFs, and had measured EMFs at schools and factories. The company hopes to install new power lines coming from New Brunswick, Canada—and their design has been reconfigured to reduce EMF exposure.

"No one wants to go on record saying the risk is real," says Dr. Keith Florig of Resources for the Future, a nonprofit research group based in Washington, D.C. Florig believes that what EPRI and others are saying is: "We aren't sure—we probably will never be—what the link is, but we don't require certainty to take steps to reduce emissions."

Deciding how much exposure is risky is difficult. Although New York and Florida have set new standards, the rules stand on shaky ground. "We don't know what to look for," says Wertheimer. "We don't know whether it's the intensity, whether it's intermittent exposure, or even whether it has something to do with resonance with the earth's fields." The Ahlbom study, which pinpoints a dose-response relationship between childhood leukemia and EMFs, helps make the case for average field exposure when coupled with other studies showing a relationship to cancer.

Last year the Environmental Protection Agency (EPA) failed to spend the $1.9 million Congress had allocated to EMF research. (The money has now been shifted to the National Institute of Environmental Health, a department that concentrates on basic research.) In 1990, a copy of an EPA report leaked to *Microwave News* called EMFs "probable" carcinogens. The wording was changed in the final draft to "possible" carcinogens, reportedly under White House pressure.

When a White House–funded report on EMFs was released in November 1992, it reported "no convincing evidence in the published literature" to support EMFs as a "health hazard," and concluded that "research into health concerns should not receive a high priority." Wertheimer says the report was "overbalanced on the skeptical side."

The public, increasingly uneasy about the dangers of exposure, isn't waiting around for authorization from government agencies, corporations, or institutions before taking action. "Control no longer resides in state and federal agencies," says Brodeur. "It's moved to the people, to citizen action and litigation."

Lawsuits filed have come from policemen with cancer who had used radar guns; the husband of a woman who died of a brain tumor and who had used a cellular phone; and ➤ 86

INDECENT EXPOSURE

➤ 49

employees claiming that occupational exposure to EMFs caused their cancer. One recent suit brought by the parents of a child who lived close to power lines and who developed cancer was rejected by the jury, who declined to hold the power company responsible—but no one expects lawsuits to drop off because of one setback.

Growing public apprehension is having a practical effect on utility companies. New power-line construction has been slowed or halted by protests in New Jersey, New Hampshire, Maine, and Washington State, and power lines have been rerouted in Texas and elsewhere. As new lines are built, where they're to be placed and what fields they will generate becomes an important consideration.

"The shortest distance between two points is no longer a straight line," says John W. Ellis, chairman of the board of Puget Sound Power and Light Company—meaning that planners now have to contend with the public's perception of the dangers, rather than simply relying on engineering surveys, as they once did.

In its March-April 1993 issue, *Microwave News* reported that tenants at some of New York's best addresses—from the Chrysler Building to Gateway Plaza—had found high levels of EMFs in their buildings. The responses of building owners were varied: In some cases, the fields were shielded (a very expensive proposition); in others, the space was used for storage instead of employees. Three firms—Watermark Associates, Marine Midland Bank, and Darby & Darby P.C.—are taking or have taken legal action against the buildings' owners.

Ironically, the first sign of EMF trouble is usually not ill health, but computer glitches. EMFs can cause interference—wavy lines and other problems—on computer monitors. That was what led the Columbia School of Public Health to rearrange a suite of offices to lower both computer and human exposure to EMFs measuring, in some areas, between 800 and 2,000 mG. Dr. Edward Christman, Columbia's director of environmental health and safety, said that the fields were below present government standards for occupational exposure, but in light of the emerging studies, he expects that standard to be "dropped before too long."

Christman says he assumed that if employees were not moved, they'd complain. "When we heard some years ago that the Russians were aiming microwaves at the U.S. Embassy in Moscow, there was a lot of chuckling [among scientists] at those crazies who were worried about low frequency exposure," says Christman. "I don't hear that many people chuckling anymore."

It's quite possible to resolve some EMF problems in existing buildings. Employees can be moved away from areas with high fields, computers can be spaced so as not to expose other workers, or lines can be reconfigured to cancel out EMFs at relatively low cost, as was recently done at a computer software company in Palo Alto, California.

When the World Bank began work on its new headquarters in Washington, D.C., architects and engineers planned ways to mitigate EMF exposure. What the World Bank wanted to avoid was a mistake at an early stage that would be costly to correct later. Richard E. Barry, a consultant to the organization, says that the entire project, which involves both renovation and additional construction, will take six years, and the bank is considering setting EMF specifications before purchasing new equipment. Says Barry, "We didn't want to wait until Year Four to learn that there was EPA research showing a definite health hazard."

Solving problems in individual buildings is one thing; doing something about the country's power-delivery system is quite another. Burying electrical-distribution lines (tightly packed in oil-filled pipes to cancel out the EMFs they produce) could be very expensive. "What people don't realize is, if this is going to be fixed, you and I are going to pay for it," says Wertheimer. The cost will have to be weighed against possible risk and benefits—and the risks have to be put in perspective. One child in 25,000 might get leukemia without EMF exposure. The Swedish study seems to indicate that exposure might raise that to 3 or 4 in 25,000.

Individual decisions about household appliances are easier. Houses can be tested, beds can be moved from "hot spots." You can move your electric clock away from your head, avoid standing over a running dishwasher, sit well away from your television. But first, unplug the electric blanket, a high source of EMFs that exposes users over a long period of time.

The last thing Wertheimer wants to see is panic. But, as she said in 1989, "I don't use an electric blanket, and I don't know anyone in the field who does." ●

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203-2211

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REC'D DOE/FE

Tony Como
Office of Coal and Electricity (FE-52)
Office of Fuels Programs - Fossil Energy
U.S. Department of Energy
1000 Independence Avenue, S.W.
Washington, D.C. 20585

re: Draft Environmental Impact Statement - Construction and Operation of New Brunswick 345-kV Transmission Tie Line; Bangor Hydro-Electric Company

Dear Mr. Como:

The Environmental Protection Agency, in accordance with its responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act has reviewed the Department of Energy's draft Environmental Impact Statement (dEIS) for Bangor Hydro-Electric Company's proposed second transmission tie line to New Brunswick.

JPD-1 EPA has determined that the dEIS adequately addresses issues within our jurisdiction and areas of expertise. On the basis of our review, we have rated this project "Lack of Objections" (LO). Please see the attached sheet for a full explanation of this rating.

Thank you for the opportunity to review and comment on this document. Please contact Steven John of my Environmental Review team at 617/565-3426 if you have any questions regarding our project review.

Sincerely,

John P. DeVillars
Regional Administrator

PRINTED ON RECYCLED PAPER

Response to JPD-1: Thank you for the review. No response required.

SUMMARY OF RATING DEFINITIONS AND FOLLOW-UP ACTION

<u>Environmental Impact of the Action</u>

LO–Lack of Objections
The EPA review has not identified any potential impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC–Environmental Concerns
The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce the environmental impact. EPA would like to work with the lead agency to reduce these impacts.

EO–Environmental Objections
The EPA review has identified significant environmental impacts that must be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU–Environmentally Unsatisfactory
The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the CEQ.

<u>Adequacy of the Impact Statement</u>

Category 1–Adequate
EPA believes that draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis or data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2–Insufficient Information
The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses, or discussion should be included in the final EIS.

Category 3–Inadequate
EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analysed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the NEPA and/or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.