State of Maine Comments on U.S. Department of Energy CRP Draft Area Recommendation Report

Task Force on High-Level Nuclear Waste
Joseph E. Brennan, Governor

April 1986

Front cover: Generalized map of crystalline rocks in Maine. From Osberg, P.H., Hussey, A.M., II, and Boone, G.M., Bedrock Geologic Map of Maine, Maine Geological Survey, 1985.

State of Maine

Joseph E. Brennan, Governor

Comments on the Department of Energy Crystalline Repository Project Draft Area Recommendation Report

Prepared by the

Governor's Task Force on High-Level Nuclear Waste

Chairman: Richard E. Barringer, Director, State Planning Office

Richard B. Anderson, Commissioner, Department of Conservation
Peter Bradford, Chairman, Public Utilities Commission
Dana Connors, Commissioner, Department of Transportation
Paul A. Fritzsche, Public Advocate
Senator Judy C. Kany, Chairman, Advisory Commission on Radioactive Waste
John Kerry, Director, Office of Energy Resources
Michael R. Petit, Commissioner, Department of Human Services
Kenneth C. Young, Jr., Commissioner, Department of Environmental Protection

Henry E. Warren, Director

April 15, 1986

STATE OF MAINE
OFFICE OF THE GOVERNOR
AUGUSTA, MAINE
04333

JOSEPH E. BRENNAN
GOVERNOR

The Honorable John Herrington
Secretary
U.S. Department of Energy
1000 Independence Avenue SW
Washington, DC 20585

Dear Secretary Herrington:

I am enclosing for your review, and that of the Crystalline Repository Project staff, Maine's response to the Draft Area Recommendation Report (DARR) released by the Department of Energy on January 16, 1986. Our case has many aspects, presented by many voices, in addition to this official response document; but ultimately, it is one case that can be stated quite simply: Maine is the wrong place for a nuclear waste repository.

In the face of an extreme and arbitrary time schedule set forth by your Department, the State has been able to mobilize government, business, and citizen resources to develop powerful scientific evidence to support this contention. As you review the enclosed evidence and the results of work in progress to be filed at a later date, I am confident you will come to the conclusion that continued expenditures of time and dollars in area characterization efforts within Maine will prove fruitless.

The evidence will show that there are many reasons that the Bottle Lake complex is inappropriate and should be dropped from the list by the Department of Energy. For example,

1. The area, already the second smallest potential site in areal extent, is made even smaller by the extensive pattern of wetlands, lakes, and streams, which are not reflected in the DARR.

2. The Department did not properly disqualify State-designated critical areas and wildlife protection zones which are "comparable State protected resources," similar in every respect to federal protection areas.

3. The Department must acknowledge that field work and monitoring would be required in Canada if further effort is expended in the Bottle Lake area. Such work would contradict prior agreements between the United States Government and Canadian governments.

4. The Department must acknowledge the many legal obstacles involved in a project which will seriously impact the Indian lands so recently restored to the Penobscot Nation and the Passamaquoddy Tribes.

The evidence will further show that a number of geologic, environmental, and methodological factors have been incorrectly or inadequately addressed. When seen together, there can be no conceivable justification for considering the Bottle Lake Complex further.

With regard to the Sebago Lake Batholith, there is equally powerful evidence that a significant mistake has been made.

1. Geophysical work conducted by an eminent expert from M.I.T. shows clearly that the proposed host rock is far too thin to house a nuclear waste respository. This condition cannot be mitigated or engineered around.

2. Contrary to assertions in the DARR, the Batholith is not "tectonically inactive."

3. The Sebago Lake watershed contains the water supply for the most densely populated and fastest growing area of Maine. Construction and operation of a nuclear waste repository would threaten the quality of that water.

4. The construction and operation of a repository would increase the levels of radiation in an area where background levels already exceed the safety standards set by EPA.

5. The Department has ignored its own study indicating that the Sebago lake area contains significant mineral resources, a factor which should disqualify the area by your stated criteria.

6. The Department has seriously underestimated the population in the area, particularly during peak seasonal periods. In addition, DOE has unfairly applied population disqualifiers in a way that does not reflect a realistic picture of the densities in that area.

All of these technical shortcomings support the common sense conclusion that these sites should be eliminated from the DOE list. I believe their presence reflects a selection process that is driven by an arbitrary time schedule rather than by the requirements of science. More importantly, it reflects an underlying selection process that is fundamentally flawed in its design. This process threatens to place the people of twelve areas under a terrible psychological and economic burden of uncertainty for years. It endangers the scientific legitimacy and public credibility that the Department must have if it is to succeed in dealing responsibly with the nation's nuclear waste problem.

I encourage you to report to the Congress that the process must be stopped now, and a mid-course review conducted at an early date. If necessary, the waste can be properly managed in a temporary facility on federal lands where it can be retrieved when a scientifically valid course has been set that will have the support of the American people.

Sincerely,

Joseph E Brennan
JOSEPH E. BRENNAN
Governor

JEB:nv
enclosure

Table of Contents

Transmittal letter from Governor Joseph E. Brennan

Executive Summary 1

Acknowledgments 5

Technical Advisory Group 6

Chapter 1: Comments on Process and Methodology

- Introduction 7
- Overview of the Screening Process 8
- Step 1: Disqualifying Factors Screen 9
- Step 2: Regional Variables Screen 10
- Coding of grid cells 14
- Weighting process: selection of weights 14
- Identification of selection and ranking of candidate areas ... 15
- Definition of candidate area boundaries 15
- Deferral analysis: general comments on process 16
- Other siting criteria: designation of the Northeast and North Central regions as separate geohydrologic settings 17
- Disqualification analysis: designation of potentially acceptable sites 17
- Process of selection of candidate areas for study in the area phase 17
- Inadequate 90 day review period 18
- Summary 19

Chapter 2: Comments on Deferral Analysis

- Introduction 21
- Candidate Area NE-2 - Bottle Lake Complex 22
- Candidate Area NE-4 - Sebago Batholith 29

Table of Contents (continued)

Technical Appendices

Methodology and process -
- Appendix A1: Analysis of DOE/CRP weight sets
- Appendix A2: Accuracy of DOE/CRP data base
- Appendix A3: Identification and selection of candidate areas
- Appendix A4: Comments on selection of areas for further study in the area phase
- Appendix A5: Comments on descriptions of the Bottle Lake and Sebago Lake candidate areas

- Appendix A6: Estimation of Flood Prone Areas

- Appendix A7: Major community water supplies and watersheds in southern Maine

Department of Conservation -
- Appendix A8: Land Use Regulation Commission

Bureau of Public Lands -
- Appendix A9: Policy on nuclear waste disposal in the Public Lands

Maine Geological Survey -
- Appendix A10: Comments on mineral resource assessment
- Appendix A11: Sebago Lake as a regional discharge zone
- Appendix A12: Designation of separate geohydrologic settings
- Appendix A13: Open-file report 86-15 - GEOSS, Inc., Gravity and its geological interpretation: the Sebago pluton and vicinity, southwestern Maine
- Appendix A14: Open-file report 86-16 - Caswell, Eichler, and Hill, Inc., Lineament analysis in central and coastal Maine using 1:250,000 scale Side Looking Airborne Radar imagery
- Appendix A15: Comments of Dr. John Ebel - Comments on regional seismicity
- Appendix A16: Preliminary comments of Dr. Patrick Barosh - Preliminary fault and lineament analysis of the Bottle Lake Complex and Sebago batholith

Department of Environmental Protection -
- Appendix A17: Bureau of Air Quality Control
- Appendix A18: Bureau of Land Quality Control
- Appendix A19: Bureau of Water Quality Control
- Appendix A20: Climatic Characteristics

- Appendix A21: Maine Historic Preservation Commission

Table of Contents (continued)

Appendix A22: Department of Human Services -
Background radiation in the Sebago batholith

Appendix A23: Department of Inland Fisheries and Wildlife

Appendix A24: State Development Office -
Tourism and recreation in the
Sebago Lake and Bottle Lake areas

State Planning Office
Appendix A25: Population density: 1980 Census data
Appendix A26: List of State properties and
environmentally significant features

Appendix A27: Department of Transportation -
Transportation systems

Materials Provided by Other Agencies

Appendix A28: Greater Portland Council of Governments -
Analysis of population growth
and seasonal population increases

Appendix A29: Maine Youth Camping Association -
Comments provided the Department of Energy,
April 8, 1986

Appendix A30: Portland Water District
Suitability of the Sebago Batholith as a
Potentially Acceptable High Level Nuclear
Waste Site

Appendix A31: Natural Resources Council of Maine -
Comments by Dr. John Creasy

Appendix A32: Letter from Dr. David Sanger, Department of Anthropology,
University of Maine, Orono, to Dr. David Wihry,
February 14, 1986

Table of Contents (continued)

Appendix A33: Letter from Margaret M. Roy, Executive Director, Saco River Corridor Commission, to Dr. Sally Mann, March 10, 1986

Appendix A34: Letter from Commissioner Kenneth C. Young, Jr., Maine Department of Environmental Protection, to Mr. Howard Larsen, Regional Director, U.S. Fish and Wildlife Service, April 8, 1986.

Appendix A35: Letter from Ambassador Allan Gotlieb to Senator George Mitchell, March 5, 1986

Appendix A36: Comments by Dr. Gene Simmons prepared for the State of Vermont

Appendix A37: Agreement between the Governments of the United States and Canada governing transit pipelines

Comments on Department of Energy Draft Area Recommendation Report

Executive Summary

This summarizes the key points made by the State of Maine in the document "Comments on the Department of Energy Crystalline Repository Project draft Area Recommendation Report." It is the result of an analysis by numerous State agencies, consultants, local government officials, and private citizens. Additional work in progress for submittal at a later date includes a verification of population data in the Sebago Lake Batholith area, and a socio-economic impact study of the potential cost to Maine if project study and implementation should continue.

It is the intent of these comments to identify and document the serious concerns the State has with the methodology used by the Department of Energy and with the nature and quality of the information used in the screening process. We demonstrate that the Department of Energy decision to include two candidate areas in Maine for study is seriously in error. Our comments are grouped in two primary categories with accompanying appendices.

I. Process and Methodology

Little or no geologic information is available that would allow the Department of Energy to determine the actual suitability of a rock body for a repository. Accordingly, the Department of Energy's emphasis at this stage of its screening was directed towards avoidance of surface areas with demonstrably incompatible land uses or environmental characteristics.

A. The DOE treatment of "highly populated areas" does not produce a fair and consistent list of municipalities with populations in excess of 2500 persons. Many Maine towns with populations in excess of 2500 persons should be disqualified.

B. Maine Land Use Regulation Commission areas zoned for Fish and Wildlife Protection serve the same purpose as Federally designated wildlife areas, and should be disqualified by the Department of Energy.

C. The regional variable screen used by DOE was severely limited by available information, and inadequate surrogate measures were often substituted. As a result:

1. Rock mass extent has been overstated.

2. Ground water discharge zones are given inadequate attention.

3. Data on the existence of mineral resources is ignored.

4. Variables used to assess seismic risk are inadequate for meaningful discrimination of rock bodies.

5. Population density and location factors are so broad in scale as to be useless in differentiating between rock body areas.

6. The extent of surface water bodies and wetlands is seriously underestimated.

7. The weighing of variables is heavily biased toward geologic factors, for which there is relatively little specific information, thus presenting an unrealistic picture of repository impacts.

8. The scale for ground water resources impact was modified without notice or justification, leading to a diminished impact analysis.

9. The process for identifying and ranking candidate areas was modified without consultation, does not consider all available information, and the results change significantly with minor only alterations in the process.

10. The deferral analysis is extremely subjective and omits a number of important factors such as water supplies, seasonal population, and degradation of the environment during construction.

D. The decision to distinguish between the North Central and Northeast geohydrologic settings was undertaken without consultation or peer review, and is technically flawed.

E. The siting process focuses on the absence of reasons to disqualify, thus favoring locations where there is little information available.

F. The basis for selecting 12 of the 20 candidate areas for characterization, as opposed to 9, 10, 13, or 20, is not substantiated and outside the context of the selection process previously established. Thus, the basis for including Bottle Lake is of dubious merit.

G. The 90 day review and comment period is totally inadequate given the new information in the draft Area Recommendation Report and the need for citizen groups to inform themselves on some very complex procedures and data prior to submitting testimony; this inadequacy is particularly troublesome in light of the enormous consequences to the State if it is not removed from consideration in the final Area Recommendation Report.

II. Deferral Analysis

This section in the draft Area Recommendation Report reviewed factors not considered in the quantitative analysis in an attempt to assure that designated areas were indeed suitable for further study by the Department of Energy. The State finds that this analysis is overly subjective and omits significant information bearing on the suitability of the candidate areas. Our comments are:

A. Bottle Lake Complex

1. Contrary to DOE estimates of 25%, this area contains 30-35% wetlands, thus reducing the area available for possible use as a site to a size below the already minimal 92 square miles.

2. The Bottle Lake area is not "generally well drained terrain", contrary to the assertion in the draft Area Recommendation Report.

3. The area is within 25 miles of an area of demonstrated seismic activity in Passamaquoddy Bay.

4. The draft Area Recommendation Report provides no evidence that earthquake activity is not likely to occur within the design life of a repository at Bottle Lake.

5. The draft Area Recommendation Report omits wildlife protection zones designated by the Land Use Regulation Commission and a number of registered critical areas.

6. The Indian Land issue clearly contradicts the positive finding that there are no land ownership conflicts.

7. Access to the Bottle Lake area by road and rail is extremely poor.

8. The Department of Energy fails to consider a number of Maine environmental statutes which would severely constrain construction and operational activities.

9. The Department of Energy fails to acknowledge the affected population in New Brunswick and the Canadian objections to the need for monitoring in their country.

10. DOE fails to evaluate the economic impact of this project on the quality of life in the Bottle Lake area.

B. Sebago Lake Batholith

1. Independent geophysical analysis of the rock body clearly indicates that it is not of sufficient thickness to support the repository proposal

2. The geology of the rock body is extremely variable, rendering it unsuitable for the intended use.

3. A number of moderate to large intensity earthquakes have occurred in areas adjacent to the Sebago Lake area. The draft Area Recommendation Report concedes a lack of knowledge of the causes of seismic activity in the Northeast.

4. Contrary to the interpretation presented in the draft Area Recommendation Report, the State has presented evidence that earthquake activity in the Sebago Lake area exceeds the regional average.

5. The draft Area Recommendation Report ignores evidence from its own reports which contradict the conclusion that no significant mineral resources occur in this area.

6. The draft Area Recommendation Report does not consider many significant rivers and streams when concluding that the area is "generally well drained."

7. The draft Area Recommendation Report analysis of population density in the Batholith area is in error and omits significant increases due to seasonal influx.

8. Because Maine law prohibits discharges to Class A waters and Great Ponds, the placement, construction, and operation of a repository will be severely constrained, if not prohibited.

9. The existence of high background levels of radiation in the Batholith area due to radon will seriously complicate monitoring of repository performance. The repository construction and operation will increase the public health danger to workers on the site and citizens in the area.

10. The draft Area Recommendation Report ignores the significance of the Sebago Lake watershed area as a source of critical regional water supplies for the southern portion of Maine, and the potential effects of the repository construction and operation on these water supplies.

11. The draft Area Recommendation Report ignores the presence of the Portland to Montreal pipeline and the international agreement which protects its status.

12. The draft Area Recommendation Report fails to address the dependence of the Sebago Lake area on tourism, and the significance of Maine's "quality of life" image to economic development in general.

Acknowledgments

Many individuals contributed to the preparation of this response to the Department of Energy draft Area Recommendation Report. The contributions ranged from providing text or data, assistance in the actual preparation of the response text or figures, or reviewing and commenting on early drafts of the response.

These individuals should be acknowledged for the work they did in meeting extremely tight deadlines in preparing this document. They include:

Advisory Commission on Radioactive Waste: Mary Grow

Department of the Attorney General: James Tierney, Attorney General, Philip Ahrens, Tom Warren

Department of Conservation: James Conners, Steve Dickson, John Forssen, Robert Gardner, Alec Giffen, Carolyn Lepage, Marc Loiselle, Cathy Stultz, Fred Todd, Andrews Tolman, Robert Tucker, Tom Weddle, and Ben Wilson.

Department of Environmental Protection: Teco Brown, Robert Demkowicz, Norma Gordon, Glenn Griswold, and John Williams.

Historic Preservation Commission: Earle Shettleworth

Department of Human Services: Donald Hoxie

Department of Inland Fisheries and Wildlife: Steve Timpano

State Development Office: Les Stevens, Will Richard

State Planning Office: Richard Kelly, Fred Michaud

Department of Transportation: Phil Henry

Marc Loiselle, of the Maine Geological Survey, compiled and edited the main text and the technical appendices, and prepared the final edited version of the response document.

Technical Advisory Group

In Executive Order number 9FY 85/86, which established the Governor's Task Force on High-Level Nuclear Waste, the Governor recognized the need to draw upon all the resources of the State to respond to the Department of Energy's draft Area Recommendation Report. In order to do so, he directed the chairman of the Task Force to establish a Technical Advisory Group, which would include "the State Geologist and appropriate State government personnel and representatives of those public and private interests whose knowledge, expertise, and perspectives are necessary to a full and adequate review of the Federal High-Level Nuclear Waste Repository Program."

The individuals who served on the Technical Advisory Group and reviewed early drafts of the State's comments are listed below. A number of comments were received from Advisory Group members and incorporated into this response; however, this does not imply that the members of the Advisory Group endorse or support all of the comments presented here.

Walter A. Anderson, State Geologist and Director, Maine Geological Survey
Fred Beck, Yarmouth
Dr. Harold W. Borns, University of Maine, Orono
Dr. William F. Brutsaert, University of Maine, Orono
Robert Campbell, Portland
Dr. John Creasy, Bates College, Lewiston
Jon R. Doyle, Esq., Augusta
Dr. Thomas Duchneseau, University of Maine, Orono
Dr. Tom Eastler, University of Maine, Farmington
A. Neil Finlayson, PE, Belfast
Minnie Lee Gartly, Greenville
A. Allan Gass, PE, Paris
Ike Goodwin, North Turner
Dr. Bradford A. Hall, University of Maine, Orono
Dr. Michael S. Hamilton, University of Southern Maine, Portland
Mark Jadkowski, Old Town
Dr. Stephen G. Pollock, University of Southern Maine, Gorham
Dr. Gregory K. White, University of Maine, Orono
Dr. David Wihry. University of Maine, Orono
James Wilfong, Stow

Chapter 1: Comments on Draft Area Recommendation Report Methodology

Introduction

The purpose of the region-to-area screening process was to "disqualify or defer those large areas not likely to contain potentially acceptable sites. Areas which remain are likely to contain sites that will, upon further study, meet the requirements for nomination for site characterization." (Department of Energy, draft Area Recommendation Report, page 1-7.)

This initial description of the region-to-area screening process reflects the unrealistic approach the Department of Energy has taken towards the identification of candidate areas and potentially acceptable sites. As stated in the quote above, the purpose of the region-to-area screening process is to disqualify or defer relatively large areas that are clearly unsuitable for a repository. However, it does not follow that areas remaining are "likely to contain sites that will...meet the requirements for site characterization." Little or no data that are directly applicable to the question of actual performance of a repository are available for any of the 236 rock bodies studied by the Department of Energy.

Because of the nature of the published information used by the Department of Energy in the quantitative selection and ranking process, most of the emphasis in this part of the screening process was towards avoidance of surface areas with incompatible land uses or environmental characteristics. The geologic factors considered in the quantitative selection and ranking process were limited, and frequently an overly simplified surrogate factor was used for a critical factor, e.g., limited portions of major rivers for regional ground water discharge zones.

This chapter presents our comments on the process used by the Department of Energy to identify and rank candidate areas. This includes the variables and weights used in the quantitative part of the selection process; the inclusion of additional siting considerations, specifically the designation of the Northeast and North Central regions as separate geohydrologic settings; the process used by the Department of Energy to decide on the number of areas for inclusion in the next phase of study; and, the method used to select the twelve areas identified for additional study.

Comments on the qualitative deferral analysis carried out for each of the candidate areas and the analysis of disqualifying conditions required to designate the candidate areas "potentially acceptable sites" are in Chapter 2 of this report.

Overview of the Screening Process

Chapter 2 of the draft Area Recommendation Report provides an overview of the region-to-area screening process. In brief, it involved four steps:

Step 1: Application of a disqualifying factors screen, using those disqualifying conditions from the Department of Energy General Siting Guidelines (10 CFR 960) determined to be appropriate for consideration at a regional scale and for which data was available. These include Federal-protected lands, State-protected lands, highly populated areas, and deep mines and quarries. Any area containing one of these features is disqualified from consideration for the surface facilities of a repository. The presence of a deep mine or quarry is sufficient to disqualify a major portion of a rock body from consideration; no deep mine or quarry is allowed within a candidate area.

Step 2: The regional variables screen uses applicable potentially adverse and favorable conditions from the General Siting Guidelines to determine the relative favorability of areas remaining after the application of the disqualifying factors screen. Sixteen variables were used in determining the relative favorability of areas. These are:

- Size of the rock body
- Major ground water discharge zones
- Rock and mineral resources
- Seismicity
- Suspected Quaternary faulting
- Postemplacement faulting
- Proposed-Federal protected lands
- Population density
- Proximity to Federal-protected lands
- Proximity to State-protected lands
- National Forest lands
- State Forest lands
- Critical habitat for threatened and endangered species
- Wetlands
- Surface water bodies
- Proximity to highly populated areas

In addition to these sixteen variables, nine sets of weights reflecting the relative importance of each of the variables were used to generate nine sets of maps showing the relative favorability of areas within the rock bodies.

Step 3: This step, termed the sensitivity analysis by the Department of Energy, was designed to examine various ways of identifying and ranking candidate areas. A specific intent of this step was to "evaluate the effects of using different sets of weights on the selection of preliminary candidate areas." Alternative methods of scaling several of the 16 variables listed above were also examined.

Step 4: The step, called the deferral analysis by the Department of Energy, was intended to examine any qualitative environmental or geologic information not included in the quantitative analysis "to ensure that there is a reasonable expectation, within the constraints of a regional study, that the candidate area warrants further examination in the area phase." (Detailed comments on the deferral analysis are presented in Chapter 2 of this response.)

After these four steps the list of candidate areas was subjected to an analysis of 10 disqualifying factors listed in the Department of Energy General Siting Guidelines to determine whether they could be designated as "potentially acceptable sites" (chapter 4 of the draft Area Recommendation Report.)

Finally, a smaller number of potentially acceptable sites was selected for study during the area phase (chapter 5 of the draft Area Recommendation Report).

Step 1: Disqualifying Factors Screen

Highly populated areas: The State has already commented to the Department of Energy that their treatment of "highly populated areas" does not produce a fair and consistent list of local municipalities with populations in excess of 2,500 persons. This inconsistency is very clearly shown in the Sebago Lake area.

The Department of Energy has insisted on a rigorous application of the Census Bureau definition of a highly populated area. This definition states that a highly populated area is any incorporated place (as recognized by the decennial report of the U.S. Census Bureau) of 2,500 or more persons, or any Census designated place (as defined and delimited by the U.S. Census Bureau) of 2,500 or more persons. In most of the 50 states, incorporated places include towns; the principal exception is New York and the six New England states. Maine's towns are not considered "incorporated" unless they have a city charter.

As a result, many towns with populations far in excess of 2,500 persons are not considered highly populated areas while cities with smaller populations are. For example, while Bridgton, Norway, Oxford, Poland, and Windham, all with populations in excess of 3,000 persons, are treated as essentially "unincorporated", low population, rural areas, Hallowell, with a 1980 population of 2,502 persons, is a disqualified area. The inequity of this situation is especially obvious for Windham, with a 1980 population of 11,282 persons. In this case the Census designated place (CDP) of North Windham, with a population of just over 5,000, is disqualified as a highly populated area, but the entire town of Windham is not.

There is in fact no functional difference between Maine's towns and cities as far as the siting of a high-level nuclear waste repository is concerned. The distinction made by the U.S. Census Bureau on the basis of a city charter is totally artificial for the purposes of the screening process. This essential equivalence makes the exclusion of Maine's towns from the definition of a highly populated area inconsistent and unfair.

See comments on population density, appendix A25, for map showing Maine cities and towns with populations over 2,500 people.

See comments provided by the Greater Portland Council of Governments, appendix A28.

State-protected lands: The Department of Energy screening methodology includes consideration of "State-protected lands" as a disqualifying factor and "proximity to State-protected lands" as an adverse variable.

The CRP screening methodology defines "State-protected lands" as

"... any site where the presence of the restricted area or the repository support facilities would conflict irreconcilably with the previously designated resource preservation use of a component of the National Park System, the National Wildlife Refuge System, the National Wilderness Preservation System, the National Wild and Scenic Rivers System, or National Forest Lands, or any comparably significant State-protected resource that was dedicated to resource preservation at the time of the enactment of the NWPA." (emphasis added)

The methodology also states that "because of diversity of use and variability in statutory authority, State-protected lands will not be solely defined by title" (page 83 of Screening Methodology Document).

The Maine Land Use Regulation Commission has zoned the State's unorganized territories, and one category (P-FW - Fish and Wildlife Protection Zones) clearly serves the same purpose as Federally designated wildlife areas where the express purpose is to preserve wildlife habitat. They are lands protected by State law and regulation. These zones should have been considered as disqualifying factors under the "State-protected lands" factor of step 1 and as an adverse variable under the "proximity to State-protected lands" variable in step 2 of the screening process.

The Department of Energy limited itself to State-owned land in applying this factor, but given their clear intent to consider non-State owned lands as State-protected lands the DOE must consider these zones as disqualifiers.

See comments prepared by the Maine Land Use Regulation Commission, appendix A8.

Step 2: Regional Variables Screen

Comments in this section deal with the selection and use of the regional screening variables. A separate appendix deals with the accuracy of the Department of Energy Crystalline Repository Project computer data base that was used to produce the quantitative screening maps, and should be referred to for more complete comments in some cases (**see appendix A2**). Many of these comments have been supplied to the Department of Energy in comments on earlier documents, but little was done to respond to the comments.

The variables used in this step were selected to address particular favorable or potentially adverse conditions listed in the General Siting Guidelines. In many case, however, adequate geologic information was lacking to address the condition directly, and some surrogate variable was used to approximate the variable.

Rock mass extent: This variable is important because it is very advantageous if the entire controlled zone for a repository is within a single, homogeneous rock type. It makes characterization of the candidate area much easier, and would increase confidence in ground water models developed for a potential repository. However, the Department of Energy did not take into account the fact that at the present time it has no knowledge of the direction of ground water flow. As a result, it considered areas immediately adjacent to the boundary of a large rock body to be just as favorable as areas in the center of the rock body.

This may not be significant in the selection of a large rock body for further study (such as the Sebago batholith), but for a smaller rock body, such as the Bottle Lake complex, it makes the body appear much more favorable than it actually is. The Department of Energy does not have the entire 92 square miles of the candidate area for study. Close to certain margins of the body a buffer zone of 3 miles or more will have to be excluded from consideration for the surface facilities if the entire controlled area is to remain in the rock body.

An alternate measure of rock mass extent is provided in appendix A2.

Ground water discharge zones: This is one of the most significant factors affecting repository performance. It is extremely important that the repository not be located in an area where ground water is flowing upward towards the surface (a discharge zone). However, the Department of Energy is lacking any information on ground water flow at repository depths in any of the 236 rock bodies they considered.

In order to consider this factor the DOE/CRP chose as a surrogate variable the portions of major rivers and major lakes. This was based on the assumption that the repository would be deep enough to be in the intermediate or regional ground water flow system, and that these ground waters would only discharge in large surface water bodies in the center or lower portions of drainage basins.

However, the Department of Energy insisted on an extremely limited view of what constituted a zone of regional ground water discharge. In particular, the only lake in the Northeast region identified as a zone of regional ground water discharge is Lake Champlain. Sebago Lake is a large, deep lake situated in the extreme lower portion of the Crooked River drainage basin, but was not considered a zone of regional discharge (**see appendix A11**). Given the fact that Sebago Lake is the water supply for over 160,000 people, consideration of the lake as a regional discharge zone would have been the reasonable and prudent approach.

Rock and mineral resources: Numerous errors in the discussion of rock and mineral resources were pointed out in the State's comments on the draft Northeast Regional Geologic Characterization Report. A number of these were corrected, but in the draft Area Recommendation Report there are again numerous errors and omissions. The most significant of these is complete omission of any data originating from the National Uranium Resource Evaluation (NURE) program. A study of the Sebago batholith in the Portland 2-degree sheet identified numerous uranium occurrences within the southern half of the batholith and the candidate area.

See comments on mineral resource assessment, appendix A10.

Seismicity: The variables used to assess seismic risk in the region-to-area screening process are inadequate for a number of reasons. First, the variable used to directly assess seismic risk, maximum expected horizontal acceleration for the next 250 years, is clearly a design and construction consideration. It has no bearing on the long term effects of seismic activity on waste isolation. In addition, it was not useful in discriminating between rock bodies in many of the 17 States; the values of horizontal ground acceleration and scales used gave most areas comparable values, so the variable was useless in actually screening out rock bodies.

Second, suspected Quaternary faulting was even less useful in differentiating between rock bodies. Chapter 4 of the draft Area Recommendation states that "there is no known documented evidence of Quaternary faulting... in the three regions" (page 4-6). Why was this factor used in the quantitative screening process? It is totally useless in discriminating between regions and rock bodies.

Third, postemplacement faulting was used as a surrogate for presumed absence of ground water conducting fractures, not as a measure of seismic risk. Even as a possible measure of fracturing and possible ground water flow it is inadequate. Many significant high-yield bedrock wells have been found associated with fractures that are not mapped faults, and the small scale State geologic map used to assess mapped faults for the screening process, while suitable for determining the boundaries of rock bodies, was not suitable for compiling faults.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

Population density and proximity to highly populated areas: Both of these variables were totally ineffective in discriminating between developed and undeveloped areas in Maine. The entire Sebago Lake candidate area, which is in the most highly populated region in the State, was assigned values of 1 (most adverse) and 2 for both population density and proximity to highly populated areas. The entire Bottle Lake candidate area, which is in a much less densely populated region, was also assigned values of 1 for population density and 1 and 2 for proximity to highly populated areas. Any population screening variable that failed to differentiate between these two areas is clearly unsuitable for screening purposes.

An alternate treatment of 1980 Census data using the areas of enumeration districts (EDs) (**see appendix A25**) provides some additional minor differentiation within the Sebago Lake batholith, but the real problem lies with the broad ranges of population density used in the scale for this variable. Similarly, the broad zones used for measuring proximity to highly populated areas effectively cancelled out this variable for all the rock bodies under consideration.

Use of the narrower alternate phase B scale for proximity to highly populated areas, together with a new analysis of the weighted average maps and identification and ranking of candidate areas, would provide a more realistic treatment of proximity to population in the Sebago Lake area. The Department of Energy shold include this analysis in the final Area Recommendation Report.

Surface water bodies and wetlands: The State argued a number of times that surface water bodies and wetlands should be disqualified from consideration for repository surface facilities. This argument was countered by the Department of Energy's insistence that the repository proper could be located beneath a surface water body or wetland. Instead, these features were rated "most adverse" in the quantitative screening.

The method the DOE/CRP used to enter the surface water bodies and wetlands into the data base was designed in such a way that areas under 320 acres were not considered in the data base, and many bodies greater than 320 acres could have been wholly or partly omitted. In general, the process tended to underestimate the amount of surface water and wetland in an area.

In addition, the Department of Energy did not use the U.S. Geological Survey 1:250,000 topographic maps as sources for rivers and streams as indicated in the final Screening Methodology Document. Instead, they used a U.S. Geological Survey 1:3,000,000 base map of the eastern United States for rivers and streams, and in the process omitted many rivers and streams in the candidate areas (**see appendix A2**).

Ground water resources

Ground water resources were considered a "phase D" variable; the data was not available for all rock bodies in the 17 States, but would be used on a rock body-by-rock body basis if it was available. (Data for three phase D variables is available for the Sebago batholith, but was not used by the Department of Energy, see below).

The scale for ground water resources on the draft Screening Methodology Document used a yield of 10 gallons per minute or less as the "most favorable" criterion (page 108 of the draft Screening Methodology Document). Maine agreed with this as a number of sand and gravel and bedrock aquifers are mapped with this value defining high-yield aquifers or high-yield zones.

However, in the final Screening Methodology Document, the scale was revised to a value of 20 gallons per minute or less for the "most favorable" criterion (page 123 of the final Screening Methodology Document). Since maps of sand and gravel aquifers and zones of high-yield bedrock wells are contoured at the 10 and 50 gallon per minute yields, this change had the effect of classifying the bulk of Maine's sand and gravel aquifers and zones of high-yield bedrock wells as "most favorable." This change was made without any justification by the Department of Energy.

Had Maine known that the criterion would have been 20 gallons per minute or less in the final Screening Methodology Document, we would have commented strongly in the draft stage that this higher threshold was not acceptable. This unanticipated change in scales in the final document left the State with no opportunity to object, and is inconsistent with the Department of Energy's stated intent to solicit State opinions during the development of the screening methodology.

Coding of grid cells

The process of converting irregular polygonal and linear data to gridded data involves averaging techniques, and decisions must be made on how to equitably represent features such as highly populated areas, surface water bodies such as lakes, rivers, and streams, faults, etc. The process used by the Department of Energy tends to underestimate the area covered by surface water bodies and wetlands, and to displace linear features such as faults. The problem is especially acute for surface water bodies and wetlands, where large numbers of small features may not be included in the data base, or long, narrow features such as Long Lake may be systematically under represented.

Specific comments on the accuracy of the DOE/CRP data base are provided in a separate appendix (**appendix A2**).

Weighting process: selection of weights

The two weighting workshops held by the Department of Energy (one for DOE/CRP staff; one for State representatives) were intended to develop broad sets of weights that reflected a wide range of opinion on the relative importance of the 16 screening variables. A more detailed analysis of the nine sets of weights used is presented in appendix A1, but in general the weights were highly skewed towards the geologic variables. This was especially true of the DOE/CRP weights.

For example, in DOE/CRP weight set C1 over 40% of the points were assigned to the variable for major ground water discharge zones. As discussed above, this variable, while theoretically very important, was not based on any actual data on ground water discharge, and was approximated by a very simplistic and unrealistic surrogate variable.

Until a broader and more reasonable set of weights that adequately addresses the realities and quality of the data and fully considers the significance of population and environmental factors is used in the quantitative screening process, the suitability of the areas identified will be open to question.

Identification of selection and ranking of candidate areas

A detailed discussion of the process the Department of Energy used to identify and rank candidate areas is provided in appendix A3. The following statements summarize the conclusions drawn from that analysis.

1) The process used by the Department of Energy to select and rank candidate areas differed from what was discussed during the methodology workshops and described in the Screening Methodology Document. Many candidate areas identified and ranked in the draft Area Recommendation Report do not, in general, individually satisfy the broad range of geologic, environmental, and socio-economic factors the Department of Energy should consider in the region-to-area screening process.

2) The selection and ranking process that was used by the Department of Energy is extremely sensitive to minor changes in the percentage of area with environmental disqualifiers and/or lower ranked grid cells. Ranking of some rock bodies went from an apparent 2-, 3-, 4-, or 5-out-of-9 to 7-out-of-9 in the identification and ranking process. If changes in ranking this great can occur the methodology is too sensitive to minor changes in the process to provide confidence that the candidate areas selected by the Department of Energy are actually among the best possible, or even adequate to meet DOE/CRP needs.

3) The Department of Energy failed to consider additional, rock body-specific information for the Sebago batholith dealing with rock body thickness, ground water resources, and thickness of overburden. This information was readily available and in a form similar to other data used by the DOE/CRP in their gridded data base.

Definition of candidate area boundaries

The draft Area Recommendation Report describes rules used for defining the boundaries of candidate areas once identified from the phase A composite map (page 3-35 and 3-36 of the draft ARR). The DOE/CRP extended the boundaries of candidate areas out to grid cells that had a frequency of 7-out-of-9 on the composite map, and also chose to:

- include significant clusters of grid cells ranked 7-out-of-9 or above if they were less than 1 mile from the main candidate area; and,

- include any isolated grid cells ranked 6-out-of-9 or less that occur within the candidate areas were also included in the candidate area.

The first rule above was applied to both the Bottle Lake and Sebago Lake candidate areas. In the case of the Bottle Lake area, a "significant" cluster of grid cells northwest of the 1000 Acre Heath was identified and included (an additional 29 square miles). This also required including the 1000 Acre Heath and flood plain of the Passadumkeag River, with a number of grid cells ranked 5-out-of-9 or less (a total of 10 square miles). This area is essentially all surface water or wetland area, and would be totally unsuited for the surface facilities of a repository. Without the inclusion of this area and the additional area to the northwest of the 1000 Acre Heath, the Bottle Lake area would contain only 51 square miles, or just barely large enough to be considered a candidate area.

In the case of the Sebago Lake area, the candidate area is bisected by the Crooked River, an environmental disqualifier, and associated lower ranked grid cells. The southeastern and northwestern portions of the candidate area are both larger than 150 square miles, and should be considered independent candidate areas. This would more accurately show the actual area the Department of Energy has available for the surface facilities, allow for more realistic calculations of average population, and provide better protection for the Crooked River and Sebago Lake State Park. If they were divided, one or both of the candidate areas might not have been included in the draft Area Recommendation Report.

Deferral analysis: general comments on process

The intent of the deferral analysis was to examine qualitative geologic and environmental information that was not included in the quantitative screening. The purpose was to avoid areas that have some "fatal flaw" not found in the computer analysis.

The lack of specific criteria used to evaluate whether the information for a candidate area indicated a "favorable" or "potentially adverse" condition makes this analysis extremely subjective. Specific comments on the conclusions reached by the Department of Energy in their deferral analysis are provided in Chapter 2 of this response.

In addition, the Department of Energy failed to consider a number of important factors in their analysis, including consideration of public water supplies and watersheds, seasonal population, economic impact (during both site screening phases and during actual repository construction and operation), and issues dealing with degradation of the environment during site characterization, repository construction, and operation.

The deferral analysis also presented a number of "favorable" conditions that were related to a single characteristic of the Northeast region as a whole, the relatively low seismicity and tectonism in the region. A total of nine "favorable" conditions relied on this single characteristic. While the potential for seismic activity and the effects on repository operation and waste isolation are important, the appearance of a multitude of "favorable" conditions for all the candidate areas based on this single factor is misleading. (Many of these "favorable" conditions are also questionable - see Chapter 2.)

Other siting criteria: designation of the Northeast and North Central regions as separate geohydrologic settings

Section 3.3, page 3-645 of the draft Area Recommendation Report, presents for the first time the Department of Energy's decision to designate the Northeast and North Central regions as separate geohydrologic settings. This is a significant decision, which has far-reaching consequences for both regions if candidate areas remain when sites are nominated for site characterization. In spite of this, the States were given no advance warning or opportunity to comment on the decision; the decision apparently was not subjected to peer review, either by the U.S. Geological Survey or independent hydrologists; and, the decision is not supported by adequate discussion and justification.

As discussed in appendix A12, none of the factors listed by the Department of Energy is sufficiently different in itself, or in its possible effects on ground water gradients and velocity at repository depths, to produce a significant difference in repository performance. We strongly object to this arbitrary decision, and do not believe that it is valid on the basis of the evidence presented.

Disqualification analysis: designation of potentially acceptable sites

After the four steps described above, the list of candidate areas was subjected to an analysis of 10 disqualifying factors listed in the Department of Energy General Siting Guidelines to determine whether they could be designated as "potentially acceptable sites" (chapter 4 of the draft Area Recommendation Report.) Similar to the deferral analysis discussed above, there were no criteria provided to evaluate the candidate area. As a result, the finding that the evidence does not support disqualification of any of the candidate areas is overly subjective.

In addition, the way the analysis is conducted - the fact that the evidence need only support a finding that the site is not disqualified - favors candidate area where there is little or no detailed geologic information. A lack of evidence is sufficient to ensure a finding that the site is not disqualified, as opposed to the more rigorous requirement that the evidence support that the site is suitable.

This problem lies in the Department of Energy General Siting Guidelines (10 CFR 960), and is reflected in the draft Area Recommendation Report.

Process of selection of candidate areas for study in area phase

Chapter 5 of the draft Area Recommendation Report provides the Department of Energy's rationale for selecting 12 of the 20 candidate areas for additional study during the area characterization phase. The discussion of the rationale is inadequate and the selection process (particularly the selection of the 11th and 12th candidate areas - the Bottle Lake Complex and the Rolesville pluton) again lacks specific criteria used to compare the candidate areas.

A more detailed discussion is provided in appendix A4, but the following statements summarize the State's comments:

1) The decision to study 12 candidate areas, as opposed to 9, 11, 13, or 20, is totally unjustified in the draft Area Recommendation Report. The rationale provided consists of "the DOE has determined it is only necessary to identify approximately 12 of the candidate areas as proposed below" and "the DOE has determined that it is appropriate to investigate approximately 12 potentially acceptable sites during the area phase."

   Arguments presented on page 5-4 of the draft Area Recommendation Report <u>do not</u> provide <u>any</u> justification for the number of areas.

2) The Bottle Lake Complex and Rolesville pluton were selected primarily on the basis of <u>geologic factors</u>. This is in spite of the entire design of the region-to-area screening process to consider geologic, environmental, and demographic factors in identifying and selecting areas for study. A comparison of <u>all</u> available information must be made.

3) An evalustion of the 20 candidate areas using the phase B alternate scales showed that of the 10 candidate areas ranked 7-out-of-9 in phase A, 6 of the candidate areas were subsequently ranked 9-out-of-9 (table 3-6 in the draft Area Recommendation Report). The Bottle Lake area, however, was only ranked 8-out-of-9 in this analysis, indicating that when <u>all</u> factors are taken into consideration it <u>is not</u> the most suitable of this group of candidate areas.

4) The comparison made between the 10 rock bodies was cursory, subjective, and in some cases inconsistent. While a large rock body is considered most desirable, the Bottle Lake and Rolesville areas are "in the middle of the range of host rock geometries and areal extent". "Except for NC-2, SE-1, and SE-6," the Bottle Lake and Rolesville areas have the least amount of overburden. "With the possible exception of SE-6" the Bottle Lake and Rolesville areas have the least amount of overburden. The candidate areas in the North Central region have been unaffected by deformation for up to 4 times longer than the Bottle Lake and Rolesville areas, the difference between approximately 250 million years and 1 billion years. The present data base on <u>all</u> the candidate areas is such that absolutely no prediction can be made on the ultimate suitability of the area for a repository.

<u>Inadequate 90 day review period</u>

The draft Area Recommendation Report contains abundant new significant information important to the identification, ranking, and selection of candidate areas for study in the area characterization phase. These include:

- significant changes in the quantitative screening process from what was described in the final Screening Methodology Document; these processes were not adequately documented in the draft Area Recommendation Report;

- a deferral analysis that had not been previously described in any detail either in the methodology workshops or the Screening Methodology Document;

- a decision to designate the Northeast and North Central regions as separate geohydrologic settings;

- an analysis of disqualifying factors related to the designation of "potentially acceptable sites" that had not been previously described in any detail either in the methodology workshops or the Screening Methodology Document;

- a series of decisions relating to the number and nature of the candidate areas that would be selected for study in the area characterization phase; these processes were not adequately documented in the draft Area Recommendation Report.

Because of the amount of new information contained in the draft Area Recommendation Report, and also because of information the Department of Energy chose not to consider in their analysis of the candidate areas, the 90 day review period that the Department of Energy has used for earlier documents in the Crystalline Repository Project is inadequate. The draft Area Recommendation Report is the first significant decision document issued in the Crystalline Repository Project. (The after-the-fact National Survey of Crystalline Rocks was issued as a final report with no opportunity for comment.)

As a result, the State of Maine formally requested an extension of the review period. After being turned down by the Department of Energy, the State filed suit in the First Circuit to force the Department of Energy to grant an extension.

Because the 90 day comment period has not given the State adequate time to consider, review, and comment upon the draft Area Recommendation Report, the State of Maine is expressly reserving the right to submit further comments and information (including but not limited to the comments referenced in this document as "work in progress") at a later date.

Summary

After a review of the methodology employed in the Department of Energy draft Area Recommendation Report, we find that:

1) the Department of Energy used a methodology that failed to consider or include significant population centers and State-protected lands, and used overly simplistic surrogate variables for critical screening factors;

2) there were significant changes in the quantitative screening process from what was described in the final Screening Methodology Document;

3) the methodology was not adequately documented in the draft Area Recommendation Report;

4) the qualitative and subjective deferral analysis lacked any obvious criteria for judging the suitability of candidate areas, and failed to consider many significant factors in evaluating the candidate areas;

5) the arbitrary and sudden consideration of an additional siting factor - a separate geohydrologic setting for the Northeast region;

6) no justification was provided for the number of candidate areas selected for study;

7) a second "methodology" was used for the selection of additional, lower ranked areas for study;

8) inadequate time was proved for State review of the draft Area Recommendation Report.

Chapter 2: Comments on Draft Area Recommendation Report Deferral Analysis

Introduction

Following the identification of preliminary candidate areas, the Department of Energy went through a deferral analysis of the areas. The draft Area Recommendation Report states (page 3-45):

> "The Step 4 deferral analyses are conducted to ensure that there is a reasonable expectation, within the constraints of a regional study, that the candidate area warrants further examination in the area phase."

In addition to the information used in the quantitative screening, additional information considered relevant by the Department of Energy was considered in the deferral analysis. Topics that were included in the deferral analyses are:

- Host rock geometry and overburden thickness
- Lithology and tectonics
- Seismicity
- Mineral resources
- Topography and surface water characteristics
- Ground water resources
- Quaternary climate
- Federal lands
- State lands
- Population density and distribution
- Site ownership
- Offsite installations
- Transportation

Each of the topics above are related to specific Department of Energy General Siting Guidelines (10 CFR 960).

The Department of Energy's treatment of a number of topics listed above was cursory and inadequate. A number of the conclusions the Department of Energy reached regarding the favorable versus potentially adverse characteristics of the candidate areas were not fully justified by information presented in the analysis. Finally, a number of important factors were omitted from the deferral analysis, including consideration of public water supplies and watersheds, seasonal population, economic impact (during both site screening phases and during actual repository construction and operation), and issues dealing with degradation of the environment during site characterization, repository construction, and operation.

This chapter is a discussion of the deferral analyses for the Bottle Lake and Sebago Lake candidate areas. It is divided into two sections, but many of the inadequacies mentioned above are found in both deferral analyses. Detailed information used for this discussion is contained primarily in the appendices to these comments or in comments developed by other groups or agencies included with this response.

NE-2 - Bottle Lake Complex (section 3.2.2.2)

"Presence of host rock with sufficient thickness and lateral extent to allow significant flexibility in selecting the depth, configuration, and location of the underground facility to ensure isolation."

The Bottle Lake candidate area is a total of 92 mi^2; this is actually an overestimate of the area that satisfied 7 of the 9 weight sets used in the quantitative analysis (see chapter 1). In addition, it is excessive in that there are abundant rivers, lakes, streams, and wetlands in the area. The Department of Energy estimates approximately 24% surface water and wetlands in the area, but this is low as the estimate comes from the DOE/CRP gridded data base. The DOE/CRP data base did not include many significant rivers and streams, and was designed to omit many lakes and wetlands when they did not make up 50% or more of a 1 square mile grid cell.

We estimate that the candidate area actually contains in excess of 30-35% surface water and wetlands, greatly reducing any "flexibility" the Department of Energy may have in siting the repository.

See detailed information on surface water and wetlands in the Bottle Lake area, appendix A5.

"Absence of Quaternary igneous activity and tectonism (faulting)."

While no active faulting has been identified in the Bottle Lake area, there are a number of reported epicenters in the area (Lepage and Johnston, 1985), and the area is within 25 miles of an area of anomalous seismic activity and crustal subsidence in and around Passamaquoddy Bay (Anderson, W.A., et al., 1984).

See comments by Dr. John Ebel on regional seismicity, appendix A15

See preliminary comments by Dr. Patrick Barosh, appendix A16, and work in progress.

"Low potential for tectonic deformations suggests that the regional ground water flow systems should not be significantly altered."

The draft Area Recommendation Report (page 3-359) concedes that "not all sites of moderate-to-large earthquakes have yet experienced one during historical times." A number of significant earthquakes are documented in the historical record in the northeastern United States and southeastern Canada. More recently, an earthquake of magnitude 5.7 occurred in New Brunswick, Canada. It is not possible to assign a "low potential" for tectonic deformation anywhere in the northeastern United States at this time. A minimum working assumption is that any area in the Northeast could experience an earthquake as large as any previously recorded.

In addition, the Department of Energy has not provided any information on the possible effect of seismic events on ground water flow. Barton (1984) has presented convincing evidence that moderate seismic events can produce large increases in ground water flow rates in mines and tunnels, and specifically questions the effects of such events on a high-level nuclear waste repository.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

See preliminary comments by Dr. Patrick Barosh, appendix A16, and work in progress.

"Absence of historical earthquakes of a magnitude and intensity that, if they recurred, could affect waste isolation" and "no indications, based on correlations of earthquakes with tectonic processes and features, that frequency of earthquake occurrence within the geologic setting may increase."

Again, the draft Area Recommendation Report has not discussed the potential for seismic events affecting waste isolation, and cannot provide any evidence that the moderate to large intensity historical earthquakes recorded in the area are not likely to occur in the Bottle Lake area in the next 10,000 years. As described above, the draft Area Recommendation Report concedes the lack of any understanding of the causes of seismic activity in the Northeast. Because of this any statements concerning possible increases in seismic activity over the next 10,000 years are unsupportable.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

See preliminary comments by Dr. Patrick Barosh, appendix A16, and work in progress.

"No evidence of significant naturally occurring material that is not widely available from other sources."

We disagree with the basic approach of this statement. While the availablity of a resource may remove any immediate economic disincentive to siting a repository, the possible presence of a significant natural resource greatly increases the probability of inadvertent intrusion in the future. As a result, the possible presence of significant natural resources, that could become scarce or desirable in the future,should be considered as a potentially adverse factor. This more conservative approach is what is intended in the natural resource criteria in the Department of Energy General Siting Guidelines (10 CFR 960).

The draft Area Recommendation Report (and Northeast Regional Geologic Characterization Report) contain a number of errors and omissions regarding the possible presence of significant natural resources.

See comments on mineral resource assessment, appendix A10.

"The presence of generally well drained terrain" and "general absence of surface characteristics or surface water systems that could lead to flooding."

Even the Department of Energy concedes that the candidate area is covered by a minimum of 24% surface water and wetlands, over 3 times more than any other candidate area ranked "7-out-of-9" except NC-2. This estimate of the area covered by surface water features is conservative (see above). The statements that the area is "generally well drained" and has a "general absence" of surface water systems that could lead to flooding is absurd in the light of this fact.

In addition, the Department of Energy did not consider many significant rivers and streams in their analysis of surface water bodies (see chapter 1). Detailed analysis of flood prone areas in organized towns has shown that many of these rivers and streams must be considered flood prone areas. Consideration of this additional information makes the Department of Energy's conclusion even more unsupportable.

See comments on estimation of flood prone areas, appendix A6.

"Absence of State lands less than 130 ha (320 acres) within and in proximity to (i.e., within 10 km (6 mi) of) the preliminary candidate area."

The draft Area Recommendation Report:

1) omitted a number of registered Critical Areas adjacent to the candidate area;

2) omitted consideration of Maine Land Use Regulatory Commission preservation zones;

3) failed to acknowledge the special significance of Maine's Public Reserved Lands.

The omission of a several State lands and lack of consideration of State regulated preservation zones is a major shortcoming of the deferral analysis. The presence of these features may disqualify portions of the candidate area, and most certainly will reduce any "flexibility" the Department of Energy may have in siting any repository facility.

See detailed comments on the description of the Bottle Lake candidate area, the Maine Land Use Regulation Commission, the policy for the management of Maine's Public Reserved Lands, and State-owned lands, (appendices A5, A8, A9, and A26).

"No projected land ownership conflicts that cannot be sucessfully resolved through voluntary purchase-sell agreements, non-disputed agency-to-agency transfer of title, or Federal condemnation proceedings."

The presence of Indian trust land and potential trust land throughout the candidate area complicates the site ownership issue far beyond the simple statement made above. There are potentially significant legal obstacles to obtaining title to much of the Bottle Lake area.

At the present time the Passamaquoddy Tribe is proposing to purchase additional land within the Bottle Lake candidate area, and has submitted legislation to the Maine Legislature to add this land to the list of areas eligible for trust status. The area under consideration for purchase would increase the amount of land held in trust from approximately 27% to 34%, and is situated such that it would reduce contiguous land available to the Department of Energy to less than one-half of the origibally defined area.

In addition, any realistic assessment of the site ownership questions should recognize the inevitability of extensive use of Federal condemnation proceedings to obtain privately owned land.

"Available access to the national transportation system through regional highways and railroads and through local highways and railroads."

The Department of Energy's discussion is grossly inadequate. While the statement above is strictly true, it is also misleading. The access to the Bottle Lake area is extremely poor, with only limited access along unpaved roads at the present time. State routes pass through or near local population centers. Only candidate area NC-2 is further from both the interstate highway system and a rail line.

No consideration was given to present severe climatic factors that will affect transport of nuclear waste.

No consideration has been given to problems associated with regional transportation of the waste, and the great distance of the Bottle Lake area from sources of the waste.

Without a further consideration of the factors above, we do not feel the conclusion reached by the Department of Energy is reasonable.

See detailed comments on transportation systems, appendix A27, and climatic characteristics, appendix A20.

Besides these factors considered by the Department of Energy, a number of additional significant factors were not considered in the deferral analysis. These include:

Environmental degradation during site characterization, repository construction, and operation.

Maine has a series of strict environmental laws administered by the Department of Environmental Protection. These statutes govern any proposed alteration of significant environmental features such as wetlands or surface water bodies, wildlife habitat, etc., and place limits on discharges into the atmosphere and surface or ground water. In some cases, as for Maine's Class A waters, the quality of the discharge must be equal to or better than the quality of the receiving waters, essentially prohibiting discharge into these waters. Discharge is also prohibited to Great Ponds.

By failing to consider the applicable environmental laws and regulations of the State of Maine prior to the selection of candidate areas or in the deferral analysis, the Department of Energy is failing to acknowledge the serious conflicts that are bound to develop if either of the two Maine sites is ultimately selected for a repository. These conflicts, when they arise, will only be resolved through costly and time consuming legal proceedings.

See comments on environmental regulations governing impacts on air, land, and water quality, appendices A17, A18, and A19.

Proximity of the Bottle Lake area to the Canadian border, including inclusion of part of the candidate area in the drainage of the St. Croix River.

A portion of the Bottle Lake candidate area drains into the St. Croix River, the boundary between Maine and the Province of New Brunswick, Canada. Articlé IV of the 1909 Treaty between the United States and Canada prohibitis the pollution of boundary waters; as a result, this constitutes a potential violation of the Treaty. In addition, the Department of Energy has stated that it will not select a candidate area for additional work in the area phase if field work in Canada is necessary in order to characterize the area. The distance from the candidate area to the Canadian border, approximately 26 miles, led the Department of Energy to conclude that no "field work" would have to be done in Canada.

Throughout chapter 3 of the draft Area Recommendation Report, population densities are provided for the candidate area as a whole and for an area within 80 km (50 mi) of the candidate area. For the Bottle Lake area this estimate is colored with the statement: "The density does not include the portion of the 80 km (50 mi) area that passes into Canada."

The draft Area Recommendation Report states (page 3-394) "The nearest operating commercial nuclear reactor is Maine Yankee which is approximately

177 km (110 mi) to the southwest." The Point Lepreau nuclear power plant, in New Brunswick, is approximately 85 mi to the northeast.

Ignoring the existence of a resident population or an operating nuclear power plant in Canada does not eliminate these factors or remove the necessity for considering them in this study or any subsequent study. It is doubtful that the Congress of the United States would direct the Department of Energy to ignore the population in adjacent Canada if there was any possibility for adverse effects from a nuclear waste repository.

Representatives of the government of New Brunswick have also informed us that the St. Croix River is now a candidate for inclusion in the Candian Rivers Program, a classification equivalent to "wild and scenic".

The Department of Energy will not be able to ignore the potential socio-economic factors or refuse to consider the Canadian population when estimating risks associated with the repository. As a result, we believe that the Department will have to cooperate with and use data collected from Canadian officials, and collect environmental, demographic, and socio-economic data in New Brunswick.

In addition, the Department of Energy has stated that it will not site a repository in a location that requires the Canadian Government to monitor any activities associated with the construction or operation of the facility. We believe that the Canadian Government will insist that the Department of Energy monitor air and water quality in the vicinity of the St. Croix River during the construction or operation of a repository in the Bottle Lake Complex, and that this monitoring violates understandings reached at a September, 1985, meeting between the United States and Canada.

Impacts of repository construction on wildlife habitat, and consequent effects on tourism and recreation possibilities.

An assessment of the impacts of a repository on fish and wildlife habitat indicates that considerable loss of habitat can be expected from construction and operations of a repository.

Direct, permanent loss of terrestrial habitat would be expected with development of roads and surface facilities such as buildings, parking areas, tailings piles, dumps, etc. Wildlife use of otherwise suitable unaltered habitat may be restricted or diminished. Effects on fish species and populations are anticipated to be less dramatic or obvious than wildlife considerations, but can be significant and important nevertheless. Chemical changes in water quality are one of the greatest potentials with mining operations. Discharge of mineral laden pumped ground water, leaching from tailings piles, uncontrolled dust movement, sedimentation, effluent discharges from water treatment facilities, etc., are all examples of sources of chemical changes which may be associated with mining operations. Effects on aquatic organisms, and fish in particular, can range from acute toxicity and mortality to sub-lethal effects on reproduction, growth, behavior, avoidance of contaminated water, and suitability for human consumption.

Uses such as hunting, trapping, fishing, bird watching and other non-consumptive activities, etc., can be expected to be curtailed in the immediate surface facilities development area. Transient summer and winter angling use, hunting, and seasonally-used camp developments have not been factored into the screening process.

See comments provided by the Department of Inland Fisheries and Wildlife, appendix A23.

Economic impact of the repository on the area.

A brief description of the significance of tourism in the Bottle Lake is provided in appendix A24 (State Development Office - Tourism and Recreation in the Sebago Lake and Bottle Lake Area). Perception of "quality of life" is a critical factor in drawing tourists to the State. Whether that diminution of quality of life is real or only perceived, the results would remain the same: less tourist business in a State which is very dependent upon tourism.

Additional work on the economic impact of a repository in the Bottle Lake area is in progress.

See description of tourism in the Bottle Lake and Sebago Lake areas, appendix A24.

Economic impact assessment, work in progress.

Potential presence of major prehistoric archeological sites in the area.

In a letter dated 14 February 1986 from Dr. David Sanger, Department of Anthropology, University of Maine, Orono, to Dr. David Wihry, who coordinated review of the draft Area Recommendation Report by UMO faculty for the Governor's Task Force, Dr. Sanger states: "These areas [Bottle Lake and Sebago Lake candidate areas] of the State are largely unexplored from an archeological perspective, but can reasonably be expected to contain sites that may very well have National Register significance" (copy attached - see appendix A32).

Possibility of climatic change.

The problem of long-term climatic change is explicitly cited in the Nuclear Regulatory Commission Guidelines for Disposal of High-Level Nuclear Waste in Geologic Repositories (10 CFR 60, section 60.122(c)(6)) and the Department of Energy General Siting Guidelines (10 CFR 960, section 960.4-2-4.) The possible effects of climatic changes on ground water behavior in the two candidate areas, both of which were partly submerged at the end of the last glaciation approximately 10,000 years ago, will have to be seriously considered.

NE-4 - Sebago Lake Batholith (section 3.2.2.3)

"Presence of host rock with sufficient thickness and lateral extent to allow significant flexibility in selecting the depth, (and) configuration, and location of the underground facility to ensure isolation" and "presence of host rock that permits emplacement of the waste at least 300 m (1,000 ft) below ground surface."

In spite of a number of references indicating the thin, sheetlike nature of the Sebago batholith (Creasy, 1979; Hodge, 1982), the Department of Energy insisted on reaching the conclusions above. A re-analysis of existing gravity data (GEOSS, Inc. 1986) demonstrates that the batholith as a whole extends to depths of no more that 600 meters below sea level, and in the candidate area it extends to depths of no more that 300 meters below sea level. This indicates that the thickness of the rock body is substantially less than the 800 meter maximum depth for a repository in crystalline rock, and in the candidate area is very likely less than the minimum depth of 350 meters (draft Area Recommendation Report, page 1-17). In other words, candidate area NE-4 should be eliminated from further consideration because it is too thin to contain a high-level nuclear waste repository.

There are a number of other adverse geologic characteristics described in the draft Area Recommendation Report that make the Sebago batholith unsuitable for consideration for the area phase. It is a thin, foliated, syntectonic body, possibly composed of several 100 to 200 meter thick "sheets" of granite, dipping 25 to 40 degrees to the east. The rock body as a whole is heterogeneous, with abundant (up to 40%) metasedimentary inclusions in a contact zone on the eastern margin and persistent (2-4%) inclusions in the main portion of the body. The texture of the main portion of the body is generally homogeneous, but may grade to coarse, pegmatitic textures over an outcrop. The body is faulted (Ben Barrows and Moll Ockett faults) and jointed, with a number of major joint sets that are commonly filled with vein quartz. The body was intruded by late pegmatites after consolidation, and was intruded in the Mesozoic by basic dikes up to 5 meters in width and traceable for hundreds of meters. There are several larger Mesozoic granite/syenite complexes that intruded the batholith in the Mesozoic - one, the Rattlesnake Hill pluton, is in the candidate area.

Recent detailed fracture analysis (Caswell, Eichler, and Hill, Inc., 1986) showed the extremely fractured nature of the rock body, and demonstrated the correlation of high yield bedrock wells with linear and lineament traces. The study also concluded that hydrologic isolation at depths of 1000 feet was highly unlikely in the Sebago Lake area.

The geometry, textural variations, later complex geologic history, and present fractured nature of the Sebago batholith make it unsuitable for a nuclear waste repository.

See comments on description of the Sebago Lake candidate area, reanalysis of gravity data for the Sebago batholith, fracture analysis of the Portland and Lewiston 2-degree sheets, and letter from Dr. John Creasy to the Natural Resources Council of Maine (appendices A5, A13, A14, and A31).

"Absence of Quaternary igneous activity and tectonism (faulting)."

While no active faulting has been identified in the Sebago Lake area, there are a number of reported epicenters in the area (Lepage and Johnston, 1985). A number of moderate to large intensity earthquakes have occurred in adjacent New Hampshire (particularly in the vicinity of Ossipee, New Hampshire), and recently an earthquake in Dixfeld, Maine, approximately 30 miles from the center of the candidate area, registered 4.3 on the Richter scale.

The occurrence of moderate to large earthquakes within the region and immediate vicinity of the Sebago Lake area make the above conclusion difficult to justify.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

See preliminary comments by Dr. Patrick Barosh, appendix A16, and work in progress.

"Low potential for tectonic deformations suggests that the regional ground water flow systems should not be significantly altered."

The draft Area Recommendation Report (page 3-359) concedes that "not all sites of moderate-to-large earthquakes have yet experienced one during historical times." A number of significant earthquakes are documented in the historical record in the northeastern United States and southeastern Canada. More recently, an earthquake of magnitude 5.7 occurred in New Brunswick, Canada (1982), and earthquakes of magnitude 5.5 (1940) and 4.7 (1982) have occurred in adjacent New Hampshire. It is not possible to assign a "low potential" for tectonic deformation anywhere in the northeastern United States at this time. A minimum working assumption is that any area in the Northeast could experience an earthquake as large as any recorded in historical time.

In addition, the Department of Energy has not provided any information on the possible effect of seismic events on ground water flow. Barton (1984) has presented convincing evidence that moderate seismic events can produce large increases in ground water flow rates in mines and tunnels, and specifically questions the effects of such events on a high-level nuclear waste repository.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

See preliminary comments by Dr. Patrick Barosh, appendix A16, and work in progress.

"Absence of historical earthquakes of a magnitude and intensity that, if they recurred, could affect waste isolation" and "no indications, based on correlations of earthquakes with tectonic processes and features, that frequency of earthquake occurrence within the geologic setting may increase."

Again, the draft Area Recommendation Report has not discussed the potential for seismic events affecting waste isolation, and cannot provide any evidence that the moderate to large intensity historical earthquakes recorded in the area are not likely to occur in the Sebago Lake area in the next 10,000 years. As described above, the draft Area Recommendation Report concedes the lack of any understanding of the causes of seismic activity in the Northeast. Because of this any statements concerning possible increases in seismic activity over the next 10,000 years are unsupportable.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

See preliminary comments by Dr. Patrick Barosh, appendix A16, and work in progress.

"The frequency of occurrence or magnitude of earthquakes within the geologic setting are no higher than within the region."

Comments on the draft Area Recommendation Report prepared by Dr. Gene Simmons of GEOSS, Inc., for the State of Vermont question the conclusion of the draft ARR that the increased frequency of earthquakes in the Sebago Lake area is due to "population patterns." The data in the draft ARR and in Lepage and Johnston (1985) show that the frequency of earthquakes in the candidate area is greater than the regional average.

In particular, on page 3-408 of the draft Area Recommendation Report it is stated that "The apparent spatial coincidence of repeated earthquake activity, shown on figure 3-100, is probably a result of population patterns." Lepage and Johnston (1985) show a similar coincidence based entirely on instrumentally recorded earthquakes. As a result, we conclude that the Sebago Lake area does have a higher frequency of occurrence of earthquakes than the region.

See comments prepared by Dr. Gene Simmons for the State of Vermont, appendix A36.

"No evidence of significant naturally occurring material that is not widely available from other sources."

We disagree with the basic approach of this statement. While the availablity of a resource may remove any immediate economic disincentive to siting a repository, the possible presence of a significant natural resource greatly increases the probability of inadvertent intrusion in the future. As a result, the possible presence of significant natural resources should be considered as a potentially adverse factor.

There were a number of errors and omissions in both the Northeast Regional Geologic Characterization Report and the draft Area Recommendation Report. These included mines and prospects that are missing from maps, are mislocated, or have improperly listed mineral assemblages.

In 1983, the Department of Energy issued two reports summarizing the National Uranium Resource Evaluation (NURE) program in two areas in Maine (Field and Truesdale, 1982; Wagner, 1982). Neither report is cited in the draft Area Recommendation Report, but both reports should be considered. This is particularly important in the case of the Sebago Batholith. Wagner (1982) reports numerous uranium occurrences in the area covered by the Portland 2-degree sheet; 25 of these occur within the rock body and 7 fall within the preliminary candidate area. This is based on an analysis of the Portland 2-degree sheet only.

The inaccuracies and inconsistencies in reporting mineral occurrences in the draft ARR, as well as the total disregard of the NURE program results, severely reduce the credibility of the mineral resource evaluation.

See comments on mineral resource assessment, appendix A10.

"The presence of generally well drained terrain" and "general absence of surface characteristics or surface water systems that could lead to flooding."

The Department of Energy did not consider many significant rivers and streams in their analysis of surface water bodies (see chapter 1). Detailed analysis of flood prone areas in organized towns has shown that many of these rivers and streams must be considered flood prone areas. Consideration of this additional information, which would have provided a much more accurate representation of flood prone areas, would require reconsideration of the conclusion above.

See comments on estmation of flood prone areas, appendix A6.

"Low population density within its boundaries and within 80 km (50 mi) of the preliminary candidate area."

The average population density of the candidate area is 62 persons per square mile; within 80 km (50 mi) it is 66 persons per square mile. The draft area recommendation report erroneously uses a figure of 76 persons per square mile as the average population density of the conterminous United States; the true figure is 64 persons per square mile (U.S. Census Bureau, 1985). As a result this statement is incorrect.

In addition, preliminary consideration of seasonal population by the Greater Portland Council of Governments indicates a 147% increase in population in the candidate area during peak summer months. This would make the average population density during the summer approxmately 160 persons per square mile.

The Sebago lake candidate area is not an area of "low population", certainly not by Maine standards or by comparison with the National average.

See material on seasonal population prepared by the Greater Portland Council of Governments, appendix A28.

See material on seasonal population submitted by the Maine Youth Camping Association, appendix A29.

"No projected land ownership conflicts that cannot be sucessfully resolved through voluntary purchase-sell agreements, non-disputed agency-to-agency transfer of title, or Federal condemnation proceedings."

Any realistic assessment of the site ownership question should recognize the inevitability of extensive use of Federal condemnation proceedings to obtain privately owned land.

"Available access to the national transportation system through regional highways and railroads and through local highways and railroads."

While it is true that State highways appear to provide access to the candidate area, there has been no consideration of the quality of the transportation network or traffic densities (including seasonal increases in an area where tourism is a major component of the economy).

No consideration was given to present climatic factors that will affect transport of nuclear waste.

No consideration has been given to regional transportation consideration, and the location of the Sebago Lake area with respect to sources of the waste.

Without a further consideration of the factors above, we do not feel the concluson reached by the Department of Energy is reasonable.

See detailed comments on transportation systems, appendix A27, and climatic characteristics, appendix A20.

Besides these factors considered by the Department of Energy, a number of additional significant factors were not considered in the deferral analysis. These include:

Environmental degradation during site characterization, repository construction, and operation.

Maine has a series of strict environmental laws administered by the Department of Environmental Protection. These statutes govern any proposed alteration of significant environmental features such as wetlands or surface water bodies, wildlife habitat, etc., and place limits on discharges into the atmosphere and surface or ground water. In some cases, as for Maine's Class A waters, the quality of the discharge must be equal to or better than the quality of the receiving waters, essentially prohibiting discharge into these waters. Discharge is also prohibited to Great Ponds.

By failing to consider the applicable environmental laws and regulations of the State of Maine prior to the selection of candidate areas or in the deferral analysis, the Department of Energy is failing to acknowledge the serious conflicts that are bound to develop if either of the two Maine sites is ultimately selected for a repository. These conflicts, when they arise, will only be resolved through costly and time consuming legal proceedings.

See comments on environmental regulations governing impacts on air, land, and water quality, appendices A17, A18, and A19.

Present above-average background radiation levels.

The Sebago batholith has uniquely high uranium levels and levels of associated alpha-emitting radionuclides in ground water, causing present population exposures several times the proposed exposure standards for a repository. We believe it is both unfair and unsafe to expose this population to any added health risk due to any exposure from a high-level nuclear waste repository, either during construction and operation phases or long-term containment phase.

Also, because of the variability and magnitude of the existing radon levels in the Sebago batholith, it will be impossible to document through monitoring that no member of the public in the accessible environment has received an additional annual dose equivalent (from radon) in excess of 75 millirems per year to the lung from the proposed repository's operation. After a repository became operational, it would be essentially impossible to demonstrate that wells drilled immediately outside the control zone found to have elevated radon levels were not receiving radionuclides from the repository.

See comments on background radiation in the Sebago batholith, appendix A22.

Presence of public water supplies and watersheds within that candidate area.

The Sebago Lake candidate area includes portions of three major drainage basins in southwestern Maine: the Saco, the Crooked, and the Androscoggin River drainage basins. Southern Maine is the most heavily developed and populous area of the State, and surface water supplies are critical to many of the major urban areas in that part of the State.

However, in the draft Area Recommendation Report no mention is made of the significance of Sebago Lake (and the associated watershed) or the Saco

River as major sources of municipal water supplies. Sources of surface water, which are the principal sources of water for urbanized areas, should be given consideration as a resource just as sources of ground water are. Serious questions of impacts on water quality are not even briefly mentioned in the draft Area Recommendation Report.

This is an extremely serious issue affecting many more people than just those within the candidate area, and should cause the Deparment of Energy to disqualify the Sebago Lake candidate area.

See comments on water supplies and watersheds in Southern Maine, appendix A7.

Impacts of repository construction on wildlife habitat.

An assessment of the impacts of a repository on fish and wildlife habitat indicates that considerable loss of habitat can be expected from construction and operations of a repository.

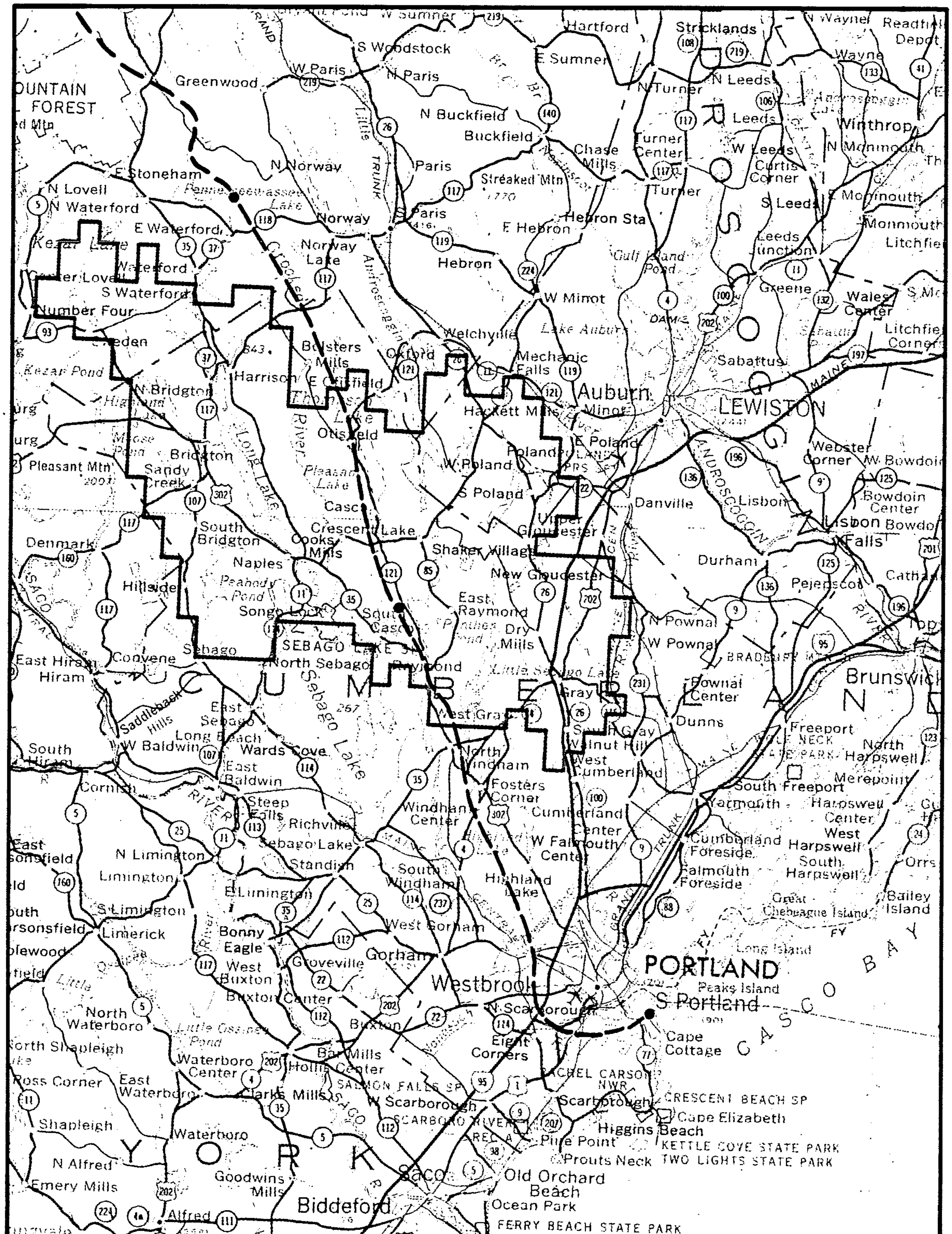
Direct, permanent loss of terrestrial habitat would be expected with development of roads and surface facilities such as buildings, parking areas, tailings piles, dumps, etc. Wildlife use of otherwise suitable unaltered habitat may be restricted or diminished. Effects on fish species and populations are anticipated to be less dramatic or obvious than wildlife considerations, but can be significant and important nevertheless. Chemical changes in water quality are one of the greatest potentials with mining operations. Discharge of mineral laden pumped ground water, leaching from tailings piles, uncontrolled dust movement, sedimentation, effluent discharges from water treatment facilities, etc., are all examples of sources of chemical changes which may be associated with mining operations. Effects on aquatic organisms, and fish in particular, can range from acute toxicity and mortality to sub-lethal effects on reproduction, growth, behavior, avoidance of contaminated water, and suitability for human consumption.

Uses such as hunting, trapping, fishing, bird watching and other non-consumptive activities, etc., can be expected to be curtailed in the immediate surface facilities development area. Transient summer and winter angling use, hunting, and seasonally-used camp developments have not been factored into the screening process.

See comments provided by the Department of Inland Fisheries and Wildlife, appendix A23.

Presence and location of the Portland-Montreal pipeline within the candidate area.

The Portland-Montreal pipeline essentially transects the Sebago Lake candidate area. This pipeline has been operating since 1941, and is covered by an agreement between the United States and Canadian governments in order to "...ensure the uninterrupted transmission by pipeline through the territory of



Approximate location of Portland - Montreal pipeline

- **Pumping station**

Source: Portland Pipe Line Corporation

Figure 2-1

one Party hydrocarbons not originating in the territory of that Party, for delivery to the territory of the other Party..." (Treaties and Other International Acts Series 8720). The agreement further states that "No public authority in the territory of either party shall institute any measures, other than those provided for in Article V, which are intended to, or would have the effect of, impeding, diverting, redirecting, or interfering with in any way the transmission of hydrocarbons in transit " (Article II, paragraph 1). Article V of the agreement states that viable reasons for temporary stoppage of flow include "actual or threatened natural disaster, an operating emergency, or other demonstrable need temporarily to reduce or stop for safety or technical reasons..."

The Department of Energy must consider the implications and costs involved with characterization activities in the vicinity of the pipeline, and the additional substantial cost involved if a portion of the Sebago Lake area containing the pipeline is selected for additional site specific work. The Department of Energy should also consider that it will be undesirable for the pipeline to remain within the restricted zone.

Economic impact of the repository on the area, in particular impact on tourism and recreation opportunities within the area.

The study provided by the State Development Office demonstrates the significance of tourism to the economy of the Sebago Lake area. Perception of the nature of the area is critical in attracting tourists to an area, and any change in the nature of the area, either real or perceived, will have a damaging effect on this segment of the economy.

Additional work on the economic impact of a repository in the Sebago Lake area is in progress.

See description of tourism in the Bottle Lake and Sebago Lake areas, appendix A24.

Economic impact assessment, work in progress.

Presence of a number of registered National Historic Landmarks not mentioned in the draft Area Recommendation Report, and potential presence of major historic and prehistoric archeological sites in the area.

The draft Area Recommendation Report omitted several sites adjacent to the candidate area which are on the National Register of Historic Places. In addition, while no historic or prehistoric archeological sites have been registered within the candidate area, the Maine Historic Preservation Commission indicates that 14 sites are known within the area.

See comments on the description of the Sebago Lake candidate area, appendix A5, and comments provided by the Maine Historic Preservation Commission, appendix A21.

Possibility of climatic change.

The problem of long-term climatic change is explicitly cited in the Nuclear Regulatory Commission Guidelines for Disposal of High-Level Nuclear Waste in Geologic Repositories (10 CFR 60, section 60.122(c)(6)) and the Department of Energy General Siting Guidelines (10 CFR 960, section 960.4-2-4.) The possible effects of climatic changes on ground water behavior in the two candidate areas, both of which were partly submerged at the end of the last glaciation approximately 10,000 years ago, will have to be seriously considered.

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Technical Appendices

Comments on Department of Energy Draft Area Recommendation Report

Appendix A1 - Analysis of the Nine Sets of Weights for Calculation of Weighted Averages

Results

From the percentages of points assigned to the 9 weight sets, it is clear that a broad range of weights was not developed by the workshop method used by the DOE. For example, variables assigned to the various groups ranged between:

Geology:	28% to 87%	
Surface water:	2% to 21%	Combining surface water and land use as environment: 9% to 57%
Land use:	7% to 36%	
Population:	5% to 35%	

There was a distinct bias in the weights towards geologic variables; given the very limited amount of geologic information that was used in the screening at this stage, this is not reasonable. In particular, the high values given to major ground water discharge zones (variable 2) by the DOE/CRP workshop groups is due more to the theoretical importance of the variable as opposed to the nature and quality of the data on this variable. A very simplistic approximation was made for discharge zones, and 3 of the 4 State groups weighted the variable lower than all the DOE/CRP groups, with one group giving it 0.0.

A "broad" range of weights was desired in order to show that the areas selected in the quantitative screen would be satisfactory even if most of the weight was given to population, or land use, or geology. However, population considerations never weighted more than 35%; "environment" never more that 57%; geology never less than 28%, and in 4 sets was weighted at 70% or greater.

There is a much more significant consequence of the strong emphasis on one of the sets of variables in the weights. Since the composite favorability map showed cells that were above the "benchmark" for 9-out-of-9, 8-out-of-9, 7-out-of-9, etc. sets of weights, if 4 of the 9 sets has geology weighted at 70% or greater, cells with a lack of adverse geologic characteristics were essentially guaranteed a 4-out-of-9 score. With 7 sets of weights having geology weighted at greater than 40%, cells with no adverse geologic factors were very likely to fall in the 7-out-of-9 range.

Therefore, a value of 7-out-of-9 or above <u>is not</u> necessarily indicative of areas that satisfy a broad range of weights, or indicative of areas that are necessarily suitable in all three categories - geology, environment, and population.

This fact, coupled with the way the DOE/CRP chose to apply the quantitative screening process, does not provide candidate areas that can be shown to be acceptable to the range of interests the Department of Energy attempted to poll in their weighting workshop.

Appendix A1

Department of Energy Phase A Weight Set - Analysis by Weight Group

Weight Set:	C1	C2	C3	C4	C5	B1	B2	B3	B4
Variable									
1	242.8	178.4	91.0	78.7	113.0	258.2	176.9	98.3	71.0
2	399.5	201.1	154.3	101.3	99.1	0.0	62.5	119.5	68.7
3	38.2	50.6	94.3	36.5	24.3	42.0	62.1	0.1	44.6
4	27.0	76.1	126.0	54.6	64.1	0.0	164.3	75.8	28.3
5	52.0	78.8	141.0	75.6	52.0	0.0	20.8	6.0	20.1
6	106.2	118.4	97.7	74.8	80.0	166.8	221.8	40.3	46.4
7	16.3	19.3	21.8	60.8	36.4	0.0	2.6	0.0	1.8
8	35.1	69.3	68.5	86.4	144.9	24.0	65.9	182.5	75.9
9	9.5	26.1	27.7	60.0	64.0	20.0	15.0	2.5	69.1
10	8.3	22.5	21.8	55.5	46.2	15.0	52.1	34.0	74.5
11	10.8	14.3	19.3	35.8	26.2	35.0	17.5	57.1	84.5
12	11.5	13.8	19.2	33.0	20.9	0.0	39.6	39.4	71.4
13	13.3	21.6	25.8	51.1	74.8	0.0	8.8	0.0	56.4
14	6.5	21.6	14.3	60.1	30.7	0.0	22.3	93.8	109.1
15	10.2	49.3	53.3	79.1	37.3	173.9	26.0	84.6	97.7
16	13.5	39.3	24.2	57.0	86.8	265.1	42.0	166.3	80.5
	1000.7	1000.5	1000.2	1000.3	1000.7	1000.0	1000.2	1000.2	1000.0

Proportions by group:

Geology	865.7	**0.87**	703.4	**0.70**	704.3	**0.70**	421.5	**0.42**	432.5	**0.43**	467.0	**0.47**	708.4	**0.71**	340.0	**0.34**	279.1	**0.28**
Surface water	16.7	**0.02**	70.9	**0.07**	67.6	**0.07**	139.2	**0.14**	68.0	**0.07**	173.9	**0.17**	48.3	**0.05**	178.4	**0.18**	206.8	**0.21**
Land use	69.7	**0.07**	117.6	**0.12**	135.6	**0.14**	296.2	**0.30**	268.5	**0.27**	70.0	**0.07**	135.6	**0.14**	133.0	**0.13**	357.7	**0.36**
Population	48.6	**0.05**	108.6	**0.11**	92.7	**0.09**	143.4	**0.14**	231.7	**0.23**	289.1	**0.29**	107.9	**0.11**	348.8	**0.35**	156.4	**0.16**
		1.00		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**		**1.00**

Variable list:

1: Rock mass extent
2: Major ground water discharge zones
3: Rock and mineral resources
4: Seismicity
5: Suspected Quaternary faulting
6: Postemplacement faulting
7: Proposed Federal-protected lands
8: Population density
9: Proximity to Federal-protected lands
10: Proximity to State-protected lands
11: National Forest lands
12: State Forest lands
13: Critical habitat
14: Wetlands
15: Surface water bodies
16: Proximity to highly populated areas

Variable groups:

Geology (1,2,3,4,5,6)

Surface water (15,16)

Land use (7,9,10,11,12,13)

Population (8,16)

Comments on Department of Energy Draft Area Recommendation Report

Appendix A2 - Accuracy of DOE/CRP Data Base

Introduction

The Department of Energy used a computer-based quantitative screening methodology in the first part of their area selection process. Maps of the 17 States had a 1 mile by 1 mile grid overlayed across them, and a value was assigned to each cell for each of the 16 variables used in the initial screening. These variables are:

1. Rock mass extent
2. Major ground water discharge zones
3. Rock and mineral resources
4. Seismicity
5. Suspected Quaternary faulting
6. Postemplacement faulting
7. Proposed Federal-protected lands
8. Population density
9. Proximity to Federal-protected lands
10. Proximity to State-protected lands
11. National Forest lands
12. State Forest lands
13. Critical habitat
14. Wetlands
15. Surface water bodies
16. Proximity to highly populated areas

These particular variables were selected because it was felt that there was data available for each of the variables over the 17 States, and that the data was relatively uniform and consistent.

Since the size of the grid cell used in the analysis was 1 square mile (640 acres), the DOE/CRP only considered features greater than 320 acres (or 1/2 of a grid cell) in this part of the screening. Smaller features were supposed to be considered in the qualitative deferral analysis. However, even features greater than 320 acres <u>might not be considered</u> in this stage <u>if</u> the feature happened to fall across two, three, four, etc. grid cells. The DOE/CRP grid might fall across a feature like Long Lake in a way such that much less than 50% of the lake would be counted. If an approximately circular 1,200 acre lake was located such that it was broken into 4 equal parts by the grid, it would not be counted. Conversely, a 400 acre lake that fell entirely into a single grid cell would cause the entire grid cell to be coded as a surface water body. However, we feel that the DOE/CRP data base tends to underestimate the percentage of surface water bodies and wetlands, and to a lesser degree highly populated areas and Public Lands, in the two candidate areas.

As a part of commenting on the draft Area Recommendation Report the values of each of the 16 variables in the grid cells in the two areas was checked.

<u>Rock mass extent</u>

This variable was designed to insure that the repository and controlled zone would be entirely within crystalline rock. This would make characterizing the hydrology of the repository site much easier, and lead to greater confidence in the results.

The measure for rock mass extent is "the diameter of a circle that can be wholly contained within the rock mass". Based on this definition, you could assume that there would be a <u>single</u> value for a rock mass. However, in the DOE/CRP data base this is not true for either rock body. Values in irregular extensions of the rock body are coded less favorable.

The DOE/CRP staff used a technique where a circle of specific diameter (based on the scale selected for this variable) was moved around the rock body. Where the circle could be placed tangent to the boundary of the rock body, all cells within the circle were coded based on the diameter of that circle. As a result, irregular extensions of the rock body, where a larger diameter circle could lie tangent to the rock boundary, had lower favorabilities.

This is superior to assigning a single value to the rock body, which would not consider any irregularities in the boundary, but it still ignores the fact that the Department of Energy has no knowledge of the direction of flow of ground water in the rock body. If the direction of flow is <u>into</u> the rock body at the boundary, the DOE/CRP technique is satisfactory; however, if the direction of flow is out of the rock body or approximately parallel to boundary, the value given the grid cell is too favorable. An approach that takes into account the lack of knowledge of the direction of ground water flow would be to code a grid cell based on the size of the circle that could wholly fit into the rock body when centered on that grid cell. This approach would favor the interior portions of rock bodies, and guarantee that regardless of the direction of ground water flow the entire control zone of "most favorable" areas would be inside the rock body.

Attached are maps of rock mass extent based on this interpretation. This leads to much lower values of rock mass extent, and favors the interior of large rock bodies over smaller rock bodies.

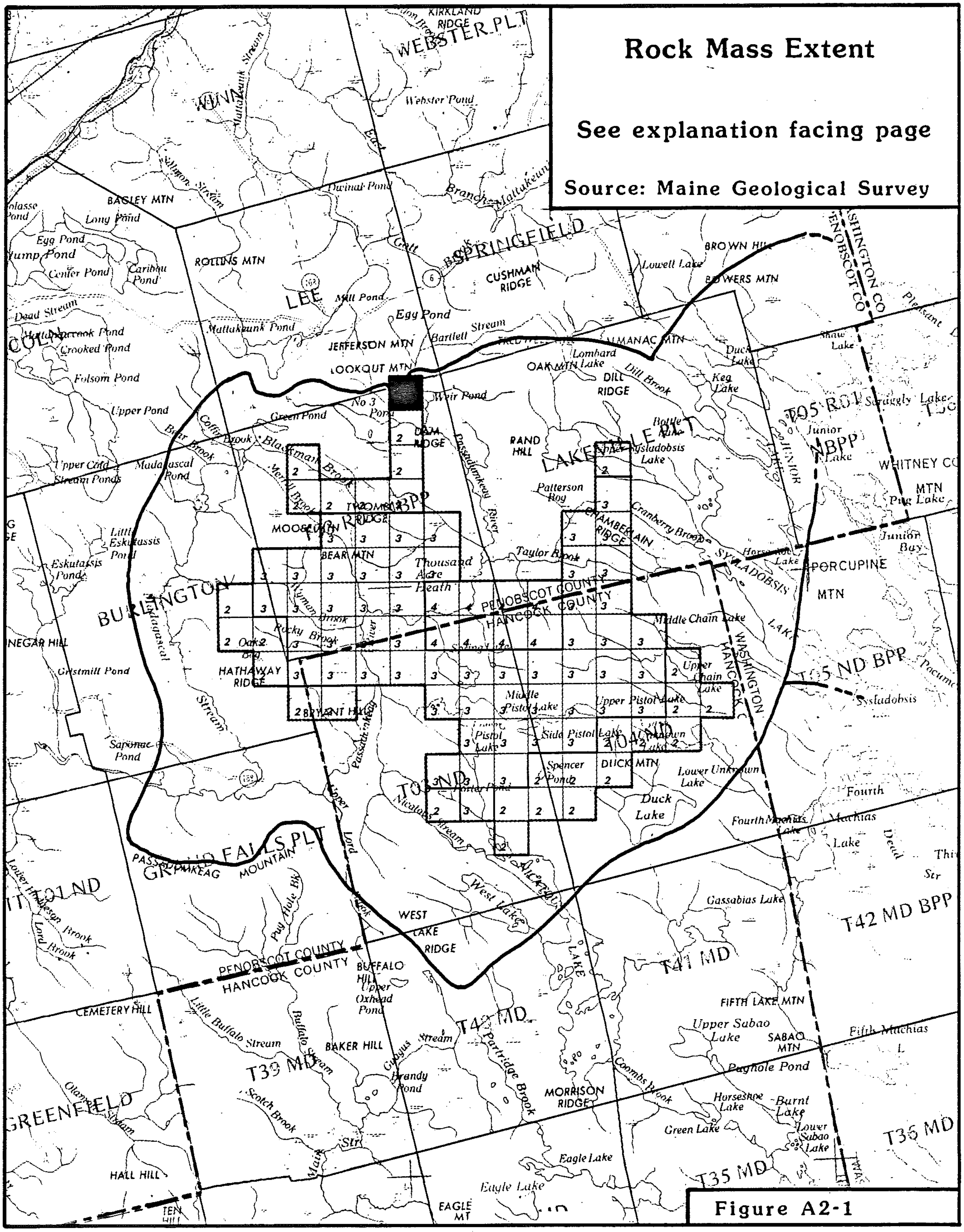
<u>Major ground water discharge zones</u>

The proxy for ground water discharge zones was major lakes and rivers. We have commented that this approach is overly simplistic, and that we felt that additional lakes and rivers in Maine should have been specified as discharge zones (including Sebago Lake). This variable was highly weighted in several sets of weights.

See comments on consideration of Sebago Lake as a regional discharge zone, appendix A11.

Figure A2-1: Alternate measure for rock mass extent.

The value assigned to each grid was determined from the diameter of the circle that could fit wholly within the rock body when centered on the grid cell. This approach assumes no information on the direction of ground water movement. It favors the interior portion of large rock bodies, where the ground water flow through crystalline rock is maximized.



Rock Mass Extent

See explanation facing page

Source: Maine Geological Survey

Figure A2-1

Figure A2-2: Alternate measure for rock mass extent.

The value assigned to each grid was determined from the diameter of the circle that could fit wholly within the rock body when centered on the grid cell. This approach assumes no information on the direction of ground water movement. It favors the interior portion of large rock bodies, where the ground water flow through crystalline rock is maximized.

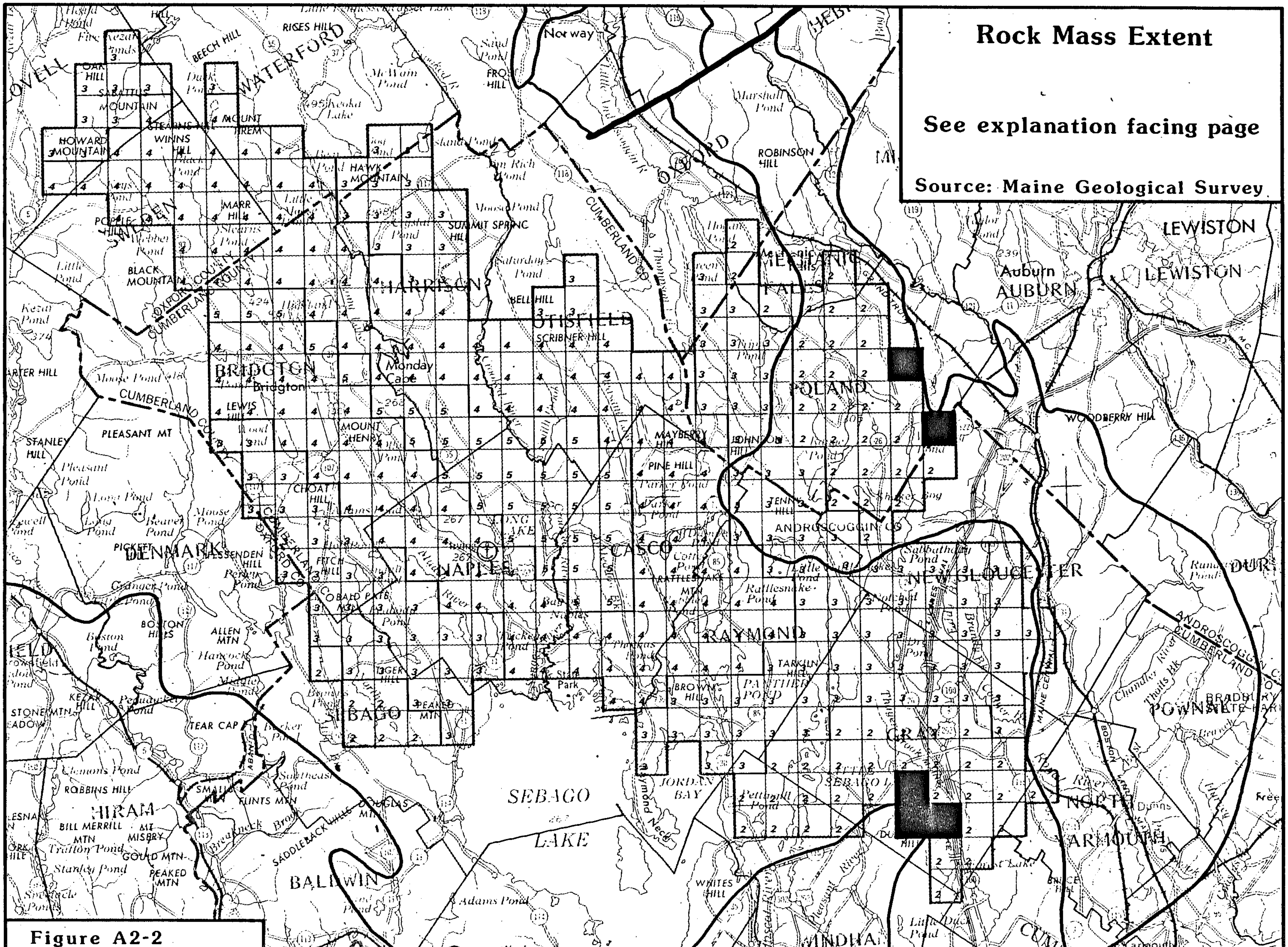

Rock Mass Extent
See explanation facing page
Source: Maine Geological Survey
WATERFORD
HARRISON
OTISFIELD
BRIDGTON
Brigdton
POLAND
MECHANIC FALLS
LEWISTON
AUBURN
Auburn
NAPLES
CASCO
DENMARK
RAYMOND
NEW GLOUCESTER
SEBAGO
GRAY
NORTH YARMOUTH
POWNAL
HIRAM
BALDWIN
SEBAGO LAKE
OXFORD
CUMBERLAND CO
ANDROSCOGGIN CO
Norway

Figure A2-2

Rock and mineral resources

See comments on mineral resource assessement, appendix A10.

Seismicity

For this screen the DOE/CRP only considered seismic risk to the facility during construction and operation of the facility, not during the post-closure period. As a result they used the estimated horizontal ground motion that could be anticipated to occur within 250 years.

We have previously commented that there are other quantitative measures such as frequency of occurrence and recurrence relations that could also have been employed and would have more useful in discriminating between rock bodies.

It has also been suggested that the Algermissen et al. (1982) seismic hazard maps underestimate the seismic hazard in the region.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

Suspected Quaternary faulting

There are no faults in Maine that are currently suspected of having been active in the Quaternary, however, comments prepared by Robert G. Gerber, Inc., for the Portland Water District suggest possible Quaternary faulting off coastal Maine (**see appendix A30**).

Postemplacement faulting

This variable was intended to look at the impact of faulting on the hydrology of a potential site. Faults that are younger than the crystalline rock may produce fractures and fracture zones that will be pathways for water flow. Therefore, extensively faulted bodies will have poor hydrologic characteristics.

Postemplacement faulting was weighted relatively highly in a number of the weight sets.

The DOE/CRP considered all mapped faults that were within 6 miles of the crystalline rock from published small scale geologic maps (such as the Maine State map). Depending on the distance of the grid cell from the mapped fault, the grid cell was assigned a value from 1 (most adverse) to 5 (most favorable).

Overlaying the areas on 1:250,000 geologic maps used to produce the Bedrock Geologic Map of Maine, a number of cells in the Bottle Lake and Sebago Lake areas appear to have incorrect values. The DOE/CRP assigned a higher (more favorable) value to a number of the cells.

Figure A2-3: Postemplacement faulting

The candidate areas were overlayed on a 1:250,000 scale map, and the faults traced onto a grid system. A series of concentric circles were drawn from the center of grid cells that contained more than 1/2 mile of fault. Grid cells that we feel are in error are shown with two values:

- the upper value is the DOE/CRP value;

- the lower value is the value we feel the grid cell should have.

Postemplacement Faulting

See explanation facing page

Source: Maine Geological Survey

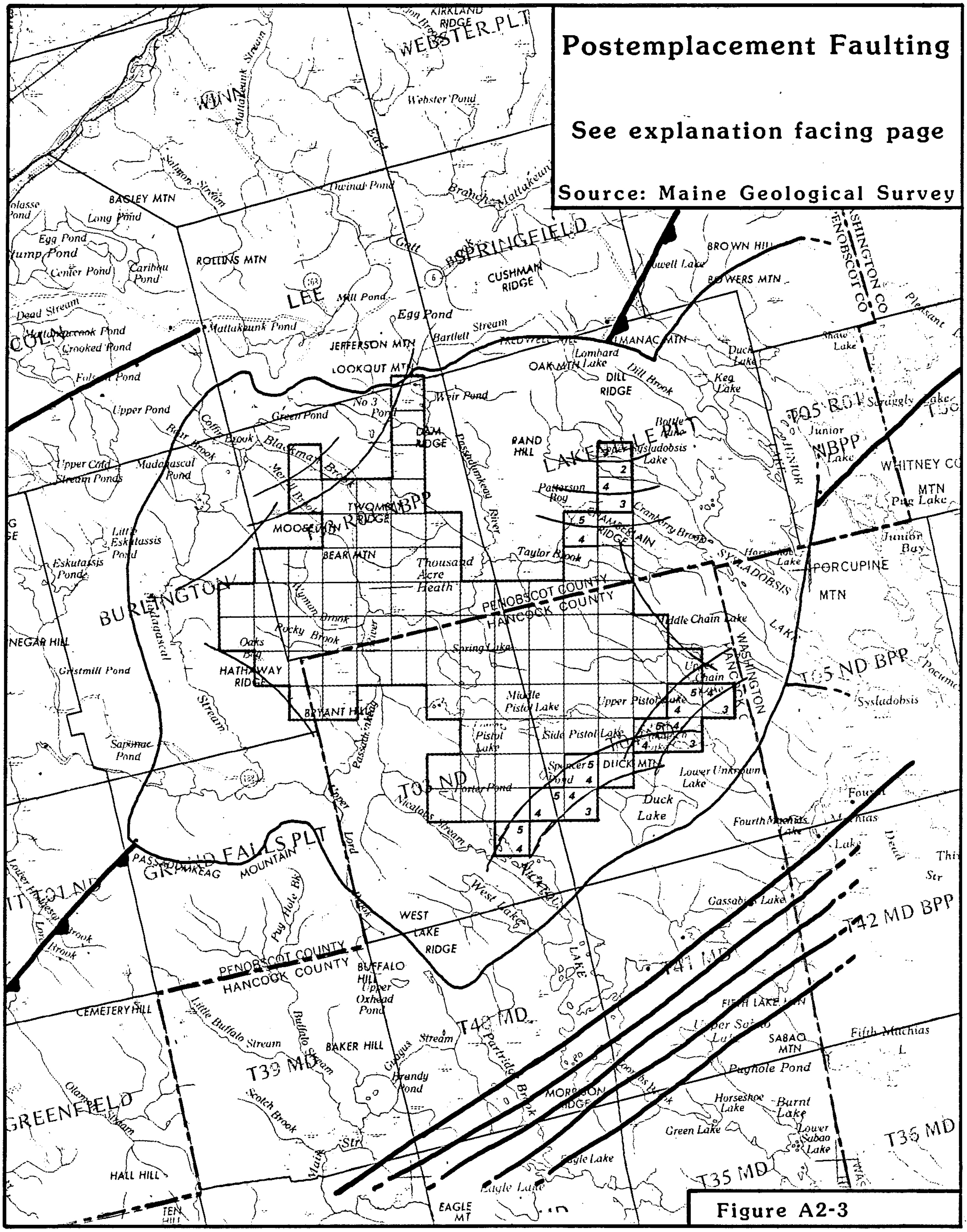


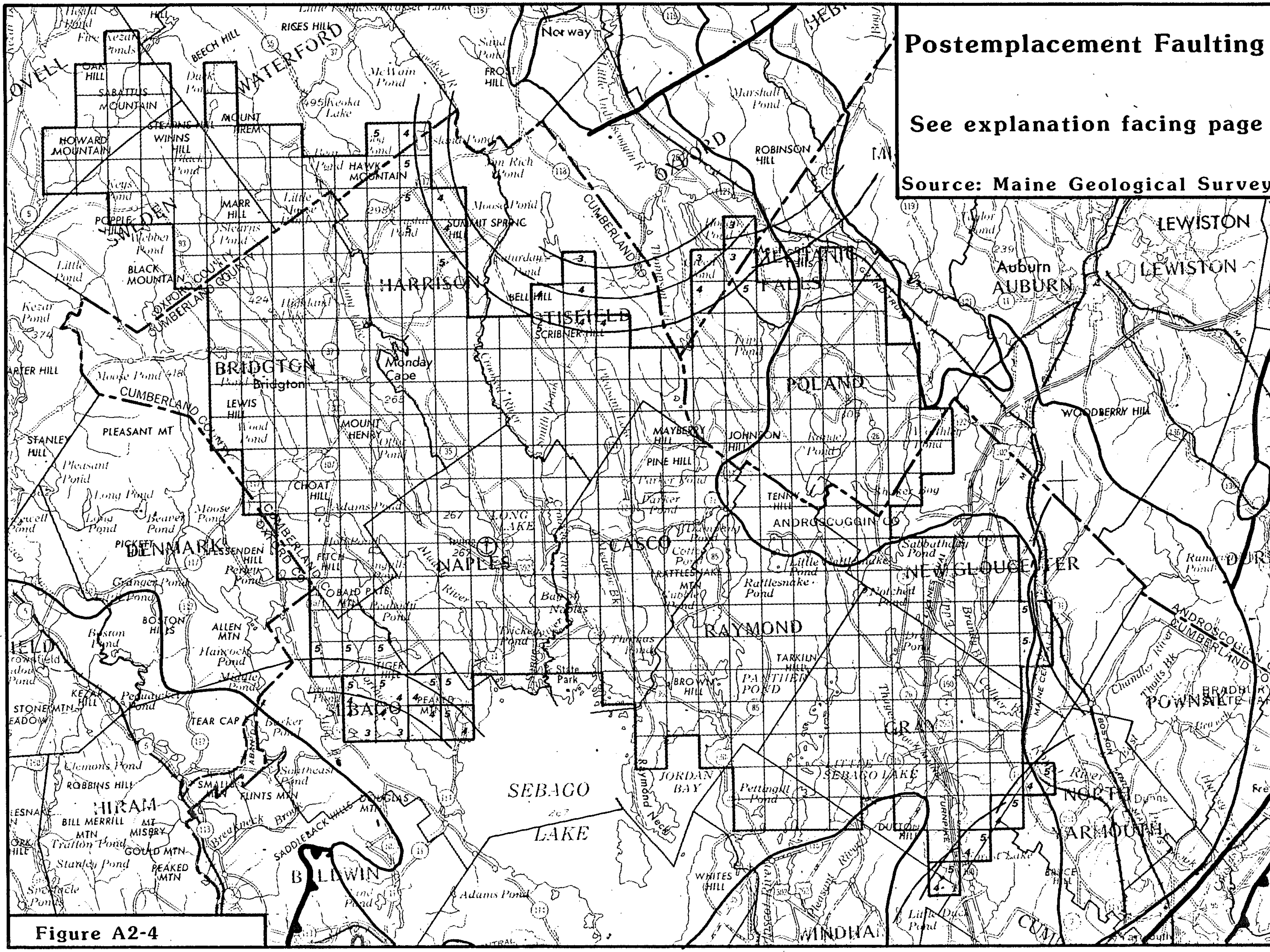
Figure A2-3

Figure A2-4: Postemplacement faulting

The candidate areas were overlayed on a 1:250,000 scale map, and the faults traced onto a grid system. A series of concentric circles were drawn from the center of grid cells that contained more than 1/2 mile of fault. Grid cells that we feel are in error are shown with two values:

- the upper value is the DOE/CRP value;

- the lower value is the value we feel the grid cell should have.



Postemplacement Faulting

See explanation facing page

Source: Maine Geological Survey

Figure A2-4

Proposed Federal-protected lands

The rationale for this variable is that if certain Federal-protected lands are disqualified, proposed Federal-protected lands should be given some adverse status.

Population density

In the Bottle Lake area the population density is very low by any measure, well below the 200 persons per square mile limit for "least adverse/most favorable".

Within the Sebago Lake candidate area two towns (Mechanic Falls, Windham) have population densities greater that 200 persons per square mile, and this is shown in the DOE/CRP data base.

The State Planning Office has provided an alternative population density map based on 1980 population by enumeration district. This alternative indicates slight but significant increases in density in the area around Bridgton and the northern part of Gray. As noted above, however, the real problem lies with the Department of Energy's failure to use a meaningful variable for population density.

See comments on reanalysis of 1980 Census data, appendix A25.

Proximity to Federal-protected lands

The rationale for this variable is that siting a repository close to a Federal park or wilderness area, etc., might have an impact on the park or other protected land.

There are presently no Federal-protected lands close enough to the two areas to have an impact on the selection process. However, a portion of the White Mountain National Forest is presently being considered as for designation as wilderness area.

Proximity to State-protected lands

The rationale for this variable is the same as for Federal-protected lands.

In the Bottle Lake area the only State-protected lands recognized by the Department of Energy within 6 miles of the area is the Machias River. They did not consider the Land Use Regulation Commission protection zones as State-protected lands. Consideration of these lands would essentially disqualify the Bottle Lake candidate area.

See comments on Land Use Regulation Commission protected lands, appendix A8.

In the Sebago Lake area there are a number of State-protected lands within and adjacent to the area. Features greater than 320 acres are the Crooked River, Range Ponds State Park, and Sebago Lake State Park. A number of features less than 320 acres in size do not show up in the gridded data.

National Forest lands

While not a disqualifier, National Forests and proximity to National Forests are adverse conditions.

There are no National Forest lands in or near the Bottle Lake area.

A section of the White Mountain National Forest is within 6 miles of the Sebago Lake area. Eight square miles of the candidate area in the northwest corner are coded "4" (less than favorable) because of proximity to the National Forest.

State Forest lands

Our Public Lands are considered State Forests for the purposes of this report.

Using the most current map of consolidated public lands, there are some changes required in the DOE/CRP data base. In particular, several cells in the northeastern part of the Bottle Lake candidate area will receive lower values.

See map accompanying comments on policy on nuclear waste disposal on the Public Lots, appendix A9.

Critical habitat for threatened and endangered species

This variable was used to avoid siting a repository where it would lead to an irreconcilable conflict with a defined habitat for a threatened and endangered species.

Maine currently has no Federally recognized habitat for threatened and endangered species. However, there may very well be threatened or endangered species which use the Bottle Lake or Sebago Lake candidate area as habitat and this issus should be studied in the future (**see appendix A34**).

Wetlands

Wetlands were considered an adverse condition for two reasons: flooding during construction and operation and environmental conflicts. It was weighted relatively highly in several sets of weights.

A major problem with wetlands is the nature of the data. There are numerous large scale wetlands inventories in the 17 States, but no uniform large scale inventory (such as the National Wetlands Inventory) covered the

Wetlands

Source: U.S. Geological Survey Land use map

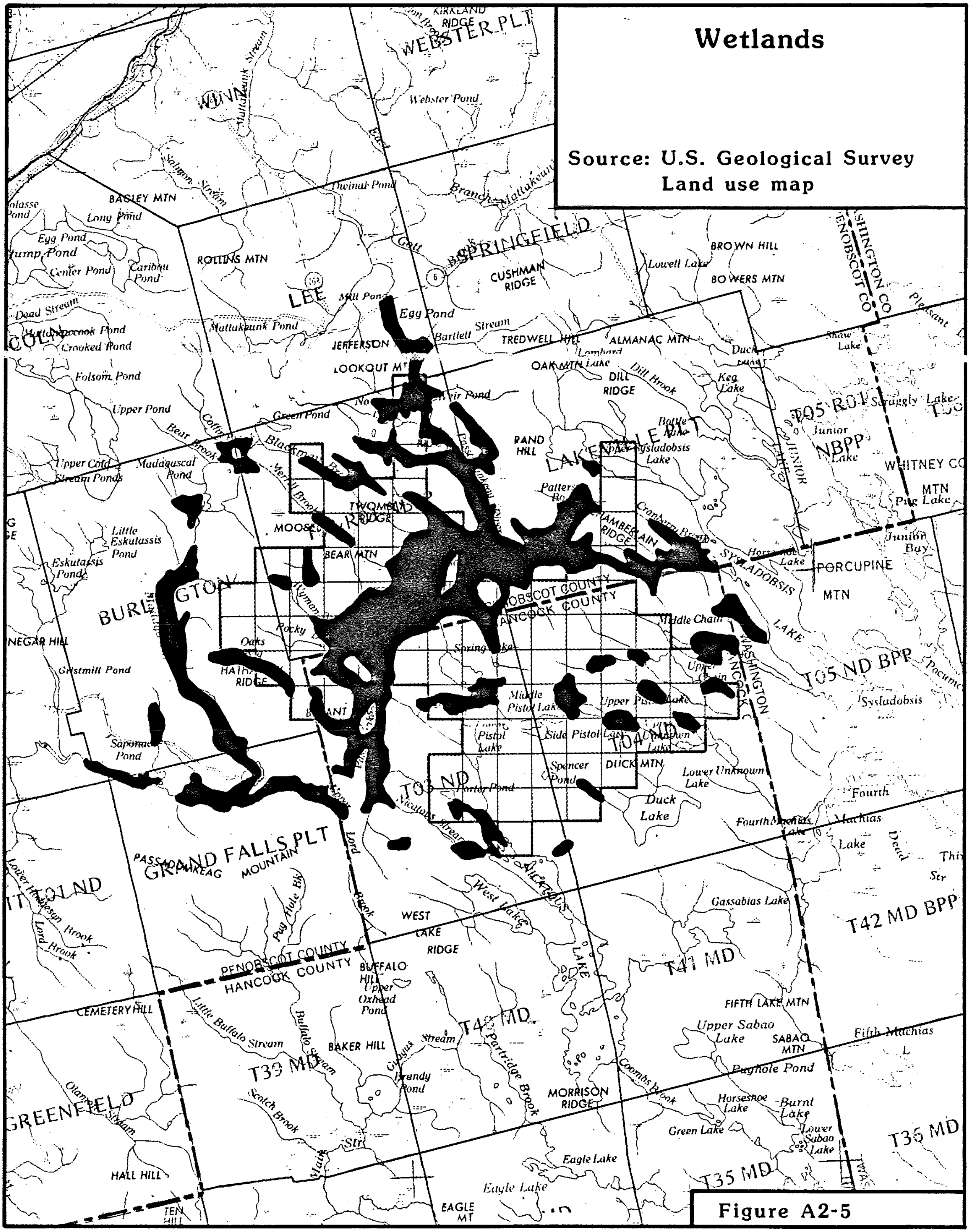


Figure A2-5

Wetlands

Source: Maine Geological Survey

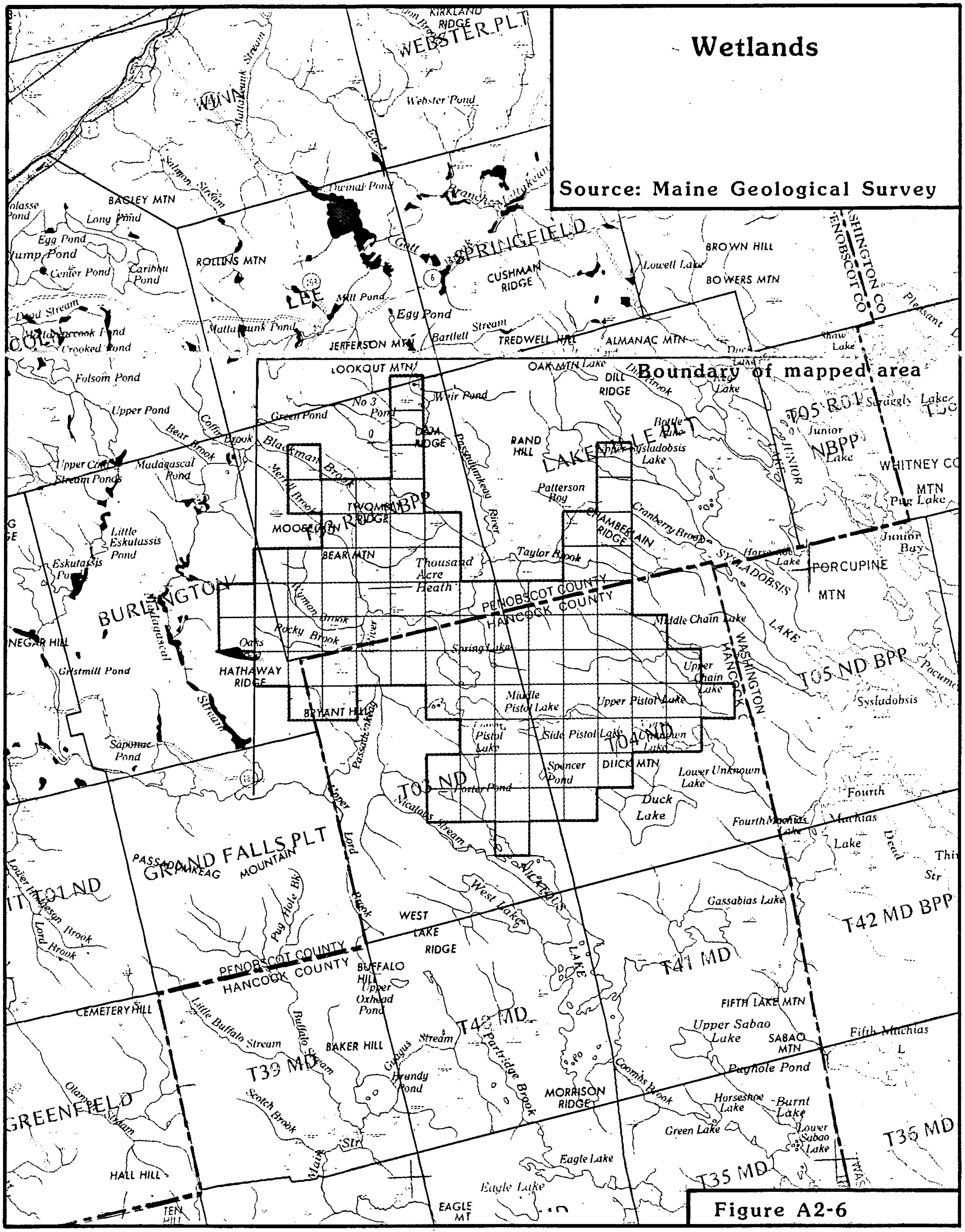


Figure A2-6

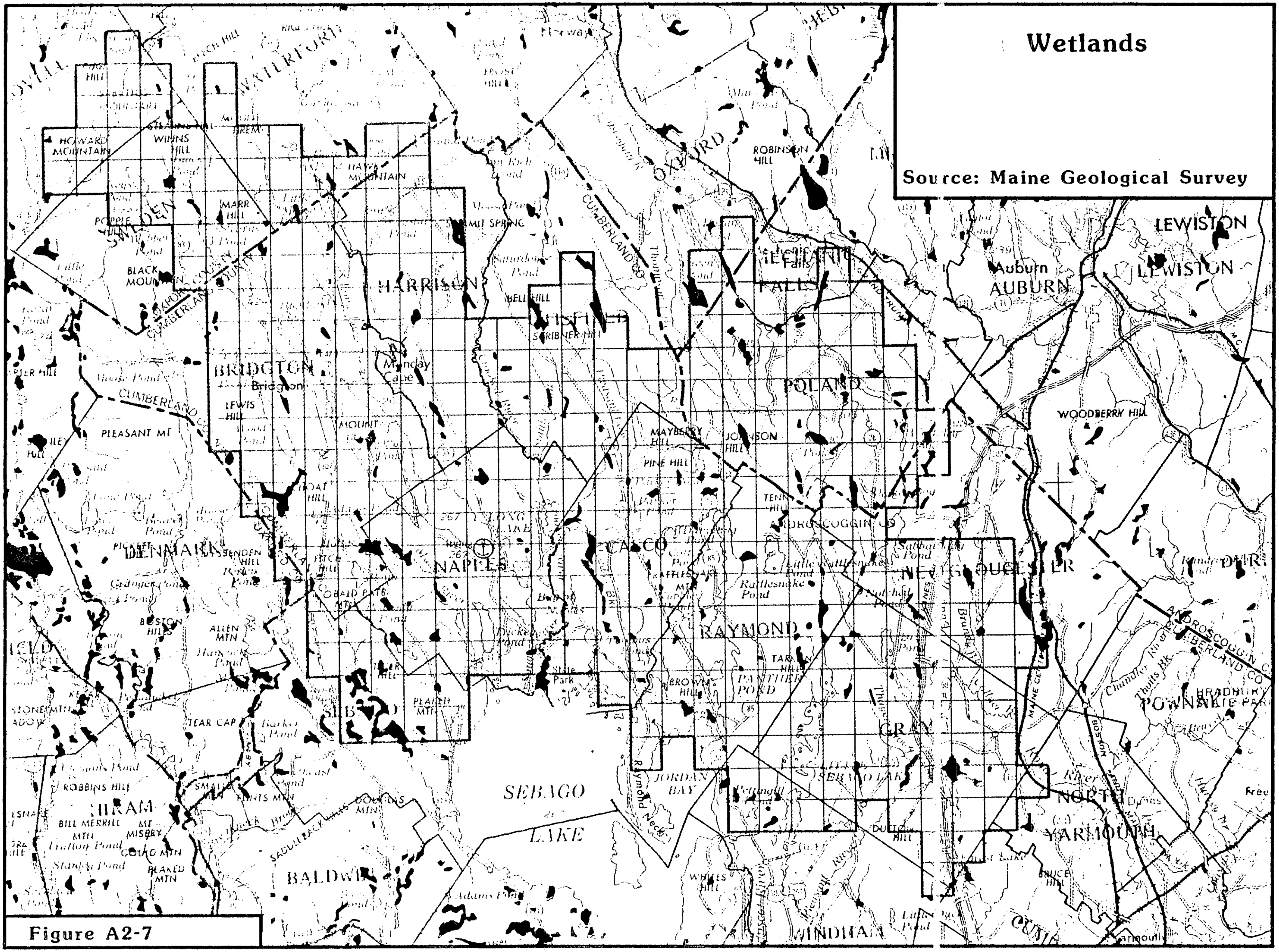


Figure A2-7

Wetlands

Source: Maine Geological Survey

Surface Water Bodies

Source: U.S. Geological Survey
1:250,000 quadrangle series

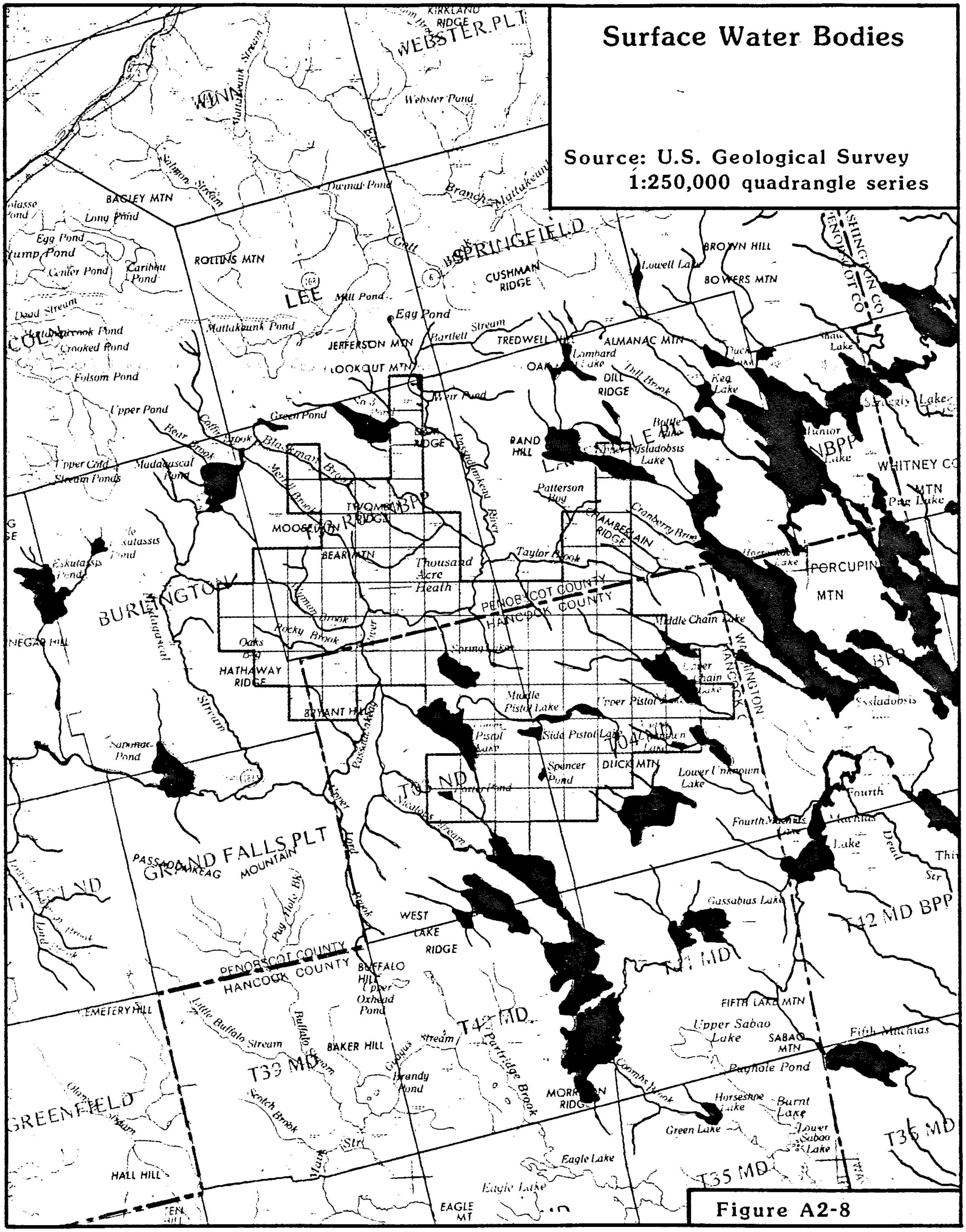


Figure A2-8

entire area. The DOE/CRP was working with a 1 square mile by 1 square mile grid cell, and thus did not have the resolution to pick up many of the small wetland areas. These settled on the 1:250,000 U.S.G.S. Land Use maps (L-series) as the source for the wetlands data.

In the Bottle Lake area, where wetlands are a major feature, there are several grid cells that appear to be miscoded. This will affect both the cell in question and adjacent cells. The limitations of the process used by the DOE/CRP to code the grid cells are especially obvious in the southeastern portion of the candidate area, where a number of significant wetland areas are discounted because of the way the grid overlay falls over the area, placing portions of the wetland areas in different grid cells.

In the Sebago Lake area wetlands constitute a minor feature. The DOE/CRP did not identify any wetlands of sufficient size (greater than 320 acres) or proper location to be shown in the data base. However, examination of maps of wetlands produced by the Maine Geological Survey for the Department of Environmental Protection shows several areas where wetlands should be a significant feature in the DOE/CRP data base.

Surface water bodies

The reason for considering this variable was potential flooding during construction and operations. However, because of the source of data used for rivers and streams the variable as presently used is a very poor surrogate variable for flooding.

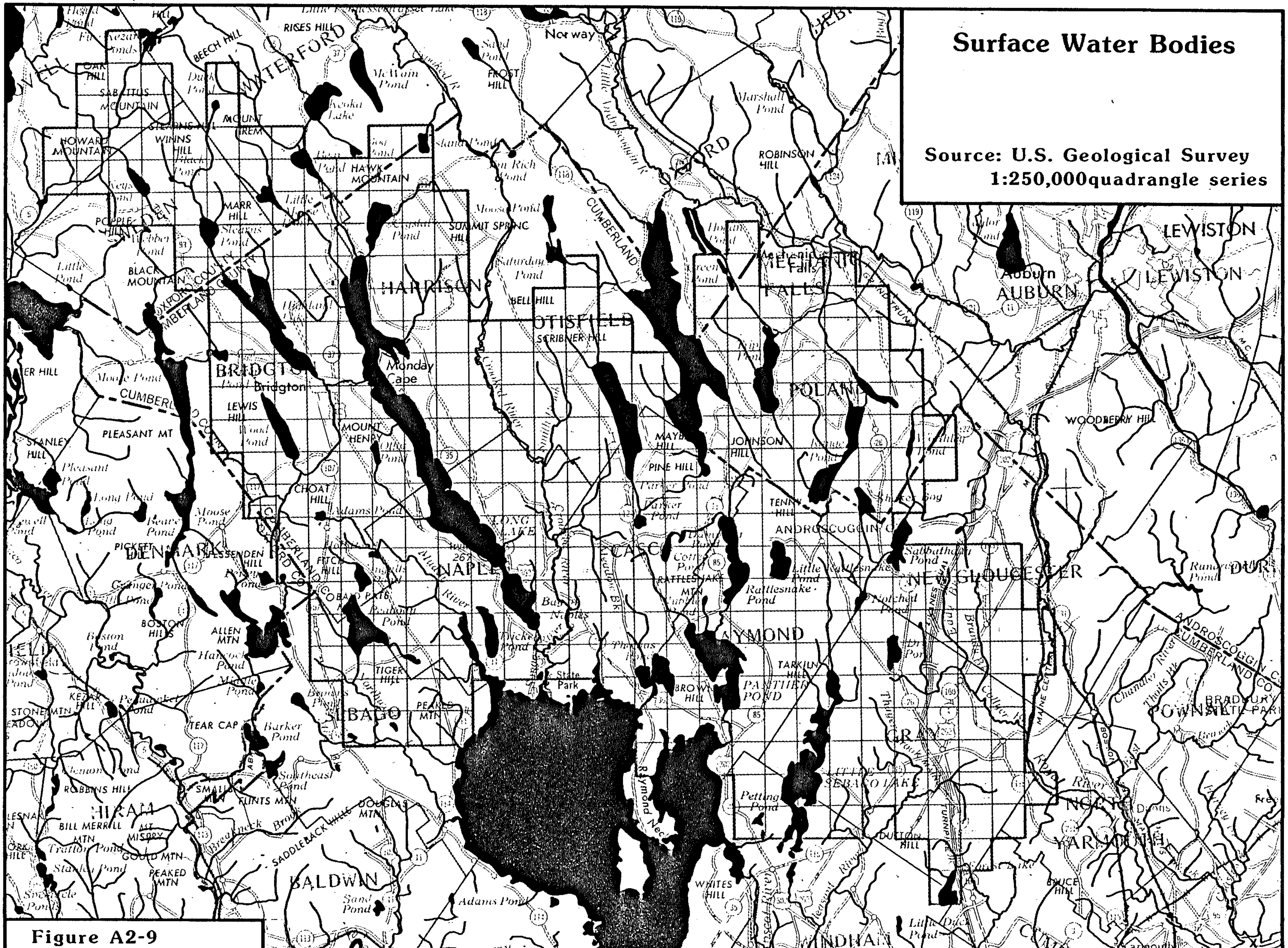
This was weighted highly in some weight sets.

In coding grid cells for surface water bodies, the Department of Energy indicated in the Screening Methodology Document the data they would use would come from (in order of preference:

U.S.G.S. Land Use maps (1:250,000)
State sources (we have no independent sources of surface water data)
U.S.G.S. 1:250,000 topographic maps
U.S.G.S. Base 3A (1:3,000,000 more or less)

In the Northeast Regional Environmental Characterization Report the DOE/CRP indicated major rivers would include "all rivers on U.S.G.S. Base 3A". <u>No rivers and streams from the 1:250,000 topographic maps were used.</u> The major rivers on U.S.G.S. Base 3A are totally inadequate to provide any measure of flood potential.

The DOE/CRP reversed the order of preference of the data sources from the methodology document to the characterization report - going from maps at 1:250,000 as the primary source to a map at approximately 1:3,000,000. Many rivers and streams were lost as a result. We feel that the Department of Energy should have used the sources of data they committed to in the Screening Methodology Document.



Surface Water Bodies

Source: U.S. Geological Survey 1:250,000quadrangle series

Figure A2-9

As described above, the process used to code lakes and ponds would tend to underestimate these features, especially long, narrow features such as Long lake and other northwest trending lakes in the Sebago Lake candidate area. There are a number of grid cells in the DOE/CRP data base that we feel should have been coded as surface water features.

The most significant shortcoming is the lack of rivers and streams in the data base. There are a number of grid cells in both the Bottle Lake and Sebago Lake areas that contain two or more rivers/streams; if these were coded as surface water, the effect would be significant.

As discussed in the appendix on estimation of flood potential, a combined wetlands/surface water body data base would eliminate some of the problems of underestimation of surface water features, and combined with use of a proper data source, is a much more realistic approach to estimating potential for flooding.

See comments on estimation of flood prone areas, appendix A6.

Proximity to highly populated areas

Proximity to highly populated areas was intended to drive the repository siting process away from population centers. It was weighted relatively highly in several weight sets. However, as evidenced by the eastern part of the Sebago Lake area, it did not accomplish its purpose.

The major reason for this is that the distances used to determine the value for the grid cell were quite large: 12 mile increments from 0 to 48 miles before a "least adverse/most favorable" value of 5 is assigned. As a result, all the Sebago rock body grid cells have values of 1 and 2, and all grid cells in the Bottle Lake complex are also coded 1 and 2. The same is true for many rock bodies in the data base, especially in the Northeast and Southeast. Therefore, the variable was not useful in discriminating between rock bodies.

The DOE/CRP suggested an alternative scale for proximity to highly populated areas that used a smaller distance increment, and therefore would have provided greater discrimination between rock bodies. The analysis in the draft Area Recommendation Report using this scale did not, however, duplicate the entire screening process, but used "benchmark" values obtained from an analysis of weighted average maps prepared with the less discriminating scale. We feel that the Department of Energy should repeat the analysis of the candidate areas from the beginning using the alternate (phase B) scale. This would demonstrate the unsuitability of the southeastern portion of the Sebago Lake candidate area.

Using the present DOE/CRP scale, the entire Sebago Lake area is coded either 1 (most adverse) or 2.

The extreme western Bottle Lake area is coded 1 (most adverse); the remainder is coded 2.

Summary

There are a number of variables (rock mass extent, postemplacement faulting, rock and mineral resources, population density, State Forest lands, wetlands, and surface water bodies) where we do have questions about the accuracy of the DOE/CRP data base.

We have several alternative grid cell maps for the variables rock mass extent and population density. These maps use a more realistic measure of the two variables.

As described in the final Screening Methodology Document, the Department of Energy should use the U.S.G.S. 1:250,000 topographic map series as the source for rivers and streams in the surface water body variable.

The Department of Energy should use a combined wetlands/surface water body data base to measure flood potential. This combined data base would solve some of the problems of underestimation of surface water features.

A more discriminating measure of proximity to highly populated areas should be used to measure this critical variable.

References

Algermissen, S.T., et al., (1982), Probabilistic estimates of maximum acceleration and velocity in rock in the contiguous United States: U.S. Geological Survey, Open-file report 82-1033.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A3 - Identification and Selection of Candidate Areas

Introduction

These comments deal with the quantitative identification and selection of candidate areas from the computer-based grid cell data used by the DOE/CRP. The Screening Methodology Document described specific steps to reach the 9 aggregate favorability (weighted average) maps (1 for each weight set), but the additional steps taken to identify a candidate area, rank it with a benchmark score, identify the number of times it occurred above the benchmark, etc., were not specified in the Screening Methodology Document. These steps are described in the draft Area Recommendation Report, but in some cases the process is qualitative and imprecise.

The comments on the nine sets of weights used in the analysis and test calculations to determine if the weighted averages were computed properly are presented in other sections. This section deals specifically with the process of selection of candidate areas after the weighted aggregate favorability maps (weighted averages) have been generated.

Comments on Selection Process

As described in the Department of Energy Screening Methodology Document (DOE/CH-1), the quantitative screening process involved (page 16):

Step 1 - This step directly uses the applicable disqualifying conditions called out by the DOE Siting Guidelines (10 CFR 960). This will eliminate certain rock bodies or portions of rock bodies from any further consideration.

Step 2 - This step uses the applicable potentially adverse and favorable conditions called out by the DOE Siting Guidelines (10 CFR 960) as scaled regional screening variables to identify the most suitable rock bodies (candidate areas) that warrant further analysis in subsequent screening phases. As described in Section 3.2.3 (of the Screening Methodology Document), weighting workshops will be held to establish individual weights for step 2 variables to indicate their relative importance. This weighting helps discriminate the most suitable rock bodies (candidate areas) from alternative points of view on the importance of the variables.

Step 3 - This step (sensitivity analysis) is designed to accomplish four major objectives. The first is to explore the implications of modifying variable scales in the selection of rock bodies (candidate areas). The second is to evaluate the effects of using the geometric mean as an alternate index of favorability. The third is to evaluate the effects of utilizing different sets of weights for the variables by preparing and comparing summary composite maps. The fourth is to allow further differentiation by incorporating other geologic variables based upon available rock body-specific data.

In particular, the Screening Methodology Document describes the evaluation of different sets of weights by preparing and comparing summary composite maps in section 3.2.5.3 on pages 50-51. A composite or aggregate favorability map is a map of the weighted average of the grid cell data for a single set of weights. A summary composite map is designed to summarize the information from different sets of weights on a single map. The use of the composite summary map is described as follows (page 50):

> "The summary composite map is used to identify similarity or overlapping areas of the most favorable candidate areas (rock bodies) on a related series of composites. For example, the CRP may want to identify which candidate areas (rock bodies) show up with a weighted average greater than 4.5 (out of 5) on all four composite maps derived using four sets of State-derived weights. A summary composite map which identifies the most highly rated candidate areas (rock bodies) on all four composites could be prepared, on three of the four composites, etc. Figure 12 (of the Screening Methodology Document) illustrates such a summary composite map. The lighter areas indicate the highest coincidence of grid cells with a weighted average greater than 4.5 on the four composite maps.
>
> The use of summary composites allows the examination of which candidate areas (rock bodies) are highly rated, as defined by the step 2 variables, under a range of scaling and weighting scenarios....."

Emphasis on the terms "candidate areas" and "rock bodies" is ours.

From this description of the process, and from earlier indications in drafts of the screening methodology and discussions at the screening methodology workshops, it was our understanding that the reason for examining various sets of weighted averages of the regional screening variables was to identify candidate areas that satisfied one or more sets of weights. That is, an area in a rock body could be identified as suitable for a given set of weights, and a geographically coincident area that independently satisfied a broad spectrum of weight sets would be judged most suitable for further study.

By "independently satisfy" a set of weights, we mean that the area that was ultimately identified by the DOE would have been identified using any single set of weights. If this is true, than any area ranking 9-out-of-9 would satisfy the concerns of all nine groups involved in the weighting process. An area ranked as 7-out-of-9 would have been identified on 7 sets of weights; the area finally identified would satisfy the concerns of 7 of the groups involved in the weighting process, etc.

This process was not followed by the Department of Energy.

The DOE/CRP used the maps of weighted averages for each of the weight sets to identify candidate areas by examining clusters of grid cells with a weighted average greater than 4.9, 4.8, etc. If a nominal 7 mile diameter circle could be fit into such a cluster of grid cells, it was called a candidate area and given a letter/number identifier. The nominal 7 mile diameter circle could contain up to approximately 2 square miles total of environmental disqualifers and/or lower valued grid cells. This was estimated visually during the identification of the candidate areas. The value for the weighted average was progressively lowered until at least 20 areas were identified on each map. More than 20 areas might be identified on a map if decreasing the value of the weighted average caused an increase in areas from less than 20 to more than 20, i.e. if 16 areas were identified for a value of 4.2 and 23 areas were identified for a value of 4.1. Tables 3-4a and 3-4b in the draft Area Recommendation report list areas that were identified on the nine maps of weighted averages.

The value of weighted average for which 20 or more areas were identified was termed the "benchmark" for that set of weights.

At this point if the DOE/CRP followed the process outlined above, the maps of weighted averages would have been examined for areas that were geographically coincident. If the same area could be identified on all nine maps (independently satisfying all nine sets of weights) it could be ranked as 9-out-of-9. If a coincident area could be found on eight maps, it could be ranked as 8-out-of-9, etc. The key point is that the candidate area independently satisfy a weight set.

Table one below was developed from tables 3-4a, 3-4b, and 3-5 in the draft Area Recommendation Report. For the candidate areas ranked 9/9, 8/9, 7/9, and 6/9 by the DOE/CRP and listed in table 3-5, it lists the weight sets where the candidate area was independently identified and the value of the weighted average where the area was first identified. For example, the Bottle Lake area, labeled NE-2, was independently identified on 6 of the 9 weight sets - sets B1, B2, B3, B4, B5, and C2. In the draft area recommendation report, however, the Bottle Lake area was ranked 7-out-of-9.

Similarly, the Cardigan area, NE-5, was independently identified on 7 of the 9 weight sets, but was ranked 8-out-of-9. (All areas ranked 9-out-of-9 were independently identified on all 9 weight sets except for the Attean area, NE-N5. This area was eliminated because of proximity to the Canadian border.)

The most extreme case is area NC-A10. This area was not independently identified on any of the weight sets, yet this area was ranked 6-out-of-9.

It is clear that the DOE/CRP did not use the interpretation of the methodology described above. Examination of tables 3-4a and 3-4b, and table 1 below shows that areas were consistently ranked higher than the interpretation that the area had to be independently identified on a weight set to qualify as having satisfied that weight set.

Discussion with DOE/CRP staff indicates that instead of requiring that a candidate area independently satisfy each weight set, an area was ranked 8-out-of-9, 7-out-of-9, or 6-out-of-9 if the grid cells within it had weighted average values above the benchmark for any 8, 7, or 6 weight sets respectively.

As an example of the process that was used, consider a case where there are only 3 sets of weights. If we have an area that consists of 25 grid cells, we can produce 3 maps showing the weighted averages for the grid cells. For weight set 1, we might have:

___	___	XX	___	___	
XX	XX	___	___	XX	
___	___	XX	___	___	Weight set 1
___	___	___	___	___	
XX	XX	___	___	___	

where an XX indicates that the grid cell did not have a value above the benchmark score for that particular weight set. For weight sets 2 and 3 we might have:

XX	___	___	XX	___	
___	___	___	___	___	
___	XX	___	XX	___	Weight set 2
XX	___	___	___	___	
___	___	XX	XX	XX	

___	XX	___	___	XX	
___	___	XX	___	___	
___	___	___	XX	XX	Weight set 3
___	XX	___	___	___	
___	___	___	XX	XX	

No individual map of weighted averages has a candidate area. But if we produce a map showing the number of times an individual grid cell was above the benchmark, we would get:

2	2	2	2	2	
2	2	2	3	2	
3	2	2	2	2	Frequency above benchmark
2	2	3	3	2	
2	2	2	2	2	

Every grid cell occurs above the benchmark on at least 2 of the 3 sets of weights, so the DOE/CRP could rank this area 2-out-of-3 in this hypothetical example. Even though no area was identified on an individual map of the weighted average, a map showing frequency of occurrence of individual grid cells above the benchmark would indicate the area was relatively favorable, scoring favorably 2-out-of-3 times.

This is the process the DOE/CRP used in ranking the Bottle Lake and Cardigan areas. A frequency map showing the number of times a grid cell scored above the benchmark value on <u>any</u> weight was produced (the phase A map of the draft ARR), boundaries were drawn enclosing clusters of highly ranked cells, a nominal 7 mile diameter circle was placed in the center of the area, and the area was ranked on the basis of the lowest frequency cell in the area. However, at this stage of identifying candidate areas from the phase A composite frequency map, up to 4 square miles of environmental disqualifier and/or lower ranked grid cell was allowed in the nominal 7 mile diameter circle.

After the nucleus of a candidate area was identified, at least two other rules were followed: the boundaries were drawn to enclose significant areas of grid cells with a frequency of 7-out-of-9 or greater, and once the original area was defined and ranked lower ranked grid cells (6-out-of-9 or less) could be included if it also allowed inclusion of significant areas of 7-out-of-9 or greater grid cells that were less that 1 mile from the original area. For this reason the Bottle Lake area has a strip of wetland with grid cell frequencies of 6/9 and 5/9 or less contained within it, and the Sebago area is split by the Crooked River disqualifier and associated cells.

It is clear to us that this "checkerboard" technique illustrated above is not what we understood from the screening methodology workshops or the final Screening Methodology Document (see above). In the extreme case of area NC-10A (not considered a candidate area), no area was present in the rock body that satisfied any of the sets of weights - the area was not suitable by any measure of the variables - yet it is considered as a relatively highly favorable area, ranked 6-out-of-9.

This "checkerboard" effect did occur in the Bottle Lake candidate area. This is illustrated in figures A3-1, A3-2, and A3-3. In figure A3-1 two groups of cells, both with a frequency of 6/9, are shown. The cell marked "A" did not score above the benchmark for weight sets B2, B3, and B4; the group marked "B" did not score above the benchmark on weight sets C4, B3, and B4. The table below summarizes the results for all three figures.

Frequency of occurrence	Weights sets where cells scored below the benchmark "A" cells	"B" cells
6/9	B2, B3, B4	C4, B3, B4
7/9	B2, B3	B3, B4
8/9	B2	B4

It is obvious that these areas did not satisfy the same weight sets, and should not be ranked comparably (essentially identically) in the screening methodology.

As table 1 (page A3-9) shows, the Cardigan area actually satisfies at most 7 of the sets of weights, the Bottle Lake area satisfies at most 6 of the sets of weights, and many of the other bodies ranked 7-out-of-9 satisfy fewer sets of weights. The modifier "at most" is used because the areas identified on the individual maps of weighted averages may not be strictly geographically coincident, reducing the area that satisfies a number of individual weight sets (see draft ARR, page 3-22). Area NC-14, ranked 7-out-of-9, was identified on 8 sets of weights, but presumably for this reason is ranked 7-out-of-9 in table 3-5.

Discussion with DOE/CRP staff and contractors (meeting of March 19, 1986, in Durham, New Hampshire) focussed, in part, on this issue. DOE/CRP contractors indicated to us that the probable reason for the discrepancy between tables 3-4a,b and table 5 in the draft Area Recommendation Report was

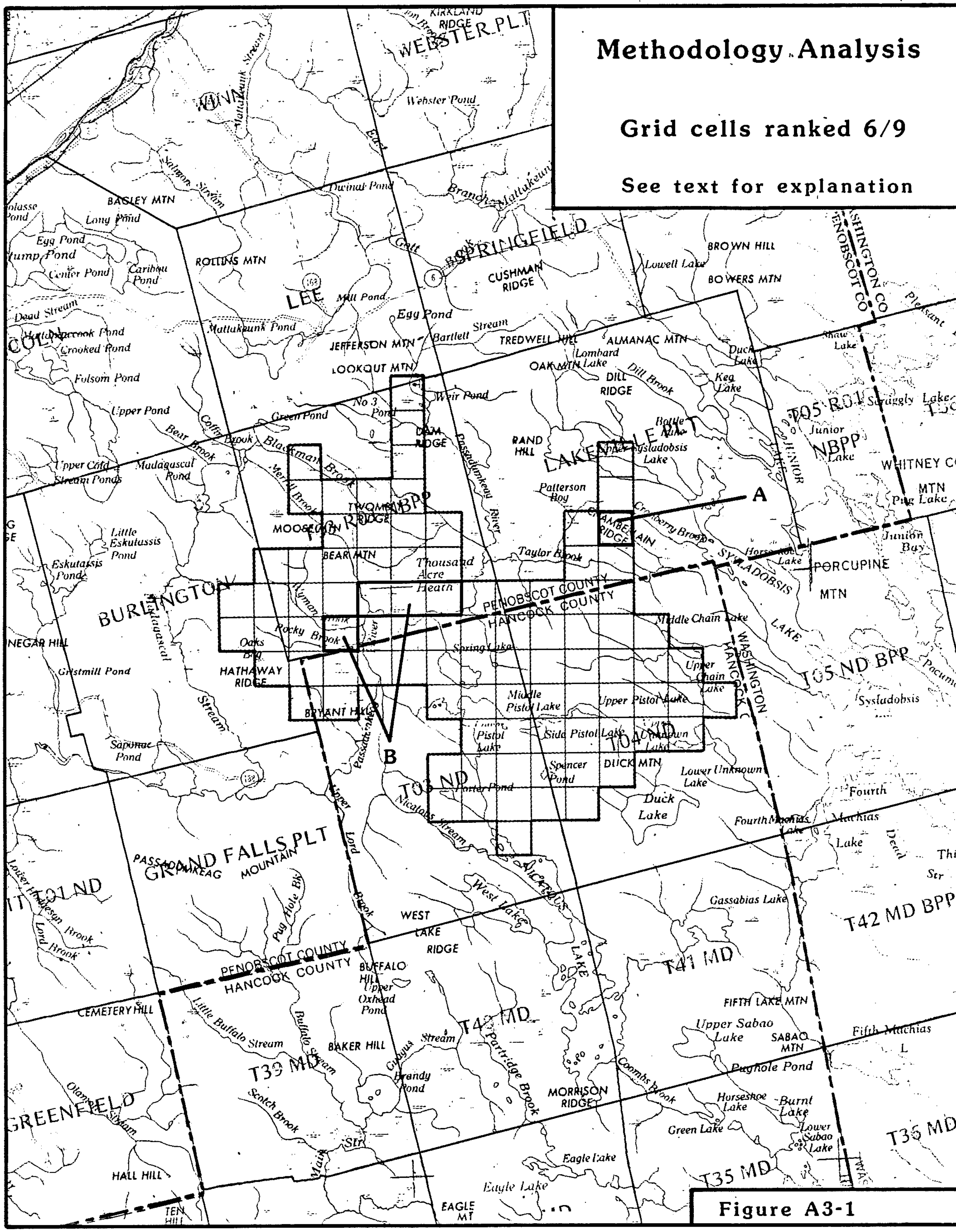
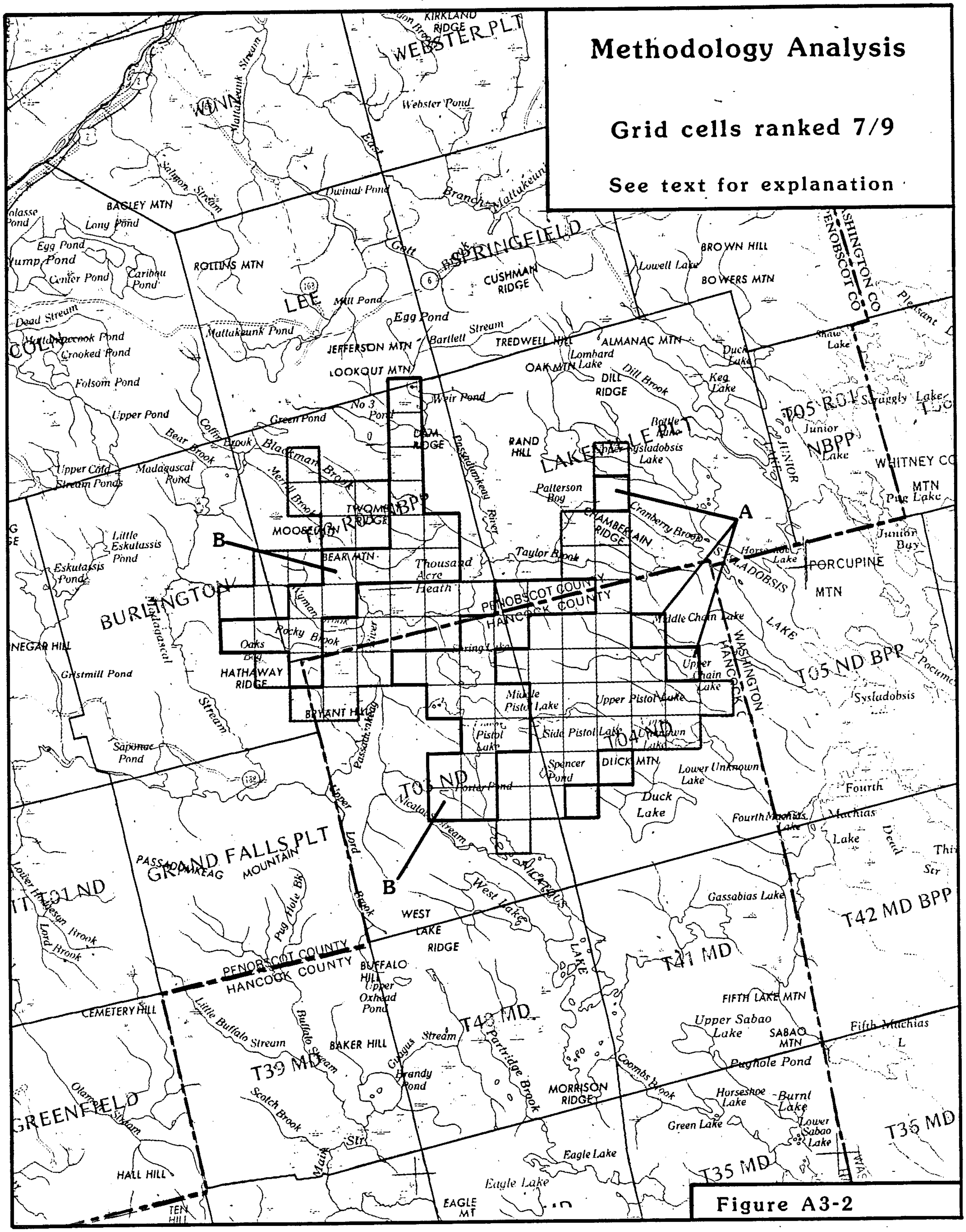

Methodology Analysis
Grid cells ranked 6/9
See text for explanation
A
B
PENOBSCOT COUNTY
HANCOCK COUNTY
WASHINGTON CO
BURLINGTON
LEE
SPRINGFIELD
WEBSTER PLT
GRAND FALLS PLT
T39 MD
T41 MD
T42 MD BPP
T35 MD
T03 ND
T05 ND BPP
GREENFIELD

Figure A3-1

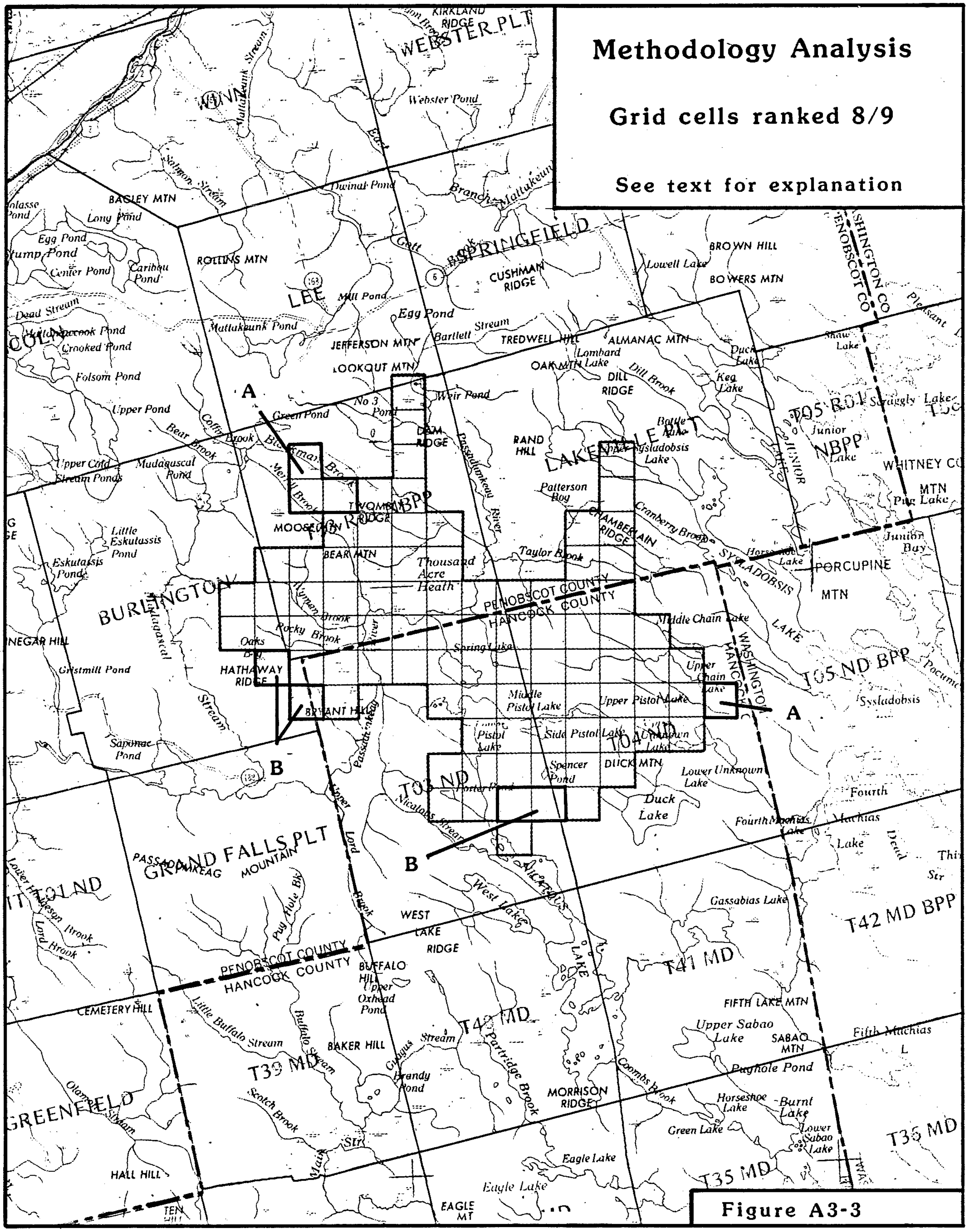


Methodology Analysis

Grid cells ranked 7/9

See text for explanation

Figure A3-2



Methodology Analysis

Grid cells ranked 8/9

See text for explanation

Figure A3-3

not the "checkerboard" effect described above, but the result of using two different tolerances for the acceptable amount of area consisting of environmental disqualifiers and/or lower ranked grid cells at the two stages described above.

When identifying candidate areas on the individual weighted average maps, up to 2 square miles of disqualified or lower ranked area was allowed in the nominal 7 mile diameter circle. When identifying candidate areas on the phase A composite frequency map, up to 4 square miles of disqualified and/or lower ranked area was allowed in the nominal 7 mile diameter circle. As a result, many areas that were identified on 2, 3, 4, or 5 individual weighted average maps were ranked 6-out-of-9 and 7-out-of-9 in table 3-5 of the draft ARR.

It has not been possible to verify this process for all the candidate areas ranked 8-out-of-9, 7-out-of-9, or 6-out-of-9 in table 1. For the Bottle Lake area, however, if a uniform 2 square miles of lower ranked cells were allowed in the area identified on the phase A composite map, the maximum ranking we could obtain (using a visual estimate of percentages of lower ranked cells in the area) was 5-out-of-9, substantially below the 7-out-of-9 ranking assigned by the DOE/CRP.

Even if the fact that different tolerances were used in the two stages described above is the primary reason for candidate areas being ranked at levels significantly higher than would be inferred from table 1, this indicates that the process used to identify candidate areas - a nominal 7 mile diameter circle containing some area of environmental disqualifier and/or lower ranked grid cells - is overly sensitive to the tolerance level used.

For example, if a uniform 2 square mile tolerance had been used in both stages, the number of candidate areas identified from the phase A composite frequency map would have been lower, and their final rankings would have been closer to values that would be inferred from table 1. Most of the candidate areas ranked as 7-out-of-9 would probably be ranked at 5-out-of-9 or lower (as described for the Bottle Lake area above).

In contrast, if the 4 square mile tolerance had been used for both stages, the benchmark values identified for the various weight sets would have been much lower. Also, the results of identifying and ranking candidate areas on the phase A composite map might have approximated the present draft ARR list of candidate areas and rankings.

Use of Additional Rock Body Specific Information in Phase D

In the Screening Methodology Document the Department of Energy committed to using certain types of information available in the quantitative screen if it was available for a specific rock body. The intent was to allow further differentiation of rock bodies and allow consideration of additional data to provide a more reliable selection and ranking process. This data could not be used for all 17 States because of lack of data for many rock bodies or because the data was inconsistent from State to State or region to region.

However, the Department of Energy chose not to use rock body-specific information in three of these areas that is available for the Sebago batholith. Information is available for:

- rock body thickness
- ground water resources
- thickness of overburden

Rock body thickness information is provided in Hodge et al. (1982). They provide an estimate of 1 km or less for the batholith. Use of this value for the Sebago batholith would have produced overall lower scores for the area because a thickness of 1 km or less is an adverse condition. Reanalysis of existing gravity information (GEOSS, Inc., 1986) indicates the body is even thinner than Hodge et al. (1982) estimated.

Ground water resource information is available for the Sebago batholith in two forms: maps of sand and gravel aquifers and maps of zones of high-yield bedrock wells. The DOE/CRP staff was aware of both series of maps. In the case of the maps of zones of high-yield bedrock wells, coverage was not available for the portion of the batholith in Oxford County.

Information on thickness of overburden is available from the same series of maps that provide bedrock well yield information.

In all cases except the estimate of rock body thickness (which was an estimate for the rock body as a whole), the information was available as area or contour maps, similar to other sources of information that was entered into the DOE/CRP gridded data base.

The DOE/CRP commented that for the Northeast region rock body-specific information was not available or was not in a form that could easily be entered into the gridded data base. For the Sebago batholith both of these statements are incorrect. The DOE/CRP committed to using this information if available, and should do so.

Summary

1) The process used by the Department of Energy to select and rank candidate areas differed from what was discussed during at the methodology workshops and described in the Screening Methodology Document. Many candidate areas identified and ranked in the draft Area Recommendation Report do not, in general, individually satisfy the broad range of geologic, environmental, and socio-economic factors the Department of Energy should consider in the region-to-area screening process.

2) The selection and ranking process that was used by the Department of Energy is extremely sensitive to minor changes in the percentage of area with environmental disqualifiers and/or lower ranked grid cells. Ranking of some rock bodies went from an apparent 2-, 3-, 4-, or 5-out-of-9 to 7-out-of-9 in the identification and ranking process. If changes in ranking this great can occur the methodology is too sensitive to minor changes in the process to provide confidence that the candidate areas selected by the Department of Energy are actually among the best possible, or even adequate to meet DOE/CRP needs.

3) The Department of Energy failed to consider additional, rock body-specific information for the Sebago batholith dealing with rock body thickness, ground water resources, and thickness of overburden. This information was readily available and in a form similar to other data used by the DOE/CRP in their gridded data base.

References

Hodge, D.S., et al., 1982, Gravity studies of subsurface mass distributions of granitic rocks in Maine and New Hampshire: Am. Jour. Sci., v. 282, p. 1289-1234.

GEOSS, Inc., 1986, Gravity and its geological interpretation: the Sebago pluton and vicinity, southwestern Maine: Maine Geological Survey, Open-file report 86-15.

Table 1. Summary of Frequency of Occurrence and Score of First Occurrence by Candidate Area and Weight Set

Candidate Area	Weight Set	C1	C2	C3	C4	C5	B1	B2	B3	B4	*
NC-3		4.9	4.7	4.7	4.5	4.5	3.9	4.7	4.1	4.3	9/9
NC-4		4.6	4.6	4.7	4.5	4.5	3.9	4.6	4.0	4.2	
NC-6		4.6	4.5	4.7	4.5	4.4	3.3	4.6	4.0	4.4	
NC-7		4.4	4.3	4.6	4.3	4.2	3.3	4.2	4.0	4.3	
NC-10		4.6	4.5	4.6	4.4	4.4	3.9	4.6	4.0	4.4	
NE-4		**4.8**	**4.6**	**4.6**	**4.4**	**4.4**	**3.6**	**4.5**	**3.9**	**4.3**	
**NE-N5		4.3	4.3	4.5	4.4	4.5	3.9	-	4.4	4.4	
SE-2		4.8	4.6	4.5	4.5	4.4	3.5	4.5	4.1	4.4	
SE-3		4.9	4.6	4.7	4.6	4.5	3.7	4.7	4.1	4.5	
SE-5		4.6	4.5	4.5	4.5	4.3	3.6	4.3	3.9	4.4	
SE-7		4.4	4.3	4.5	4.4	4.3	3.3	4.2	4.0	4.4	
NE-5		4.3	4.3	4.4	4.3	4.2	3.3	-	3.9	-	8/9
NC-2		4.6	4.5	4.6	4.3	4.4	3.6	4.5	-	-	7/9
NC-9		4.8	4.5	4.5	-	4.2	3.6	4.4	-	-	
NC-12		4.8	4.6	4.6	4.2	-	3.6	4.5	3.9	-	
NC-13		-	-	-	-	-	3.5	4.2	4.1	-	
NC-14		4.4	4.2	4.5	4.3	4.2	-	4.3	3.9	4.3	
NC-A5		4.3	4.2	4.4	-	-	-	4.2	-	-	
NE-2		**4.6**	**4.3**	**4.4**	**4.2**	**4.3**	-	**4.2**	-	-	
SE-1		-	-	-	4.3	4.2	-	-	4.3	-	
SE-4		4.6	4.4	4.5	4.2	4.3	-	4.5	-	4.2	
SE-6		4.3	4.2	4.4	4.2	4.2	-	-	-	4.2	
NC-A10		-	-	-	-	-	-	-	-	-	
NE-1		**4.5**	**4.2**	-	**4.2**	**4.2**	-	**3.9**	-	-	6/9
NE-3		**4.6**	-	-	-	**4.2**	-	-	-	-	
Benchmark		4.3	4.2	4.4	4.2	4.2	3.3	4.2	3.9	4.2	

* DOE/CRP frequency of occurrence ranking from draft ARR table 3-5.

** NE-N5 was eliminated from consideration due to proximity to the Canadian border

Comments on Department of Energy Draft Area Recommendation Report

Appendix A4 - Comments on Selection of Areas for Further Study in the Area Phase

Chapter 5 of the draft Area Recommendation Report provides the Department of Energy's rationale for selecting 12 of the 20 candidate areas for study in the area phase. The discussion is very brief considering the effort made by the DOE/CRP to identify, rank, and analyze the candidate areas in chapter 3 of the draft Area Recommendation Report.

Number of Study Areas

As the Department of Energy states on page 5-3 of the draft Area Recommendation Report, they "... could propose to identify all 20 of the candidate areas as potentially acceptable sites." They chose not to do this, instead choosing to study 12 areas in detail in the area phase.

There was no rationale provided for why it was decided to study 12 areas.

Identification and study of all 20 areas would have been consistent with:

- stated DOE/CRP policy that "15-20" areas would be included in the area characterization phase;
- the fact that all 20 candidate areas were ranked 7-out-of-9 or better by the DOE/CRP;
- the fact that none of the 20 areas were found to have any characteristics of sufficient adverse factors that would have caused the DOE/CRP to defer them at this time;
- the finding that all 20 areas were suitable for designation as "potentially acceptable sites".

The rationale for not choosing this option was (page 5-3): "In order to provide sufficient confidence that DOE will be able to nominate up to five sites in crystalline rock for characterization, the DOE has determined that it is only necessary to identify approximately 12 of the candidate areas..." The Department of Energy works under the assumption that 3-5 sites in crystalline rock will need to be identified during area characterization, but no material is provided to support consideration of less than the 20 areas identified through the quantitative analysis.

Another possibility would have been for the Department of Energy to study only the top ranked areas identified in the quantitative analysis. This would have involved studying 9 areas, comprising a total of 3,124 square miles. The average size of these areas is approximately 350 square miles. However, because of the need to provide "sufficient confidence that the DOE will be able to nominate up to five sites in crystalline rock...", the Department of Energy "...has determined that it is appropriate to investigate approximately 12 potentially acceptable sites during the area phase". Again, no material is provided to support the necessity to study 12 areas in the next phase. This is in spite of the fact that the three additional areas selected for study were identified as less suitable in the quantitative analysis and add only 312 square miles to the total area being studied, or add approximately 10% additional area. If 10% additional, less suitable area is required to provide confidence that the program will succeed, then the Department of Energy must have limited confidence in the initial quantitative identification and ranking of candidate areas.

Without additional material to support the decision to study 12 areas in the next phase, the decision appears to be extremely arbitrary.

Selection of areas for study

After making the decision to study 12 areas in the next phase, the Department of Energy chose to study:

- the top 9 areas (ranked 9-out-of-9);
- the one area (NE-5, Cardigan, New Hampshire) ranked 8-out-of-9;
- 2 of the 10 areas ranked 7-out-of-9.

It is at point that the method used for ranking the areas becomes critical. At the time the decision was made to study 2 of the 10 areas ranked 7-out-of-9, it appeared as though all 10 areas were essentially equivalent with respect to the quantitative analysis. As discussed in appendix 3, however, this block of 7-out-of-9 areas differed greatly in the number of weight sets they independently satisfied. It was only the combination of using a grid cell frequency-of-occurrence composite map and different tolerances of lower-ranked grid cells allowed in the areas that produced a block of "equal" candidate areas.

We feel strongly that the 10 areas ranked 7-out-of-9 are not "equal" with respect to the quantitative analysis, and properly ranking them would lead to very different decisions on the number and identification of areas to study.

The Department of Energy developed an entirely new process for selecting the 2 areas to study. This selection process focussed entirely on geologic information contained in the deferral analysis, presumably to give emphasis to post-closure factors. This is in spite of the entire design of the region-to-area screening process, which was supposed to take into account geologic, environmental, and demographic information.

The selection process also lacked any definite criteria used to evaluate even the limited information used by the DOE/CRP. As a result, the selection process is overly subjective, and in places inconsistent.

The accompanying table provides a comparison of the ten candidate areas ranked 7-out-of-9 by the Department of Energy. It contains information taken from the descriptions of the candidate areas in chapter 3, but is not limited to geologic information.

An examination of the geologic factors listed on pages 5-6 and 5-7 in the draft Area Recommendation Report demonstrates these inconsistencies. For example:

- large area is cited as a positive feature, yet there are 4 candidate areas larger than SE-4 and NE-2;

- shallow overburden is a positive feature (at least in characterization studies), yet 3 areas have thinner or more limited overburden;

- the extent of exposure for NE-2 is grossly overstated as 25%. This is based on a 1:500,000 surficial geologic map of Maine, where the DOE/CRP interpreted "thin drift" (up to 3 meters of cover) as exposed bedrock. The presence of a minimum of 24% surface water and wetlands, with the 1000 Acre Heath occupying the center of the pluton, should have indicated how unreasonable this estimate is. It is much more probable that there is no more than 3-5% exposure in the candidate area, comparable to other rock bodies;

- lithologic homogeneity between the 10 candidate areas varies, but 3 bodies (NE-2, SE-4, and NC-2) are ranked comparably with respect to lithologic homogeneity;

- major structures (faults and fracture zones) are absent from all the 10 rock bodies except one;

- timing of last deformation (1 billion versus less than 380 million years ago) would not favor the Southeast or Northeast regions, although this factor is probably irrelevant as far as the origin of late fractures that could conduct ground water is concerned. Glacial subsidence and isostatic rebound is the most recent event to have affected the North Central and Northeastern regions;

- the geologic information available for the Bottle Lake Complex is not particularly extensive. The most recent work was a Ph.D. dissertation, now published as a U.S.G.S. Professional Paper (Ayuso, 1984). However, this professional paper is primarily a mineralogical/petrological investigation, not a structural study, and was not intended to be a structural study. As a result, there is probably no more information available for the Bottle Lake Complex than most of the other areas, and essentially no information that will allow prediction of the suitability of the host rock.

Examination of additional factors shows that:

- the seismicity in the two areas selected is significantly higher than in many of the areas;

- the mineral potential in area NE-2 is higher than that reported for many of the areas;
- there is a greater percentage of surface water features (at least 24%) in the Bottle Lake area than in all the other areas except one;
- the presence of State-protected lands in the Bottle Lake area (Land Use Regulation Commission fish and wildlife protection zones) was not considered by the Department of Energy;
- site ownership issues with the large percentage of Indian trust land will present serious legal problems and delays;
- populations densities within 80 km (50 mi) of the area comparable to most of the other 9 areas;
- the area extends into a portion of the St. Croix River drainage basin, which is a boundary water; proximity to Canada will require the Department of Energy to conduct an active monitoring program in Canada.

Because of these factors, we do not feel the selection process was valid, or that the Bottle Lake candidate area is "more suitable" for characterization than any of the other areas ranked 7-out-of-9 by the Department of Energy.

Summary

Chapter 5 of the draft Area Recommendation Report provides essentially no justification for the decision to select 12 candidate areas for study as potentially acceptable sites. The decision appears to be extremely arbitrary.

The process used to select 2 of the 10 candidate areas ranked 7-out-of-9 by the Department of Energy considered only limited geologic information for the areas, and lacked any specific criteria for evaluating the rock bodies. As a result, the selection process is subjective and incomplete, leading to the erroneous inclusion of the Bottle Lake candidate area in the list of areas for further study.

References cited

Ayuso, R.A., 1984, Field relations, crystallization, and petrology of reversely zoned granitic plutons in the Bottle Lake Complex, Maine: U.S.G.S. Professional Paper 1320.

Comparison of 10 Candidate Areas Ranked "7-out-of-9" in the Department of Energy Draft Area Recommendation Report

Topic	NC-2 Puritan Batholith	NC-9 Undifferentiated granites	NC-12 Archean gneiss	NC-13 Archean gneiss	NC-14 Archean gneiss
Host rock geometry and overburden thickness	Area: 171 mi^2	249 mi^2	171 mi^2	60 mi^2	287 mi^2
	Thickness: >6 km	**no information**	>10 km	>10 km	>10 km
	Exposure: ~4%	0%	<1%	0%	0%
	Overburden: <100 ft	>300 ft	<100 ft - >300 ft	>200 ft	200-300 ft
Lithology and tectonics	Lithology: foliated gneiss; heterogeneous with younger intrusives	granitoid	gneiss and granite; heterogeneous	gneiss and granite; heterogeneous	gneiss and granite; heterogeneous
	Major structures: foliated; normal faults	**no information**	foliation, lineation, folding (?); possible thrust faults	foliation, lineation, folding (?); possible thrust faults	foliation, lineation, folding (?); possible thrust faults
	Deformation history: $>10^9$ years	$> 10^9$ years	$> 10^9$ years	$> 10^9$ years	$> 10^9$ years
Seismicity	low to very low	low to very low	magntude 2.6 immediately adjacent to area with no mapped structure; magnitude 4.6 on Morris fault approximately 40-45 mi west of area	magnitude 4.6 on Morris fault approximately 6-12 mi north of area	low to very low
Mineral resources	numerous prospects and abundant exploration acttivity surrounding candidate area	no prospects, etc.	no prospects, etc.	no prospects, etc.	no prospects, etc.
Topography and surface water characteristics	1425-1600 ft; 2% surface water; 34% wetlands	1280-2040 ft; 6% surface water; 1% wetlands; major surface water bodies present	1250-1435 ft; 2% surface water; 1% wetlands; major surface water bodies present	1150-1160 ft; limited surface water and wetlands within area	1025-1075 ft; 6% surface water; 0% wetlands; major surface water bodies present
Ground water resources	glacial deposits; outwash covers ~40% of area	glacial deposits; outwash covers ~10-20% of area	glacial deposits; outwash covers ~20% of area	glacial deposits; sand and gravel lenses	glacial deposits; sand and gravel lenses
(Quaternary climate)					

Comparison of 10 Candidate Areas Ranked "7-out-of-9" in the Department of Energy Draft Area Recommendation Report

Topic	NC-2 Puritan Batholith	NC-9 Undifferentiated granites	NC-12 Archean gneiss	NC-13 Archean gneiss	NC-14 Archean gneiss
Federal lands	no disqualifiers; National Forest land covers most of area	3 WPA >320 acres 8 WPA <320 acres (~2% of area) wildlife refuge and wilderness areas w/in 6 mi 12 WPA >320 acres w/in 6 mi 40 WPA <320 acres w/in 6 mi potential National Scenic Trail w/in 6 mi	2 WPA >320 acres 10 WPA <320 acres 16 WPA >320 acres w/in 6 mi 54 WPA <320 acres w/in 6 mi	1 WPA >320 acres overlaps part of area 2 WPA <320 acres 11 WPA >320 acres w/in 6 mi 37 WPA <320 acres w/in 6 mi	
State lands	none	1 State WMA >320 acres 5 State WMA <320 acres 28% State Forest 1 State park partly w/in area 1 State park w/in 6 mi 8 State WMA >320 acres w/in 6 mi 30 State WMA <320 acres w/in 6 mi 2 scientific/natural areas w/in 6 mi 1 State wild and scenic river w/in 6 mi 1 State forest w/in 6 mi 8 unnamed parcels of State forest w/in 6 mi	3 State WMA >320 acres in or overlap area 8 State WMA >320 acres w/in 6 mi 11 State WMA <320 acres w/in 6 mi	4 State WMA < 320 acres 2 State WMA >320 acres w/in 6 mi 12 State WMA <320 acres w/in 6 mi	
Population density and distribution	averages: 3/mi^2 13/mi^2	2 >1000/mi^2 w/in 10 mi averages: 6/mi^2 18/mi^2	1 HPA w/in area 2 HPA w/in 10 mi 1 >1000/mi^2 w/in area 3 >1000/mi^2 w/in 10 mi averages: 37/mi^2 35/mi^2	1 HPA w/in 10 mi 1 >1000/mi^2 w/in 10 mi averages: 5/mi^2 16/mi^2	
(Site ownership)					
(Offsite installations)					
(Transportation)					

Comparison of 10 Candidate Areas Ranked "7-out-of-9" in the Department of Energy Draft Area Recommendation Report

Topic	NC-A5 Undifferentiated granites	NE-2 Bottle Lake Complex	SE-1 Fredericksburg Complex	SE-4 Rolesville Pluton	SE-6 Lithonia gneiss
Host rock geometry and overburden thickness	Area: 70 mi^2	92 mi^2	64 mi^2	142 mi^2	67 mi^2
	Thickness: **no information**	**no information**	>5 km	13-15 km	**no information**
	Exposure: 0%	**3-5% *****	estimated extensive	estimated extensive	fairly extensive
	Overburden: >200 ft	<10 ft - >100 ft	+/- 50 ft (?)	20 - 100 ft (?)	+/- 30 ft
Lithology and tectonics	Lithology: granitoid	granite	layered granite w/ subordinate amphibolite	granite	banded gneiss
	Major structures: **no information**	dikes; joints; minor foliated zones	foliation; dikes; jointing	weak foliation; dikes; jointing	folding; foliation; small scale shear zones
	Deformation history: > 10^9 years	possible post-emplacement faulting; <380 m.y.	Hercynian extension and faulting ~300 m.y.; Triassic faulting ~220 m.y.	possible post-emplacement faulting; <300 m.y.	> 200 m.y. (?)
Seismicity	low to very low	4 epicenters <2.5 in area 2 epicenters 2-3 w/in 6 mi Norumbega Fault Zone ~6 mi to SE	located in Central Virginia Seismic Zone - relatively high seismicity; numerous events >MM IV in vicinity	located in zone of relatively low seismicity; MM IV maximum w/in zone; 2 MM III w/in 9 mi	located in zone of relatively low seismicity; MM VI maximum w/in zone
Mineral resources	no prospects, etc.	Several prospects for Mn, Cu, Fe, Au, Ag adjacent to area; potential for U mineralization; peat	no prospects, etc. w/in area, but adjacent to Cu/Ag/Au/Pb/Zn district in different rock type to NW	no prospects, etc. w/in area; Mn deposits ~2 mi SE of area; Cr prospect ~11 mi NE of area	no prospects, etc. w/in area; 2 AU mines w/in 6 mi
Topography and surface water characteristics	850-950 ft; 4% surface water; 0% wetlands; major surface water body in area	300-1169 ft; 6% surface water; 18% wetlands; major surface water body in area	200-400 ft; no large lakes or reservoirs w/in area or w/in 6 mi; <1% wetlands	200-470 ft; no large lakes or reservoirs w/in area or w/in 6 mi; <1% wetlands	740-1160 ft; no large lakes or reservoirs w/in area or w/in 6 mi; <1% wetlands
Ground water resources	glacial deposits; buried channel sands	glacial deposits; sand and gravel aquifers; bedrock wells	sapprolite and bedrock wells	sapprolite and bedrock wells	sapprolite and bedrock wells
(Quaternary climate)					

Comparison of 10 Candidate Areas Ranked "7-out-of-9" in the Department of Energy Draft Area Recommendation Report

Topic	NC-A5 Undifferentiated granites	NE-2 Bottle Lake Complex	SE-1 Fredericksburg Complex	SE-4 Rolesville Pluton	SE-6 Lithonia gneiss
Federal lands	none	none	none	4 sites on NRHP w/in area proposed archeological district w/in area	4 sites on NRHP w/in area
State lands	3 State WMA >320 acres w/in 6 mi 1 State WMA <320 acres w/in 6 mi 1 State park w/in 6 mi 2 unnamed parcels >320 acres w/in 6 mi	presence of LURC P-FW protection zones not considered by the DOE/CRP adjacent to and overlaps 2 public lots >320 acres; other public lots <320 acres w/in 6 mi 3 Critical Areas w/in 6 mi - 316, 518, 567 possible archeological sites	none	1 State Park/Natural Heritage Area <320 acres 1 Natural Heritage Area <320 acres 1 State Recreation Area >320 acres w/in 6 mi 1 Natural Heritage Area <320 acres w/in 6 mi	1 State Park >320 acres w/in 5 mi 1 Natural Heritage Area >320 acres w/in 1 mi
Population density and distribution	1 >1000/mi^2 w/in 8 mi averages: 4/mi^2 19 mi/^{2}	1 HPA w/in 8 mi averages: <1/mi^2 23/mi^2	2 HPA w/in 10 mi 3 >1000/mi^2 w/in 10 mi averages: 45/mi^2 123/mi^2	5 HPA w/in 10 mi 1 >1000/mi^2 w/in 10 mi averages: 103/mi^2 129/mi^2	9 HPA w/in 10 mi 1 >1000/mi^2 w/in 10 mi averages: 108/mi^2 261/mi^2
(Site ownership)		Indian fee and potential trust lands within and adjacent to area			
(Offsite installations)					
(Transportation)					

Comments on Department of Energy Draft Area Recommendation Report

Appendix A5

Specific Comments on Descriptions

of the

Bottle Lake Candidate Area

and

Sebago Lake Candidate Area

Specific comments on the descriptions of the Northeast Region and the Bottle Lake and Sebago Lake candidate areas are given below. Reference is to page number and section number in the draft Area Recommendation Report.

Section 3.2.2.1 - Northeastern Region

Section 3.2.2.1.1.1, page 3-349, paragraph 3. Referenve to "the last advance before retreat was less than 12,000 years ago" is not cited. A previously cited reference (Mickelson et al., 1983) states that New England was ice free from between 12,000 and 11,000 year ago; no mention of any advance after 12,000 years BP is made in that reference.

Section 3.2.2.1.1.1, page 3-353, paragraphs 1 and 2. Estimates of erosion during the past several million years range from 4 meters/100,000 years to 7 meters/100,000 years. This is a regional average, and does not address the question of the maximum amount of glacial erosion that could occur in a given area. Based on bedrock topography and buried valleys in Maine, it is very likely that local glacial erosion will greatly exceed the 7 meters/100,000 years maximum total erosion quoted in the text.

Section 3.2.2.1.1.1, page 3-349ff, paragraph 3. We agree that the effects of renewed glaciation on the hydrologic system are uncertain, and have not even been cursorily addressed by the DOE. Given the fact that parts of both the Sebago lake and Bottle Lake areas were under sea level as recently as 10,000 years ago suggests that the effects on regional gradients could be very large.

Given that Earth-Sun orbital parameters influence the timing of glacial episodes in a periodic manner (Crowley, 1983; Hays et al., 1976; Imbrie and Imbrie, 1980), glaciation is likely to occur again. As noted on page 3-349, forward modeling suggests that 23,000 years from now the next glacial advance may be complete (Imbrie and Imbrie, 1980).

The nature of glaciations in the Quaternary is reflected in the oxygen isotope record of deep-sea cores (Berggren et al., 1980). During the Quaternary there has been a trend to larger amplitude excursions in the oxygen isotope record in the late Quaternary (Berggren et al., 1980; Kennett, 1982). This pattern suggests that the largest glaciations occurred in the last million years.

Relevant to the timing of the next glacial advance is the present progress through the Holocene interglacial. Evidence of sea level rise (summarized in Morner, 1982) illustrates that the eustatic Holocene sea level rise, resulting from glacial retreat, has ceased in the last 1000 years. Additionally, modern oxygen isotope values indicate that deglaciation has reached the interglacial isotopic values of preceding interglacial stages (Berggren, 1980). Consequently, sea level records and isotopic data indicate a full interglacial condition presently exists on earth.

Imbrie and Imbrie's (1980) model suggests that currently the next glacial advance is imminent and, 23,000 years from now, will reach a full extent comparable to the last Wisconsinan advance . The most recent Laurentide ice sheet may have advanced over a period of as little as 10,000 years (Bowen, 1978).

If the next advance is the same in location and of the same extent as the last Wisconsinan advance, the ice sheet could produce a considerable overburden in the Bottle Lake Complex and Sebago Lake batholith candidate areas in the next 10,000 years. Isostatic crustal depression, similar to that which resulted during the previous glaciation, would be expected to commence during the next 10,000 years. Consequently, the possibility exists that in less than 10,000 years the candidate areas may be subjected to crustal movement leading to direct changes in hydrologic regime.

As stated on page 3-353, "Although the geologic setting is one in which climatic changes have certainly affected the hydrologic system throughout the Quaternary Period, it is uncertain to what degree these changes have affected the hydrologic system." The argument presented above stresses that the hydrologic regime of the candidate may change in the next 10,000 years. Candidate areas with uncertain and unpredictable future hydrologic regimes is reason to disqualify them from further consideration.

Another factor to be considered in long term climatic change is significant changes in precipitation (and its effects on hydrologic gradients) associated with global warming due to increased CO_2 concentrations in the atmosphere.

The problem of long-term climatic change is explicitly cited in the Nuclear Regulatory Commission Guidelines for Disposal of High-Level Nuclear Waste in Geologic Repositories (10 CFR 60, section 60.122(c)(6)) and the Department of Energy General Siting Guidelines (10 CFR 960, section 960.4-2-4.)

<u>Section 3.2.2.1.1.2, page 3-356, paragraph 3.</u> The report states that "no tectonic features in the candidate areas are associated with Triassic or Cenozoic events." Coastal Maine was subjected to rifting throughout the

Mesozoic as the Atlantic Ocean opened and the North American and European/African plates separated. In particular, there was abundant igneous activity in southwestern Maine during the Triassic, Jurassic, and Cretaceous. Besides dike swarms, several significant and mappable Mesozoic igneous complexes were intruded into the Sebago Batholith (Pleasant Mountain and Rattlesnake Mountain). The Rattlesnake Mountain body was first mapped in the late 1970s, and additional bodies may very well be present. The extent of dike swarms is also unknown through most of the extent of the batholith.

While this igneous activity may not be regarded as a "tectonic feature" for the purposes of this report, there is no doubt that it has affected the candidate rock body and must be considered in evaluating the suitability of the area for a repository.

Section 3.2.2.1.1.3, page 3-359, paragraph 2. We agree that due to the limited information on seismic activity in the Northeast and the inability to identify specific geologic features associated with historic seismic activity it is quite probable that "not all potential sites of moderate-to-large earthquakes have yet experienced one during historical times." The conclusion to be drawn from this is that not all sites of potential moderate-to-large earthquakes have been or can be identified. A conservative approach is to assume that the largest earthquake experienced in the region may occur anywhere within the region.

Section 3.2.2.1.1.5, page 3-364, paragraph 2. In earlier comments on the Regional Geologic Characterization Report we argued that commercial well yield information is not a reliable guide to well yield versus depth relations (and as a result fracture density versus depth) because of the economic forces driving domestic well development. We have a number of reported instances of high yield wells (greater than 50 gallons per minute) which produced only after penetrating fracture systems at depths in excess of 200 meters.

Section 3.2.2.1.1.5, page 3-264, paragraph 3. The statement that surficial aquifers are "geographically restricted" appears to be intended to reduce their significance. However, because these major sources of potable water are "geographically restricted" and in some cases are the major source of domestic water for community water supplies, they are a valuable resource and assume a greater importance than is implied by the draft Area Recommendation Report.

Section 3.2.2.1.2.3, page 3-366. The Portsmouth-Dover-Rochester area extends into Maine as well, as indicated earlier in the paragraph.

Section 3.2.2.2 - Bottle Lake Candidate Area

Section 3.2.2.2.1, page 3-369, paragraph 4. The geologic cross section presented on Osberg et al. (1984, 1985) is an interpretation of the thickness based on references cited in the preceding paragraph of the draft Area

Recommendation Report. A thickness of 3.5 to 4 km should be indicated as an inferred thickness with no supporting geophysical evidence.

Section 3.2.2.2.1, page 3-369, paragraph 5. The statement that "outcrops are present throughout much of the candidate area" gives the impression that bedrock outcrop is the rule in the area. Ayuso (1984, page 2) states that outcrops are common on hills and along lakeshores, and that felsic (rim facies) rocks outcrop better than mafic (core facies) rocks. This is obvious from his map, which shows very few outcrop localities in the central portion of the Passadumkeag River pluton. The 1,000 Acre Heath should be indicative of the amount of outcrop to be expected in the central portion of the body.

The "thin drift" indicated on Thompson and Borns (1984, 1985) may have up to 3 meters of cover. It should not be interpreted as "outcrop" in any sense of the word. In addition, it is totally unrealistic to use a 1:500,000 map of surficial deposits as a quantitative guide to the amount of outcrop expected in an area.

It is unlikely that there is more than 2%-4% of exposed crystalline rock in the study area, although there may be nearly continuous exposure over limited areas.

Section 3.2.2.2.2, page 3-377, paragraph 2. While Ayuso (1984) did not map any major cataclastic zones within the Passadumkeag River pluton, similar aged plutons are cut by northeast trending faults which may be related to the Norumbega fault system. In particular, the Center Pond pluton (Osberg et al., 1984, 1985), which is essentially contemporaneous with the Passadumkeag River pluton (Loiselle et al., 1982), is cut by a major northeast trending fault zone. It is quite likely that minor cataclasis and mylonitization associated with the Norumbega fault system is present in the Passadumkeag River pluton.

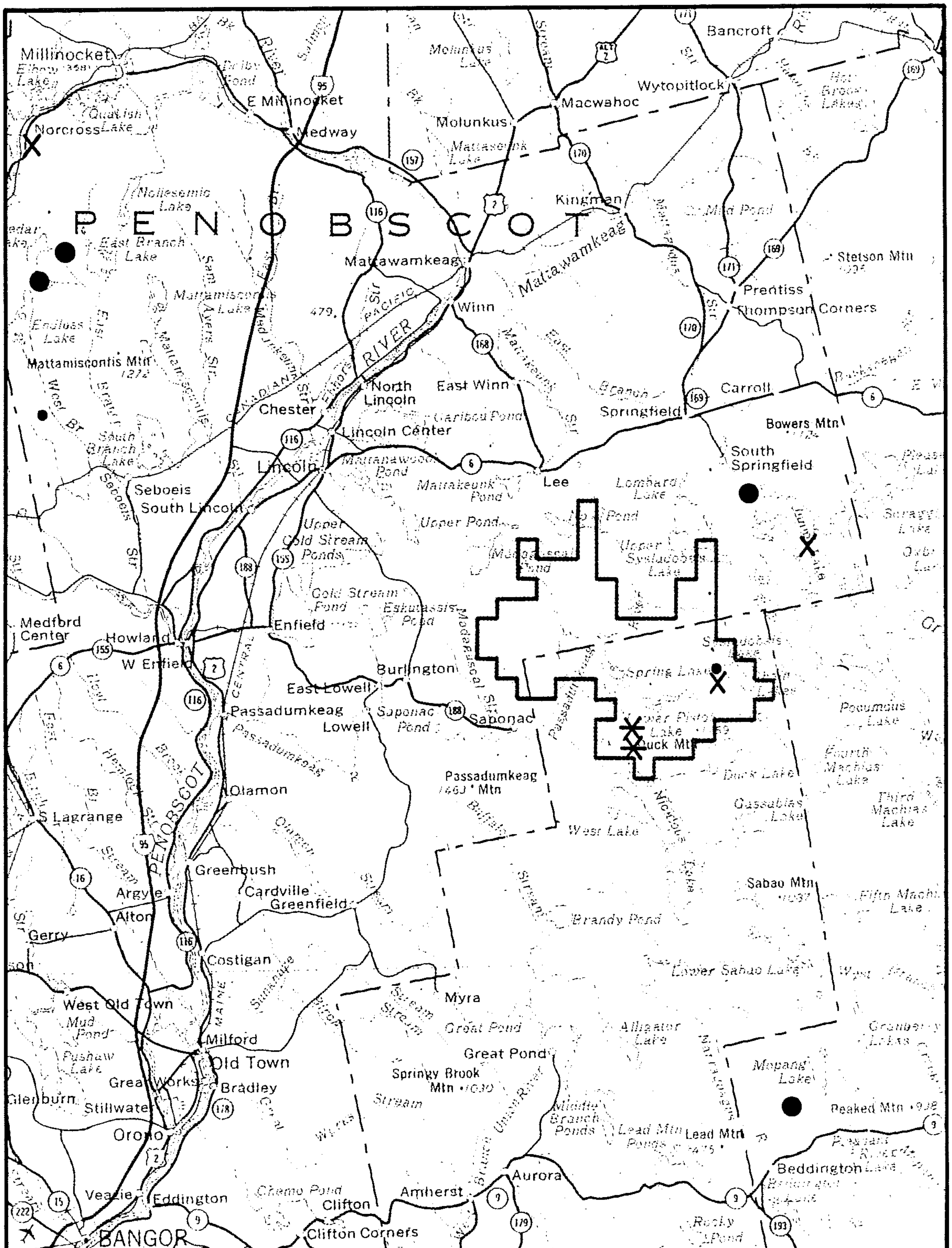
The zones of northeast trending foliation in the core facies of the Passadumkeag River pluton (Ayuso, 1984) are probably related to this northeast trending fault system.

Section 3.2.2.2.3, page 3-380, paragraph 1, and figure 3-90. Figure 3-90 is not complete - there are four epicenters of magnitude 2.5 or less located between the north end of Nicatous Lake and Spring Lake which are missing from the figure. The events occurred in 1975, 1981, and 1982 (Lepage and Johnston, 1985). (See attached map.)

Section 3.2.2.2.4, pages 3-380 to 3-381.

See detailed comments on mineral resource assessment, appendix A10.

Section 3.2.2.2.5, page 30383, figure 3-92. The percentage of wetlands and surface water bodies in the candidate area is in excess of the 24% indicated in the text. Based on the U.S.G.S. Land Use map and the 1:250,000 topographic map for the Millinocket quadrangle we estimate in excess of 30-35% wetlands and surface water bodies in the candidate area.



Earthquake Epicenters 1975 - 1984

Precisely located

- • M < 2.0
- ● M 2.0 - 2.9

Poorly located

- ✳ no magnitude given
- × M < 2.5

Source: Maine Geological Survey

Figure A5-1

In addition, the candidate area is bisected by the flood plain and associated wetlands of the Passadumkeag River, severely limiting flexibility in siting a repository in the area.

Section 3.2.2.2.6, pages 3-387 to 3-389, figure 3-94. There is inadequate information to draw any conclusions regarding bedrock well yields and bedrock ground water resources in the candidate area.

The surficial aquifer boundaries were developed from reconnaissance information, primarily limited surficial geologic mapping and photo-interpretation. There is inadequate well yield information to assess the potential ground water resources in the candidate area. The surficial aquifers are not "restricted to the boundaries of the preliminary candidate area", but cut the candidate area in half. The characterization of "high yield" aquifers as aquifers with greater than 100 gallons per minute yield is contrary to the definition of a significant surficial aquifer adopted by the Maine Legislature. Surficial aquifers with a yield greater than 10 gallons per minute have severe limitations on development on or near them.

Section 3.2.2.2.9, page 3-389 to 3-390. Current information on State Public Lands in the vicinity of the candidate area (the result of consolidation of public lands that has been ongoing since the late 1970s) shows significant public lands in the southern portion of the candidate area (**see map accompanying comments on policy for nuclear waste disposal on the Public Lands, appendix A9**).

A number of State-recognized critical areas were omitted from the draft Area Recommendation Report. These are:

Saponac Esker (pre-1983)	#316	Immediately south of candidate area along the Passadumkeag River
Grand Falls Rapids (December 1983)	#466	On town line between Grand Falls Plantation and T3 ND
Stand of *Calypso balboa* (June 1984)	#518	North of area in town of Lee
Old growth hemlock stand (October 1985)	#567	Within candidate area adjacent to No. 3 Pond

These critical areas, even those that were included post-NWPA, should have been mapped and considered in the deferral analysis.

In addition, the State Planning Office conducted a Natural Areas inventory, the predecessor to the Critical Areas Program. These features are significant environmental features, and should have been considered in the deferral analysis for the area (**see attached maps in appendix A26**).

Sand and Gravel Aquifers

Source: Maine Geological Survey

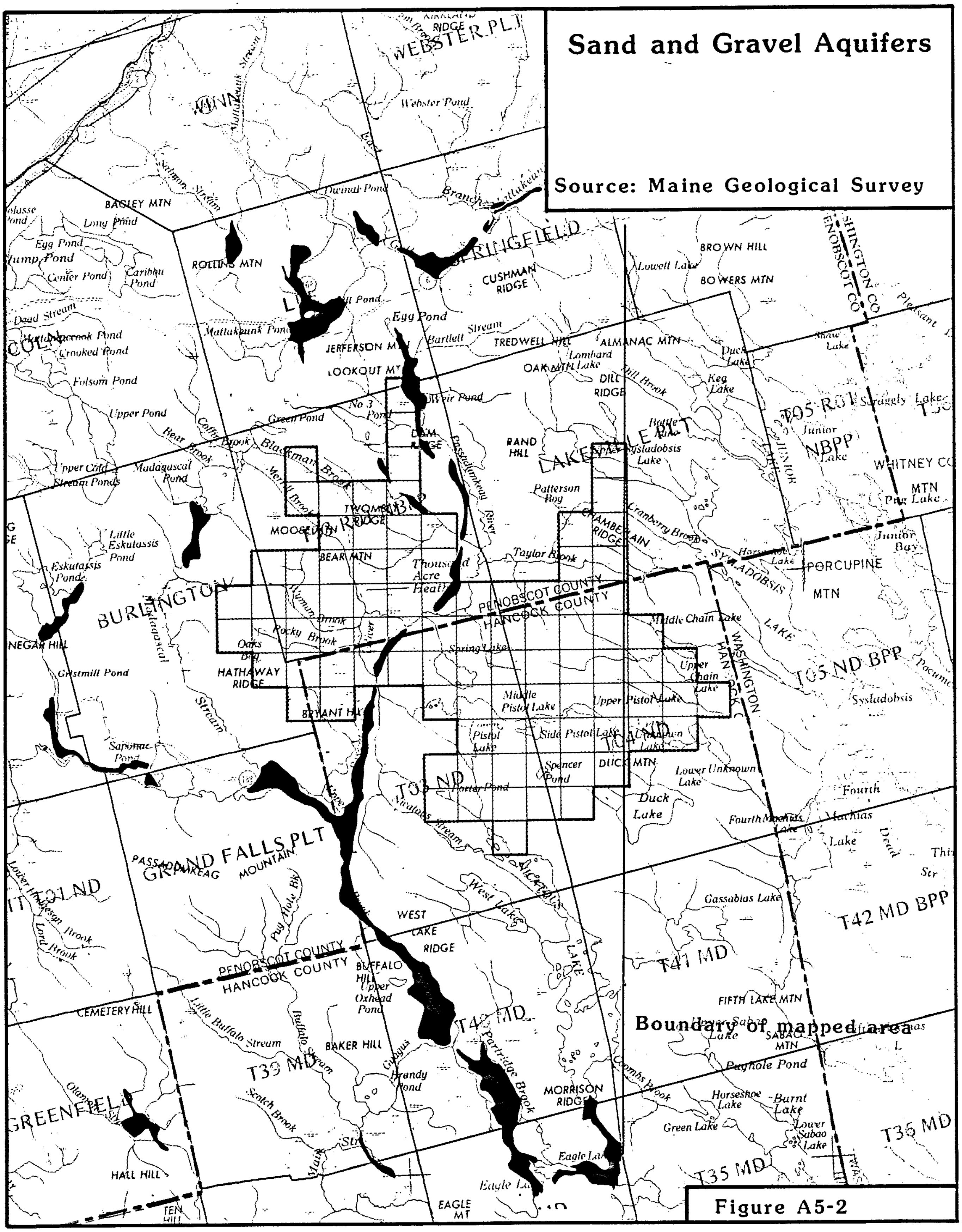


Figure A5-2

Section 3.2.2.2.10, page 3-390, paragraph 2. Maine statutes define the Passadumkeag and St. Croix Rivers as Class A waters. For such waters discharges must be equal to or higher quality than the receiving waters. It is quite likely than any construction operations would violate these limitations on water quality for these rivers.

Section 3.2.2.2.10, page 3-390, paragraph 2. The mayfly species Siphlonisca aerodromia was thought to be extinct in the 1930s. This species was recently rediscovered by Dr. Katherine Gibbs of the University of Maine in the Tomah Stream drainage a few miles to the east of the Bottle Lake area. Habitat is sufficiently similar in the Passadumkeag River drainage to warrant consideration that this species is also present in the candidate area.

See letter from Maine Department of Environmental Protection to Mr. Howard Larsen, U.S. Fish and Wildlife Service, appendix A34.

Section 3.2.2.2.11, page 3-394, paragraph 1 and footnote. The estimate of population density with 80 km (50 mi) of the candidate area should not ignore the resident population in Canada. Ignoring the resident population will not avoid the necessity to consider adverse effects of a repository on this population.

Section 3.2.2.2.13, page 3-394, paragraph 3. Maine Yankee is the closest U.S. commercial nuclear reactor. However, the nuclear reactor at Point Lepreau, New Brunswick, is closer to the candidate area (approximately 85 miles).

Section 3.2.2.2.14, page 3-395.

See detailed comments on transportation systems, appendix A27.

Section 3.2.2.3 - Sebago Lake Candidate Area

Section 3.2.2.3.1, page 3-399, paragraph 2. The geologic cross section in Creasy (1979) does not introduce the possibility that the body may be up to 5 km thick. This has been misinterpreted. In the text, Creasy states (1979, page 17) "it is speculated that the granites of the Sebago pluton in fact may be multiple intrusions of several thick (100-200m) curved (?) sheets or 'fingers' each which may deform a surrounding envelope of cover rocks and which might, in a regional structural restoration, be stacked one over another with interdigitating metasediments."

See letter of 20 March 1986 from Dr. John Creasy to the Natural Resources Council of Maine, appendix A31.

Section 3.2.2.3.1, page 3-400, figure 3-96. The zone of granite on the eastern side of the rock body with abundant metasedimentary inclusions is not the Westbrook phase. It has no formal name. The Westbrook phase refers to rocks in the extreme southeastern portion of the body dated by Brookins and Hussey (1978).

Section 3.2.2.3.2, page 3-404, paragraph 3. See preceding comment on the name "Westbrook phase".

Section 3.2.2.3.2, page 3-405, paragraph 1. The fact that the eastern margin of the granite contains "metasedimentary inclusions that may exceed 100 meters (328 feet) in diameter and account for up to 40% of a given outcrop" should indicate that this portion of the rock body is not suitable for characterization. It is a complex, heterogeneous contact facies of the main body of the granite, and should be avoided if any field studies are undertaken in area.

The northeastern corner of the candidate area (east of the Black Cat granite) includes this contact facies, and should be eliminated from consideration.

See letter of 20 March 1986 from Dr. John Creasy to the Natural Resources Council of Maine, appendix A31.

Section 3.2.2.3.2, page 3-206, paragraph 2. The Ben Barrows fault extends a minimum of 7 km (4.3 miles) into the granite. The quadrangle to the west has not been mapped in detail, and on the 1:500,000 Bedrock Geologic map of Maine the fault was not extended beyond the border of the Poland quadrangle.

The Moll Ockett fault cuts the batholith for a minimum of less than 3 km (2 miles), as indicated on the geologic map of the Bryant Pond quadrangle (Guidotti, 1965).

See letter of 20 March 1986 from Dr. John Creasy to the Natural Resources Council of Maine, appendix A31.

Section 3.2.2.3.2, page 3-407, paragraph 2. This paragraph is useful in summarizing the complexity of the Sebago Batholith. It is a thin (less than 600 m), foliated, syntectonic body, possible composed of several 100 to 200 meter thick "sheets" of granite, dipping 25 to 40 degrees to the east. The rock body as a whole is heterogeneous, with abundant (up to 40%) metasedimentary inclusions in a contact zone on the eastern margin and persistent (2-4 %) inclusions in the main portion of the body. The texture of the main portion of the body is generally homogeneous, but may grade to coarse, pegmatitic textures over an outcrop. The body is faulted (Ben Barrows and Moll Ockett faults) and jointed, with a number of major joint sets that are commonly filled with vein quartz. The body was intruded by late pegmatites after consolidation, and was intruded in the Mesozoic by basic dikes up to 5 meters in width and traceable for hundreds of meters. There are several larger Mesozoic granite/syenite complexes that intruded the batholith in the Mesozoic - one, the Rattlesnake Hill pluton, is in the candidate area.

This is not the description of a granite that should ever seriously be recommended for detailed study for a deep geologic disposal facility.

Section 3.2.2.3.3, page 3-408, paragraph 4, figure 3-100. This map of epicenters is incomplete. A number of earthquakes (magnitude 2.0 to 4.0) occurred in the eastern portion of the candidate area (Lepage and Johnston, 1985) (see attached map). In addition, a number of significant earthquakes in excess of magnitude 4.0 in western Maine and adjacent New Hampshire was not given adequate treatment in this section of the draft Area Recommendation Report.

See comments by Dr. John Ebel on regional seismicity, appendix A15.

Section 3.2.2.3.4, page 2-410.

See detailed comments on mineral resource assessment, appendix A10.

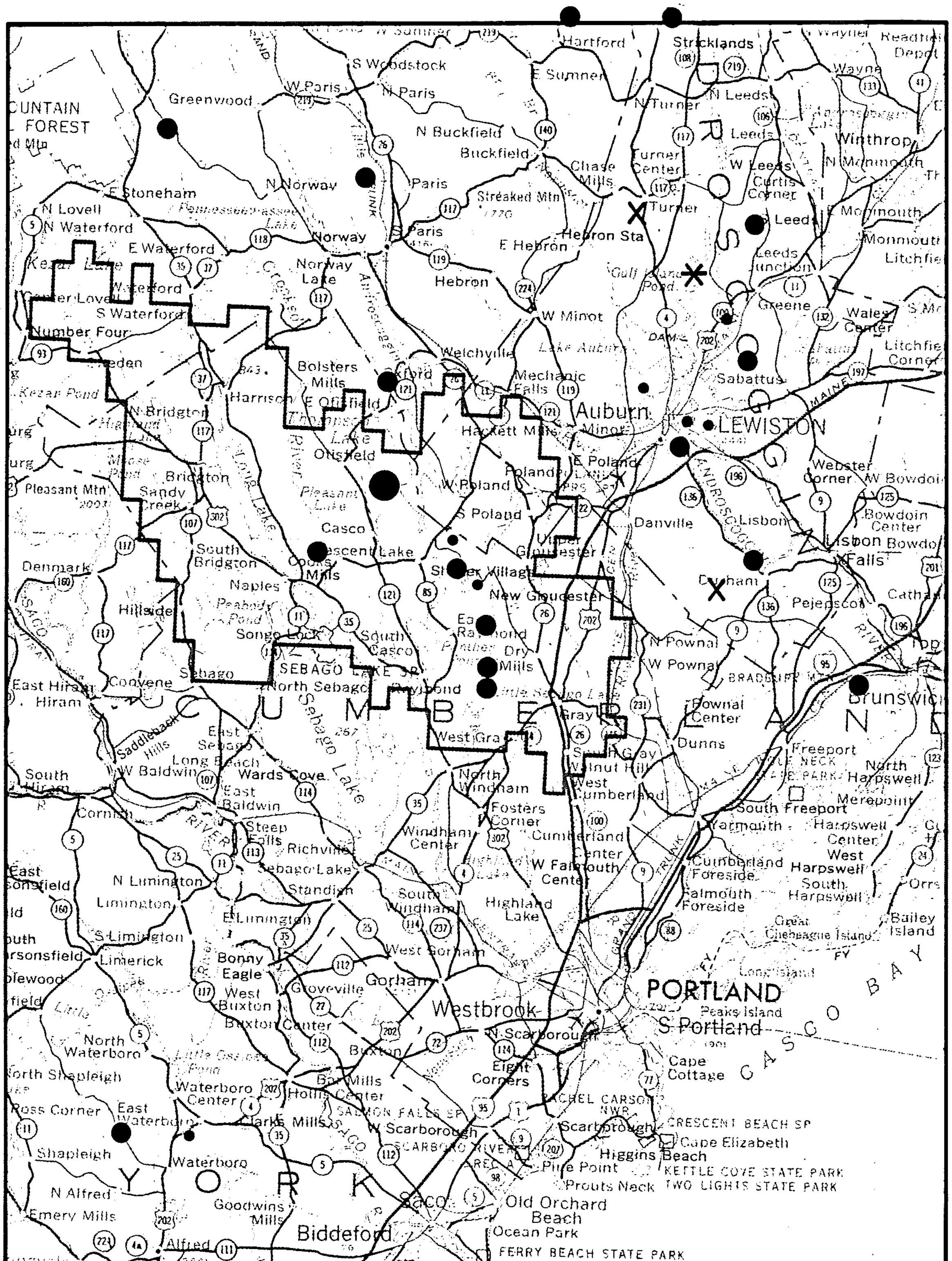
Section 3.2.2.3.5, page 3-413, paragraph 1. Because of the one square mile grid cell size and the scale of the source of the wetlands information (1:250,000 U.S.G.S. Land Use maps), numerous small wetlands present in the candidate area were not noted.

No mention was made of the fact that the bulk of the candidate area occupies the Sebago Lake watershed. Sebago Lake is the principal water supply for the greater Portland area, serving an estimated population of 160,000. In addition, the western portion of the candidate area is in the Saco River drainage. The Saco River has been recognized as a major regional water resource.

See comments on public water supplies and watersheds, appendix A7.

Section 3.2.2.3.6, page 3-413, paragraph 2ff. There are a significant number of deep bedrock wells (greater than 300 feet) in the candidate area with yields greater than 10 gallons per minute (figure 3-103c). Of greater significance is the correlation of high yield zones at all depths (figures 3-103a-c) suggesting deep vertical fracture systems which can yield large quantities of water to properly drilled wells.

The statement on the top of page 3-418, that the "distribution of 'high' yield zones.....do not suggest the existence of major water-bearing fractures within the preliminary candidate area" is ludicrous from an inspection of figures 3-103a-c. Significant yields (greater than 10 gallons per minute) from a bedrock well in granite can only come from secondary porosity and permeability. Unless the Department of Energy wants to suggest dissolution, this evidence indicates jointing and fracturing.



Earthquake Epicenters 1975 - 1984

Precisely located

• M < 2.0

● M 2.0 - 2.9

⬤ M 3.0 - 3.9

Poorly located

✳ no magnitude given

× M < 2.5

Source: Maine Geological Survey

Figure A5-3

Section 3.2.2.3.6, page 3-418, paragraph 2. Published sand and gravel aquifer maps exist for the entire rock body and candidate area. These maps (Maine Geological Survey Sand and Gravel Aquifer Maps 11 and 12, Caswell and Lanctot, 1979a,b) were cited in the Northeast Regional Geologic Characterization Report. We do not understand how they were omitted from the draft Area Recommendation Report.

There are numerous sand and gravel aquifers in the Crooked River and Little Androscoggin River drainages. The Gray Delta provides water to several municipalities, industries, and homes.

Section 3.2.2.3.9, page 3-422 et seq.

In their description of the Sebago Lake candidate area, the Department of Energy omitted or mislocated a number of State-protected lands and properties. The attached list and maps provide an inventory of State properties and significant environmental features (**appendix A26**).

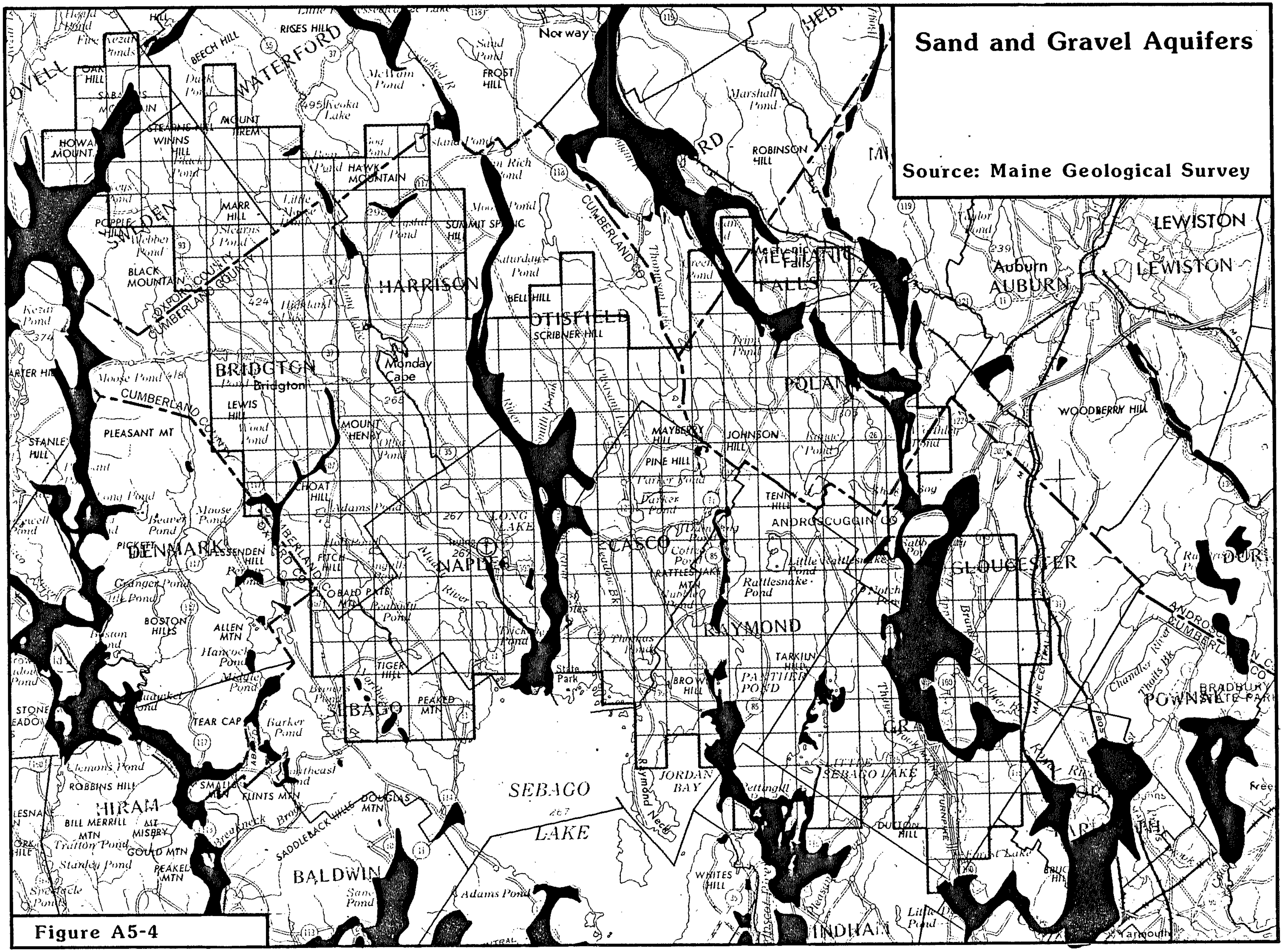
In addition, the State Planning Office has conducted a Natural Areas inventory, the predecessor to the Critical Areas Program. These features are significant environmental features, and should have been considered in the deferral analysis for the area (**see attached map in appendix A26**).

Section 3.2.2.3.10, page 3-428, paragraph 4. The Saco, Crooked, and Little Androscoggin Rivers are classified as Class B1 or lower. However, the Crooked River is a feeder to Sebago Lake, and as there are no discharges allowed to a Great Pond (i.e., Sebago Lake) or its tributaries, there are no discharges allowed to the Crooked River.

Section 3.2.2.3.10, page 3-429, table 3-12, and paragraph 2. The George Severns House is now a registered historic site. Two additional registered sites within the area are Friends Meeting House (Casco) and Poland Railroad Station (Poland). Five additional sites and/or historic districts adjacent to the candidate area were omitted from table 3-12 (**see appendix A21**). All Soul's Chapel is in Poland, not Mechanics Falls.

Section 3.2.2.3.11, page 3-430, bottom of paragraph 1. The average population density of the candidate area is approximately 62 persons/square mile. Within 80 km (50 miles) of the candidate area it is approximately 66 persons/square mile. The national average (benchmark for "low" population density) is 64 persons/square mile, not the 76 persons per square mile mentioned in the draft Area Recommendation Report. As a result, there is not "low" population with 80 km (50 mi) of the candidate area, and the candidate area itself has only marginally "low" population as of the 1980 U.S. Census.

The draft Area Recommendation Report mentions the North Windham CDP as a highly populated area, which is correct. However, North Windham is not a town; it is a part of the town of Windham. Using the arbitrary Census Bureau definition of a "highly populated place", however, the town of Windham, with a



Sand and Gravel Aquifers

Source: Maine Geological Survey

Figure A5-4

1980 population of 11,282 persons is not considered a highly populated place. See the comments provided earlier in chapter 1.

Section 3.2.2.3.14, page 3-431, paragraph 2.

See detailed comments on transportation systems, appendix A27.

Section 6.0 - References

Page 6-36. Schafer, J.P., and J.H. Hartshorn, 1965, "The Quaternary of New England", in The Quaternary of the United States, edited by H. Wright and D.G. Frey, Princeton University Press, Princeton, N.J., pp. 113-128. This reference cannot be found anywhere in the text in the Northeastern Region (section 3.2.2).

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Morner, N.-A., 1982, Sea level curves, in: The Encyclopedia of Beaches and Coastal Environments, M. L. Schwartz (Ed.), Stroudsburg, PA: Hutchinson Ross, p. 729-733.

Osberg, P.H., et al., (1984, 1985), Bedrock Geologic of Maine: Maine Geological Survey.

Thompson, W.B., and Borns, W.W., Jr., (1984, 1985), Surficial Geologica Map of Maine: Maine Geological Survey.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A6 - Estimation of Flood Prone Areas

The Department of Energy Screening Methodology Document indicates that the primary reason for the inclusion of surface water bodies as a regional screening variable is to consider a surface variable indicative of conditions that could lead to flooding of the facility (pages 113-114). The definition states (in part) that "Major rivers are included in this category as a surrogate, though not very accurate, measure of flood potential."

If it was the intent of the Department of Energy to use surface water bodies (as represented in the DOE/CRP gridded data base) as a surrogate for measuring flood potential, they failed completely.

The following comments use the Sebago Lake candidate area as an example because detailed National Flood Insurance Program (NFIP) flood boundary and floodway maps are available for most of the towns in the area. The comments apply equally to the Bottle Lake area, however, where the problem may be increased due to the high percentage of wetlands and surface water bodies in the area.

Within the entire Sebago Lake candidate area, only one river is mapped and included in the DOE/CRP data base (the Crooked River). In addition, the technique used to enter lakes and ponds into the data base systematically underestimates the number of lakes and ponds in the area. As a result, many surface water bodies in the area are not used in the screening process.

An examination of NFIP flood boundary and floodway maps for several communities in the area shows many other rivers and streams and small lakes and ponds have significant 100 year floodways associated with them that could not have been considered in the screening process. In some cases 3rd order streams with sufficient upstream drainage areas have a significant 100 year floodway.

A more realistic consideration of flood potential could have been done if:

- the Department of Energy had used NFIP (or comparable) floodway and flood boundary maps in the DOE/CRP data base; or

- the Department of Energy had used the data sources for surface water bodies indicated in the final Screening Methodology Document.

Given the very large scale of the floodway and flood boundary maps and the limited coverage within the 17 States, the first possibility above is unrealistic. However, the drainage mapped on the U.S. Geological Survey 1:250,000 topographic maps provide a much better approximation to the NFIP floodway and flood boundary maps than the approximately 1:3,000,000 U.S. Geological Survey map of the Eastern United States used in the screening process.

In the Screening Methodology Document the Department of Energy indicated the data for surface water bodies would come from (in order of preference):

U.S.G.S. Land Use maps (1:250,000)
State sources
U.S.G.S. 1:250,000 topographic maps
U.S.G.S. Base 3A (1:3,000,000 more or less)

In fact, it was stated (page 115): "Additional major rivers included in the surface water body variable will be identified from USGS Map 3A..." (emphasis is ours).

In the Northeast Regional Environmental Characterization Report, however, they indicated major rivers would include "all rivers on U.S.G.S. Base 3A". No rivers or streams from the Land Use maps or rivers and streams from the 1:250,000 topographic maps were used. As a result, the treatment of flood potential in the screening process is all but worthless.

It would appear that the Department of Energy went to considerable lengths to include significant factors in their analysis and screening of rock bodies for the draft Area Recommendation Report. It is unfortunate that the usefulness of these factors is all but eliminated by failing to use a reasonable source of data.

Combined wetlands and surface water body data base

Wetlands were also considered as a proxy for potential flooding. Since two variables were used as a surrogate variable for potential, the Department of Energy should consider combining the two data sets into a single data set for consideration of surface water features. There are several advantages to this approach:

- the problem of underestimation of surface water features in the conversion of mapped features to the gridded data base would be reduced; and,

- consideration of a combined data set would be a more realistic approximation to flood potential, as many wetlands lie in the flood plains of rivers and streams.

If surrogate variables have to be used in estimating critical factors, every attempt should be made to use the best possible, most realistic surrogate variables possible.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A7

Major Community Water Supplies and Watersheds in Southern Maine

The Sebago Lake candidate area includes portions of four major drainage basins in southwestern Maine: the Saco, the Crooked, the Androscoggin, and the Royal River drainage basins. Southern Maine is the most heavily developed and populous area of the State, and surface water supplies are critical to many of the major urban areas in that part of the State.

Sebago Lake and the Crooked River watershed:

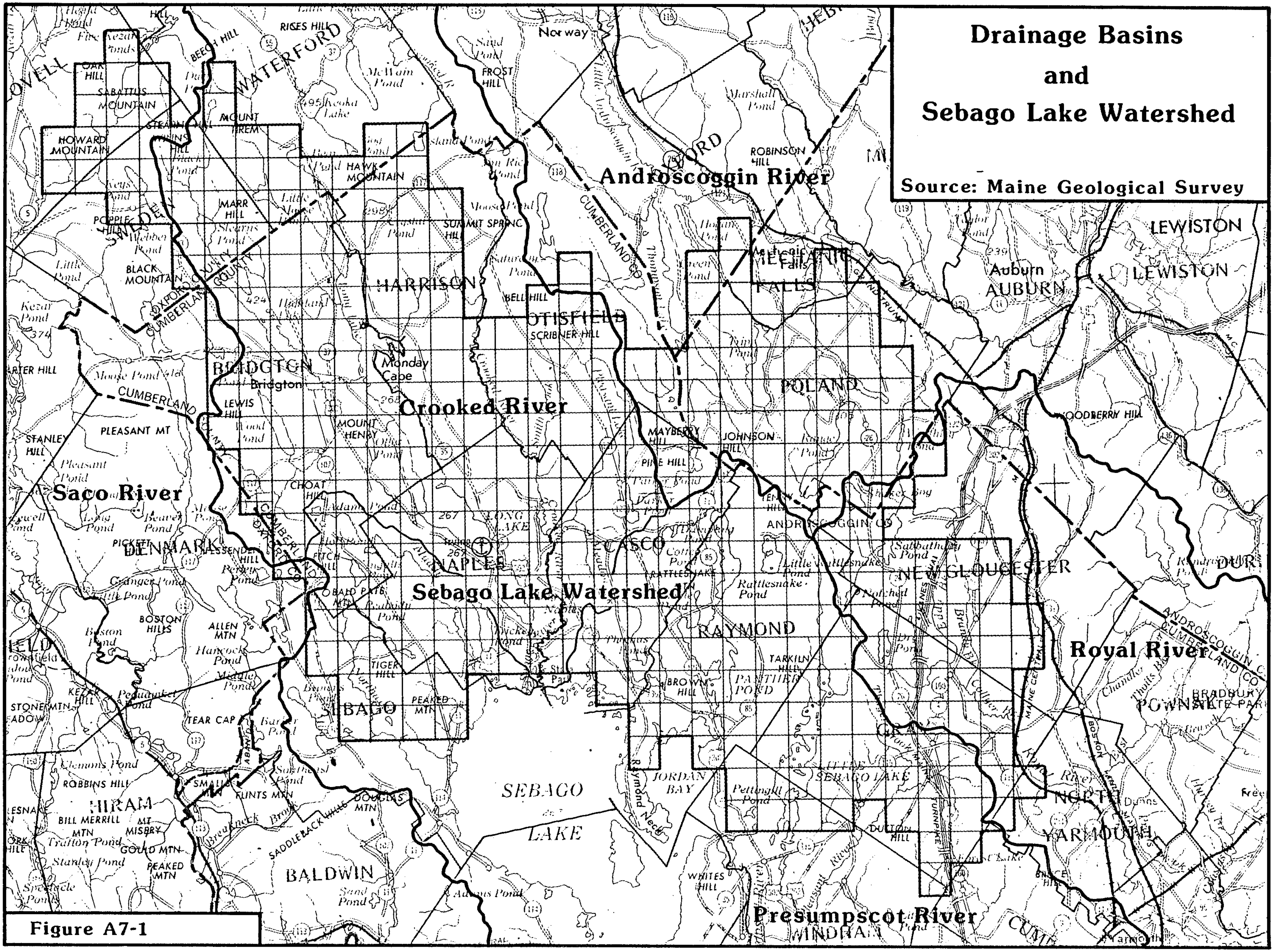
Comments provided to the Department of Energy by the Portland Water District (**see appendix A30**) raises many of the same concerns about the Department's draft Area Recommendation Report as are mentioned in this response. Comments include the importance of the watershed and water supply to over 160,000 people in southern Maine; the probability that Sebago Lake is a zone of regional ground water discharge for the Crooked River drainage basin; adverse environmental impacts associated with construction and operation of a repository; presence of sand and gravel aquifers in the area; complex and unsuitable geology of the batholith; inadequacies in the Department of Energy's treatment of seismicity and tectonics; and, inadequate treatment of mineral potential mineral resources.

In addition, a discussion of the legal status of the watershed as a State-protected resource is provided. Maine statute (Chapter 157 of Private and Special Laws of 1913) provided that the State Board of Health (now the Department of Human Services) protect against pollution and secure the sanitary protection of the waters of the lake and any of its direct tributaries. The Portland Water District itself was given authority to regulate any development within 200 feet of the lake.

The importance of Sebago Lake and its watershed is obvious; the Department of Energy should disqualify the Sebago Lake candidate area from consideration for a high-level nuclear waste repository.

The Saco River watershed:

As indicated in the letter from Margaret M. Roy, Executive Director of the Saco River Corridor Commission, to Dr. Sally Mann (10 March 1986 - copy attached - **see appendix A33**), current daily demand on the Saco River by the Biddeford-Saco Water Company averages 3.9 million gallons per day, with a maximum daily demand of 7.6 million gallons per day. Up to an additional 1 million gallons per day may be withdrawn by the Kennebunk-Kennebunkport-Wells Water District.



Drainage Basins and Sebago Lake Watershed

Source: Maine Geological Survey

Figure A7-1

Projected increases in population have to led to estimates of future use of this regional water supply over the next 25-50 years. Quoting from the U.S. Army Corps of Engineers report cited in the letter: "It is therefore crucial that every precaution be taken to preserve this vital resource."

The Maine Legislature recognized the significance of the Saco River to southern Maine in 1973 with the establishment of the Saco River Corridor Commission to protect and preserve this resource.

The Androscoggin Watershed:

The Gray Delta, in the eastern end of the candidate area, extends for more than 15 miles through Poland, New Gloucester and Gray, and is estimated to yield more than 50 gallons per minute through most of this area. As much as 159 feet of overburden is present in this aquifer, which serves as the water supply for the town of Gray and recharges the Poland Spring Bottling Plant's springs and wells. For many residents in this highly populated portion of the candidate area this aquifer is the sole source of potable water. By their nature sand and gravel aquifers are highly vulnerable to contamination, and as such now merit special protection by the State (**see appendix A19**). This major resource should have been given consideration in the draft Area Recommendation Report.

However, in the draft Area Recommendation Report no mention is made of the significance of Sebago Lake (and the associated watershed), the Saco River, or the Gray Delta as major sources of municipal water supplies. Sources of surface water, which are the principal sources of water for urbanized areas, should be given consideration as a resource just as sources of ground water are. While resource loss through direct loss of land or restriction on extraction are unlikely, serious questions of impacts on water quality are not even briefly mentioned in the draft Area Recommendation Report.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A8

Department of Conservation - Land Use Regulation Commission

Summary

These comments address the adequacy of the application of certain of the regional screening factors and variables to the Bottle Lake Complex (NE-2) -- one of the two areas in Maine identified as a possible site for a nuclear waste facility in the Draft Area Recommendation Report for the Crystalline Repository Project, January, 1986.

The major point made by these comments is that the Department of Energy overlooked the Commission's protection districts, notably fish and wildlife protection districts, when screening the site for "state protected lands". This does not appear appropriate in light of the Department of Energy's stated methodology.

These comments also point out resource information the Department of Energy has apparently overlooked in carrying out this screening process.

Background on "State-Protected Lands"

The U.S. Department of Energy has placed a great deal of importance on considering "state-protected lands" in evaluating areas for their potential as a possible crystalline repository for high level nuclear wastes. The Department of Energy methodology includes consideration of "state-protected lands" as a disqualifying factor and "proximity to state-protected lands" as an adverse variable.

The DOE/CRP screening methodology defines "state-protected lands" as

> "... any site where the presence of the restricted area or the repository support facilities would conflict irreconcilably with the previously designated resource preservation use of a component of the National Park System, the National Wildlife Refuge System, the National Wilderness Preservation System, the National Wild and Scenic Rivers System, or National Forest Lands, or any <u>comparably significant state-protected resource</u> that was dedicated to resource preservation at the time of the enactment of the NWPA." (emphasis added)

The methodology document goes on to state that "the evaluation of 'comparably significant' has been based on a thorough study of the statutory authority for each category of lands that the states and DOE/CRP staff suggested could warrant disqualifier status." We find it difficult to understand why, if a "thorough study" was carried out, such areas as critical areas and wildlife and game management areas in Maine were considered disqualifying factors and similar areas designated by the Land Use Regulation Commission (LURC) were apparently not similarly considered.

Since the Department of Energy placed emphasis on a review of statutory authority, we have appended a synopsis of LURC's statutory authority to these comments (see appendix).

Comment Relative to LURC's Program

The Fish and Wildlife Protection Zones (P-FW) were given no recognition in the screening process. These zones serve the same purpose as federally designated wildlife areas where the express purpose is to preserve wildlife habitat and they are clearly lands protected by state law and regulation. Therefore, these zones should have been considered as disqualifying factors under the "state-protected lands" factor of step 1 and as an adverse variable under the "proximity to state-protected lands" variable in step 2 of the screening process.

See the enclosed map for the various locations of this zone within the Bottle Lake area.

The Department of Energy limited itself to state-owned land in applying this factor and while the LURC P-FW zones are not state-owned, the methodology states that "because of diversity of use and variability in statutory authority, state-protected lands will not be solely defined by title" (page 83 of screening methodology document). As a result, there is nothing to prevent the Department of Energy from considering these zones as disqualifiers at this point.

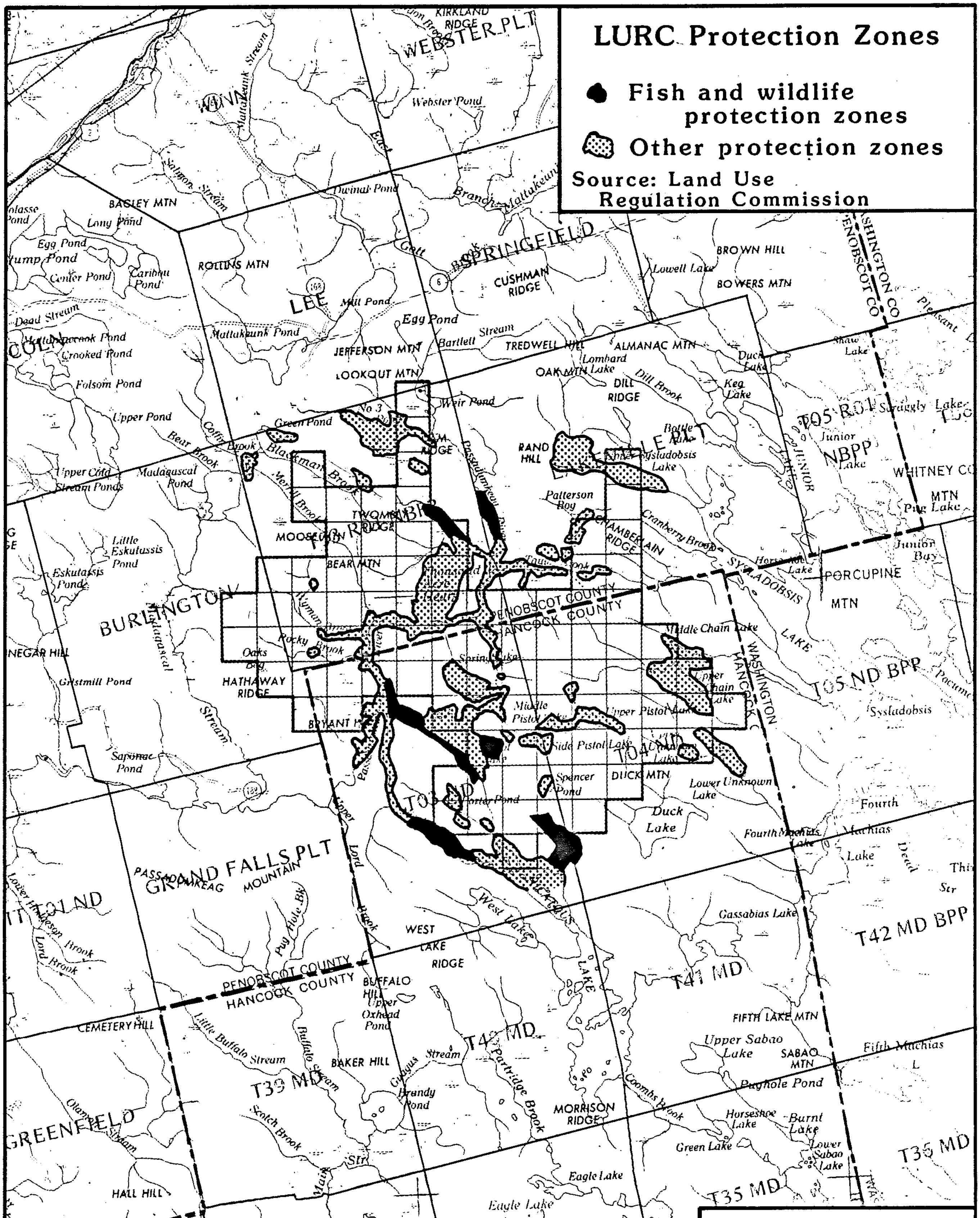

LURC Protection Zones
Fish and wildlife protection zones
Other protection zones
Source: Land Use Regulation Commission
WEBSTER PLT
Webster Pond
Dwinal Pond
BAGLEY MTN
Long Pond
Egg Pond
Center Pond
Caribou Pond
ROLLINS MTN
LEE
SPRINGFIELD
CUSHMAN RIDGE
BROWN HILL
Lowell Lake
BOWERS MTN
Mill Pond
Egg Pond
Mattakeunk Pond
Crooked Pond
Folsom Pond
Upper Pond
Bartlett Stream
JEFFERSON MTN
TREDWELL HILL
ALMANAC MTN
Lombard Lake
LOOKOUT MTN
OAK MTN
DILL RIDGE
Dill Brook
Keg Lake
Duck Lake
Shaw Lake
Weir Pond
Green Pond
RAND HILL
T05 R01 NBPP
Junior Lake
WHITNEY CO MTN
Pug Lake
Madagascal Pond
Upper Cold Stream Ponds
Patterson Bog
CHAMBERLAIN RIDGE
Cranberry Brook
Little Eskutassis Pond
Eskutassis Pond
MOOSEHORN
BEAR MTN
TWOMBLY RIDGE
PORCUPINE MTN
Junior Bay
BURLINGTON
PENOBSCOT COUNTY
HANCOCK COUNTY
Middle Chain Lake
SYSLADOBSIS LAKE
WASHINGTON
HANCOCK
NEGAR HILL
Gristmill Pond
Rocky Brook
Oaks Bog
HATHAWAY RIDGE
Spring Lake
Upper Chain Lake
T05 ND BPP
Sysladobsis
Middle Pistol Lake
Upper Pistol Lake
BRYANT HILL
Side Pistol Lake
T04 ND
Sapomac Pond
Spencer Pond
DUCK MTN
Lower Unknown Lake
Porter Pond
Duck Lake
Fourth Machias Lake
Fourth Machias Lake
T03 ND
GRAND FALLS PLT
PASSADUMKEAG MOUNTAIN
T01 ND
Gassabias Lake
T42 MD BPP
Upper Lord Brook
West Lake
WEST LAKE RIDGE
T41 MD
BUFFALO HILL
Upper Oxhead Pond
CEMETERY HILL
FIFTH LAKE MTN
Upper Sabao Lake
SABAO MTN
T40 MD
BAKER HILL
Little Buffalo Stream
Buffalo Stream
T39 MD
Partridge Brook
Brandy Pond
Scotch Brook
Pughole Pond
MORRISON RIDGE
Coombs Brook
Horseshoe Lake
Burnt Lake
GREENFIELD
Green Lake
Lower Sabao Lake
T35 MD
Eagle Lake
T35 MD
HALL HILL
EAGLE MT

Figure A8-1

Appendix

The Land Use Regulation Commission is a state land use planning and regulatory agency responsible for regulating land use in the unorganized areas of Maine -- those areas of Maine without local land use controls.

The Commission's enabling legislation (Title 12, MRSA, Section 681 - 689) states in part that:

> "The Legislature finds that it is desirable to extend principles of sound planning, zoning and subdivision control to the unorganized and deorganized townships of the State: To preserve public health, safety and general welfare; to prevent inappropriate residential, recreational, commercial and industrial uses detrimental to the proper use or value of these areas; to prevent the intermixing of incompatible industrial, commercial, residential and recreational activities; to provide for appropriate residential, recreational, commercial and industrial uses; to prevent the development in these areas of substandard structures or structures located unduly proximate to water or roads; to prevent the despoliation, pollution and inappropriate use of the water in these areas; and to preserve ecological and natural values.
>
> "In addition, the Legislature declares it to be in the public interest, for the public benefit and for the good order of the people of this State, to encourage the well planned and well managed multiple use of land and resources and to encourage the appropriate use of these lands by the residents of Maine and visitors, in pursuit of outdoor recreation activities, including, but not limited to, hunting, fishing, boating, hiking and camping." (12 MRSA, Section 681)

LURC's Planning and Regulatory Process

The Commission's decision-making relies on the principles espoused within its enabling legislation which was originally signed into law in 1969, a Comprehensive Land Use Plan originally adopted in 1976, and Land Use Districts and Standards which were first adopted in 1972. Land Use Zoning Maps have been adopted for each township within the Commission's jurisdiction based on zone descriptions within the Land Use Districts and Standards. The Commission's regulations are subject to the review and approval of the State legislature and the Plan is subject to the approval of the Governor.

The statute directs the Commission to adopt a comprehensive land use plan to serve as the basis for the Commission's regulations.

The Commission's Comprehensive Plan recognizes the uniqueness of Maine's unorganized areas and establishes several broad goals including:

> "Support and promote the management of all the resources, based on the principles of sound planning and multiple use, to enhance the living and working conditions of the people of Maine, to ensure the separation of incompatible uses, and to assure the continued availability of outstanding quality water, air, forest, wildlife and other natural resource values of the jurisdiction.
>
> "Conserve, protect and enhance the natural resources of the jurisdiction primarily for fiber and food production, non-intensive outdoor recreation and fisheries and wildlife habitat." (Comprehensive Plan for the Unorganized Areas of Maine, p. 66)

The Commission's Land Use Districts and Standards and zoning maps for this area identify several protection zones which occur within the Bottle Lake Complex. The Commission's enabling statute defines protection zones as follows:

> "Areas where development would jeopardize significant natural, recreational and historic resources, including, but not limited to, flood plains, precipitous slopes, wildlife habitat and other areas critical to the ecology of the region or State." (12 MRSA, Section 685-A, 1)

The three most prevalent protection zones within the subject area are Fish and Wildlife Protection, Wetland Protection, and Shoreland Protection Zones.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A9

Department of Conservation - Bureau of Public Lands

Policy on Nuclear Waste Disposal in the Public Lands

GENERAL. The proposed Bottle Lake Nuclear Waste Disposal Site includes, in its southern reaches, about 3,000 acres of the Public Reserved Lands System in Hancock County. As outlined in the following material, the Bureau of Public Lands strongly opposed the designation of this target area for the purposes set forth.

The Public Reserved Lands endure as a post-Revolutionary Trust of the People of the State of Maine. They were established by the General Court of Massachusetts, beginning in 1780, and later ratified in the Articles of Separation through which Maine achieved Statehood. Any attempt to modify the broad purposes for which these lands were established is a matter to be resolved through Constitutional process.

Certainly, there are physical and biological reasons arguing against the disposal of nuclear waste within the target area, not the least of which is the potential contamination and passage of groundwater. On these particular lands, however, the importance of public confidence becomes a critical issue -- for the popular attachment to this land exceeds that of privilege. It is not something to be granted or revoked at the pleasure of the sovereign. These lands are, in fact, held by the people. They use and enjoy them by actual right, as guaranteed in the Constitution, and any allocation, therefore, for such purposes as toxic waste disposal, which operates against the will of the people, constitutes a deliberate and violent assault on that right.

HISTORICALLY PERMITTED USES. Originally, these lands were set aside to encourage religious and educational values and to support the operation of the General Court (Legislature). There were provisions, therefore, that public lots be assigned for use by the schools, by the first settled minister, and in support of the ministry. One additional lot, the State Lot, was generally sold to produce revenue for the Legislature. In 1831, the uses for the public lots were restricted to educational purposes; and in 1974, with the creation of the Bureau of Public Lands to administer these lands, Maine's Supreme Court, in an Opinion of the Justices, determined that a broader interpretation of "public purpose", including such activities as recreation, resource protection, wildlife habitat, and scientific study would be appropriate.

The Maine Legislature, as a result, in 30 MRSA Section 4162 provided that:

> "Multiple use" shall mean management of all of the various renewable surface resources of the public reserved lots, including outdoor

recreation, timber, watershed, fish and wildlife and other public purposes; it means making the most judicious use of the land for some or all of these resources over areas large and diverse enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; it means that some land will be used for less than all of the resources; and it means harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or greatest unit output.

The statutory language gives clear direction to the Bureau of Public Lands to provide for single use areas within the Public Reserved Lands System, which would disqualify lands from consideration as nuclear waste disposal sites. These would include the categories of backcountry, critical areas, and wildlife zones under the definitions provided by the Department of Energy.

EXISTING POLICY. Integrated Resource Policies for the Public Reserved Lands, adopted December 30, 1985, serve to enlarge on the Legislative mandate. They address the matter of nuclear waste disposal, as follows:

> The Bureau's underlying commitment to a balanced program of resource values and uses -- emphasizing the natural integrity of the landbase -- will render inconsistent certain activities which might otherwise be interpreted as benefits and/or services. This applies particularly to the disposal of waste products, especially nuclear and other toxic wastes, which might, because of the nature of the waste, serve to discourage public interest in its constitutional right to the use and enjoyment of these lands.

A small corner of the Bottle Lake pluton falls within the Duck Lake Unit of the Public Reserved Lands System. This Unit is in the process of management plan development for the next 10 year period. The area within the pluton is a remote and beautiful corner of the Unit that will be set aside for backcountry recreation and will not be available for development or other intensive uses.

The only conclusion that can be drawn from the above discussion is that the impact of a nuclear disposal site in the Bottle Lake pluton would have a major detrimental impact on public lands that would be totally incompatible with our policies and statutes. Furthermore, it would violate the Special Constitutional Trust status of these lands for the people of Maine.

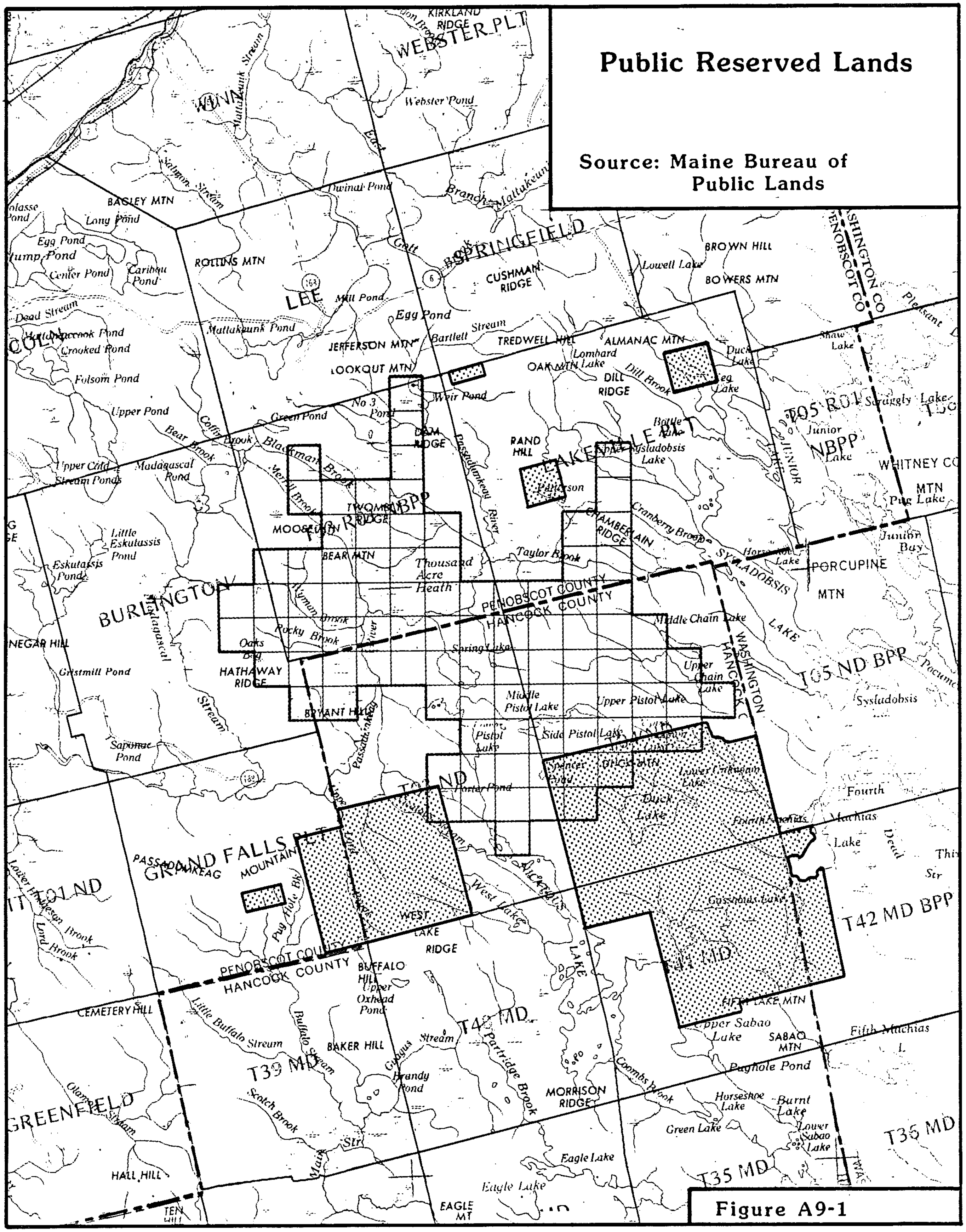

Public Reserved Lands
Source: Maine Bureau of Public Lands
WEBSTER PLT
KIRKLAND RIDGE
Webster Pond
WINN
Mattakeunk Stream
Salmon Stream
BAGLEY MTN
Long Pond
Egg Pond
Caribou Pond
Center Pond
ROLLINS MTN
LEE
Mill Pond
Egg Pond
Mattakeunk Pond
Dead Stream
Crooked Pond
Folsom Pond
Upper Pond
SPRINGFIELD
CUSHMAN RIDGE
BROWN HILL
BOWERS MTN
Lowell Lake
JEFFERSON MTN
LOOKOUT MTN
Bartlett Stream
TREDWELL HILL
ALMANAC MTN
Lombard Lake
OAK MTN
DILL RIDGE
Dill Brook
Weir Pond
Green Pond
No 3 Pond
DAM RIDGE
RAND HILL
Bear Brook
Coffin Brook
Blackman Brook
Upper Cold Stream Ponds
Madagascal Pond
Merrill Brook
TWOMBLY RIDGE
MOOSEHORN
BEAR MTN
Thousand Acre Heath
Taylor Brook
CHAMBERLAIN RIDGE
Cranberry Brook
Passadumkeag River
Little Eskutassis Pond
Eskutassis Pond
BURLINGTON
PENOBSCOT COUNTY
HANCOCK COUNTY
Middle Chain Lake
Rocky Brook
Spring Lake
Upper Chain Lake
WASHINGTON
HANCOCK
NEGAR HILL
Gristmill Pond
HATHAWAY RIDGE
BRYANT HILL
Middle Pistol Lake
Upper Pistol Lake
Side Pistol Lake
Pistol Lake
Saponac Pond
Porter Pond
Spencer Pond
Duck Lake
Lower Unknown Lake
PORCUPINE MTN
SYSLADOBSIS LAKE
T05 ND BPP
T05 R01 NBPP
Junior Lake
Junior Bay
WHITNEY CO
Pug Lake
Scraggly Lake
Sysladobsis
Fourth Machias Lake
Dead Stream
GRAND FALLS PLT
PASSADUMKEAG MOUNTAIN
Pug Hole Bk
WEST LAKE RIDGE
West Lake
Gassabias Lake
T42 MD BPP
T41 MD
T01 ND
Lord Brook
PENOBSCOT COUNTY
HANCOCK COUNTY
BUFFALO HILL
Upper Oxhead Pond
CEMETERY HILL
Little Buffalo Stream
Buffalo Stream
BAKER HILL
T40 MD
Partridge Brook
FIFTH LAKE MTN
Upper Sabao Lake
SABAO MTN
Fifth Machias L
Pughole Pond
T39 MD
Brandy Pond
Scotch Brook
MORRISON RIDGE
Coombs Brook
Horseshoe Lake
Burnt Lake
Green Lake
Lower Sabao Lake
GREENFIELD
Eagle Lake
T35 MD
HALL HILL
EAGLE MT
TEN HILL

Figure A9-1

Comments on Department of Energy Draft Area Recommendation Report

Appendix A10 - Comments on Mineral Resource Assessment

Review of the mineral resources data compiled in the draft ARR revealed four major problems: 1) inaccurate or inconsistent presentation of mineral resource locations, 2) omission of National Uranium Resource Evaluation (NURE) data, 3) omission of the Maine Peat Resource Evaluation Program data, and 4) arbitrary deviation from the natural resource criteria specified in the Department of Energy General Siting Guidelines (10 CFR 960).

Figures 3-91 (Bottle Lake area) and 3-101 (Sebago Lake area) are defined in the text as showing all potential strategic, metallic, and energy-related resources within 10 km (6 miles) of the preliminary candidate areas. However, several localities on figure 3-101 (ME-38, 39, 70, 73, 74, 122, 123, 464) are within 10 km of the Sebago rock body, but not the preliminary candidate area. If the intent is to show only those mineral localities within 10 km of the candidate area, the occurrences mentioned above should be deleted from figure 3-101.

However, we feel it is more appropriate to show the location of mineral resources within 10 km of the rock body. In this case, the following localities should be added to figure 3-101: ME-57, 59, 64, 86, 89, 98, 100, 104, 105, 107, 119. Locality ME-97 is within 10 km of the candidate area, and should be added to figure 3-101 regardless. (See attached map.)

Using a limit of 10 km from the rock body, locality ME-252 should be added to figure 3-91. (See attached map.)

The following mineral occurrences are not located accurately on plate 3A of the Northeast Regional Characterization Report and figures 3-91 and 3-101: ME-55, 73, 97, 194, 252, 501, and 502. The Mills Quarry (located at ME-74) should be added to table C-2 and plate 3A of the Northeast Regional Geologic Characterization Report, as Rand (1957) reports columbite as occurring at the site. The Bassick Prospect (Rand, 1957) should also be added to table C-2 and plate 3A of the Northeast Regional Geologic Characterization Report, and figure 3-91 of the draft Area Recommendation Report.

In 1983, the Department of Energy issued two reports summarizing the National Uranium Resource Evaluation (NURE) program in two areas in Maine (Field and Truesdale, 1982; Wagner, 1982). Neither report is cited in the draft ARR. This is particularly important in the case of the Sebago Batholith. Wagner (1982) reports numerous uranium occurrences in the area covered by the Portland 1° by 2° map; 25 of these occur within the rock body and 7 fall within the preliminary candidate area shown in figure 3-101 (see attached map).

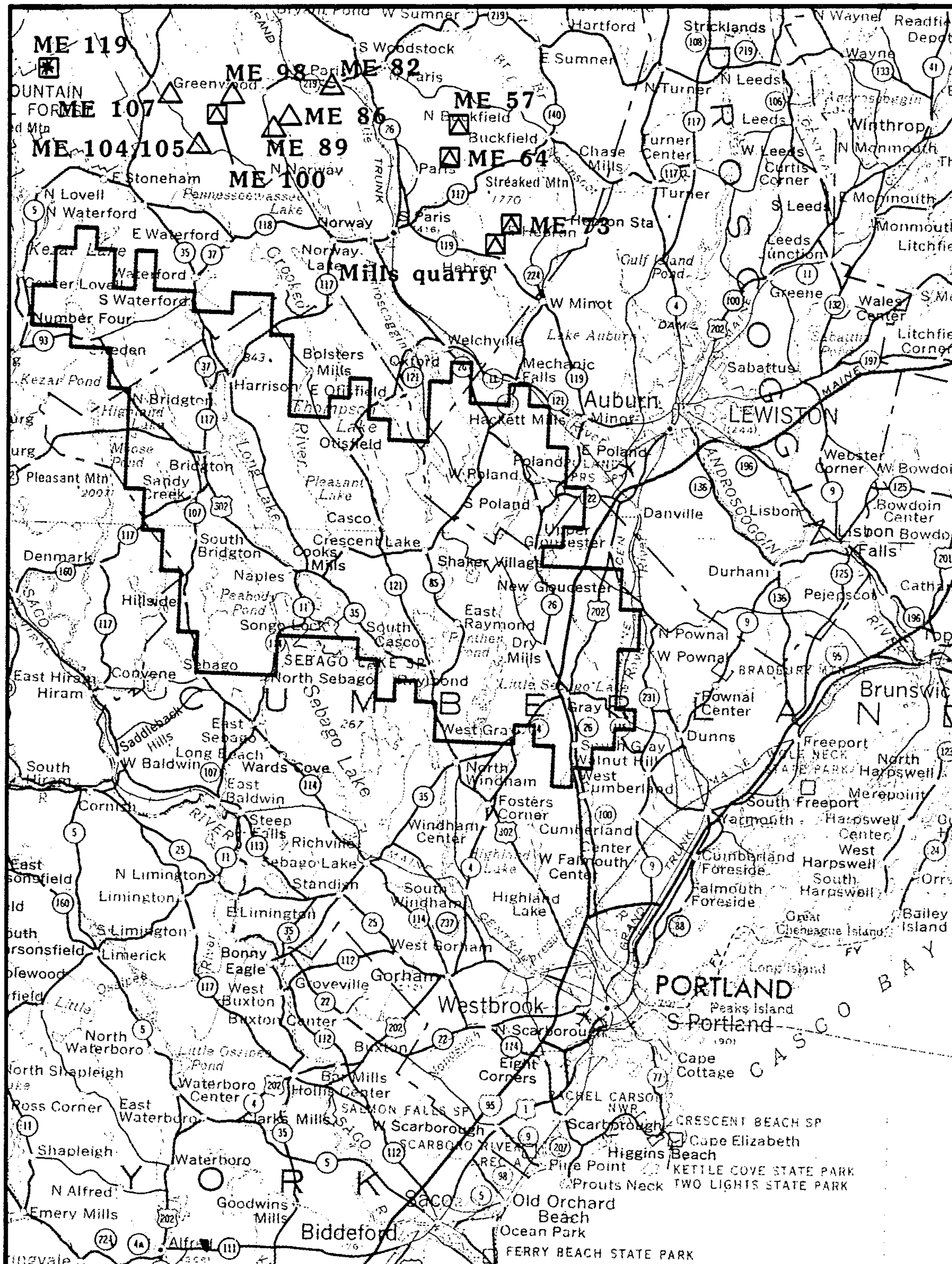
Between 1979 and 1983, the Department of Energy funded the Maine Peat Resource Evaluation Program to evaluate the fuel potential of Maine's peat resources. Yet the results of this project are not considered in the draft ARR despite the mineral resource criteria including energy-related resources. Maine has documented resources of over 136,000,000 short tons of air-dried fuel-grade peat (Cameron and others, 1984a,b,c,d,e). This represents a significant energy resource, particularly to a State such as Maine that imports most of its fuel. One of the State's most significant peat deposits occurs in the middle of the Bottle Lake candidate area. The 1,000 Acre Heath contains an estimated 2,363,200 short tons of air-dried commercial-quality peat.

The inaccuracies and inconsistencies in reporting mineral occurrences in the draft ARR, as well as the total disregard of the NURE program results, severely reduce the credibility of the mineral resource evaluation.

Of greater significance is the DOE's disregard of the natural resource criteria set forth in the Nuclear Waste Policy Act of 1982 guidelines. The General Siting Guidelines (960.4-2-8-1-C) specify the potentially adverse conditions concerning natural resources as: "(1) Indicators that the site contains naturally occurring materials, whether or not actually identified in such form that (i) economic extraction is potentially feasible during the foreseeable future or (ii) such materials have a greater gross value, net value, or commercial potential than the average of other areas of similar size that are representative of, and located in, the geologic setting." The guidelines do not limit the natural resources to metallic, "unique", or strategic mineral resources.

The DOE Region-to-Area Screening Methodology for the Crystalline Repository Project report issued in April 1985 narrows the rock and mineral resource criteria to strategic and unique mineral resources. Unique mineral resources are defined as "those which do not have an alternate source within a comparable distance from the market for that resource." In the draft ARR, mineral resources are further limited to strategic, metallic, and energy-related resources. The DOE's decision to limit the definition of natural resources, specifically mineral resources, is both arbitrary and unnecessary, and not in keeping with the intent of the Nuclear Waste Policy Act of 1982. A more accurate representation of the mineral resource potential would be to include all of the mineral localities shown on Plate 3A as occurring inside or within 6 miles of the rock body (a total of 135 mineral resource localities for the Sebago batholith) as well as the results of the Department of Energy-funded uranium and peat evaluation programs.

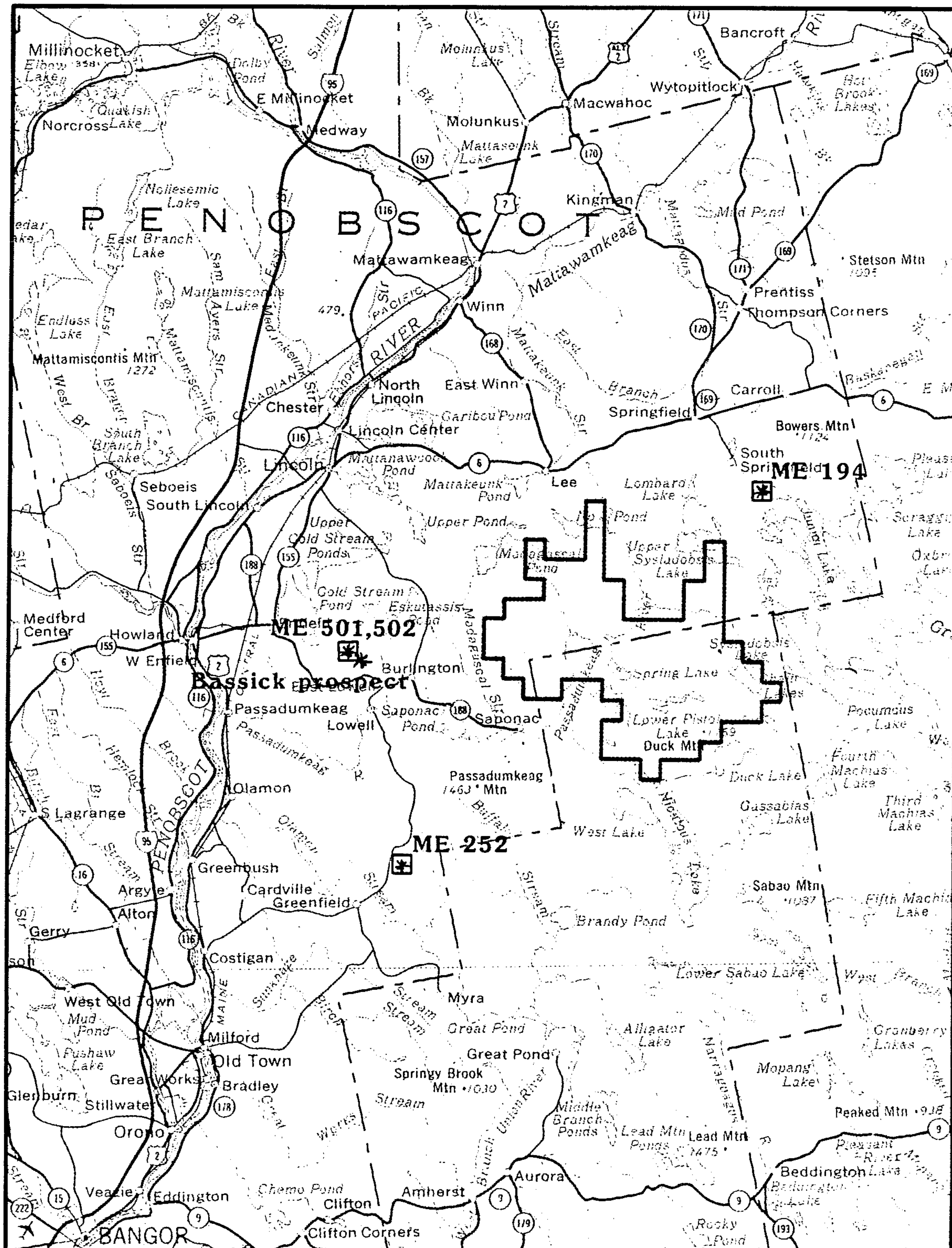
It should also be noted that geological, geophysical, and geochemical investigations have revealed mineralized areas in the Bottle Lake complex. Doyle and others (1961) identified a zone of sulfide mineralization along the northern contact of the granite in the Lee-Springfield-Carroll area. Post and others (1967) found several anomalously high levels of heavy metals in stream sediments in the Bottle Lake complex. Nowlan and Hessin (1972) reported anomalously high contents of molybdenum, arsenic, tungsten, and bismuth in stream sediments near the northeastern granite-country rock contact. Otton and others (1980) observed anomalously high concentrations of uranium and thorium in the northeastern portion of the complex. They suggested the setting is favorable for uranium-molybdenum vein or contact metasomatic deposits in the granite or its aureole.



Mineral Resources Omitted or Mislocated

Source: Maine Geological Survey

Figure A10-1



Mineral Resources Omitted or Mislocated

Source: Maine Geological Survey

Figure A10-2

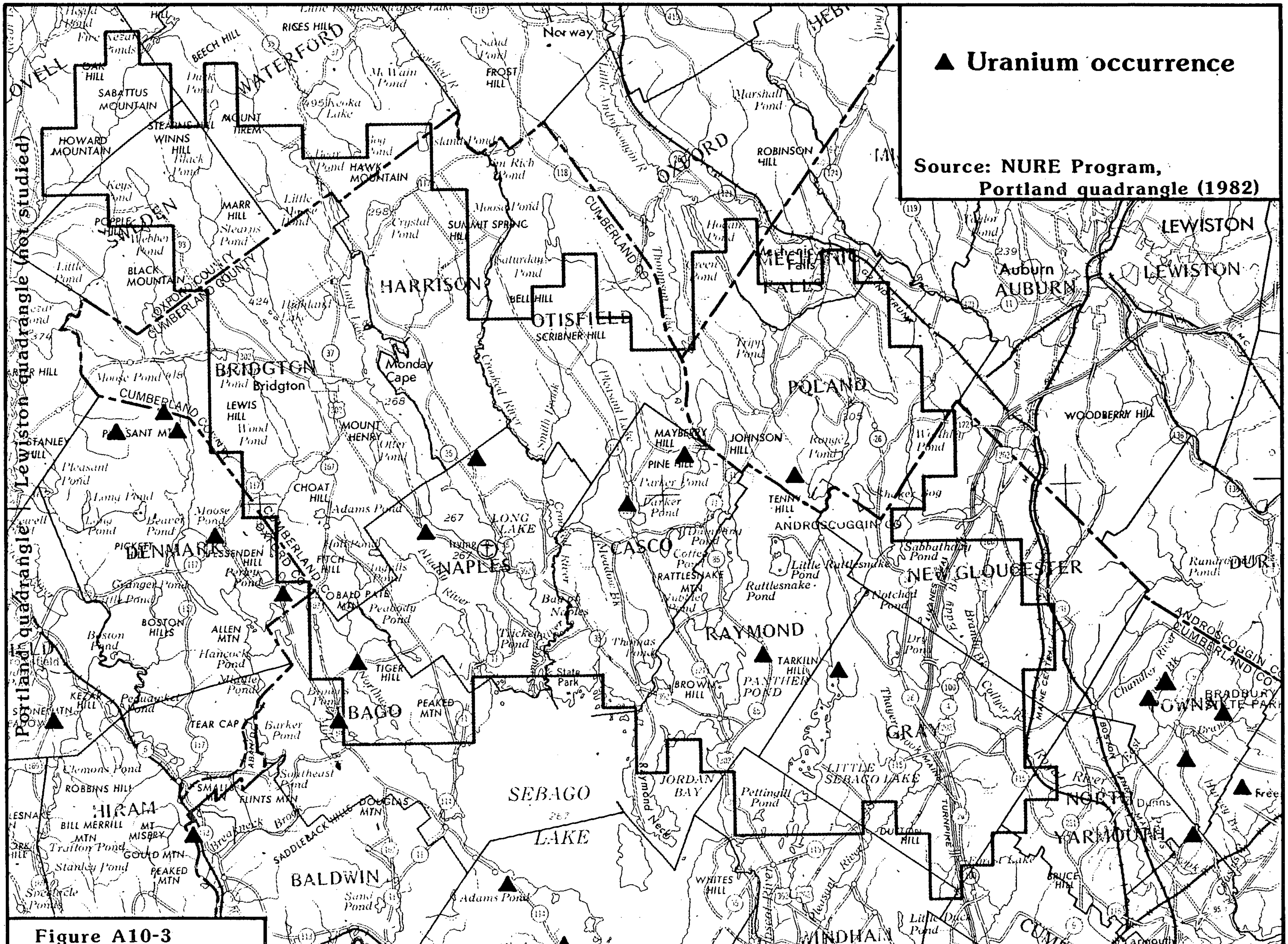

▲ Uranium occurrence
Source: NURE Program, Portland quadrangle (1982)
Lewiston quadrangle (not studied)
Portland quadrangle
WATERFORD
HARRISON
OTISFIELD
BRIDGTON
Bridgton
POLAND
DENMARK
NAPLES
CASCO
RAYMOND
NEW GLOUCESTER
SEBAGO
SEBAGO LAKE
GRAY
HIRAM
BALDWIN
OXFORD
AUBURN
Auburn
LEWISTON
Norway
NORTH YARMOUTH
JORDAN BAY
LITTLE SEBAGO LAKE
OXFORD COUNTY
CUMBERLAND COUNTY
ANDROSCOGGIN CO
CUMBERLAND CO

Figure A10-3

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1984a, Volume 1, Aroostook County, Maine Geological Survey, Bull. 28.

1984b, Volume 2, Penobscot County, Maine Geological Survey, Bull. 29,

1984c, Volume 3, Piscataquis and Somerset Counties, Maine Geological Survey, Bull. 30.

1984d, Volume 4, Southern and Western Maine, Maine Geological Survey, Bull. 31.

1984e, Volume 5, Washington County, Maine Geological Survey, Bull. 32.

Doyle, R.G., et al., 1961, A detailed economic investigation of aeromagtnetic anomalies in eastern Penobscot County, Maine: Maine Geological Survey, Special Economic Study Series No. 1.

Field, M.B., and Truesdale, D.B., 1982, National Uranium Resource Evaluation, Bangor and Eastport quadrangles, Maine: Bendix Field Engineering Corp, Grand Junction, CO, Report # PGJ/F-113(82), 30 p., microfiche appendix, 23 plates.

Nowlan, G.A., and Hessin, T.D., 1972, Molybdenum, arsenic, and other elements in stream sediments, Tomah Mountain, Topsfield, Maine: U.S. Geological Survey, Open-file report 1766.

Otten, J.K., et al., 1980, Anomalous uranium and thorium associated with granitic facies at the Bottle Lake quartz monzanite, Tomah Mountain, eastern Maine: U.S. Geological Survey, Open-file report 80-991.

Post. E.V., et al., 1967, Map of southeastern Maine showing heavy metals in stream sediments: U.S. Geological Survey, Mineral Invest., Field Studies Map MF-301.

Rand, J.R., 1957, Maine pegmatite mines and prospects and associated minerals: Maine Geological Survey, Mineral Resources Index No. 1.

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Wagner, H.D., 1982, National Uranium Resource Evaluation, Portland quadrangle, Maine: Bendix Field Engineering Corp, Grand Junction, CO, Report # PGJ/F-028(82), 28 p., microfiche appendix, 11 plates.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A11

Comments on the Probability that Sebago Lake is a Zone of Regional Ground Water Discharge

Based on the size (28,711 acres,) depth (101 feet average, 316 feet maximum), position in the drainage basin, lack of surrounding discharge areas, and topographic position, it is very likely that Sebago Lake represents a regional discharge area. In order to verify this assumption, several preliminary water budgets were calculated for the lake.

Unfortunately, inflow data is limited and lake contents and outflow data are not as precise as would be desirable. Therefore, one budget was performed using long-term regional estimates and another using data from a seven month period in 1977. Neither budget was sufficiently precise to yield absolute numbers, however, both indicated that 25-35% of the outflow was ground-water discharge.

It is important to consider that Sebago Lake is relatively low in the basin, and represents a large and deep potential ground-water sink. The lake contains a number of springs, which derive their flow, in part, from sand and gravel aquifers. It is, at the least, a local discharge area.

If Sebago is <u>not</u> a regional discharge area, then significant quantities of water must pass <u>under it</u>, eventually surfacing in the Atlantic Ocean, off Portland. The regional geology, which includes a large metasedimentary package, would impede this flow and make such a system unlikely to develop. There is evidence in Gorham, downgradient of Sebago, of buried valleys with very slow-moving bedrock ground water, based on geochemical studies of relict Pleistocene seawater (Tepper, 1980).

Given the limited available data, all indications point toward Sebago Lake receiving deep discharge. There being no other likely area for this discharge to occur, it is important to consider Sebago as a regional discharge area until proven otherwise. This is particularly true given the fact that Sebago Lake is the source of drinking water for the Greater Portland area. Grid cells within five miles of the lake should be classified as most adverse. In addition, the proximity of the candidate area to a major regional discharge zone should be considered an adverse factor in the Department's deferral analysis.

Reference

Tepper, D.H., 1980, Hydrogeologic setting and geochemistry of residual periglacial Pleistocene seawater in wells in Maine: M.S. thesis, University of Maine, Orono.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A12

Comments on the Designation of the Northeast and North Central Regions as Separate Geohydrologic Settings

The Department of Energy has separated the Northeast and North Central ground water regions into two separate "geohydrologic regions" based on three criteria: topography (relief), bedrock geology (age of bedrock), and nature of glacial/surficial deposits. While there are measurable difference in all three of these variables, the major unanswered question is whether these variables make a significant difference in ground water flow velocities or gradients at repository depths?

Additionally, it is questionable whether there is sufficient technical justification for separating the single ground water region described in U.S.G.S. Water Supply Paper 2242 (which has undergone extensive U.S.G.S. peer review) into two regions. There is evidence that the U.S.G.S., while recognizing the differences in topography, bedrock geology, and glacial style, still believed that the similarities of drift over fractured, metamorphosed/crystalline bedrock more than overcame the differences.

Topography (Relief)

Based on theoretical analyses (Toth, 1963), the flow gradients and proportion of flow entering deep flow systems is dependent on local relief. The more local relief present, the greater the proportion of the flow will be concentrated in local flow systems and discharged into local sinks. If the permeability of deeper formations is equivalent, gradients will be lower in deep flow systems in areas of high relief (see Toth figures 2g and 2h, for example). While this and similar analyses leave out a number of real-world variables, they do isolate the influence of topography on flow system development.

An increase in water-table relief of four times decreased gradients at repository depths between 2 1/2 to 3 times, based on Toth's analysis. Since the water table is a subdued replica of the land surface, an increase of relief of five to six times would be need to increase the water-table amplitude four times. Heath (U.S.G.S. WSP 2242) indicates an increase in hill top elevation of from 300-600 meters in the Midwest to "over 1500 meters" in the White Mountains. Actual maximum relief (highest mountain top to local surface water) in the Sebago area is less than 500 meters; in the Bottle Lake area it is less than 250 meters. Most of both areas has less relief than the areas measured (Pleasant Mountain in the Sebago Lake area; Passadumkeag Mountain in the Bottle Lake area).

While we do not have equivalent measurements for the areas in the North Central region, the difference between the 250-500 meters of actual relief in

Maine versus the 100-300 meters of relief in the North Central region mentioned in the draft ARR is unlikely to result in a difference in water-table amplitude of even a factor of 1.5. This might decrease gradients at repository depths in the Northeast region by at most 10% to 15%. Since these areas of high relief do not dominate the areas, the influence on gradients will be even less at repository depths.

Glacial/Surficial Deposits

It is more difficult to quantify the influence of the difference in the nature and thickness of surficial deposits between New England and the North Central region. It is true that till cover is generally thicker and more continuous in the North Central region, and there are some extensive glacial lake deposits there. A thicker and more continuous surficial "aquifer" will tend to concentrate flow in shallow flow systems, since it will provide a continuous medium. If it is of uniformly low permeability, it will reduce net recharge to bedrock and will lower deep gradients.

Discontinuous and variable surficial deposits will result in shorter flow paths being available in surficial materials; depending on the permeabilities, ground water flow may be refracted down into bedrock or discharged into surface water. Net recharge to bedrock in the Northeast is estimated at 8-15 cm/year (Caswell, 1978) and appears to be somewhat concentrated in areas of higher permeability surficial deposits. Average ground water recharge in Wisconsin has been estimated to be 15-25 cm/year (University of Wisconsin Extension, 1985). If 65% to 75% of the recharge moves through surficial flow systems, then net recharge to bedrock would be 9-18 cm/year, or not significantly greater than that in the Northeast.

The slight increase in recharge possible in the North Central region would tend to increase gradients at repository depth and add to any effect of higher topography in the Northeast. However, the influence of differences in topography and nature of glacial/surficial deposits between the two regions is small and probably results in negligible change in gradients.

Age of Bedrock

The influence of the difference in ages of bedrock is somewhat imponderable. Both areas are deeply eroded and the exposed crystalline rocks have been emplaced/metamorphosed at great depth, subjected to at least one period of mountain building, and then been uncovered during long periods of erosion. The next effect of these processes on fracturing in the rock should be quite similar whether the rock was emplaced 320 million years ago or 1,200 million years ago. The rock fractures appear to depend on the most recent loading/unloading history. In both cases deep erosion was followed by glacial loading and subsequent unloading.

Since the rocks are similar in physical properties, the brittle fractures which result from such a process are likely to be similar. The age of the rock is not a governing factor in its structural response.

The DOE adds one final point: that saline waters have been encountered at depth in some Precambrian Shield rocks, and have not, to date, been found in the Northeast. Given the very limited extent of deep drilling in this area, it is unlikely that brine pockets, if they exist, would have been discovered. Deep ground water in Maine is often highly mineralized (iron, manganese, sulfides) as a result of long residence in flow systems. Whether the high salinity noted in deep North Central region wells is a result of similar travel times acting on different country rocks around crystalline rock bodies is not known. Without further evidence, the presence of deep saline waters is not an adequate discriminant between the two areas.

Summary

None of the factors listed by the DOE is sufficiently different in itself, or in its possible effects on ground water gradients and velocity at repository depths, to produce a significant difference in repository performance. We strongly object to this arbitrary decision, and do not believe that it is valid on the basis of the evidence presented.

In addition, the DOE apparently has not subjected this decision to any outside peer review by either the U.S.G.S. or State geologists. In contrast, Water Supply Paper 2242 had to undergo an intensive internal technical review by U.S.G.S. hydrologists prior to its publication. The peer review process is a means to insure that the ideas are reasonable and technically defensible; just as State review of DOE documents is intended to support State and public confidence in the process. This arbitrary decision, first presented in the draft ARR with little technical justification, does not add to the technical credibility of the program.

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Caswell, W.B., 1978, Ground water handbook for the State of Maine: Maine Geological Survey.

Heath, R.C., 1984, Ground-water regions of the United States: U.S.G.S. Water Supply Paper 2242.

Toth, J., 1963, A theoretical analysis of groundwater flow in small drainage basins: Jour. Geophys. Res., v. 68, p. 4795-4812.

University of Wisconsin Extension, 1985.

Appendix A13:

GEOSS, Inc., 1986, Gravity and its geological interpretation:
The Sebago Pluton, southwestern Maine

Maine Geological Survey, Open file report 86-15

Reference document; contact source agency for availability

Appendix A14:

Caswell, Eichler, and Hill, Inc., 1986,
Lineament analysis in centra and coastal Maine
using 1:250,000 Side Looking Airborne Radar imagery

Maine Geological Survey, Open file report 86-16

Reference document; contact source agency for availability

Appendix A15:

Comments on regional seismicity provided by Dr. John Ebel, Boston College and Weston Observatory

Review of discussions of seismicity in the DRAFT AREA RECOMMENDATION REPORT FOR THE CRYSTALLINE REPOSITORY PROJECT, VOLUME 1.

by John E. Ebel, Assistant Professor of Geophysics, Boston College
Assistant Director, Weston Observatory

I have three major criticisms of the DRAFT AREA RECOMMENDATION REPORT (DARR) sections pertaining to the seismicity of the northeast in general and to the the seismic potential associated with the selected plutons in New England in particular. My first criticism is that the relationship between earthquakes and plutons is not discussed. The 1982 Miramichi, New Brunswick earthquake (body-wave magnitude mb=5.7) occurred within a granitic pluton and may have fractured that pluton all the way to the surface (Wetmiller et. al., 1984). Campbell (1978) showed that strong intrusions, like granitic plutons, can amplify somewhat a prevailing regional stress field, especially for certain orientations of the pluton relative to the stress field. Thus, the interiors of granitic plutons could be sites where earthquakes may tend to occur. Engelder (1982) showed that joints in some rocks may be associated with the modern stress field. Ground cracks found after the Miramichi, New Brunswick, earthquake in 1982 was probably due to movement induced by the earthquake on a pre-existing joint (Wetmiller et. al., 1984). It should be noted that both plutons selected as possible sites in Maine have had epicenters located within their mapped boundaries. Thus, this question of the relationship of the seismicity with the plutons is quite relevent in these cases.

The second major criticism is that the report overplays the uncertainty in the location and depth of the earthquakes in the region. Ebel (1984 and 1985) discussed the epicentral and depth accuracy for both the historic and modern events. He concluded that many of the the recent epicenters may be as accurate as a few kilometers, in contrast to the DARR report which implies that all the epicenters may have a large error. Furthermore, a number of events in the regions have well-determined depths from aftershock or microseismic studies (Ebel, 1985). Some depths have been found to be 2 km or less (Ebel, 1985). Thus the statements in the DARR discussions of the individual plutons in the northeast region that the earthquakes all occur below the repository horizons are not entirely correct.

The third criticism is that the Algermissen et. al. (1982) seismic hazard maps are not the most up-to-date and that they may in fact underestimate the seismic hazard of the region. Bernreuter et. al. (1985)

presented the results of a seismic hazard analysis in the eastern U.S. where they found a greater seismic hazard for a site near Bath, Maine, than that found by Algermissen et. al. (1982). The choice of seismic hazard analysis used obviously impacts the seismic safety considerations necessary for any repository design and engineering.

I also have a number of more minor comments on the text and figures. Specifically:

Figure 3-83. The map of the instrumentally recorded earthquakes in this figure does not even include eastern Maine or the Bottle Lake pluton area.

Page 3-357 to 358. The large earthquakes near Passamaquoddy Bay in eastern Maine, especially the 1904 event, are not mentioned in the text. The proximity of this earthquake to the Bottle Lake complex should certainly be mentioned.

Page 3-359. The report states that "not all potential sites of moderate-to-large earthquakes have yet experienced one during historical times." This statement demands that the report assess the possibility that the selected plutons could be one of these as yet unknown sites. However, this is not addressed in the DARR.

Figures 3-90 and 3-100 and the accompanying texts. In both cases the errors of the recent epicenters (since 1975) may be better than implied in the text. Also magnitudes for a number of the more recent events are known and should be reported. The Sebago Lake pluton has obviously had intensity VI events near or within it, and yet these stronger events are given no special discussion in the text.

References cited above which do not appear in the report.

Bernreuter, D.L., J.B. Savy, R.W. Mensing, J.C. Chen, and B.C. Davis, 1985, SEISMIC HAZARD CHARACTERIZATION OF THE EASTERN UNITED STATES, Volume 1: METHODOLOGY AND RESULTS FOR TEN SITES, Lawrence Livermore National Laboratory Report UCID-20421 to the U.S. Nuclear Regulatory Commission.

Campbell, D.L., 1978, Investigation of the stress-concentration mechanism for intraplate earthquakes, Geophys. Res. Lett., 5, 477-479.

Ebel, J.E., 1984, Statistical aspects of New England seismicity from

1975 to 1983 and implications for past and future earthquakes, Bull. Seism. Soc. Am., 74, 1311-1330.

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Engelder, T., 1982, Is there a genetic relationship between selected regional joints and contemporary stress within the lithosphere of North America?, Tectonics, 1, 161-177.

Wetmiller, R.J., J. Adams, F.M. Anglin, H.S. Hasegawa, and A.E. Stevens, 1984, Aftershock sequences of the 1982 Miramichi, New Brunswick, earthquake, Bull. Seism. Soc. Am., 74, 621-654.

Review of Section 5 SEISMICITY
from the NORTHEAST REGIONAL GEOLOGIC CHARACTERIZATION REPORT

by John E. Ebel, Assistant Professor of Geophysics, Boston College
Assistant Director, Weston Observatory

In general, Section 5 entitled "Seismicity" in the NORTHEAST REGIONAL GEOLOGIC CHARACTERIZATION REPORT addresses all of the major issues regarding the earthquake activity in the northeast region. The report is fair and accurate in presenting the latest scientific thinking upon some of the topics related to assessing seismic hazard. However, there are other topics where the report relies upon questionable or outdated references or where potentially important information is not presented. Three major shortcomings of the report are:

1. The seismic zonation studies referenced in the report in Section 5.3.1 do not include the most recent thinking on the subject. The studies cited are Hadley and Devine (1974), Barosh (1978), Chiburis (1981), and Barstow et. al. (1981). Important studies which were omitted are Ebel (1984) and Bernreuter et. al. (1985). These latter studies incorporate more fully the modern seismicity. The choice of a zonation map can have a significant affect upon the calculated seismic hazard at a particular site, as shown by Bernreuter et. al. (1985). For instance, Algermissen et. al. (1982) used a zonation map which they developed in consultation with other experts to derive seismic hazard values throughout the United States. They calculated a value of about 15% of gravity as the strong ground motion value which has a 90% chance of not being exceeded in 250 years. Bernreuter et. al. (1985) used zonation maps from a number of different seismic experts and found that, at a site near Bath, Maine, the value of ground acceleration which as a 90% chance of not being exceeded in 250 years ranges from 18% of gravity to 36% of gravity, depending upon the expert zonation map used. This entire range of values is greater than that calculated by Algermissen et. al. (1982).

2. Considering the purpose of this document as a review of the seismicity of the region in preparation for selecting crystalline rock, high-level radioactive waste sites, the report lacks an in-depth discussion of the relationship of the seismicity with granitic and mafic plutons. This is

especially important since the 1982 Miramichi earthquake (body-wave magnitude mb=5.7) occurred in a granitic pluton in New Brunswick and caused a fracture which may have ruptured to the surface of the pluton (Wetmiller et. al., 1984). Campbell (1978) showed that a strong granitic pluton could concentrate some stress within itself, so an aseismic character of the interiors of such plutons cannot be immediately assumed if these plutons sit in weaker country rock. Engelder (1982) also argued that some joint sets in the northeast may be related to the present stress field, although the relationship of these joints with the present seismicity is not been discussed. However, the 1982 Miramichi earthquake caused displacement on a pre-existing joint (Wetmiller et. al., 1984).

3. Focal depths of a number of events in New England are well constrained by aftershock or microseismic studies. Ebel (1985) discusses a number of these events. Some of the shocks were at depths of 2 km or less, indicating that very shallow focal depths are possible in New England.

I also have a number of more minor comments about the report. They are:

Page 5-2. Nottis (1983) containes a reexamination of the entire Chiburis (1981) catalog with numerous corrections. This reference should be included here.

Page 5-7. Ebel (1984) argues that the epicentral accuracy in Maine is better than 10 km in many cases. The reports claims the accuracy is at best .1 degree (about 11 km) in Maine.

Page 5-14. The question of the relationship between the frequency of earthquake occurrence and the locations of larger earthquakes is asked, but never answered or discussed. Ebel (1984) argues that such a relationship does exist.

Section 5.3.2. As an example of the problems of the Algermissen et. al. (1982) study, their zonation map totally ignores the more prominent seismicity of the Passamaquoddy Bay region of eastern Maine where Leblanc and Burke (1985) estimate that two earthquakes of magnitude mblg about 5.7 to 5.8 took place in 1869 and 1904 respectively.

Section 5.4.2. The U.S. Geological Survey has gone so far as to argue that a Charleston-type earthquake could occur anywhere along the eastern U.S. seaboard (Bernreuter et. al., 1985). This should certainly be mentioned and discussed here.

Section 5.6. Ebel (1984) presented recurrence relations based upon recent seismic data. These values should be presented here also.

References cited above which do not appear in the report.

Bernreuter, D.L., J.B. Savy, R.W. Mensing, J.C. Chen, and B.C. Davis, 1985, SEISMIC HAZARD CHARACTERIZATION OF THE EASTERN UNITED STATES, Volume 1: METHODOLOGY AND RESULTS FOR TEN SITES, Lawrence Livermore National Laboratory Report UCID-20421 to the U.S. Nuclear Regulatory Commission.

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Appendix A16:

Dr. Patrick Barosh
Preliminary fault and lineament analysis of the Bottle Lake Complex
and the Sebago batholith

Preliminary Evaluation of the fault and lineament

Analysis of the Bottle Lake Complex and

Sebago Lake batholith areas, Maine

by
Patrick J. Barosh
Patrick J. Barosh and Associates

Both the Bottle Lake complex and the Sebago Lake batholith lie in a zone of northeast-trending high-angle faults, with right-lateral movement, that crosses Maine. They also are crossed by numerous northwest- and north-trending topographic lineaments. These match the trend of relatively young cross faults in nearby areas, where more detailed mapping has been done.

The Bottle Lake complex lies between the Lewiston fault zone, with an indicated 70 km of right-lateral movement, on the north and the Norumbega fault zone, that also has considerable right-lateral offset, on the south. Both these faults form wide northeast-trending zones adjacent to the complex.

A series of northeast to north-northeast-trending lineaments extends between and oblique to these two fault zones and crosses the Bottle Lake complex. The most prominent of these passes through 1000 Acre Heath in the middle of the complex (shown in Barosh, 1981, Fig. 4). This lineament is now shown as a fault on either side of the complex (Osberg and others, 1985). These faults may have formed prior to the emplacement of the complex, but have probably been reactivated since. Two other lineaments that cross the complex also coincide in part with faults mapped on the northeast side of the complex. All these lineaments may be fault zones and perhaps acted as crossover faults, with right-lateral movement, between the Norumbega and Lewiston zones.

Several lesser parallel lineaments, striking just east of north, cross all or parts of the Bottle Lake complex and probably also represent fracture zones. In addition, many prominent northwest-trending lineaments are present in the area of the complex. They nearly parallel the direction of movement of glacial ice and it is difficult to separate possible fracture zones from glacial features, but some must certainly be reflecting structure, given the abundance of faults of this trend elsewhere.

The Sebago lake batholith lies mostly northwest of the Lewiston fault zone, that passes through its southeastern part. The Moll Ockett and Ben Barrows faults to the north of the Lewiston are apparently similar and would also cross the batholith. Others may be present. A wide zone of northeast-trending lineaments, seen in the topography, lake and stream alignments, bedrock surface configuration and surficial fill trends, crosses the southern Sebago Lake batholith from mid Sebago Lake south. These may represent a wide fracture zone along the Lewiston fault zone and perhaps structures branching from it.

The western part of the Maine portion of the Sebago Lake batholith is crossed by a conjugate set of northwest- and north-trending lineaments expressed in the topography and pattern of the glacial river system. They may represent fractures, such as those apparently controlling some Mesozoic (?) basic dikes near Fryeburg. One of the north-trending lineaments is aligned with others to the north and appears to be part of a discontinuous lineament extending to Quebec. A change in the trends of the major rivers occurs across this lineament; they trend westward, west of it.

Two prominent northwest-trending river valleys, marked by glacial fill, are present: one along the Saco river and another extending northwestward from Lewiston. These valleys also mark apparent offsets in late Pleistocene shoreline features. The one extending from Lewiston coincides with a broad zone of disruption in the trend of geologic features that lies along the northeast side of the Sebago Lake batholith and continues beyond it to the northwest. A complex fracture zone appears necessary to explain the features along it.

Numerous other northwest-trending lineaments, seen in satellite imagery and topographic, radar and bedrock surface data, cross the batholith, but as at Bottle Lake they nearly parallel the direction of glacial flow and structural interpretation is more difficult.

The conjugate lineament pattern of the western part of the batholith is where more plutons of the White Mountain Plutonic Series are located. This pattern may reflect the conjugate set of fractures, proposed by several geologists to control the emplacement of the plutonic series. Some of the many small northwest-trending lineaments present over the entire area of the batholith must represent faults of the kind mapped to the north and west, where a few have post-Cretaceous movement (Freedman, 1950).

Thus both the Bottle Lake complex and the Sebago Lake batholith are crossed by three principal trends of lineaments, that appear to indicate considerable fracturing of each granitic body. Potential fractures need not have much displacement to form wide, open zones, that control water flowage. Indeed, some exposed northwest-trending faults with small displacement in the region have unexpectedly wide broken zones.

References

Barosh, P.J., 1981, The Penobscot lineament, Maine, in O'Leary, D.W. and Earle, J. L., eds, Proceedings of the Third International Conference on Basement Tectonics. Basement Tectonics Comm. Pub. n. 3. p. 119-135 also as U. S. Nuclear Regulatory Commission Rept. NUREG/CR-2291, 36 p.

Freedman, Jacob, 1950, Stratigraphy and structure of the Mt. Pawtuckaway quadrangle, southeastern New Hampshire: Geol. Soc. Am. Bull., v. 61, p. 449-492.

Osberg, P.H., Hussey, A.M., II and Boone, G.M., eds, 1985, Bedrock geologic map of Maine: Maine Geol. Survey, Scale 1:500,000.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A17

Department of Environmental Protection - Bureau of Air Quality Control

The loading, unloading, and transportation of crushed stone from the mining of the high level nuclear waste repository is expected to contribute approximately 135 tons of total suspended particulates (TSP) to the atmosphere each year of construction (see calculation below). The concentrations of particulates at the fenceline of the property cannot be quantified without modeling the emission data with meteorological conditions found at the site. However, as seen in Table 5.4.6 on Page 5.50 of the report Management of Commercially Generated Radioactive Waste, Environmental Impact Statement, Volume 1, the annual average particulate concentrations at the fenceline for the reference site is 170 ug/m^3. The Maine standard for particulate matter concentration for any 24 hour period at any location shall not exceed 150 ug/m^3; and the annual geometric mean of the 24-hour particulate matter concentrations at any location shall not exceed 60 ug/m^3 (Section 584-A Enactment).

The quantities of effluents released to the atmosphere during construction of a geologic repository as reported in Table 5.4.4. on page 5.48 of Management of Commercially Generated Radioactive Waste, Environmental Impact Statement, Volume 1, could be modeled to determine concentrations beyond the facility's perimeter. Impacts from indirect sources such as truck traffic and construction equipment have not been routinely analyzed for other types of facilities.

An ambient standard for radon gas has not been established as of the writing of this memorandum. However, with the evidence of high levels of radon found in the granite formations, it is clearly an issue to be resolved prior to excavation of granite for this facility (see comments by the Maine Department of Human Services).

The incineration of 1.8×10^6 tons of coal during the construction phase of the high level nuclear waste repository has the potential of major impacts on the air quality. Without additional information on the type of incinerator, type of coal (sulfur, ash content) it is not possible to predict concentrations that may result from this type of facility. The anticipated increased emissions of particulates, sulfur oxides, nitrogen oxides, carbon monoxide and volatile organic compounds from the incineration of an estimated 1.8×10^6 tons of coal for seven years is likely to require best available control technology. The nitrogen oxide emissions are particularly subject to review for a facility in the Sebago Lake region, since it may contribute to ozone formation in a preexisting nonattainment area.

Calculation of Total Suspended Particulate (TSP)

Based on a <u>seven year construction period</u>

<u>Loading</u> - Particulate Matter >10u

77,000,000 metric tons
77,000,000 x 2,200 = 1.69×10^{11}
1.69×10^{11} ÷ 2,000 = 84,700,000 tons/7 yrs

<u>Emission Factor</u> .0003 x 84,700,000 = 25,410 lbs TSP/7 yrs

25,410 ÷ 7 = 3,630 lbs/yr
3,630 ÷ 2,000 = 1.815 tons per yr

<u>Loading</u> - Particulate Matter <10u

77,000,000 metric tons
77,000,000 x 2,200 = 1.69×10^{11}
1.69×10^{11} ÷ 2,000 = 84,700,000 tons

<u>Emission Factor</u> .0001 x 84,700,000 = 8,470 lbs for 7 yrs

8,470 ÷ 7 = 1,210 lbs per yr
1,210 ÷ 2,000 = 0.605 tons per yr

<u>Unloading</u> - Particulate Matter >10u

77,000,000 metric tons
77,000,000 x 2,200 = 1.69×10^{11} tons
1.69×10^{11} ÷ 2,000 = 84,700,000 tons

<u>Emission Factor</u> .0003 x 84,700,000 = 25,410 lbs TSP for 7 yrs

25,410 ÷ 7 = 3,630 lbs per yr
3,630 ÷ 2,000 = 1.815 tons per year

<u>Unloading</u> - Particulate Matter <10u

77,000,000 metric tons
77,000,000 x 2,200 = 1.69×10^{11} tons
1.69×10^{11} ÷ 2,000 = 84,700,000 for 7 yrs

<u>Emission Factor</u> .00002 x 84,700,000 = 1,694 lbs for 7 yrs

1,694 ÷ 7 = 242 lbs per yr
242 ÷ 2,000 = 0.121 ton per yr

Transporting Crushed Stone

$$E = .5 \times (5.9) \times \frac{5}{12} \times \frac{21}{30} \times \left(\frac{50}{3}\right)^{0.7} \times \left(\frac{6}{4}\right)^{0.5} \times \frac{365-150}{365} = 4.5$$

84,700,000 ÷ 7 = 12,100,000 ÷ 50 = 242,000

VDT = 0.24 miles x 242,000 = 58,080 miles per year
58,080 x 4.5 = 261,360 lbs per year
261,360 ÷ 2,000 = 130.68 tons per year

Sum of Particulates

130.68 + 0.121 + 1.815 + 0.605 + 1.815 = 135.04 tons per yr

Comments on Department of Energy Draft Area Recommendation Report

Appendix A18

Department of Environmental Protection - Bureau of Land Quality Control

Environmental statutes administered by the Department of Environmental Protection, Bureau of Land Quality Control, are:

The Site Location of Development Act
Title 38 M.R.S.A., Sec. 481 et seq.

The Solid Waste Management Act
Title 38 M.R.S.A., Sec. 1301 et seq.

The Great Ponds Act
Title 38 M.R.S.A., Sec. 386 et seq.

The Stream Alteration Act
Title 38 M.R.S.A., Sec. 425 et seq.

The Freshwater Wetlands Act
Title 38 M.R.S.A., Sec. 405 et seq.

In order to evaluate the compatibility of a high level nuclear waste repository with Maine environmental statutes, the following DOE documents were reviewed: Final Environmental Impact Statement, Management of Commercially Generated Radioactive Waste, Volume 1, October 1980 (DOE/EIS 0046F); Draft Area Recommendation Report for the Crystalline Repository Project, Overview, January 1986 (DOE/CH-15(0)) and Volume 1, January 1986 (DOE/CH-15(1)).

None of these documents describes the repository facility in sufficient detail to accurately compare the facility to the standards of each statute.

Our discussion generally follows from the generic sense of a repository located in either site NE-2 or NE-4. Where there is specific information noted on either area, that information will be noted.

The Department of Energy must apply for and receive all State of Maine permits prior to the construction of a repository at either site NE-2 or NE-4.

With respect to transportation concerns, the disposal of nuclear waste at either NE-2 or NE-4 would require the wastes to travel through or near Maine's largest population centers. Road transportation to the Sebago Lake area would transit the heavily utilized Route 302. This may require DOE to utilize off-peak delivery to minimize potential accidents (**see comments by Department of Transportation, appendix A27**).

The proposed repository site is sufficiently large to contain a number of streams and/or freshwater wetlands. The majority of these streams and wetlands tend to be exceptional quality fisheries and wildlife habitat. Fast flowing natural streams tend to be very good cold water fisheries habitat. Major relocation or alterations of large sections of streams generally do not receive approval because of the adverse effect on fisheries habitat. Any repository located in Maine must be located and designed in such a manner that direct and indirect impacts on streams are minimized.

The area of the proposed repository, including the waste rock piles, would be the largest single project since the major airports in Portland and Bangor or Loring AFB. As such, drainage patterns will be affected in major areas. This will require control and management of large amounts of surface water. The series of holding areas will need great engineering detail to locate and construct. Given the 40-plus inches of precipitation in the Northeast, this surface water control will be much more expensive than if the repository were located in a more arid area.

This high precipitation level severely complicates the management of the leachate generated from the waste rock area. The EIS discussed leachate treatment in two methods: 1) evaporation ponds, or 2) a treatment plant. Evaporation ponds, simply stated, do not work in Maine. At either NE-2 or NE-4 there are no available waste water treatment plants to handle the quantity of waste water to be treated. Therefore, DOE must consider the expense of treating and discharging waste water (**see comments by the Bureau of Water Quality Control, appendix A19**).

Cumberland and York Counties are the two fastest growing counties in Maine, and as such wildlife habitat is being quickly reduced. Because of the size of this development, a HEP (Habitat Evaluation Procedure) study must be completed. This study will address the importance and nature of habitat in the area to be developed. Depending on the results of the study, a mitigation plan for loss of important habitat must be designed, then put into practice. The costs of this total amount of work are undetermined at this time.

The Sebago Lake area, site NE-4, is perhaps the fastest growing recreation area in Maine. Land values are increasing and population influx is at an all time high. There are direct socio-economic impacts from the influx of a major work force and the local purchases of goods and services. These impacts can be calculated and if necessary mitigated. However, at this time the methods of estimating the socio-economic impacts of locating a high level nuclear waste repository in a major outdoor recreation area are limited. The repository should be located in an area of extremely low population and recreational use.

Both sites in Maine would require the excavation of large amounts of granite in order to construct the repository. The granite in the Sebago batholith is high in uranium and its daughter products. To date, little information has been provided on the health effects of a large waste site containing radioactive rock (**see comments by Maine Department of Human Services, appendix A22**). One potential for mitigation of these health effects is to locate the facility in a host rock that does not have high ambient levels of radiation associated with it.

The project will require significant amounts of electricity to operate. The project will generate some, if not all, of its electricity from burning coal. The Air Bureau must determine air quality in the two proposed project sites to determine the impact on air quality from the burning of coal (**see comments by Bureau of Air Quality Control, appendix** A17). Any project would have to have BACT for the emissions. No calculations have been provided on the amount of ash to be generated by the project. To date, only two licensed coal ash disposal sites exist in Maine. Proper disposal of coal ash may require that DOE construct its own disposal site, which would result in additional negative environmental impacts.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A19

Department of Environmental Protection - Bureau of Water Quality Control

The most obvious concern about the underground disposal of high level nuclear waste in Maine is the potential introduction of radionuclides into bedrock aquifers, which ultimately discharge into shallow aquifers and surface water. However, even if contamination of ground water with radionuclides through accident or during the containment phase were not an issue, the construction and operation of such a facility will pose serious water quality problems which must be addressed.

The excavation of 2000 acres of granite will cause severe erosion problems, and problems with runoff from the mine tailings site. This may lead to discharges of high levels of silt, total dissolved solids, sodium, phosphorus, iron, uranium, and uranium daughter products.

Maine law prohibits or restricts the discharge of such contaminants to ground or surface water. The degree of protection in any area depends on the water's classification. Under current Maine law (38 MRSA Sections 363, 363A) the discharge of any substance into Class A waters is prohibited unless the discharge will be equal to or better than the quality of the receiving waters. No discharges of substances which are harmful to water quality or aquatic life are permitted to GP-A waters. Discharges to Class B-1 waters which impair the use of the water for potable water supplies, water contact recreation, or fish and wildlife habitat are also prohibited.

All of the streams and rivers in the Bottle Lake area are considered Class A waters (38 MRSA Section 368). GP-A waters include all lakes and ponds over 10 acres in size (Great Ponds) in both the Bottle Lake and Sebago Lake areas, and would include tributaries to these lakes, such as the Crooked River. There are 46 Great Ponds in the Sebago Lake candidate area, and 15 in the Bottle Lake candidate area. All surface waters in the Sebago Lake area not classified GP-A are classified B-1.

Thus, mining operations within Class A or GP-A watersheds (all of Bottle Lake and most of the Sebago Lake area) could not discharge silt or other pollutants to surface water under Maine law. This will make construction of a repository nearly impossible except in portions of the Sebago Lake area, and very difficult and expensive in the areas where it may be permitted.

An additional concern for surface waters is that the eastern portion of the Bottle Lake drains to the St. Croix River, boundary water between the United States and Canada. Article IV of the Federal Government's 1909 treaty with Canada and Great Britain prohibits the pollution of boundary waters.

All ground water within the Sebago Lake and Bottle Lake areas is classified as GW-A (38 MRSA Section 171-B). Class GW-A waters shall be free of radioactive matter or any matter that imparts color, turbidity, taste, or odor which would impair usage of these waters (38 MRSA Section 363-B). Any activity which discharges contaminants to ground water in excess of drinking water standards is prohibited under Maine law. To comply with this law the repository will need to be constructed so that radioactive substances do not come in contact with ground water, and the quarrying of the granite and runoff from mine tailing will not impact ground water.

The siting of any activity which may discharge contaminants to sand and gravel aquifers is severely restricted under 30 MRSA Section 481 et seq. The Sebago Lake area has several large sand and gravel aquifer systems. Another aquifer serves as the Harrison-North Bridgton municipal water supply. Other public water supply wells in or near the Sebago Lake area which utilize sand and gravel aquifers include the Portland Water District wells in North Windham and Cumberland Center, and wells serving the towns of Oxford, Norway and South Paris.

Many of the sand and gravel aquifers in the Sebago Lake area may qualify as Class I aquifers under the EPA ground water protection strategy. The aquifers:

- have high hydraulic conductivities, and as a result are highly susceptible to ground water contamination;
- serve as water supplies which are irreplaceable except at very high cost;
- serve a substantial number of people at the present time, and will serve thousands more by the time of site operation.

Class I aquifers are very valuable and vulnerable, and should receive the highest protection possible.

In summary, even ignoring potential impacts of radioactive waste disposal on water quality, it does not appear possible to construct an underground waste repository at either Bottle Lake or Sebago Lake under current Maine law. This is due to water quality problems associated with such a large mining operation conflicting with the high protection standards which Maine has set for the waters in these two regions.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A20

Department of Environmental Protection - Bureau of Air Quality Control

Characteristics of Maine Climate

Transportation within Maine and along the coast is affected by the climate of the State. The more important relevant characteristics include the frequent passage of storms over or near Maine and the changeability of the weather, which results in part from the frequency of storms. This changeability means that weather is unpredictable over both short and long periods of time. Furthermore, the common occurrence of fog along coastal areas can create a hazard for most transportation systems.

Maine is located in a band of westerly winds which encircle the earth in the middle latitudes. Air masses that originate in higher or lower latitudes interact to form storm systems within this circulation. These low-pressure storm systems are the major producers of moisture year-round in the State. The main tracks of the systems, shown in the attached figure, show a tendency for movement toward the northeastern United States and over or near Maine.[4] Because of the preferred tracks, a large number of storm systems pass over or near Maine compared to most other sections of the country. Measurable amounts of precipitation fall an average of <u>one day in three</u> over much of the State.[1]

Maine's precipitation is fairly evenly distributed throughout the year. However, most of the precipitation during the winter occurs as snow. The southern part of the State averages 20 days each winter with one inch or more of snow. Several snowstorms of five inches or more occur each year, disrupting transportation and communications.[1] As much as 27 inches of snow may fall in a single storm in Portland.[5] Very heavy snow is often associated with coastal storms, or "Northeasters". The heavy precipitation and strong winds associated with these storms may seriously affect coastal areas. Ice pellets and freezing rain or drizzle may also create perilous conditions for transportation. Analysis of Portland weather data for 1983-1985 showed between 10 and 16 days each year on which ice pellets or freezing rain or drizzle was reported.[5]

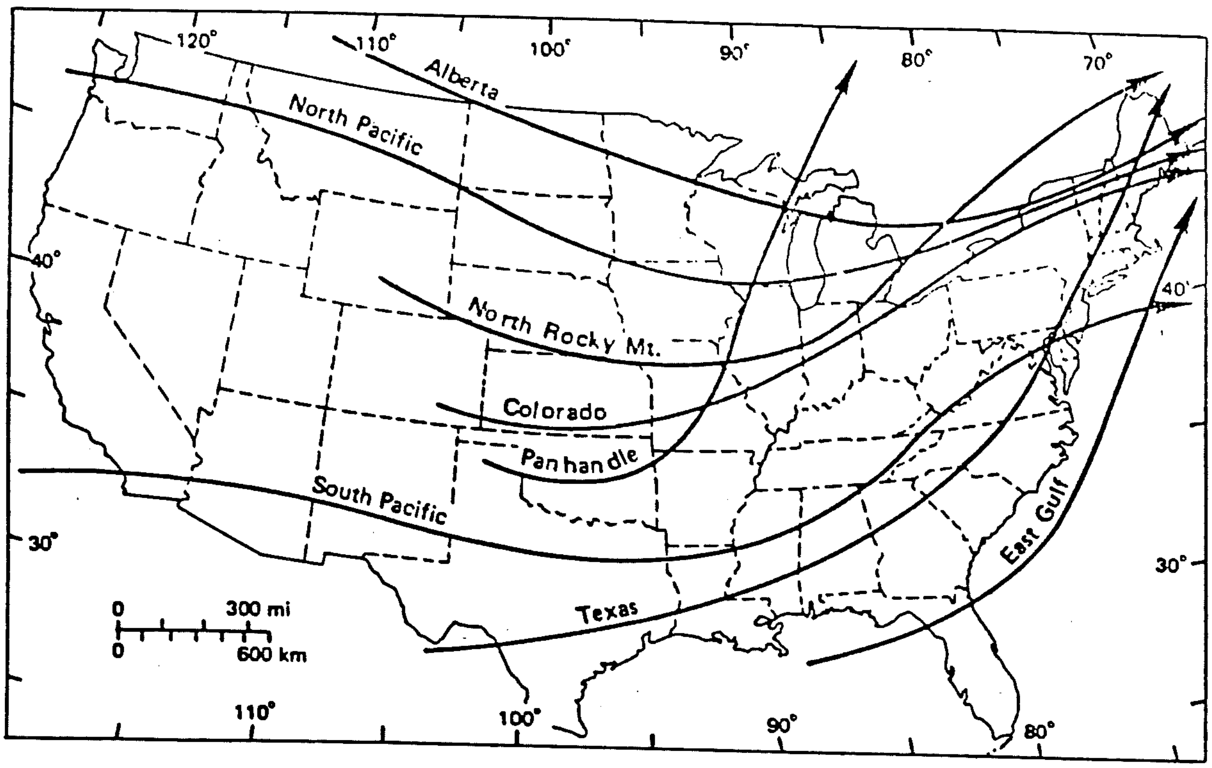
Due to the high frequency of storm events and the progression of contrasting air masses, Maine's weather alternates from fair to cloudy or stormy conditions roughly twice a week. These changes in weather patterns are often accompanied by abrupt changes in temperature, moisture, sunshine, wind speed, and wind direction. However, there are no regular or consistent patterns to this sequence. There are periods of time during which a weather condition will persist for several days. As a result, it is extremely difficult to accurately predict changes in weather in Maine.

Changeability is also an important feature of Maine's weather over longer time scales. A specific month or season may display very different characteristics from one year to another. A normal, or average, month, season, or year is the exception rather than the rule. Thus, averages are often insufficient for important planning purposes. For example, seasonal snowfall is subject to wide variations from the average. In Bangor the seasonal snowfall between 1953 and 1970 ranged from 32.5 to 181.9 inches.[5] The length of the winter season, i.e., the length of time between the first and the last measurable snowfall, is also quite variable. This period ranged from 91 days to 192 days (52% of days in the year) in Portland between 1881 and 1981. The first measurable snowfall occurred as early as October and the last, as late as May.[5] Again, because of this large variability, accurate predictions are extremely difficult.

The coast of Maine has the highest number of hours of fog on the Atlantic coast. Heavy fog is frequent and sometimes persistent. Moose Peak Lighthouse on Mistake Island, midway between Mt. Desert Island and Eastport, averages 1580 hours per year of heavy fog. At Eastport heavy fog is reported typically 65 days per year; at Portland, 55 days per year.[2]

Examination of Portland weather data for 1983-1985 showed 143 to 168 days per year (up to 46% of days in the year) with some fog reported. On 30 to 39 days each year heavy fog (with visibility of 1/4 mile or less) was reported.[3] The fog was not highly seasonally oriented, but rather fairly evenly distributed throughout each year. The length of episodes of fog was also evaluated based on observations taken every three hours. For 1983-1985 in Portland the period of fog ranged from one three-hour observation to 24 consecutive three-hour recordings. Roughly 40 to 45% of the episodes lasted 12 hours or more (i.e., four or more consecutive three-hour observations with fog); 11 to 14% lasted 24 hours or more (i.e., eight consecutive three-hour reports).[3] Thus, the frequency and persistence of fog conditions along the coast may affect air, land, and sea transportation.

In summary, adverse weather events affecting transportation systems are likely to occur throughout the year in Maine. Any proposal for ongoing waste transport must be evaluated carefully in light of these adverse meteorological conditions.



Main tracks of cyclonic (low-pressure) systems across the United States. (NRC, 1983)

Figure A20-1

References

1. Lautzenheiser, R. E., 1972. Climate of Maine, from Climatography of the United States No. 60-17. U.S. Department of Commerce/National Oceanic and Atmospheric Administration, Environmental Data Service, Silver Springs, Maryland.

2. Ludlum, D., 1976. The Country Journal New England Weather Book. Houghton Mifflin Company, Boston, Massachusetts.

3. National Oceanic and Atmospheric Administration, 1983-1985. Local Climatological Data, Monthly Summaries for Portland, Maine.

4. National Research Council (NRC), 1983. Acid Deposition: Atmospheric Processes in Eastern North America. National Academy Press, Washington, D.C.

5. National Weather Service, 1986. Climatological data summaries. Portland, Maine.

Comments on Department of Energy Draft Area Recommendation Report

Appendix A21 - Maine Historic Preservation Commission

Attached are maps showing the locations of sites entered in the National Register of Historic Places which are within the areas proposed for study by the Department of Energy.

Within and adjacent to the boundaries of the Sebago Lake Batholith there are 21 individually listed properties (all of historic/architectural significance) and 4 historic districts which contain historic, architectural, and archeological resources. Acreage of properties has been additionally noted on the maps. At this time no prehistoric archeological sites have been registered, but 14 are known within the area. For further details on these, contact Dr. Arthur Spiess. Likewise, no historic archeological sites have been individually registered, but 21 are recorded. For further details on these, contact Dr. Robert Bradley.

As for the Bottle Lake Complex, no properties of any kind have been registered as of this date. In fact, the Commission has no inventory data for the area, as it has yet to be surveyed for any types of historic resources.

Indeed, no official surveys have been conducted to date in Cumberland and Androscoggin Counties. Oxford County has so far only been surveyed for above-ground architectural resources (as opposed to historic and prehistoric archeological sites). The Commission will shortly be assessing the Oxford County architectural survey data to determine what buildings are eligible for the National Register.

A great deal of additional surveys - architectural, historic archeological, and prehistoric archeological - will be necessary before the Commission can confidently comment on the two large proposed candidate areas and the effect of the proposed construction and operations on historic resources.

Also attached is a copy of the Commissions's policy in this matter.

List of Registered Historic Places and Historic Districts

#	Name	Town
1	William F. Perry House (1 Acre)	Bridgton
2	The Stone House (0.25 acres)	Bridgton
3	Farnsworth House (0.5 acre)	North Bridgton
4	Walker Memorial Hall (0.5 acres)	Bridgton
5	Friends Meeting House (1 acre)	Casco
6	Pennell Institute (1 acre)	Gray
7	* Cumberland and Oxford Canal	Gorham, Westbrook
8	Barrows-Scribner Mill (4 acres)	Harrison
9	* Knight's Olde Country Store (0.5 acre)	Lovell
10	* "The Elms" (0.25 acre)	Mechanic Falls
11	* George Severns House (0.25 acre)	Mechanic Falls
12	Manor House (1 acre)	Naples
13	Sam Perley Farm (2 acres)	Naples
14	Songo Lock (1.75 acres)	Naples
15	New Gloucester Historic District	New Gloucester
16	The Nutting Homestead (1 acre)	Otisfield
17	All Souls Chapel (1 acre)	Poland
18	Maine State Building (1 acre)	Poland
29,20	Poland Spring Bottling Plant and Spring House (0.5 acre)	Poland
21	Poland Railroad Station (0.5 acre)	Poland
22	United Society of Believers (Shaker Village)	Poland, New Gloucester
23	* Waterford Historic District (35 acres)	Waterford
24	Nathaniel Hawthorne Boyhood Home	South Casco
25	* Parson Smith House (5 acres)	Windham

* Site is adjacent to the candidate area

Maine Historic Preservation Commission

Policy on High-Level Nuclear Waste

Prepared February 24, 1986

The Maine Historic Preservation Commission, as a participant in Federal environmental review under the National Historic Preservation Act of 1966, will be reviewing any Federal high-level nuclear waste dump proposed location in Maine.

As more details become available relating to the establishment of such a facility, the Commission will review such information to determine whether the construction will have an adverse effect upon any structure or site of historic, architectural, or archeological significance as defined by the National Historic Preservation Act of 1966.

At this point the Commission projects that its review will examine proposed construction from the standpoint of two levels - primary and secondary. A primary adverse effect would be damage to or destruction of historic resources directly resulting from the emplacement of a facility on or below the landscape, including any ancillary components such as access roads and support structures. Secondary adverse effect would depend upon, for example, the size of the area surrounding the facility restricting access to historic resources.

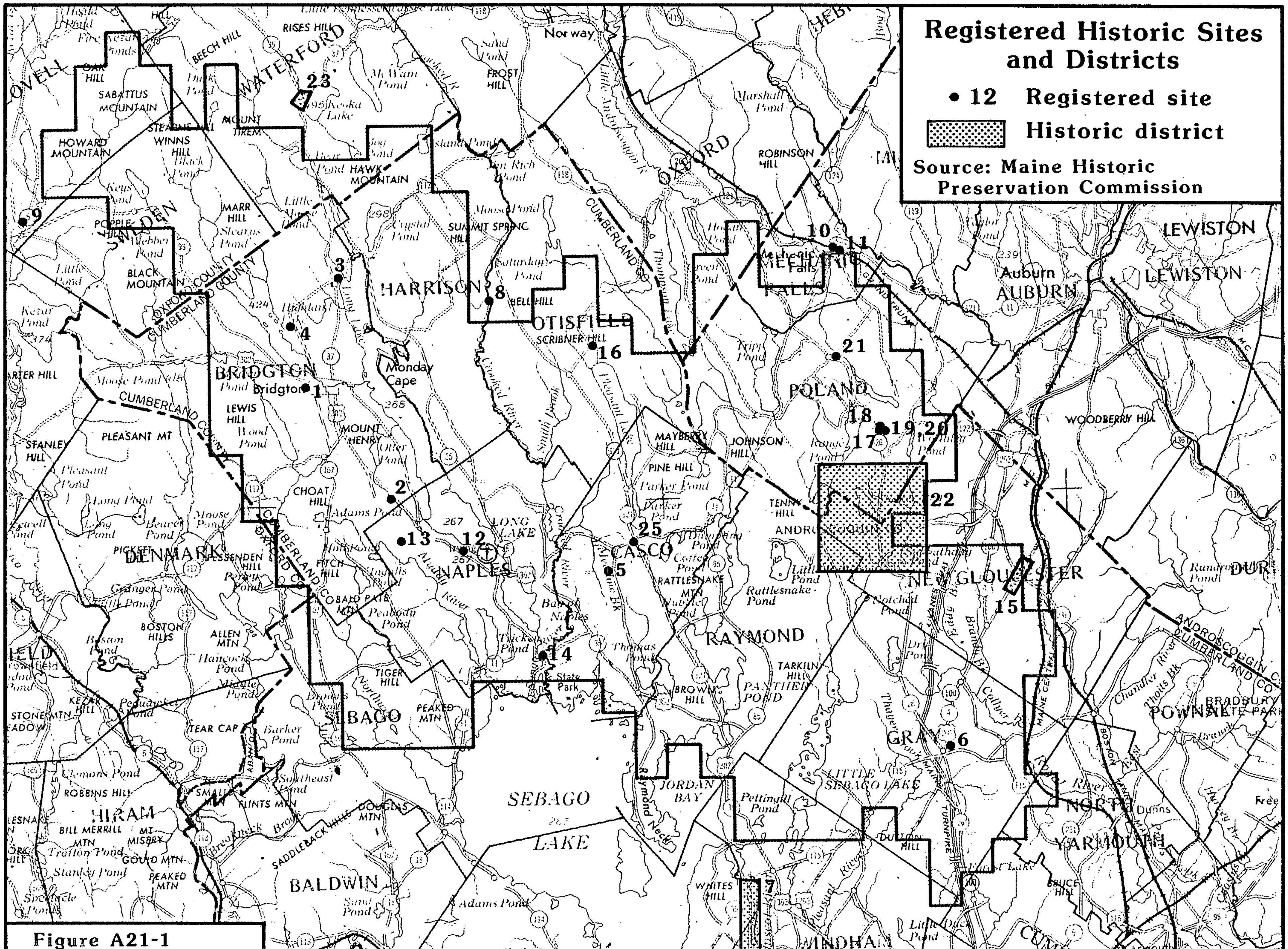

Registered Historic Sites and Districts
• 12 Registered site
Historic district
Source: Maine Historic Preservation Commission
WATERFORD
Norway
OXFORD
HARRISON
OTISFIELD
MECHANIC FALLS
AUBURN
LEWISTON
BRIDGTON
POLAND
DENMARK
NAPLES
CASCO
RAYMOND
NEW GLOUCESTER
SEBAGO LAKE
GRAY
POWNAL
NORTH YARMOUTH
HIRAM
BALDWIN
WINDHAM
CUMBERLAND COUNTY
OXFORD COUNTY
ANDROSCOGGIN CO
CUMBERLAND CO

Figure A21-1

Comments on Department of Energy Draft Area Characterization Report

Appendix A22

Department of Human Services

Background Radiation in the Sebago Batholith

Individual radiation protection requirements from the U.S. Environmental Protection Agency regulations for the disposal of high-level nuclear waste state:

> "Disposal systems for spent nuclear fuel or high-level or transuranic radioactive waste shall be designed to provide a reasonable expectation that, for 1,000 years after disposal, undisturbed performance of the disposal system shall not cause the annual dose equivalent from the disposal system to any member of the public in the accessible environment to exceed 25 millirems to the whole body or 75 millirems to any critical organ. All potential pathways (associated with undisturbed performance) from the disposal system to the people shall be considered, including the assumption that individuals consume 2 liters per day of drinking water from any significant source of ground water outside the control area"

The U.S. Environmental Protection Agency (EPA) chose the limits of 25 millirem/year (mr/year) to the whole body and 75 millirem/year to any critical organ because it believes these limits represent a sufficiently stringent level of protection for situations where no more than a few individuals are likely to receive these exposures in the first 1,000 years. If such an individual were exposed to these levels over a lifetime, the EPA estimates that this would cause 5×10^4 (5 per 10,000) chance of incurring a premature fatal cancer (1).

Radionuclides occur naturally in the earth in very large amounts. Every person on earth is exposed to background radiation from these natural radioactive elements. One source of this exposure to natural background radiation comes from naturally occurring radionuclides in ground water. The EPA acknowledges that "elevated uranium and alpha-emitting radionuclides (in groundwater) are generally limited to the Rocky Mountain region and Maine and Pennsylvania in the East (1)." Uranium-238 decays to radium-226 which in turn decays to radon-222.

The EPA excludes radon-222 ingested in drinking water when calculating the annual dose equivalent, but does consider radon-222 when calculating the annual dose equivalent from all other potential exposed pathways. This is important for two reasons:

1) Radon-222 is more mobile than its parents and is not 100% dependent on ground water for movement, and

2) Current studies show that in a residential setting, radon-222 is readily released from drinking water into the air inside the home, making the lung the major organ of concern.

The national average for indoor radon-222 concentrations is 836 picoCuries/cubic meter or 0.836 picoCuries/liter (pCi/l) or 0.22 working-level-months (WLM) (2).

The rate of radon-222 production in soil and water is influenced by the distribution of uranium in the earth's upper crust. The EPA has estimated that the average soil in the country contains about 1 part-per-million (ppm) of uranium. Phosphate rock contains 50-125 ppm, and granite contains about 10-50 ppm in the Northeast and as much as 500 ppm in the western United States.

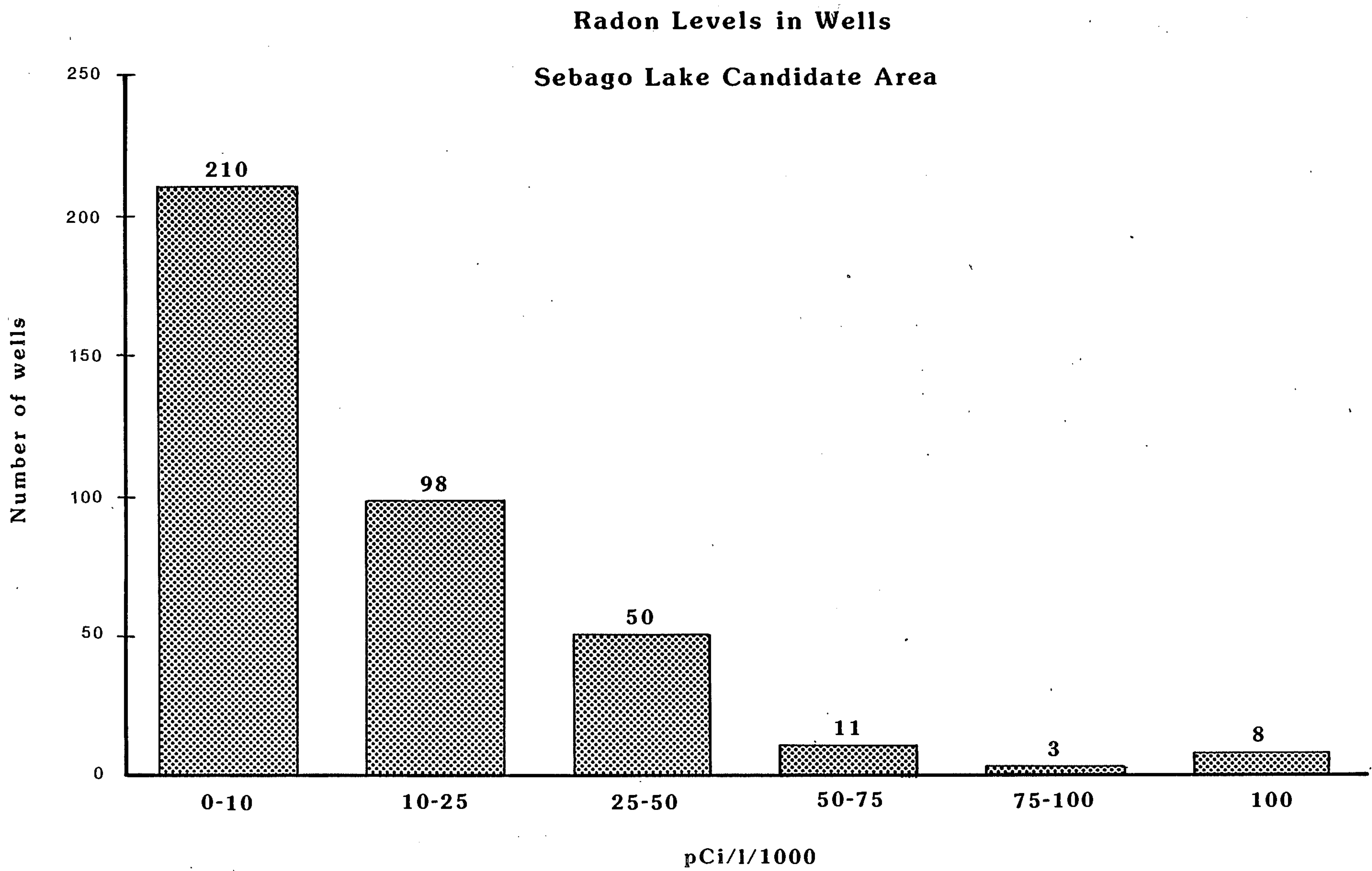
Expected excess lung cancer mortality rates in individuals exposed to various levels of airborne radon daughters and a comparison with the observed lung cancer mortality is shown in table 1.

Table 1. Expected excess lung cancer mortality rates in individuals exposed to various levels of airborne radon daughters and a comparison with observed lung cancer mortality (2)

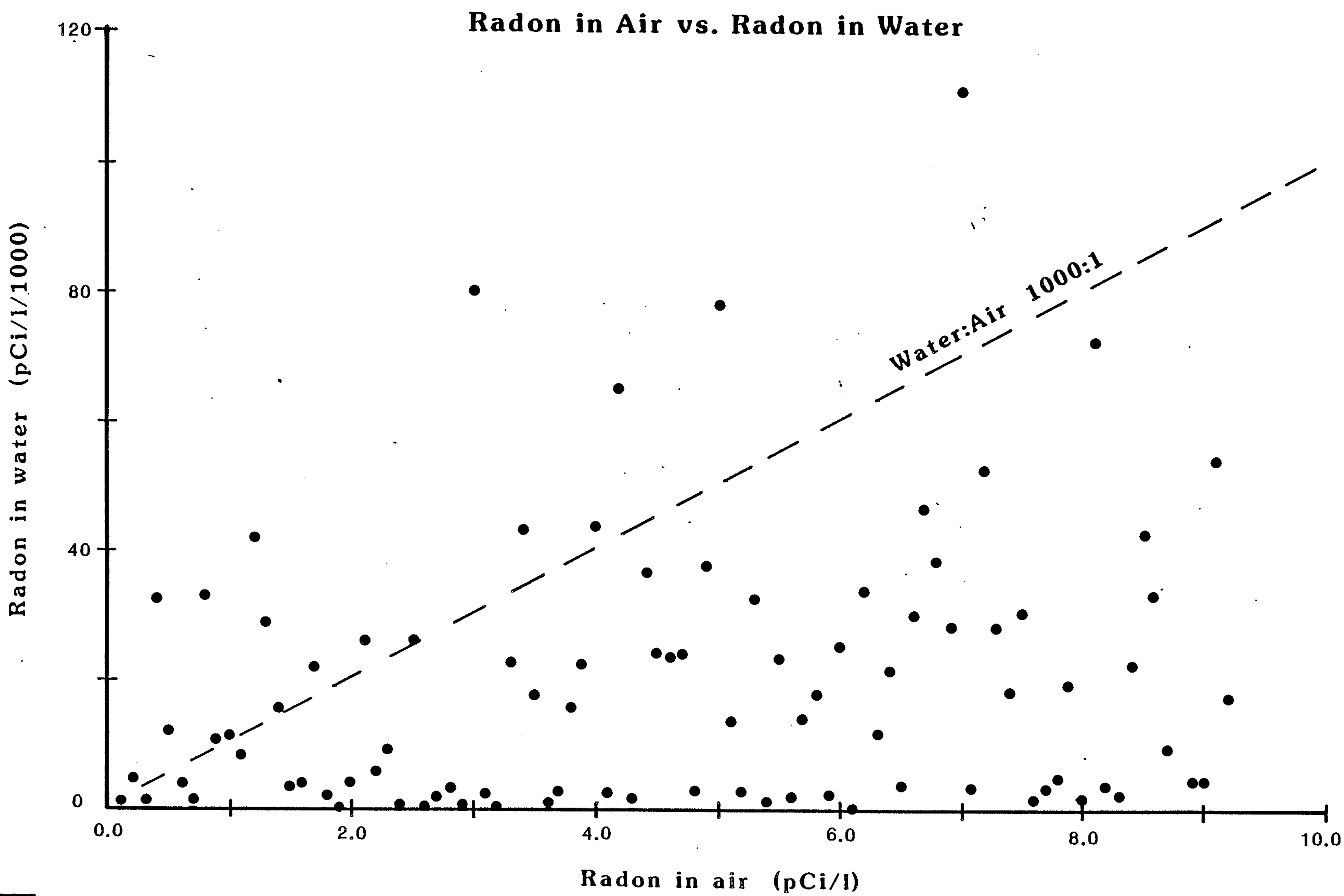
Conditions	Radon Daughters Exposure (WLM/year)	Lifetime Risk (Lung cancer deaths/ million exposed)
Average indoor concentration	0.2	1,800
Possible indoor concentration	0.5	4,600
	1.0	9,100
	2.0	18,000
	4.0	36,000
Observed lung cancer mortality in a population of one million		
Male		58,000
Female		14,000

Over 3,000 private and public wells in Maine have been analyzed for radon-222, and 380 of these wells are located in the 19 towns associated with the Sebago Batholith. A summary of the radon data indicates that 55% of the wells have radon-222 levels less than 10,000 pCi/l, 26% have radon levels between 10,000 and 25,000 pCi/l, 13% have radon levels between 25,000 and 50,000 pCi/l, and 6% have levels in excess of 50,000 pCi/l (3). See figure 1.

The national average indoor and outdoor concentrations of radon are 0.83 pCi/l and 0.18 pCi/l respectively. A 1 pCi/l increase in indoor concentration is typical for normal usage of water containing 10,000 pCi/l of radon (2). Air and water measurements made in approximately 100 homes here in Maine suggest that this exchange rate of 1 pCi/l(air) for 10,000 pCi/l(water) is conservative enough to balance time spent out-of-doors (figure 2).



Radon Levels in Wells
Sebago Lake Candidate Area
Number of wells
0
50
100
150
200
250
210
98
50
11
3
8
0-10
10-25
25-50
50-75
75-100
100
pCi/l/1000



Radon in Air vs. Radon in Water
120
80
40
0
Radon in water (pCi/l/1000)
0.0
2.0
4.0
6.0
8.0
10.0
Radon in air (pCi/l)
Water:Air 1000:1

Figure A22-2

A person exposed to a continuous 1 pCi/l level for one year will receive a radon daughter exposure of approximately 0.26 working level months per year (WLM/yr) (2). In addition, 1 WLM is equivalent to 0.71 RAD for an adult male; 0.63 RAD for an adult female, and 1.25 RAD for a 10 year old child (4). For an adult male:

1 WLM/year = (0.71 RAD)(quality factor of 20/RAD) = 14.2 rem/year

= 14,200 mr/year

Therefore, based on the exposures from natural background radon and additional radon potentially released from water, one may expect the following excess lung cancer mortality rates and exposures in Maine homes <u>prior to the construction of a repository:</u>

Table 2. Excess lung cancer mortality rates and annual exposures expected for individuals using private wells in the Sebago batholith.

% wells	Radon levels (pCi/l)	Radon Daughter Exposure (WLM/year)	Lifetime Risk (Lung cancer deaths/ 10,000 exposed)	Radon Daughter Exposure (mr/year) (Adult male)
55%	<10	0.20-0.46	1- 4	2,800 - 6,440
26%	10- 25	0.46-0.8	4- 7	6,400 - 11,900
13%	25- 50	0.85-1.50	7-13	11,900 - 21,000
3%	50- 75	1.50-2.15	13-19	21,000 - 30,000
1%	75-100	2.15-2.60	19-23	30,000 - 36,000
2%	>100	>2.60	>23	>36,000

From table 2 one can see the magnitude of the background radiation problem in the Sebago batholith, and the difficulty the Department of Energy or any other agency would have in monitoring a high-level nuclear waste repository for a possible addition of 75 mr/year exposure to the lung.

A map of community water systems which meet the criteria for "significant sources of water" in 40 CFR 191 are listed in table 3 and shown on figure 3. Smaller, non-community water systems are listed in table 4.

Conclusions:

1) The Sebago batholith, with its uniquely high uranium levels and associated alpha-emitting radionuclides, causes population exposures several times the proposed exposure standards for a repository, thus raising the question of whether it is safe or fair to expose this population to <u>any added health risk</u> due to exposure from a high-level nuclear waste repository. This includes risks associated with

construction and operation periods, and the long-term containment period.

2) Because of the variability and magnitude of the existing radon levels in the Sebago batholith, it will be impossible to document through monitoring that no member of the public in the accessible environment has received an additional annual dose equivalent (from radon) in excess of 75 millirems per year to the lung from the proposed repository's operation.

References

(1) 40 CFR Part 191, Environmental Standards for the management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes

(2) Department of Energy, Indoor Air Quality Environmental Information Handbook, Radon, DOE/PE/72013-2, January 1986

(3) Maine Department of Human Services

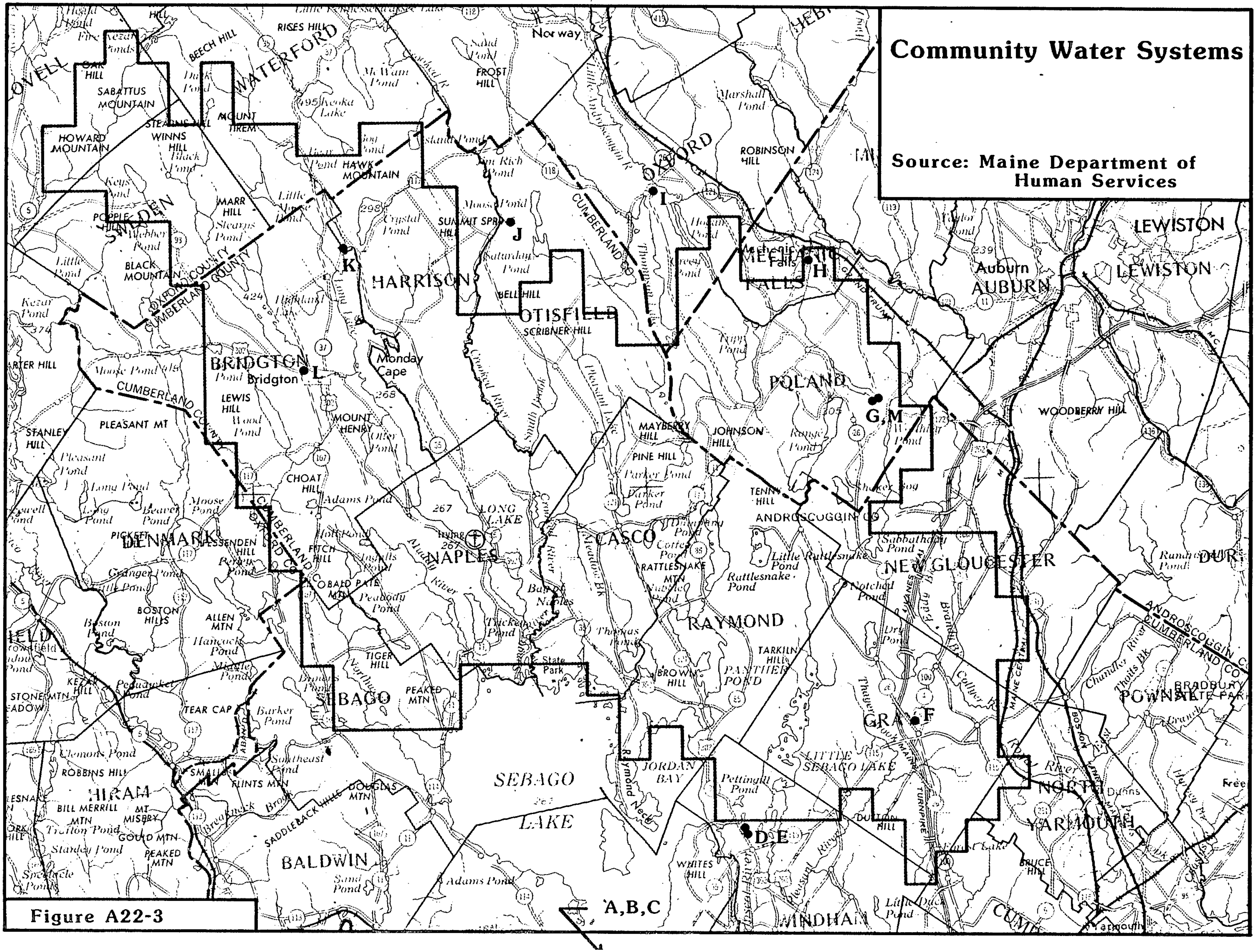
(4) National Council on Radiation Protection and Measurement, Exposure from the uranium series with emphasis on radon and its daughters, Report number 77

Table 3: Community Water Systems

Symbol on map	Name	Source	Gallons per day
A	Portland	Lake	20,000,000
B	Portland	Lake	
C	Standish	Lake	250,000
D	North Windham	Well	150,000
E	North Windham	Well	
F	Gray	Pond	240,000
G	Poland Spring Bottling Co.	Well	100,000
H	Mechanics Falls	Stream	120,000
I	Oxford	Well	65,500
J	Bolsters Mills	Spring 33	16,500*
K	Harrison	Well	525,000*
L	Bridgton	Lake	148,000
M	Lower Range Pond	Pond 90898	95,000

* Estimated values

These water systems fit the criteria for a "significant source of ground water" in 40 CFR 191



Community Water Systems

Source: Maine Department of Human Services

Figure A22-3

Table 4: Non-Community Water Systems

Name	Town	Population Served	Water Use (GPD*)	Source
Camp Wohelo	Raymond	280	16,200	Sebago Lake
Camp William Hinds	Raymond	201	11,160	2 drilled wells; lake
Camp Dr. Johnson's	Casco	186 + 67	11,385	2 drilled wells; lake
Camp Ceda	Casco	450	20,250	1 drilled well; 2 lakes
Camp Tripp Lake	Poland	320 + 110	18,250	Drilled well; dug well; lake
Camp Agassiz	Poland	300 + 105	17,175	1 drilled well
Camp Hoop (basketball)	Casco	253	11,385	Lake
Camp Samoset	Casco	340	17,550	1 drilled well
Camp Kingswood	Bridgton	310	11,070	2 drilled wells; lake
Camp Winona	Bridgton	310	13,650	Well
Camp Tapawingo	Sweden	235	10,575	1 drilled well; lake
Camp Wigwam	Waterford	245	11,025	1 drlled well; spring
Camp Wazizatah	Waterford	270	12,150	Spring; lake
Point Sebago Outdoor Resort	Casco	936	42,120	Lake
Camp O-AT-KA, Inc.	East Sebago	250	11.250	Lake
Quisisana	Lovell	310	13,950	1 drilled well; 2 springs; lake
Camp Pinecliffe	Harrison	300	13,500	Spring; lake
Vacationaland Camp Sites	Harrison	250	11,250	Lake
Keoka Beach Campground	South Waterford	260	11,270	Lake
Papoose Pond Camping Resort	Sweden	360	16,200	7 well points
Lakeside Pines Campground	North Bridgton	370	12,950	1 drilled well; lake
Long Lake Campsites	North Bridgton	320	11,200	Well
Camp Wildwood	North Bridgton	242	10,980	1 drilled well

Table 4: Non-Community Water Systems (continued)

Name	Town	Population Served	Water Use (GPD*)	Source
Cole Farms	Gray	235	10,575	-
The Inn at Poland Spring	Poland	510	22,950	Well
Centennial Spring House	New Gloucester	250	11,250	Drilled well
Lake Region High School	Naples	626	10,000	Drilled well
Morton's Bottle Club	Naples	451	15,785	-

Comments on Department of Energy Draft Area Recommendation Report

Appendix A23

Comments of the Department of Fisheries and Wildlife

The Department of Fisheries and Wildlife biologists at Gray and Enfield have only had a brief opportunity to review the draft ARR and comment on its findings for the preliminary candidate areas in each region. Since the DOE region-to-area screening process utilized rather gross-scale characterization for disqualifying factors and favorability variables, it is difficult at this time to do much more than to propose, list, and map some additional disqualifiers and variables we feel should have the same status as used in the DOE report. More specific concerns would show up in the next phase of DOE's selection process, area characterization, if that stage is reached.

The following items are proposed for consideration as potential site disqualifiers or adverse factors. These are from unpublished files and thus would not have been available to the DOE under their region-to-area screening methodology.

Disqualifying factors

Rare and endangered species critical habitats - bald eagle territories. Nesting sites should be considered "critical habitats" and be afforded the same status as Federally listed critical habitats (i.e., those listed in the Federal Register). No active eagle nests are located within the preliminary candidate areas but a number are within the immediate area (two are within 10 miles) and an unlocated nest may be within 10 to 12 miles of the Bottle Lake Complex. It is also likely that, as eagle population continues to increase, there may be more new nests within the area in the future. The major concerns are for territory disturbance resulting from any human use activities such as construction of access roads, etc. The existing located eagle territories in the vicinity of the Bottle Lake Complex are shown on the attached map and listed as follows:

Number	Township	Location
75B	T39 MD	Brandy Pond
76A	T40 MD	Nicatous Lake
78A	T42 MD BPP	Third Machias Lake
79A	T5 ND NBPP	Pocumcus Lake
81B,C	T5 ND NBPP	Junior Bay, West Grand Lake
95B	Passadumkeag	Penobscot River
96	Howland	Penobscot River
97A	Medway	Penobscot River
135A	T5 ND NBPP	Lower Chain Lake

State Protected Lands

Deer wintering areas (DWAs). Very protective restrictions on timber harvest and a general prohibition on structural development within documented deer wintering areas has been established through the Land Use Regulation Commission (LURC) zoning in the unorganized territories. This zoning has the effect of designating deer wintering areas as critical habitat and we would request that it be considered as such for the screening process. Development of access and site facilities as contemplated and outlined in the draft ARR would not appear to fall within the permitted uses for LURC zoned deer wintering areas. The location of zoned deer wintering areas can be obtained from LURC zoning maps (**see comments by LURC - appendix A8**).

Deer wintering areas in organized townships are generally not afforded the same zoning protection as in unorganized towns. Also, although many areas have been roughly located and mapped they have not all been subjected to the same ground truthing as required for LURC zoned areas. Additional located but unzoned DWAs in unorganized townships under LURC jurisdiction fall within this same "potential" category. We would request that these unzoned deer wintering areas in both organized and unorganized towns be at least considered equivalent to several of the variables used in the favorable/potentially adverse screening process used by the DOE. Maps showing the locations of these unzoned deer wintering areas in the vicinity of the Sebago Lake and Bottle Lake areas are attached.

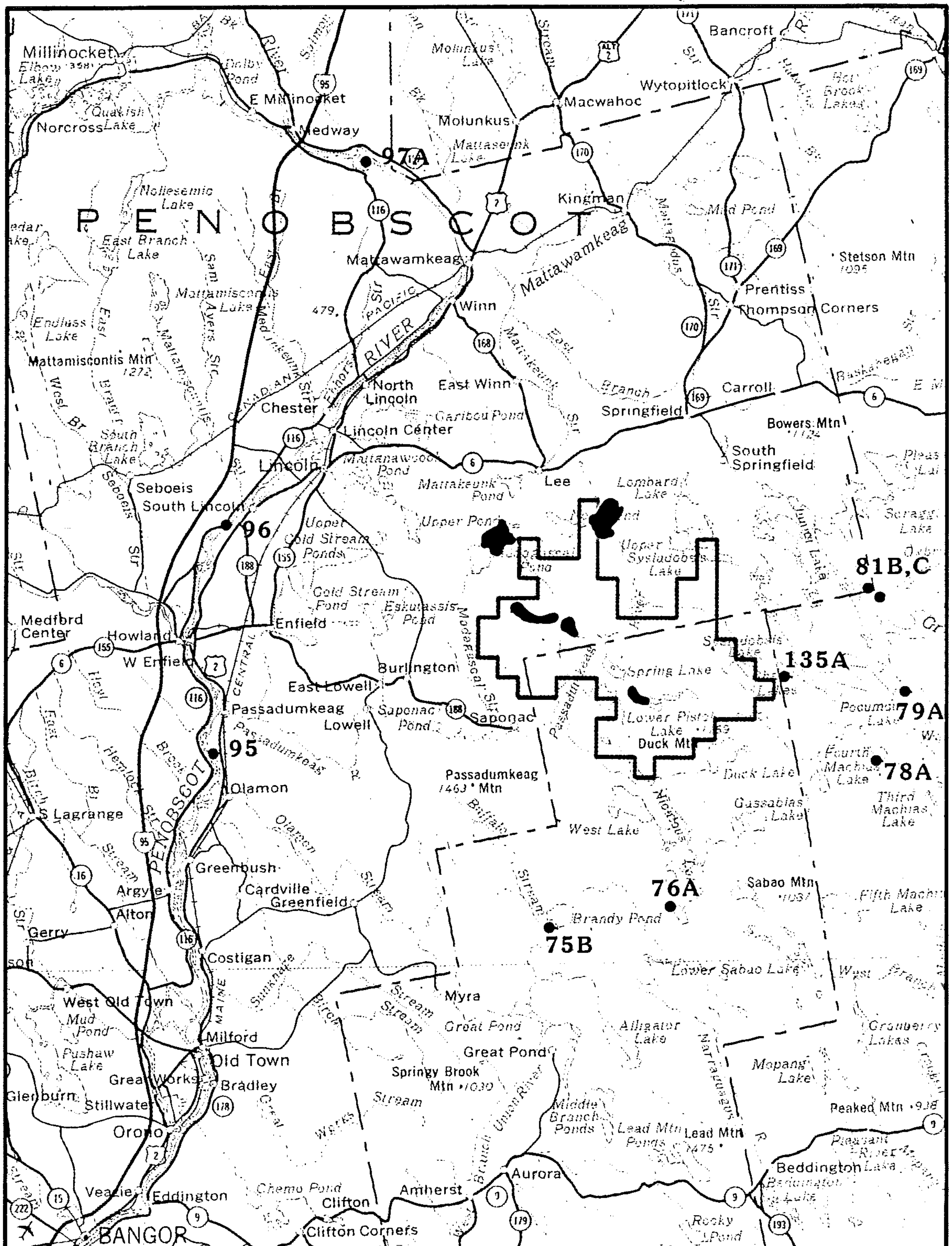
Other adverse factors

Wildlife and fisheries habitat. This analysis outlines some of the possible effects a deep mining operation associated with repository would have on wildlife and fisheries habitat. This is not an exhaustive list, but is intended to point out a few generic concerns which would be associated with any deep-mining project. Specific impact assessment would be possible only after details of a project and an actual site location were better known.

Wildlife

Direct, permanent loss of terrestrial habitat would be expected with development of roads and surface facilities such as buildings, parking areas, tailings piles, dumps, etc. Actual siting and layout determine actual types and "value" of habitat affected and thus overall impact on wildlife populations. For example, locating surface facilities within, or a road through, a deer wintering area would, generically, have more impact on a given deer population than if the site were outside what is considered highly important deer habitat. Similarly, other wildlife species with different habitat requirements would be affected to greater or lesser degree depending upon location within areas more or less important to their particular life histories.

Seasonal timing of certain activities or habitat disruption may involve critical periods for particular wildlife species (i.e., during water fowl nesting or brooding) and cause greater impacts than the same activities at some other season.



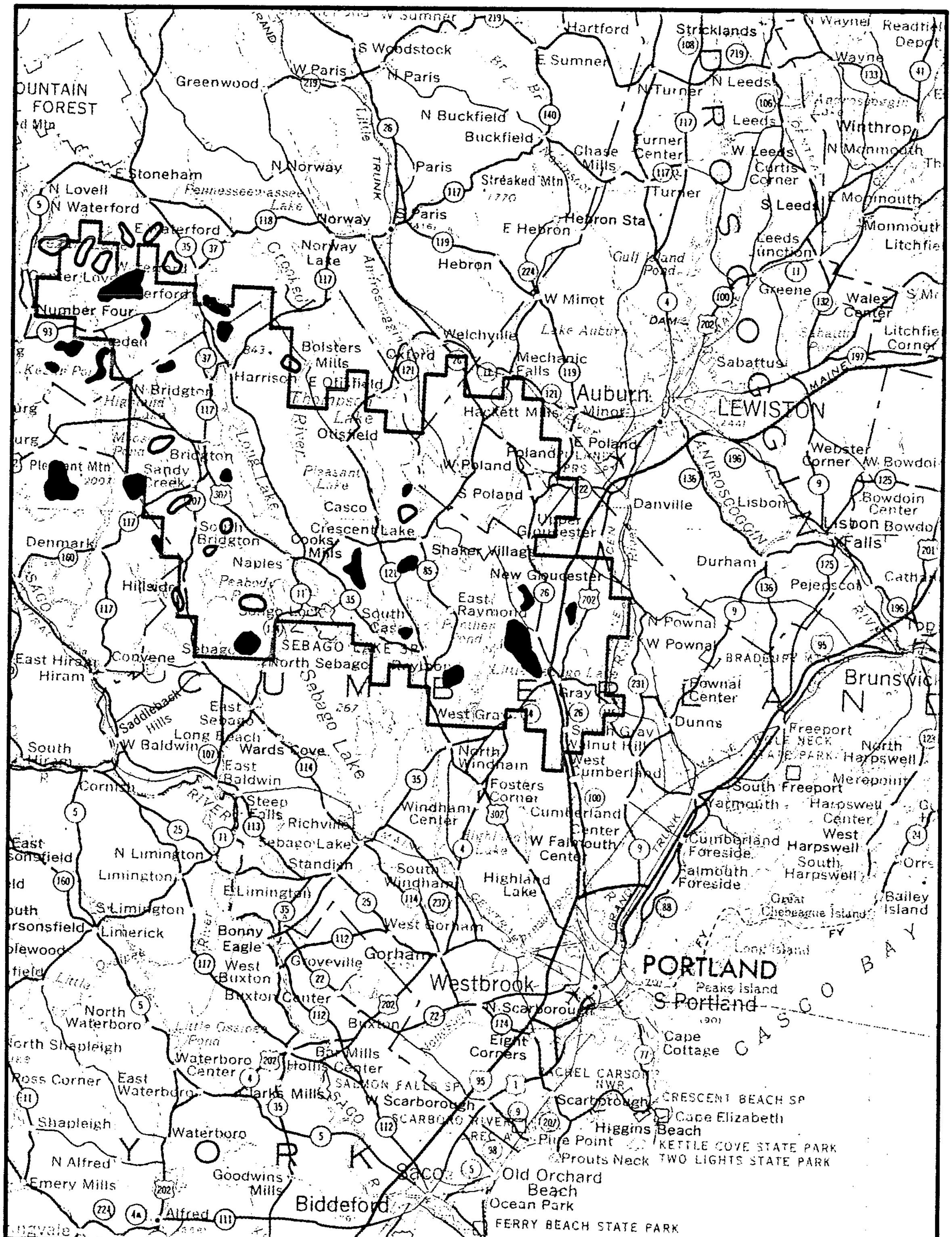
Selected Wildlife Habitat

79A Eagle nest (present and historic)

Possible unzoned deer wintering areas

Source: Maine Department of Inland Fisheries and Wildlife

Figure A23-1



Unzoned Deer Wintering Areas

Field checked

Not field checked

Source: Maine Department of Inland Fisheries and Wildlife

Figure A23-2

Wildlife use of otherwise suitable unaltered habitat may be restricted or diminished if roads, fences, or other facilities block travel corridors between habitats or if levels of human activity within adjacent developed areas are not tolerated by certain species.

Temporary habitat alteration, such as during construction phases, may discourage wildlife use of an area until the activity ceases and/or the habitat is restored.

Changes in vegetative cover, for example from mature woodland to open maintained grassland, will diminish habitat suitability for some species while enhancing it for others. Population shifts thus occur and, to continue the example, if the favored species are prey (i.e., rodents, hares, etc.), then predators (i.e., fox) can also be expected to increase. Therefore, changes in population of one species are likely to affect, chainwise, a series of other species.

Efforts to minimize impacts during siting, construction, and operation, such as specific location, time of year for certain activities, active mitigation programs, etc., should be assessed in early stages of project development.

Fisheries

Effects on fish species and populations can be significant and important. Given reasonable efforts to avoid direct alteration of surface waters, actual physical habitat disturbance or destruction can be minimized. Some permanent loss of productive habitat can be anticipated from road construction where culverts are installed, or if surface waters (small streams) are piped to aid drainage around or away from surface or underground facilities.

Less obvious, but more detrimental effects can result from:

Improper installation of water crossings can create hydraulic drops ("hanging culverts"), raise water velocities (through channel constriction), or create flat, shallow sheets of water during low flows, all of which may impede fish movements. Improper soil erosion control during construction activities or operation can result in sedimentation of streams which may cover fish spawning substrate, "smother" aquatic invertebrates and fish eggs, cause fish to move to avoid heavily silted water, contribute toward more rapid warming of water which may make it unsuitable for temperature limited salmonids, and, through all of these effects interfere with fisheries productivity if not actual loss.

Water temperatures may be raised above threshold limits for certain species during warm summer periods if shading vegetation is removed from stream banks. Even when thresholds are not exceeded fish growth rates and resistance to disease may be diminished if temperatures are raised above optimums. Direct runoff from buildings and paved areas can increase water temperatures. Detention or retention ponds used to control water runoff can also cause warming of discharges to waterways. Subtle warming of shallow ground water discharges to streams may result from clearing vegetation back away from the waterway.

Chemical changes in water quality are one of the greatest potentials with mining operations. Discharge of mineral laden pumped ground water, leaching from tailings piles, uncontrolled dust movement, sedimentation, effluent discharges from water treatment facilities, etc., are all examples of sources of chemical changes which may be associated with mining operations. Effects on aquatic organisms, and fish in particular, can range from acute toxicity and mortality to sub-lethal effects on reproduction, growth, behavior, avoidance of contaminated water, and suitability for human consumption.

Nutrient increases to waterways, ultimately to lakes and ponds, can cause increased primary productivity which may accelerate eutrophication. To a point, some nutrient enrichment may not be detrimental. But, if the delicate balance of input to a system is upset, the consequences may be, in the extreme, increased algae growth (i.e., blooms) and subsequent low dissolved oxygen levels which may exceed tolerances of fish and other aquatic organisms. Sub-lethal effects and changes in biotic community structure, including suitability for certain fish species, may be experienced long before the extremes are reached.

A final item, relating to both fish and wildlife resources, is the question of reduction of recreational human use opportunity due to any development. Recreational use is an important aspect of fish and wildlife management. Restrictions on public access to lands and waters result in a direct loss of resource use opportunity which must be considered in addition to any impacts on the actual fish or wildlife populations themselves. Uses such as hunting, trapping, fishing, bird watching and other non-consumptive activities, etc., can be expected to be curtailed in the immediate surface facilities development area. How large an added "off limits" area will be restricted remains to be seen. Loss of aesthetic appeal due to development may also reduce use of an area regardless of actual physical barriers to such uses.

<u>Seasonal human population.</u> The DOE use of a 320 acres or greater criterion for identifying and mapping surface water bodies means many small ponds, wetlands, and streams have not been screened out yet. While it is likely that development of a 400 acre surface facility, as envisioned by the DOE, would not necessarily be precluded by the presence of these waters, there are some questions remaining which have not been addressed to date.

One question concerns the potential loss of recreational use opportunity within the "controlled area" surrounding the surface facility. Will hunting, fishing, and other recreational uses be foregone or severely restricted within all or part of this area? Is the potential impact of siting a facility thus much greater than the actual "footprint" of the facility itself?

Another question relates to seasonal human populations within the identified candidate areas. Transient summer and winter angling use, hunting, and seasonally-used camp developments have not been factored into the screening process. Indeed, little published data is available concerning seasonal populations. However, as part of our Department's fisheries management programs, we have been collecting data and developing at least rough estimates of angler use on selected lakes and ponds. In addition, some estimates of seasonal camp development are available from our regional staff. More exact data for camps could be obtained from town or State tax records. We would recommend consideration of such seasonal populations in the screening process. Examples of seasonal use estimates are attached.

Estimates of Use of Lakes and Ponds in the Bottle Lake Complex Preliminary Candidate Area

Angler use estimates:

Water	Location*	Angler Days Winter	Angler Days Summer	Fish Stocking (1985)
West Lake	C	1,800	2,400	1,500 salmon 2,600 trout 600 salmon
Duck Lake	B	1,200	1,800	3,000 trout
Porter Pond	A	100	No estimate	
Lower Pistol Pond	A	100	No estimate	3,000 trout
Spring Lake	A	340	No estimate	1,000 trout 450 salmon
Nicatous Lake	C	450	No estimate	2,700 salmon
Upper Dobsis Lake	A	150	No estimate	850 salmon

Recreational use estimates:

Water	Location*	Seasonal Camp Development	Camping Sites	Additional Day Use
West Lake	C	100 +/-	No	Yes
Duck Lake	B	10	Yes	Yes
Nicatous Lake	C	2 sets sporting camps plus 10 private	Yes	Yes
Spring Lake	A	1	No	Yes
Lower Pistol Pond	A	2	Yes	Yes
Upper Dobsis Lake	A	25 to 30	No	Yes
Madagascal Pond	C	Shoreline 80% developed	No	Yes
Side Pistol Pond	A	1	Yes	Yes
Upper Chain Lake	A	few	Yes	Yes

Estimates of Use of Lakes and Ponds in the Bottle Lake Complex Preliminary Candidate Area (continued)

Recreational use estimates (continued):

Water	Location*	Seasonal Camp Development	Camping Sites	Additional Day Use
Unknowns	B	few	Yes	Yes
Green Pond	C	2 to 3	No	Yes
Number Three Pond	A	few	No	Yes
Middle Chain Lake	B	few	Yes	Yes

* Location code:

A = all or most of lake within area
B = part of lake within area
C = lake within 1 mile of site boundary

Estimates of Use of Lakes and Ponds in the Sebago Lake Batholith Preliminary Candidate Area

Lake Name	Town	Acres	Location Code*	Angler Days Winter	Angler Days Summer	Fish Stocking (1985) BKT	BNT	SAL	TOGUE
Adams Pond	Bridgton	45	A	closed	160	700			
Beaver Pond	Bridgton	69	A	110	240				
Highland Lake	Bridgton	1,401	A	2,300	4,900		500		
Holt Pond	Bridgton	25	A	40	90				
Ingalls Pond	Bridgton	141	A	230	500	700			
Otter Pond	Bridgton	90	A	150	310				
Woods Pond	Bridgton	442	A	725	1,550				
Coffee Pond	Casco	137	A	closed	475	700			
Dumpling Pomd	Casco	30	A	50	100				
Owl Pond	Casco	20	A	30	70				
Pleasant Pond	Casco	1,077	A	(3,000)	3,750	1,500		400	
Parker Pond	Casco	166	A	275	575				
Thomas Pond	Casco	442	A	725	1,550	900			
Crystal Lake	Gray	189	A	(1,000)	675	400	500		
Forrest Pond	Gray	210	B	350	725				
Little Sebago Lake	Gray	1,898	A	3,125	6,650				
Notched Pond	Gray	77	A	closed	275				
Crystal Lake	Harrison	461	A	750	1,600				
Island Pond	Harrison	166	A	270	580	300			
Cushman Pond	Lovell	32	B	closed	110	2,800			
Dan Charles Pond	Lovell	28	A	45	100				
Brandy Pond	Naples	762	A	1,250	2,675				
Long Lake	Naples	4,867	A	8,000	17,000			900	
Sebago Lake	Naples	28,771	B	(7,000)	(44,500)				
Trickey Pond	Naples	311	A	(1,250)	1,100	1,000			1,500
Sabbathday Lake	New Gloucester	340	A	(750)	1,200	1,000			
Lily Pond	New Gloucester	38	A	65	125	400			
Moose Pond	Otisfield	160	C	260	560				
Saturday Pond	Otisfield	179	B	290	625				
Thompson Lake	Otisfield	4,426	A	(7,500)	15,500			1,200	

Estimates of Use of Lakes and Ponds
in the
Sebago Lake Batholith Preliminary Candidate Area (continued)

Lake Name	Town	Acres	Location Code*	Angler Days Winter	Angler Days Summer	Fish Stocking (1985) BKT	BNT	SAL	TOGUE
Upper Range Pond	Poland	391	A	(300)	1,350	300		100	
Middle Range Pond	Poland	266	A	(1,000)	1,300			500	800
Lower Range Pond	Poland	290	A	475	1,025				
Worthley Pond	Poland	42	A	70	150	200	100		
Tripp Lake	Poland	768	A	(600)	2,700		450		
Crescent Pond	Raymond	716	A	1,175	2,500				
Nubble Pond	Raymond	23	A	40	80	300			
Panther Pond	Raymond	1,439	A	(1,000)	5,000	1,200		500	600
Raymond Pond	Raymond	346	A	(500)	1,200		850		
Peabody Pond	Sebago	735	A	1,200	2,575			350	1,500
Perley Pond	Sebago	29	B	50	100				
Black Pond	Sweden	16	A	25	55				
Keyes Pond	Sweden	192	A	310	670				
Stearns Pond	Sweden	255	A	420	890				
Bear Pond	Waterford	376	A	(1,000)	1,300			100	300
Lower Moose Pond	Waterford	30	A	65	140				
Mud Pond	Waterford	45	A	70	150				
5-Kezars Ponds	Waterford	211	C	330	740				
Totals		53,280		48,620	113,195				

* Location code:

A = all or most of lake within area
B = part of lake within area
C = lake within 1 mile of site boundary

Angler day estimates: values in ( ) taken from Clerk census; other values from regonal averages based on 1983 questionnaire

Comments on Department of Energy Draft Area Recommendation Report

Appendix A24

State Development Office - Division of Tourism

Tourism and Recreation in the Sebago Lake and Bottle Lake Areas

Introduction

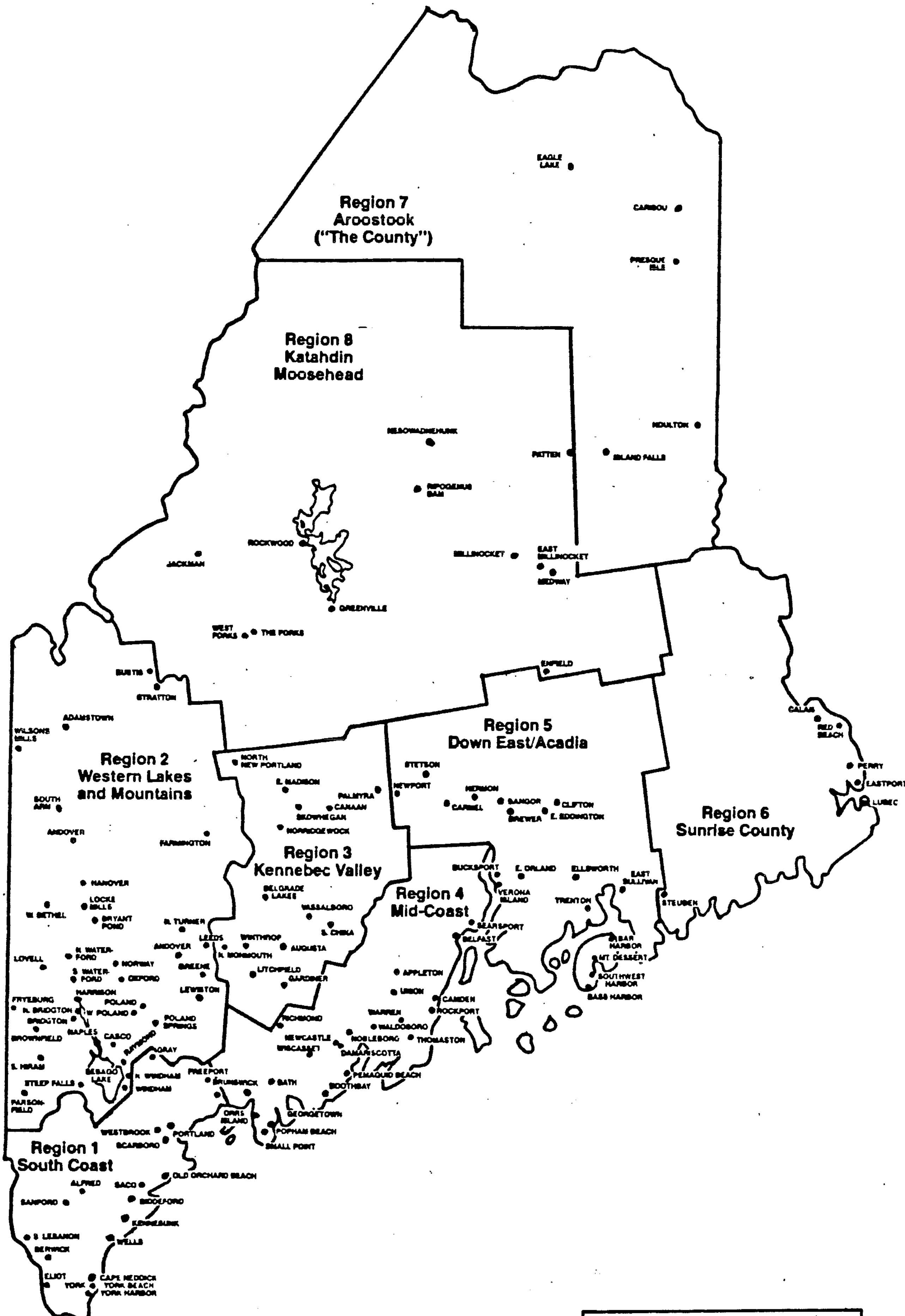
The data contained in the tables which follow focus upon the presence of tourism and recreation at the lowest level of analysis... that is, at the lowest level which the data allow. Date for two tourism regions, Western Lakes and Mountains and Katahdin/Moosehead, are presented. When the data allows, focus is upon a smaller unit of analysis, the Economic Summary Area (ESA). With the Western Lakes and Mountains region, attention is on the Sebago Lake ESA and the Fryeburg ESA. Within the Katahdin/Moosehead region, focus is on the Lincoln ESA which contains the Bottle Lake area. Towns contained within these ESAs are:

Sebago Lake ESA	Fryeburg ESA	Lincoln ESA	
Bridgton	Baldwin	Mattawamkeag	Enfield
Casco	Brownfield	Kingman Twp.	Lincoln
Gray	Denmark	Drew Plt.	Lee
Harrison	Fryeburg	Webster Plt.	Springfield
Naples	Hiram	Winn	Carroll Plt.
Raymond	Lovell	Chester	Lakeville
Sebago	Porter	Seboeis Plt.	Burlington
Standish	Stoneham	Maxfield	Lowell
Windham	Stow	Passadumkeag	Howland
	Sweden	Grand Falls Twp.	Edinburg
	Cornish		
	Parsonfield		

The three ESAs which contain the two proposed nuclear waste sites collectively represent an annual travel and tourism sales expenditure of $58.16 million. Losses due to development of a waste facility in either of these two areas would be a function of land actually removed from public access and the public's image of these areas as a place to vacation. Applying the traveler sales multiplier of 1.58, traveler induced sales in these three ESAs represent a grand total of $91.89 million in 1984 dollars.

The attached maps locate the two tourism regions and the three ESAs. Although a very small percentage of Maine's land is directly involved, the economic impact stands to be disproportionately large.

To what extent the public's image of the entire State as a place to vacation would be impacted is not known. In addition to the $58.16 million discussed above, another $1.180 billion annual tourism and travel expenditures



Region 7
Aroostook
("The County")
Region 8
Katahdin
Moosehead
Region 2
Western Lakes
and Mountains
Region 3
Kennebec Valley
Region 5
Down East/Acadia
Region 6
Sunrise County
Region 4
Mid-Coast
Region 1
South Coast

Figure A24-1

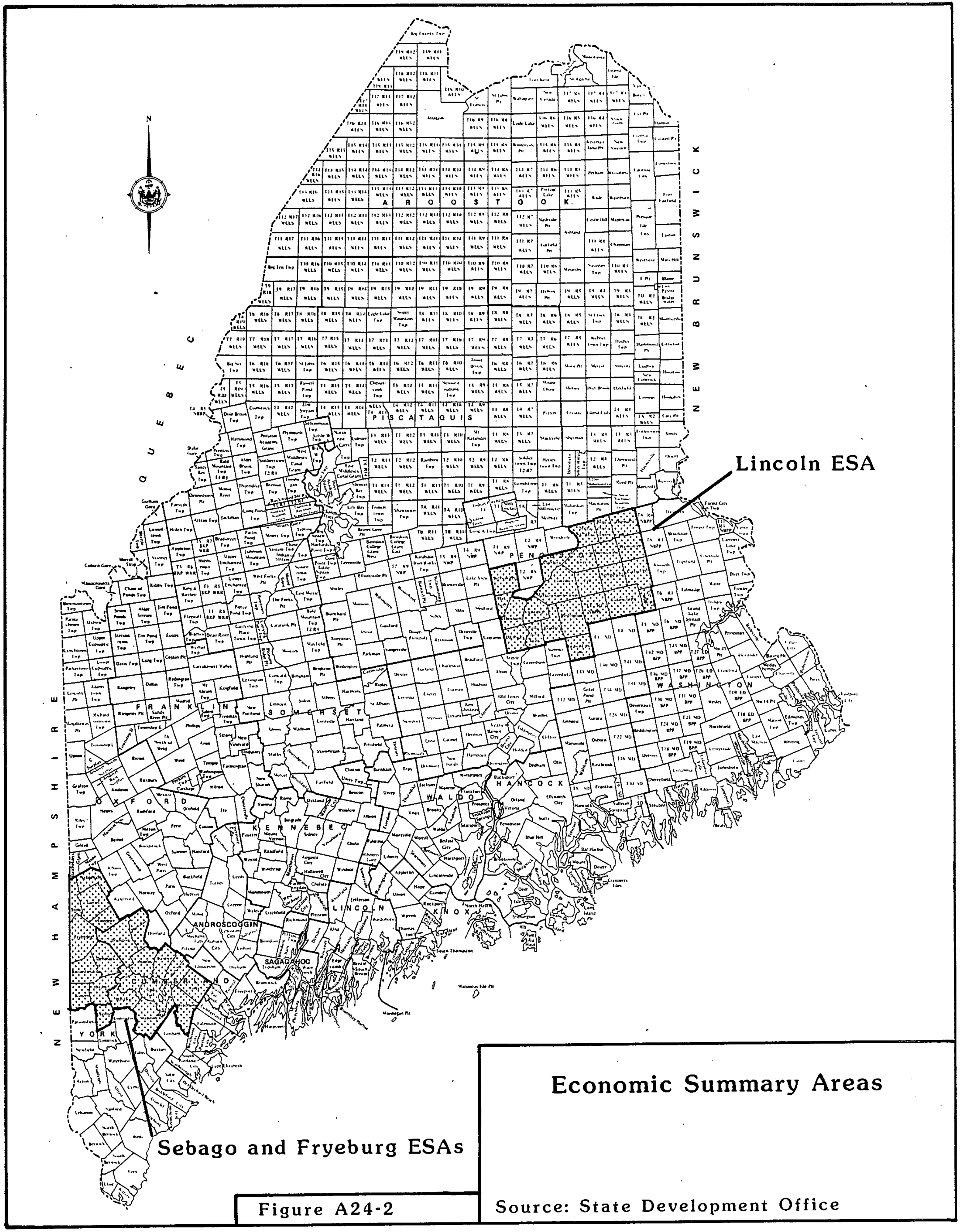

Lincoln ESA
Sebago and Fryeburg ESAs
QUEBEC
NEW BRUNSWICK
NEW HAMPSHIRE
AROOSTOOK
PISCATAQUIS
PENOBSCOT
WASHINGTON
FRANKLIN
SOMERSET
HANCOCK
OXFORD
WALDO
KENNEBEC
ANDROSCOGGIN
LINCOLN
KNOX
SAGADAHOC
CUMBERLAND
YORK
Economic Summary Areas
Source: State Development Office

Figure A24-2

stand at risk. In 1984, these $1.24 billion represented 13.5 percent of all goods and services sold in the State of Maine. In other words, $1.24 billion represented a $1,074 spent for every man, woman, and child in the State.

On its license plates, Maine advertises itself as "Vacationland". Whether the quality of life in Maine would be compromised by the location of nuclear waste facility is debatable. But, whether that diminution of quality of life is real or only perceived, the results would remain the same: less tourist business in a State which is very dependent upon tourism.

The Data

The data which follow present road traffic flow, information center traffic, numbers of travelers by accommodation type, lodging occupancy rates, lodging distribution, travel expenditures, and State park use.

Table 1 shows the average monthly traffic flow past the Maine Department of Transportation traffic counter maintained year round on U.S. Route 302 in Bridgton. In 1985, traffic moved between an average daily high of 4,718 vehicles in July to an average daily low of 2,176 vehicles in March. This suggests an approximate doubling of the traffic flow in the peak summer months.

The one tourist information center maintained within the three ESAs is located in Fryeburg near the New Hampshire border. Open during the months May through October, 22,926 walk-ins visited the center in 1985, a 16.6 percent increase over 1984 (table 2). As explained elsewhere in this paper, the Western Lakes and Mountains region (which contains the Sebago Lake candidate area) has the most balanced seasonal visitation rate of Maine's eight tourism regions. As a result, the Fryeburg center, which is open for only 6 months of the year, must under represent actual tourist flow; it misses the six months of winter activity, including the entirety of the ski season.

Approximately 2.3 million person trips per year (one person making one trip) are made to the Western Lakes and Mountains region and Katahdin/Moosehead region. This is a conservative figure; with the exception of eastern Canadians, foreign travelers are not counted. About 2 out of 3 visitors to these two regions are nonresidents. As noted above, tourism in the Western Lakes and Mountains region is a balanced, year 'round business (table 3).

Table 4 shows that within the Sebago, Fryeburg, and Lincoln ESAs, the TRAITS II model of lodging inventory list 86 hotel/motel/resort establishments (6 percent of the State total) and 35 campgrounds (12 percent of the State total). This is a conservative number because it does not include all establishments which are licensed by the Division of Health Engineering. Rules for inclusion of lodging establishments with the TRAITS II model inventory are as follows:

- Must be primarily used by short-term guests, four weeks or less. Longer term rentals are assumed to be for semi-permanent residents, or summer-long users not affected by current marketing and development programs.

- Must be of a quality level that would be acceptable to a significant number of travelers (as examples, "men only" establishments or welfare housing would not be included).

In 1985, hotel, motel, and resort occupancy rates in the Western Lakes and Mountains region ranged between 19 percent (in April) and 63 percent (in August), with an average occupancy rate of 32.2 percent (table 5). In the Katahdin/Moosehead region, occupancy rates ranged from 12 percent (April) to 63 percent (August), with an average of 40.6 percent In the Western Lakes and Mountains region, 66 percent of properties are open all year; in the Katahdin/Moosehead region the rate is 67 percent. This exceeds the Statewide average percentage of 50 percent by 16-17 percent. Again, as indicated above, the Western Lakes and Mountains region is less seasonal and more year 'round that is the case with other tourism regions in Maine.

Campgrounds in the Western Lakes and Mountains region had an average occupancy rate in 1985 of 43.3 percent; the Katahdin/Moosehead region had an average rate of 54.6 percent. These rates exceed the 1984 rates by 3.5 percent and 1.4 percent respectively.

Traveler expenditures as a function of accommodation type used for the Sebago Lake, Fryeburg, and Lincoln ESAs for 1984 are given in table 6. As quoted above, this totaled to $58.16 million.

Of the $58.16 million, 17.2 percent ($9.99 million) was generated by lodging sales, 25.9 percent ($15.08 million) by food sales, 19.3 percent ($11.24 million) by transportation sales, 10.2 percent ($5.95 million) by recreation sales, 25.1 percent ($14.62 million) by retail sales, and 2.2 percent ($1.29 million) by other sales (table 7).

Applying the traveler sales multiplier of 1.58 to account for additional expenditures not captured by the survey techniques, traveler induced sales represent $91.89 million in 1984 dollars.

The State maintains two park/facilities in the Sebago Lake ESA - Songo Lock and Sebago Lake State Park. In the Lincoln ESA, Morgan Beach is leased by the Department of Conservation to the town of Enfield. The three facilities recorded over 292,000 visitors in 1985 (table 8).

Table 1: Average Monthly Traffic Flow

Bridgton Station, U.S. Route 302

1984 and 1985

Month	Sunday 1984	Sunday 1985	Weekday 1984	Weekday 1985	Saturday 1984	Saturday 1985	Average day 1984	Average day 1985
January	2,825	2,847	1,977	2,069	2,805	2,981	2,215	2,310
February	2,975	3,117	2,136	2,245	2,717	3,116	2,338	2,494
March	2,720	2,525	1,912	2,008	2,897	2,672	2,168	2,176
April	2,460	2,358	1,862	2,088	2,336	2,448	2,015	2,178
May	3,207	2,905	2,242	2,484	2,890	3,000	2,472	2,617
June	3,258	3,414	2,654	2,873	3,362	3,466	2,841	3,035
July	4,904	5,203	2,654	2,873	3,362	3,466	2,841	3,035
August	5,185	5,140	4,197	4,391	5,236	5,097	4,486	4,598
September	5,210	*	2,901	*	4,195	*	3,415	*
October	4,835	5,341	3,448	3,569	5,300	4,690	3,910	3,982
November	2,280	2,310	2,118	2,249	2,496	2,601	2,195	2,308
December	2,385	2,064	2,145	2,191	2,451	2,509	2,223	2,218

* Insufficient data to compute an average

Source: Maine Department of Transportation, Monthly Traffic Record

Table 2: Fryeburg Information Center Visits 1981 - 1985

Year	Visits		
1981	10,029		
1982	19,573		
1983	25,087		
1984	19,656		
1985	22,926		

1985 (by month)

Month	Visits
May	526
June	2,461
July	7,005
August	7,039
September	3,429
October	2,466

Source: Maine Publicity Bureau

Table 3: Resident and Nonresident Person Trips

by Season and Tourism Region 1984-1985

(in thousands)

Season	Western Lakes and Mountains	Katahdin/Moosehead	Total
Spring	403	51	454
Summer	475	104	579
Fall	404	221	625
Winter	436	104	540
Total Residents and Principal Markets	1,720	480	2,200
Other U.S. Nonresidents	78	39	117
Total	1,798	519	2,317

Source: U.S. Travel Data Center

Table 4: Distribution of Hotels, Motels, Resorts, and Campgrounds within the Sebago Lake, Fryeburg, and Lincoln ESAs

1984

Economic Summary Area	Hotels, Motels and Resorts #	% of State	Campgrounds #	% of State
Sebago Lake	64	4.50	19	6.55
Fryeburg	18	1.20	12	4.14
Lincoln	4	0.30	4	1.38
Total	86	6.00	35	12.07

Source: TRAITS II Model

Table 5: Hotel, Motel and Resort Occupancy Rates

by Region and Month

1984 and 1985

Economic Summary Area	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Western Lakes and Mountains	1984	31	37	32	20	20	25	61	65	38	34	20	24
	1985	27	34	27	19	20	24	57	63	36	33	20	26
Katahdin/ Moosehead	1984	27	37	30	12	36	44	59	64	51	38	56	23
	1985	32	40	31	12	38	47	58	63	50	37	52	27

Source: TRAITS II Model

Table 6: Traveler Expenditures in the Sebago Lake, Fryeburg, and Lincoln

Economic Summary Areas

by Accommodation Type Used

1984

(millions of dollars)

Economic Summary Area	HMR	Campgrounds	Friends/ Relatives	Other**	Day Trippers	Pass Throughs	Total*
Sebago Lake	7.38	3.79	3.22	0.42	0.36	0.24	15.40
Fryeburg	9.11	18.49	9.31	0.52	0.44	0.29	38.15
Lincoln	0.82	0.21	3.46	0.05	0.04	0.03	4.61
Total*	17.31	22.49	15.99	0.99	0.84	0.56	58.16

* Items may not sum to total due to rounding

** Boats, sleeping in cars, etc.

Source: TRAITS II Model

Table 7: Traveler Expenditures in the Sebago Lake, Fryeburg, and Lincoln

by Category and Accommodation Type Used

1984

(millions of dollars)

Category	HMR	Campgrounds	Friends/ Relatives	Other**	Day Trippers	Pass Throughs	Total*
Lodging	6.06	3.72	----	0.21	----	----	9.99
Food	4.25	6.13	3.85	0.24	0.26	0.35	15.08
Transportation	1.98	5.35	3.35	0.19	0.16	0.21	11.24
Recreation	0.93	2.87	1.73	0.19	0.23	----	5.95
Retail	3.42	4.42	6.48	0.12	0.18	----	14.62
Other	0.66	----	0.58	0.04	0.01	----	1.29
Total*	17.31	22.49	15.99	0.99	0.84	0.56	58.17

* Items may not sum to total due to rounding

Source: TRAITS II Model

Table 8: State Park and Recreation Use

Sebago Lake, Fryeburg, and Lincoln Economic Summary Areas

1985

Economic Summary Area	Facility	Use Type	# of Visitors
Sebago Lake	Songo Lock	Cultural/educational	50,386
	Sebago Lake	Swimming/picnicing Camping	139,053 98,167*
Lincoln	Morgan Beach	Swimming/picnicing Day use	3,500** 1,000**

* Visitor nights

** Estimates

Source: Maine Department of Conservation, Bureau of Parks and Recreation, Monthly Public Use Report

Comments on Department of Energy Draft Area Recommendation Report

Appendix A25 - Population Density: 1980 Census Data

Population

Enclosed is a population density map based on the land area of each Census enumeration district (ED), a more accurate representation of population density in the Sebago Lake area. This map should be used to determine the value for population density in any given grid cell and to calculate the aggregate favorability for individual grid cells. The attached table provides the populations of the enumeration districts (from the 1980 Census) and the areas for each district. The areas were determined by planimetering the enumeration districts.

Also attached are maps showing cities and town in Maine with a 1980 population greater than 2,500 persons, and cities and towns with a 1980 population greater than 2,500 persons and a population density greater than 64 persons per square mile. As we have argued in earlier letters to the Department of Energy, there is no functional difference between communities with a city charter versus other incorporated towns as far as the siting of a nuclear waste repository is concerned. The distinction drawn by the U.S. Census Bureau and the Department of Energy is arbitrary and unfair, leading to the inequitable treatment of a large segment of Maine's population.

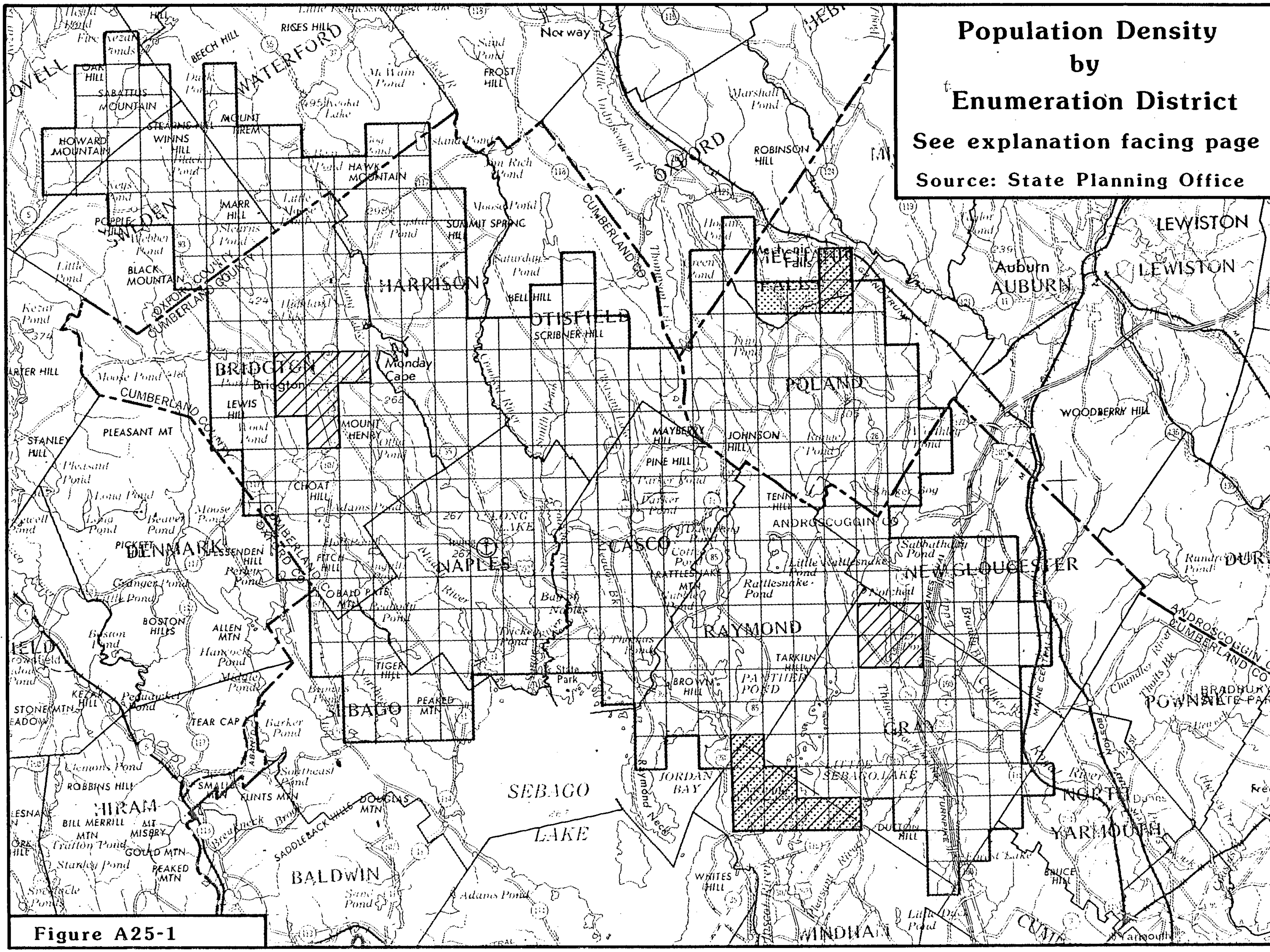
The cities and towns shown on the attached map should be disqualified from the screening process.

Figure A25-1: Alternate population density based on Census Enumeration Districts

The population densities calculated by the Department of Energy did not use the smallest unit for which population data was available. Using the areas of enumeration districts for communities in the Sebago Lake candidate area, significant additional grid cells were ranked in the 200-299 persons per square mile category.

Specifically, on figure A25-1, the dotted pattern shows areas which the Department of Energy determined to have a population density between 200-299 persons per square mile. (The rest of the area is less than 199 persons per square mile.) The calculation was based on the area of the town.

The lined pattern are the areas which have a population density of 200-299 persons per square miles based on the area of Census enumeration districts. Additional areas are shown in Gray and Bridgton. Two square miles of area in Mechanic Falls drops to less than 199 persons per square mile (the two western grid cells) because of the concentration of population in the enumeration district.



Population Density by Enumeration District

See explanation facing page

Source: State Planning Office

Figure A25-1

Population and Census Enumeration Areas

Sebago Lake Candidate Area

Cumberland County

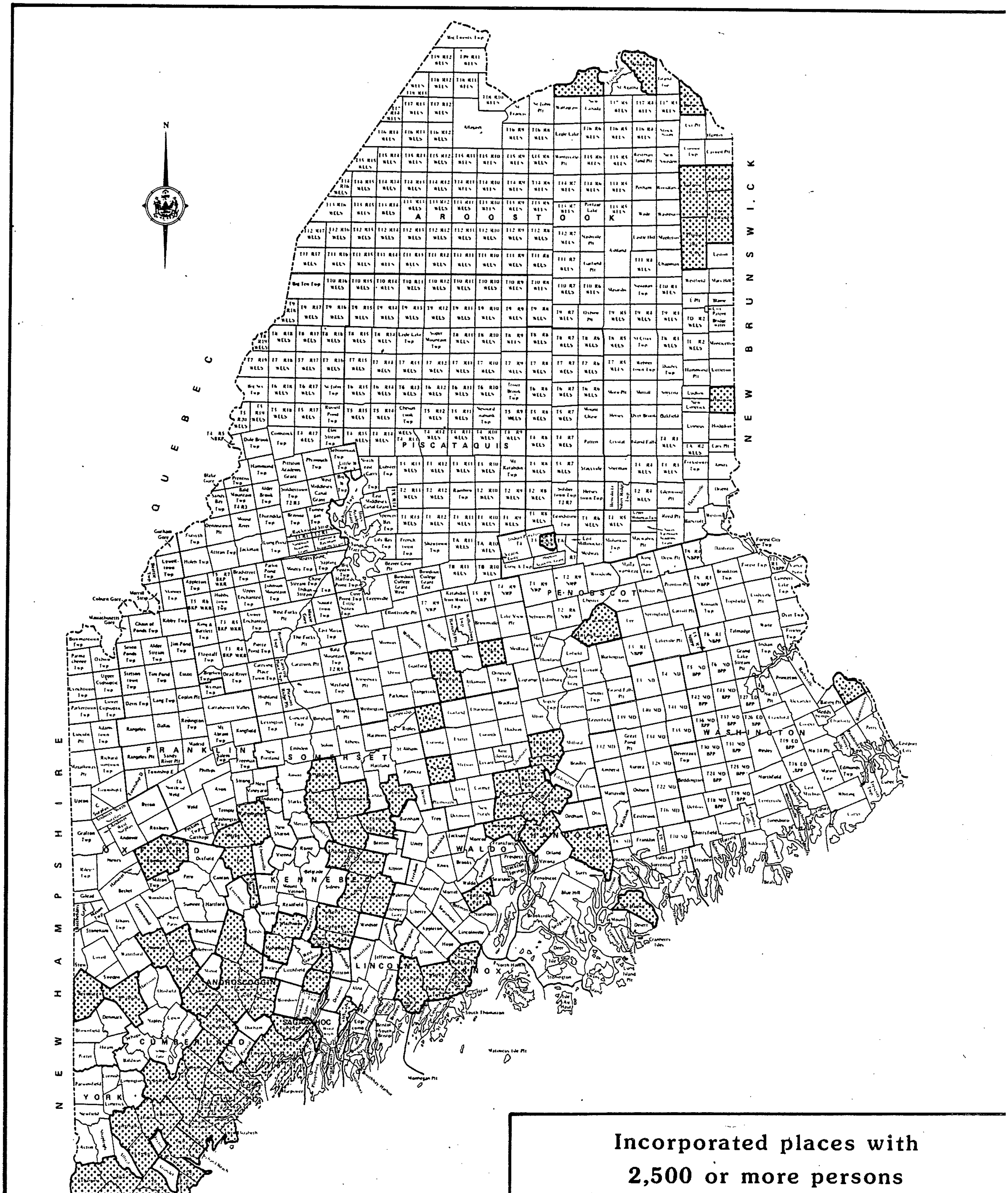
Town/CDP/ED	Area (sq. mi.)	Population	Density (people/sq. mi.)
Bridgton	68.8	3,528	51.3
CDP	5.0	1,639	327.8
ED 556	29.7	944	31.7
ED 557	5.8	187	32.2
ED 558	28.3	758	26.8
Casco	32.9	2,243	68.2
ED 569	17.5	838	47.9
ED 570	15.4	1,405	91.2
Gray	48.8	4,344	89.0
ED 574	16.8	1,608	95.7
ED 575	3.4	718	211.2
ED 576	19.8	1,378	69.6
ED 577	8.8	640	72.7
Harrison	36.5	1,667	45.7
ED 553	27.0	1,333	49.4
ED 554	9.5	334	35.2
Naples	36.3	1,833	50.5
ED 559	24.9	1,229	49.4
ED 560	11.4	604	53.0
New Gloucester	44.6	3,180	71.3
ED 551	26.8	2,486	92.8
ED 552	16.0	694	43.4
Raymond	36.3	2,251	62.0
ED 571	17.0	562	33.1
ED 572	10.5	831	79.1
ED 573	8.8	858	97.5
Sebago	36.1	974	27.0
ED 561	25.5	781	30.6
ED 562	10.6	193	18.2
Windham			
ED 580	6.5	1,340	206.1

Androscoggin County

Town/CDP/ED	Area (sq. mi.)	Population	Density (people/sq. mi.)
Mechanic Falls	11.4	2,616	229.5
CDP	6.4	2,198	343.4
ED 364	5.0	418	83.6
Poland	44.9	3,578	79.7
ED 365	9.6	917	94.0
ED 366	23.5	1,625	69.1
ED 367	11.8	1,036	88.2

Oxford County

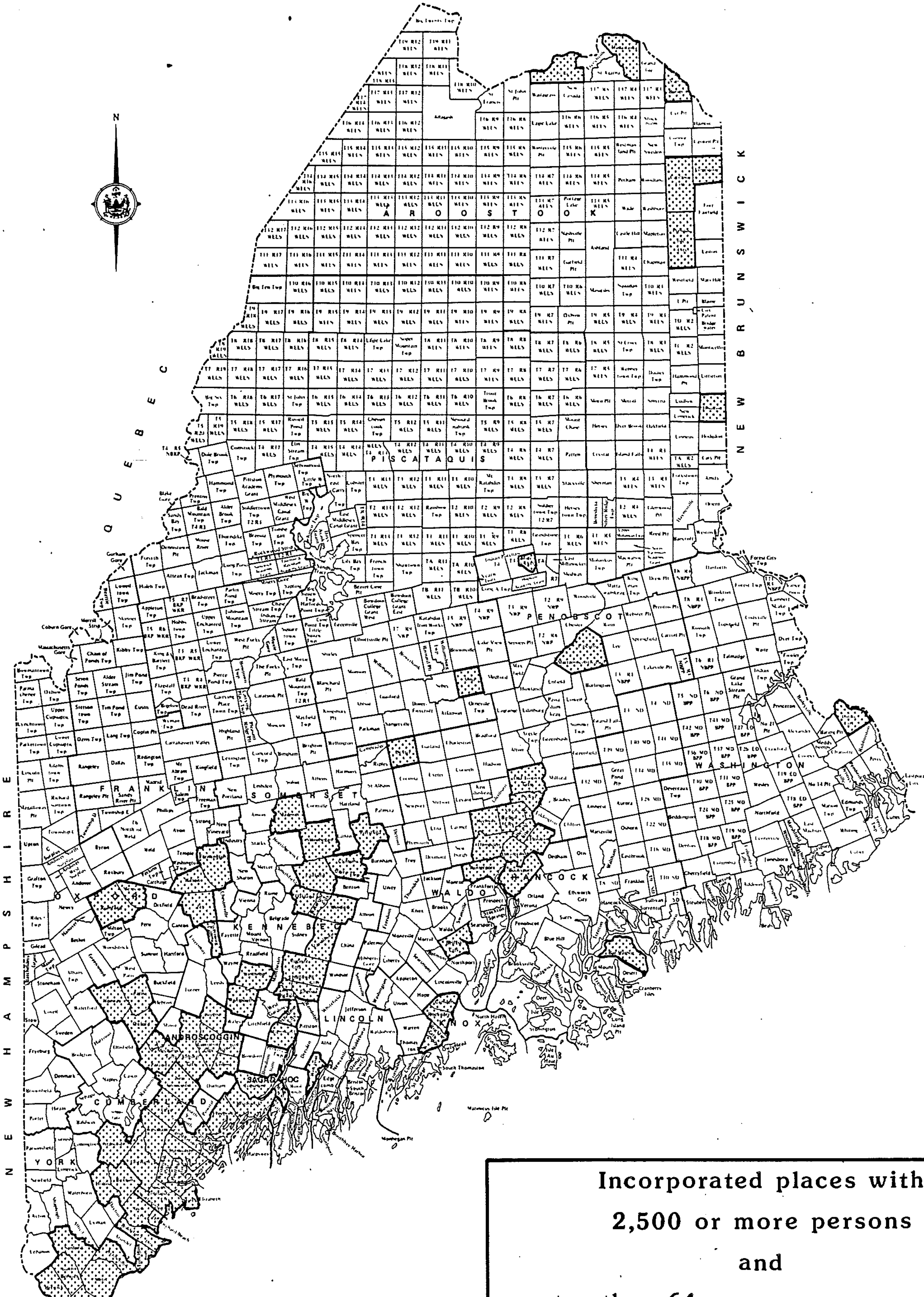
Town/CDP/ED	Area (sq. mi.)	Population	Density (people/sq. mi.)
Lovell	43.6	767	17.6
ED 161	23.0	469	20.4
ED 162	20.6	298	14.5
Otisfield			
ED 174	44.9	897	20.0
Oxford	41.9	3,143	75.0
ED 157	19.5	676	34.7
ED 158	11.6	1,434	123.6
ED 159	10.8	1,033	95.6
Sweden			
ED 160	29.3	163	5.6
Waterford	47.0	951	20.2
ED 142	27.5	677	24.6
ED 143	19.5	274	14.1



Incorporated places with 2,500 or more persons

Figure A25-2

Source: 1980 U.S. Census



Incorporated places with

2,500 or more persons

and

greater than 64 persons per square mile

Source: 1980 U.S. Census
and State Planning Office

Figure A25-3

Comments on Department of Energy Draft Area Recommendation Report

Appendix A26

Listing of State Properties

and

Significant Environmental Features

in the

Bottle Lake Candidate Area

and

Sebago Lake Candidate Area

The following lists and attached maps provide a summary of State-owned properties and environmental features that are recognized as significant by the State. The area is more limited than the area described in the draft Area Recommendation Report, and these maps are intended only to point out features mislocated or omitted by the Department of Energy within the area shown on these maps.

Bottle Lake Candidate Area

Public Reserved Lots - see map in appendix A9.

Critical Areas:

CA 316	Saponac Esker Segment
CA 466	Grand Falls Whitewater - Passadumkeag River
CA 518	Lee Passadumkeag Calypso Stand
CA 567	No. 3 Pond Old Growth Hemlock Stand

Natural Areas:

NA 1143	1000 Acre Heath
NA 1281	Duck Lake
NA 1416	Nicatous Lake
NA 1417	The Horseback (esker)

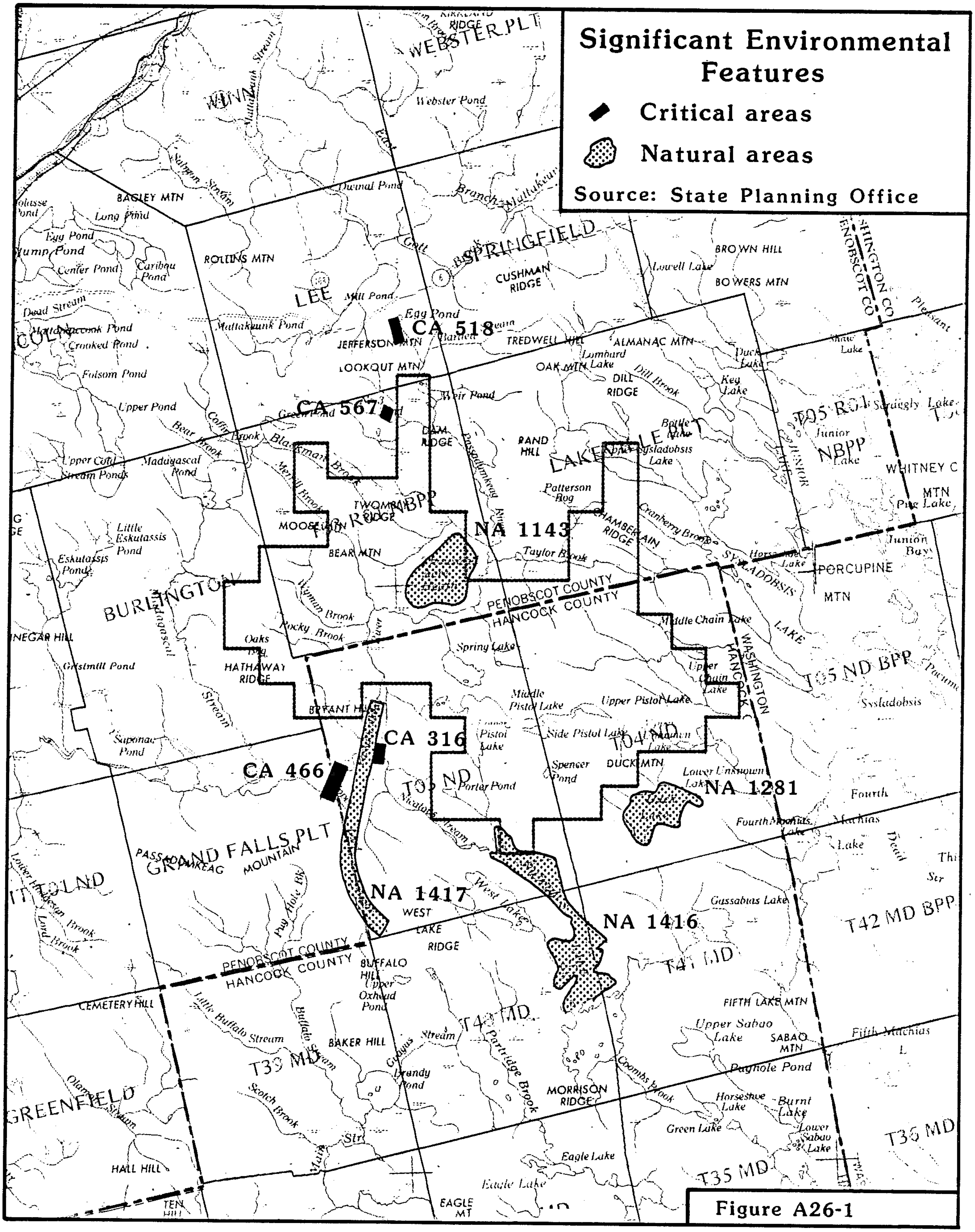

Significant Environmental Features
Critical areas
Natural areas
Source: State Planning Office
CA 518
CA 567
NA 1143
CA 316
CA 466
NA 1281
NA 1417
NA 1416
PENOBSCOT COUNTY
HANCOCK COUNTY
SPRINGFIELD
LEE
WINN
WEBSTER PLT
BURLINGTON
GRAND FALLS PLT
GREENFIELD
LAKEVILLE
T39 MD
T35 MD
T36 MD
T42 MD BPP
T05 ND BPP

Figure A26-1

Sebago Lake Candidate Area

State Parks:

Bradbury Mountain - Pownal
Little Ossipee River - Baldwin and Denmark
Pequawket Pond - Brownfield
Range Ponds - Poland
Runaround Pond - Durham
Sabattus Island - Bridgton
Sebago Lake - Casco and Naples

Outstanding Rivers:

Crooked River
Saco River

Wildlife Management Areas:

Kezar Pond - Fryeburg
Brownfield - Brownfield and Fryeburg
Northwest River - Sebago
Steep Falls - Baldwin and Standish

Fish Hatcheries - see map

Forest Ranger Stations and Fire Towers - see map

Public Boat Ramps (with some component of State or Federal funding) - see map

Department of Transportation Maintenance Lots - see map

Pineland Center (Department of Mental Health and Mental Retardation) - see map

Critical Areas:

CA 2	New Gloucester Black Gum Stand
CA 26	Standish Mountain Laurel Stand
CA 34	Denmark Sassafras Stand
CA 63	Sebago Rare Plant Station
CA 70	Black Pond Island Heronry
CA 92	Mt. Apatite (tourmaline occurrence)
CA 120	Welchville Inland Heronry
CA 127	Oxford New Jersey Tea Stand
CA 128	Frye Island Black Gum Stand
CA 154	Wade Quarry (tourmaline occurrence)
CA 211	Hiram Falls (Great Falls)
CA 276	Kezar Falls Gorge
CA 296	Hiram Broad Arrow Pine
CA 306	Sebago Lake White Oak Stand
CA 308	Five Kezar Pond Esker Segment
CA 314	Whtney Hogan Pond Esker Segment
CA 387	Poland Spring Esker Segment
CA 445	Gould Mountain Rare Plant Stand

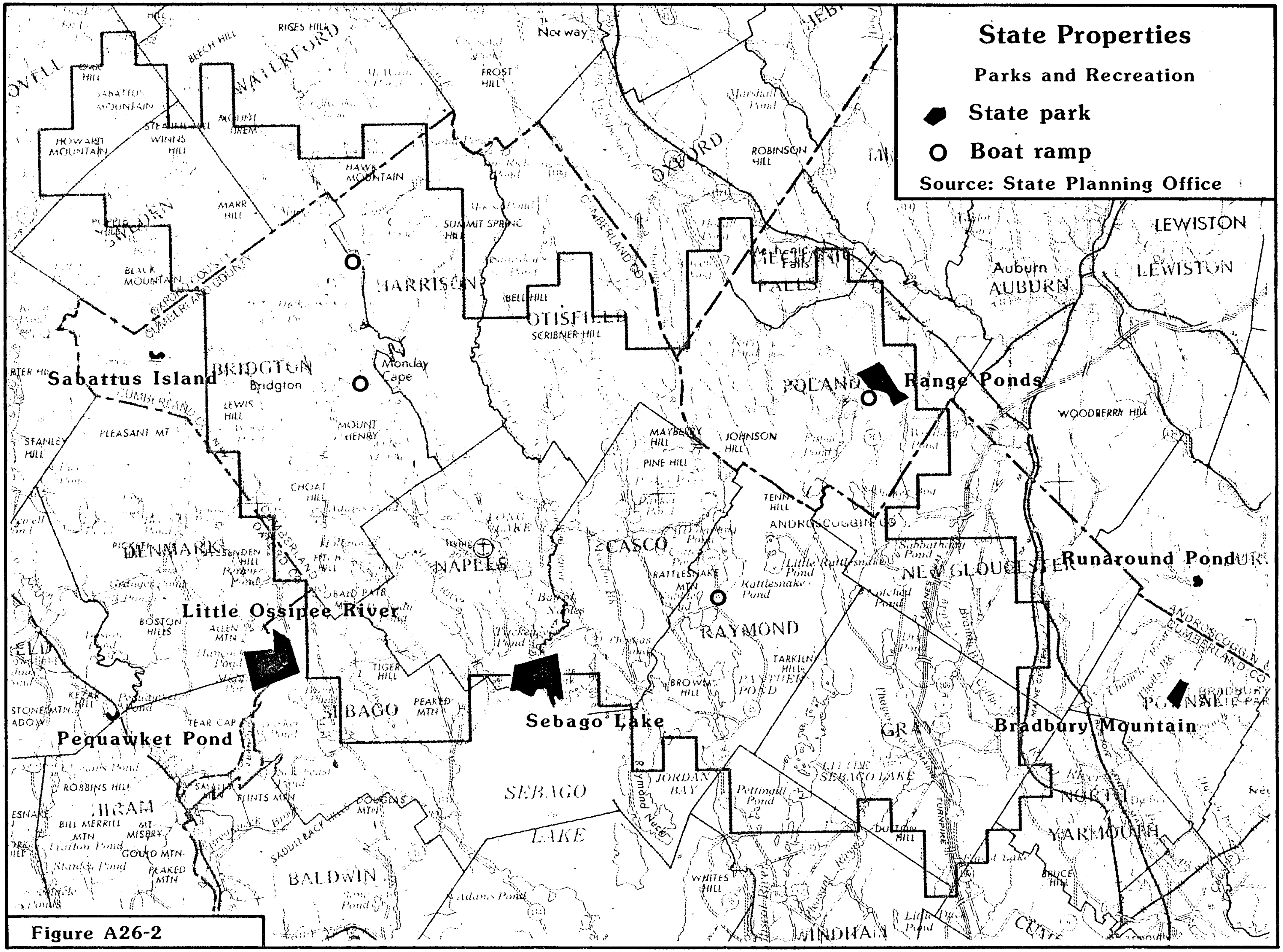
CA 516 Harrison Rare Plant Station

Proposed critical areas:

Gray Delta
Adams Rare Plant Stand

Natural Areas:

NA 45	Black Pond
NA 55	Boulder Field
NA 89	Colley Hill
NA 95	Crooked River
NA 132	Frye's Leap
NA 287	Poland Pitch Pines
NA 319	Sabattus Mountain
NA 320	Sebago Lake
NA 335	The Sinkhole
NA 350	Sweden Plains
NA 569	Bear Mountain
NA 583	Northwest River
NA 616	Poland Esker
NA 618	Thompson Point Beach
NA 633	Nubble Pond
NA 719	Black Cat Mountain
NA 832	Webb-Rowe Mountain
NA 834	Rattlesnake Mountain
NA 837	Little Sebago Island
NA 838	Douglas Hill
NA 839	New Gloucester Outwash Plain
NA 875	Thompson Lake Heath
NA 876	Otis Gore Scenic Vista
NA 877	Otisfied Scenic Vista
NA 878	Bald Pate Mountain
NA 879	New Gloucester Scenic Vista
NA 958	Raymond Black Birch
NA 961	Woods Pond Deer Yard
NA 962	Willett Brook Swamp
NA 1136	Oxford Plain
NA 1628	Hawk Mountain Slide
NA 1645	Catamount Leap


State Properties
Parks and Recreation
State park
Boat ramp
Source: State Planning Office
Sabattus Island
Range Ponds
Runaround Pond
Little Ossipee River
Pequawket Pond
Sebago Lake
Bradbury Mountain
WATERFORD
HARRISON
OTISFIELD
BRIDGTON
Bridgton
POLAND
LEWISTON
AUBURN
Auburn
DENMARK
NAPLES
CASCO
RAYMOND
NEW GLOUCESTER
SEBAGO
SEBAGO LAKE
BALDWIN
HIRAM
GRAY
NORTH YARMOUTH
WINDHAM
Norway
Monday Cape
ANDROSCOGGIN CO
CUMBERLAND CO
Figure A26-2

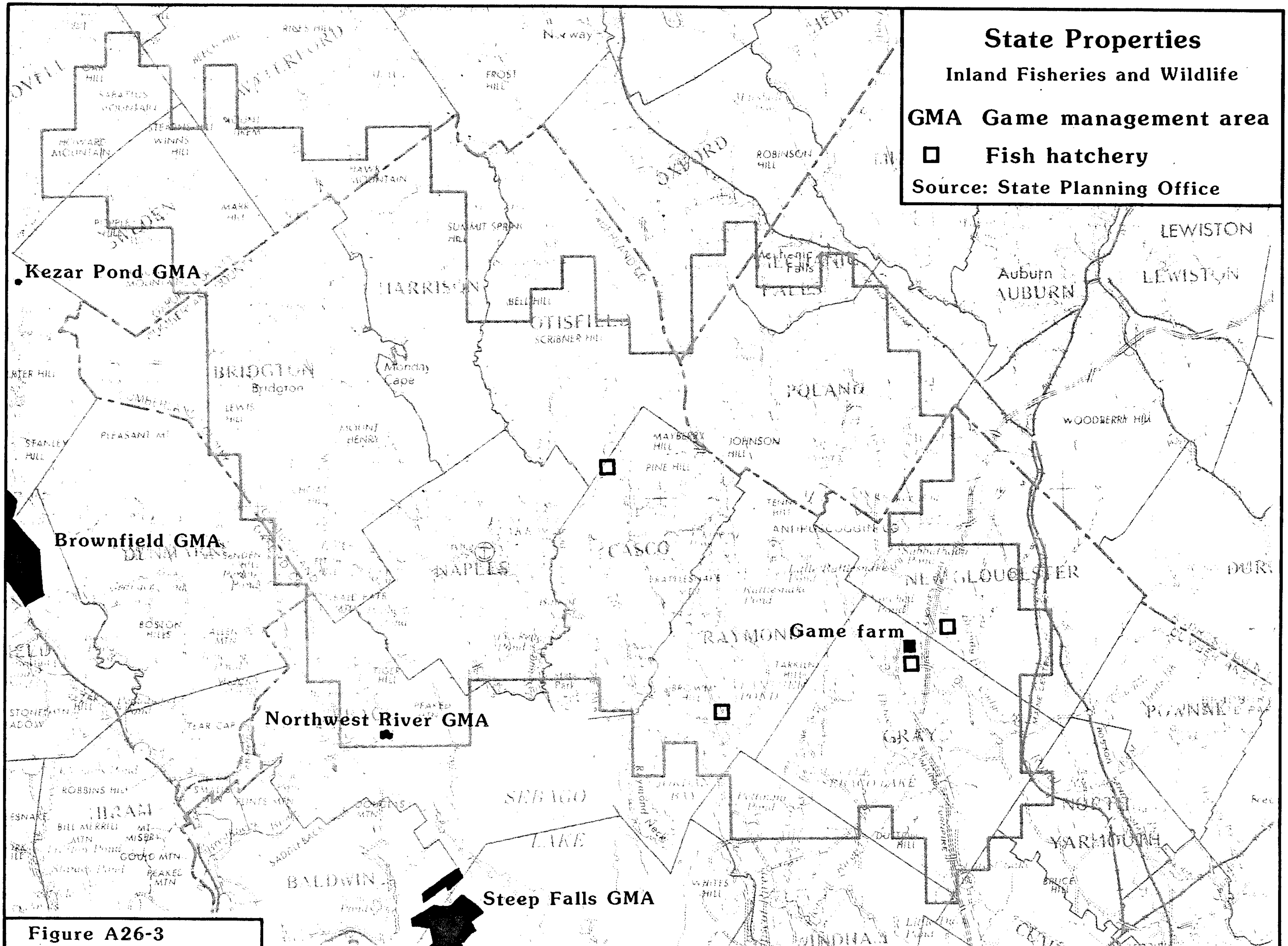

State Properties
Inland Fisheries and Wildlife
GMA Game management area
Fish hatchery
Source: State Planning Office
Kezar Pond GMA
Brownfield GMA
Northwest River GMA
Steep Falls GMA
Game farm
LEWISTON
Auburn
HARRISON
Bridgton
POLAND
CASCO
GRAY
BALDWIN

Figure A26-3

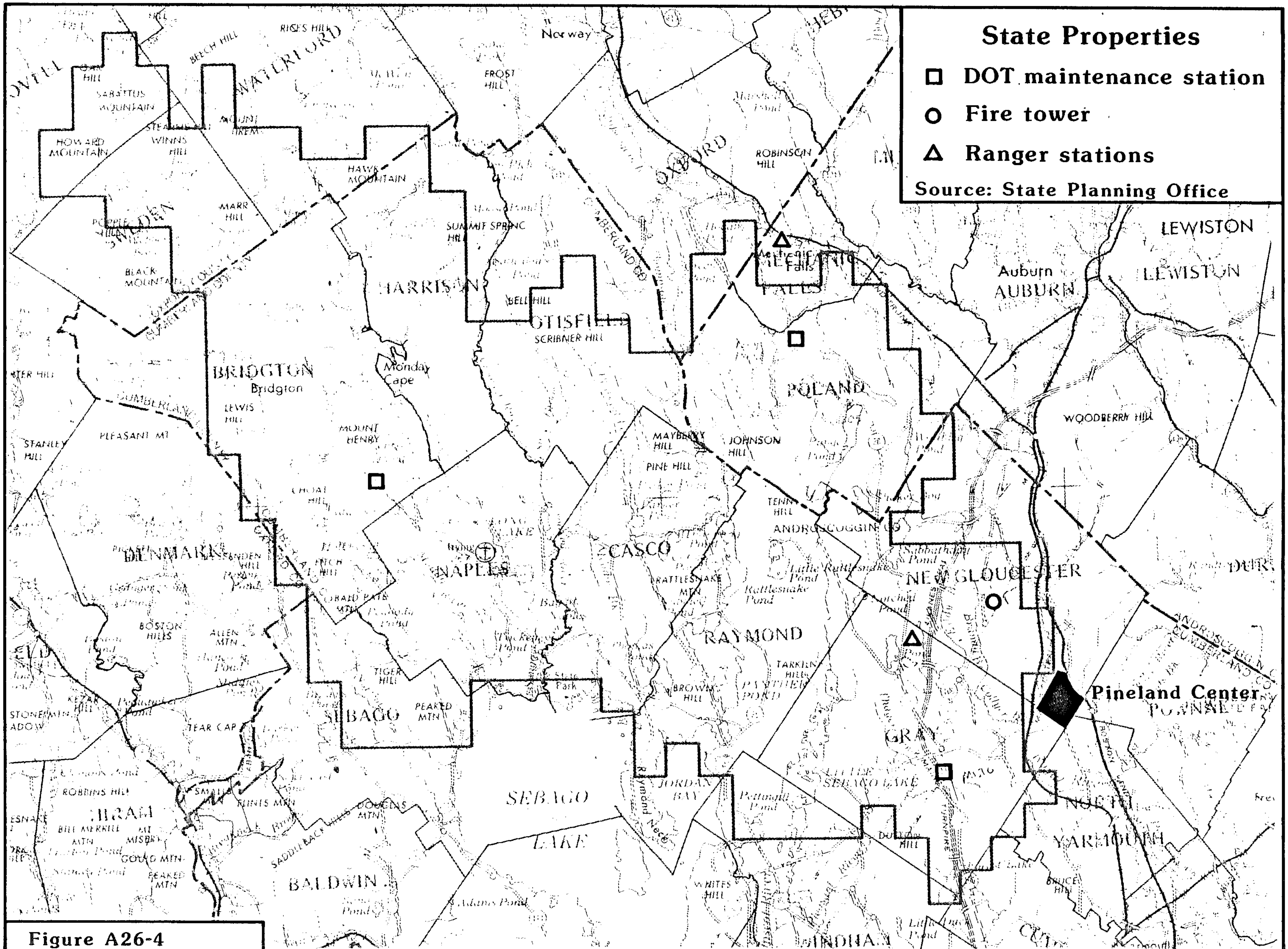
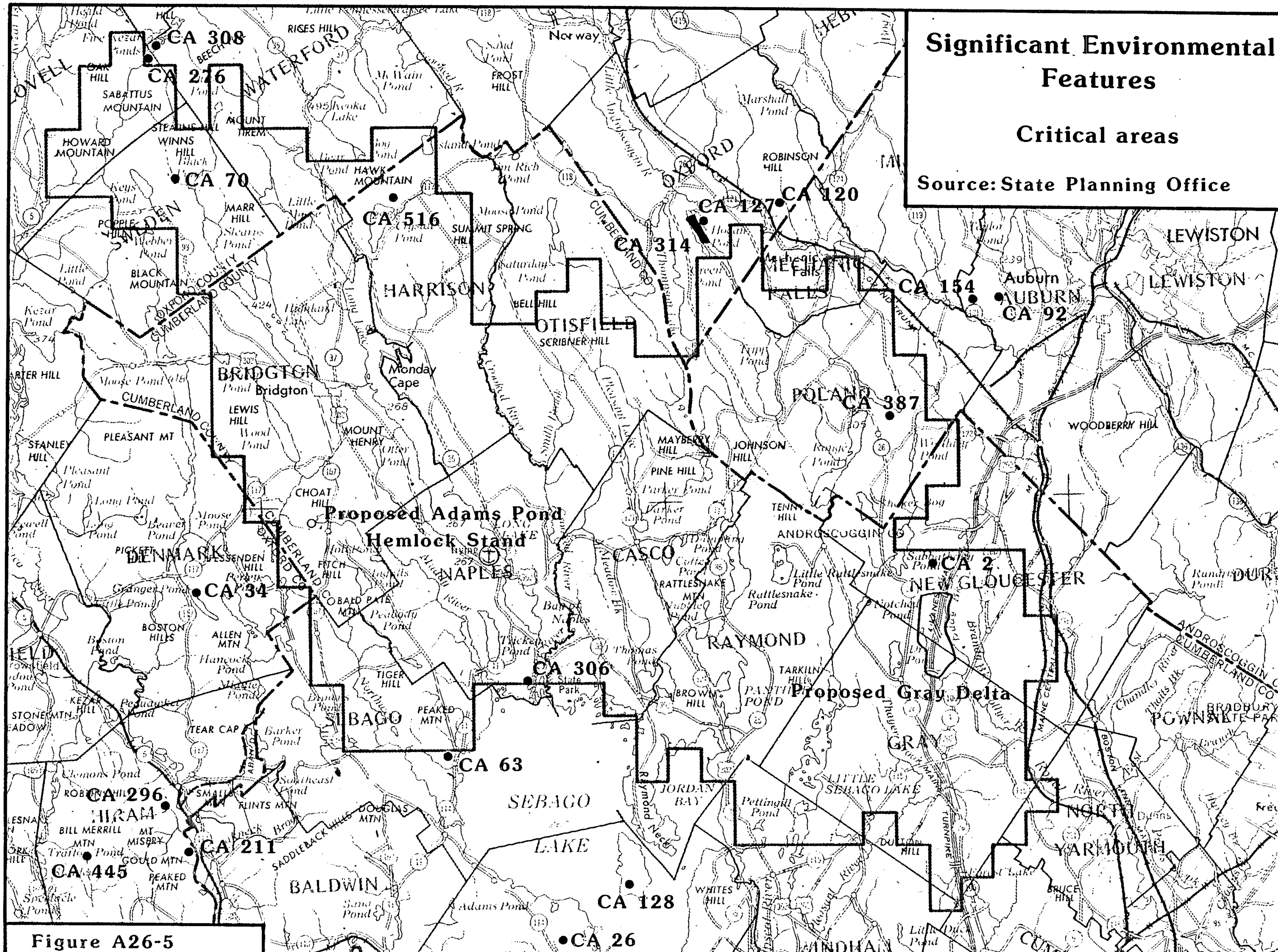
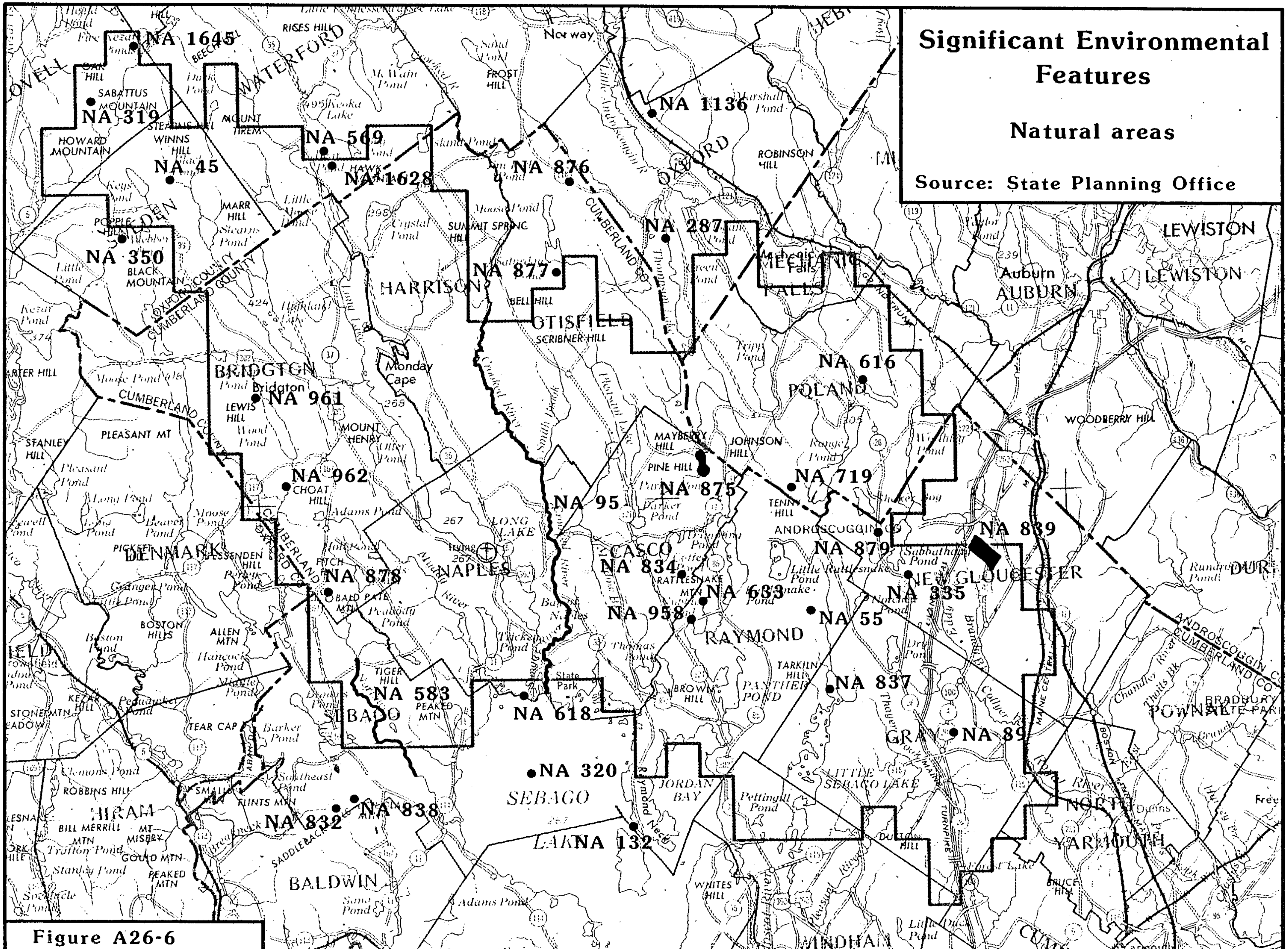

State Properties
DOT maintenance station
Fire tower
Ranger stations
Source: State Planning Office
Pineland Center
Norway
WATERFORD
HARRISON
OTISFIELD
OXFORD
MECHANIC FALLS
Auburn
AUBURN
LEWISTON
BRIDGTON
Bridgton
POLAND
DENMARK
NAPLES
CASCO
RAYMOND
NEW GLOUCESTER
SEBAGO
GRAY
SEBAGO
LAKE
BALDWIN
HIRAM
NORTH
YARMOUTH
POWNAL
JORDAN BAY
ANDROSCOGGIN CO
CUMBERLAND CO
WOODBERRY HILL
HOWARD MOUNTAIN
HAWK MOUNTAIN
PLEASANT MT
SCRIBNER HILL
BELL HILL
PINE HILL
JOHNSON HILL
ROBINSON HILL
RATTLESNAKE MTN
Monday Cape
MOUNT HENRY
LEWIS HILL
CHOAT HILL
TIGER HILL
PEAKED MTN
TEAR CAP
ROBBINS HILL

Figure A26-4



Significant Environmental Features
Critical areas
Source: State Planning Office
CA 308
CA 226
CA 70
CA 516
CA 314
CA 127
CA 120
CA 154
CA 92
CA 387
CA 2
CA 34
Proposed Adams Pond Hemlock Stand
CA 306
Proposed Gray Delta
CA 63
CA 296
CA 211
CA 445
CA 128
CA 26
WATERFORD
HARRISON
OTISFIELD
OXFORD
MECHANIC FALLS
AUBURN
LEWISTON
BRIDGTON
POLAND
CASCO
NAPLES
DENMARK
NEW GLOUCESTER
RAYMOND
SEBAGO
GRAY
HIRAM
BALDWIN
POWNAL
NORTH YARMOUTH
SEBAGO LAKE

Figure A26-5



Significant Environmental Features

Natural areas

Source: State Planning Office

Figure A26-6

Comments on Department of Energy Draft Area Recommendation Report

Appendix A27 - Transportation Systems

General Comments

These comments pertain directly to the information on transportation systems included in the draft ARR, and to issues such as regional transportation, quality of the transportation network, and highway safety within Maine.

Regional Transportation Considerations

Although some emphasis has been placed on local access transportation issues in the draft ARR, none was given to the problem of transporting the waste into the State of Maine. Maine is located in the easternmost part of the United States and all waste generated by other States which is designated for disposal at a facility in Maine must be funneled through the major population centers along the East coast. The megalopolis (one of the nation's largest), stretching from Washington, D.C., to Maine's southern border, has a national transportation network which, at times, is being used beyond its present capacity.

The attached table presents a comparison of average distances from the edge of a candidate area to the nearest interstate highway and mainline railway. Percentages obtained from an evaluation of this data shows that:

Candidate areas within 5 miles or less of an interstate highway:

Northeast	1/3	33%
North Central	1/10	10%
Southeast	3/7	42%

Candidate areas within 5 miles or less of a mainline railroad:

Northeast	1/3	33%
North Central	7/10	70%
Southeast	5/7	71%

Average distance from:	Interstate Highway	Mainline Railway
Northeast	7 miles	16 miles
North Central	29 miles	6 miles
Southeast	11 miles	3 miles

This brief analysis, which gives no consideration to quality of the transport network, shows that the Northeast region is not particularly well suited for rail transport of nuclear waste, the Department of Energy's presently preferred means of transport. The use of barges as a reliable means of transporting high level nuclear waste into the State of Maine has been mentioned at various hearings conducted by the DOE in the State. Maine, with its many miles of coastline, has a number of ports, but only one may have the facilities needed to off load this type of material. At that commercial facility the possibility of an accident would have a potential for major disruption of primary sectors of the economy in the affected area (10 CFR 960.5-2-(c)(4) DOE General Siting Guidelines), and significant public health effects.

The Maine Department of Transportation recommends that a comprehensive study on transport of nuclear waste through the major East coast population corridor be done as soon as possible, preferably prior to the final selection of potentially acceptable sites for area phase studies. This study should include consideration of risk to public health and safety, environmental and socio-economic impacts, and transportation related costs.

Highway Safety Averages

The attached table, taken from the 1984 compilation of highway statistics published by the U.S. Department of Transportation, National Highway Administration, shows that among States with candidate areas Maine ranks 4th in fatal accidents per million vehicle miles and 3rd in non-fatal accidents per million vehicle miles.

Maine is slightly below the national average in fatal and non-fatal accidents per million vehicle miles.

Attached maps show locations within and adjacent to the two candidate areas where the accident rate is statistically higher than Statewide averages. This data was obtained from accidents reported over a three year period in the State of Maine.

Quality of Transportation Network

As shown in the attached table, also taken from the 1984 highway statistics, Maine is the only candidate area State that has a percentage of major collectors with a rating <2.0 that is higher than the national average. The Northeast as a whole has a significantly lower percentage of major collectors with rating >3.5 (average of 18.6%), well below the national average of 30.9%.

For minor collectors, the two Northeast States have a significantly greater percentage of these roads in the lowest class, <2.0. The average for Maine and New Hampshire (21.8%) is over twice the national average of 10%. As in the case of the major collectors, the average percentage of minor collectors with ratings >3.5 (10.4%) is the lowest of the three regions, and well below the national average of 17.2%

Attached maps show locations within the candidate areas with poor road quality. These areas would require significant upgrading to provide an adequate road structure to transport construction materials and waste shipments.

Climate and Weather

The Department of Energy General Siting Guidelines (10 CFR 960) state that a history of severe winter storms should be considered a potentially adverse condition. This certainly applies to Maine and the Northeast as a whole. Present day weather and climate conditions must be considered not only with respect to transportation of high-level nuclear waste, but also with respect to construction and operation of the facility. Significant delays and "down time" during construction and operation would significantly increase costs and reduce the Department of Energy's ability to produce reliable schedules for initial operation and receipt of wastes during the repository's lifetime.

See comments on climate characteristics in Maine, appendix A20.

Traffic Density in the Sebago Lake Area

Traffic densities have been consistently increasing at the Bridgton monitoring station. The figures below show this annual increase since 1983, and the significant increase in traffic during the summer (high tourist) months.

Traffic Count at Bridgton Monitoring Station, U.S. Route 302

Month	1983	1984	1985	% increase 1983-85
January	1,892	2,215	2,311	22.1
February	2,217	2,340	2,494	12.5
March	1,812	2,169	2,177	20.1
April	1,910	2,016	2,178	14.0
May	2,368	2,473	2,618	10.5
June	2,809	2,842	3,036	8.1
July	4,811	4,440	4,719	-0.2
August	4,422	4,437	4,599	4.0
September	3,215	3,416	3,326	3.5
October	4,077	3,911	3,982	-2.3
November	1,980	2,196	2,308	16.6
December	2,073	2,223	2,219	7.0
Yearly Average	2,799	2,894	2,997	7.8

The greater percentage increase in the winter months is indicative of the increase in resident population in the Sebago Lake region. The relatively smaller increase in the summer months is a result of the dilution of resident population by transients.

Specific Comments on Draft ARR Sections 3.2.2.1, 3.2.2.2, and 3.2.2.3

The data on transportation presented in sections 3.2.2.2.14 and 3.2.2.3.14 indicate a lack of any meaningful evaluation of the transportation systems in either candidate area using 10 CFR 960.5-2-7 (DOE General Siting Guidelines). The following comments indicate the concerns the Maine Department of Transportation has relative to available access to the candidate areas.

3.2.2.2.14 (Bottle Lake Area)

The data presented in this section of the draft Area Recommendation Report is incorrect in places. The distance to Route 6 from the candidate area is 2 miles, not 20 miles; U.S. Route 1 is east of the candidate area and does not circle it; and, Route 9 has no restrictions against truck traffic.

The highway access route from I-95 to the northern part of the candidate area using U.S. Route 2 and Route 6 should be disqualified (see map NE-2A in draft ARR report) as these highways pass directly through the business district of Lincoln (population 5000 more or less) and could cause a transportation related risk to the public health and safety of this community; see 10 CFR 960.5-2-7(c)(4).

The use of Routes 6, 155, and 188 from the I-95 interchange in Howland or a route using the I-95 interchange in T2 R8 NWP and going south of Lincoln using the State and local road systems to get to the western edge of the candidate area will require significant reconstruction or upgrading to provide an adequate route from a national transportation system; see 10 CFR 960.5-2-7(c)(3).

The Maine Central Railroad system 9 miles west of the candidate area will require building a new branch line which must traverse a terrain that is quite hilly and may need many structures to cross the many streams between this rail system and the candidate area; see 10 CFR 960.5-2-7(c)(2).

The use of the Canadian Pacific Railway Ltd. should be disqualified as the railroad system is owned and maintained by a Canadian corporation.

See attached maps of the Bottle Lake Area to aid in evaluation of these remarks presented on section 3.2.2.2.14 of the draft ARR.

Section 3.2.2.3.14 (Sebago Lake Area)

The choice of highways deemed available to provide access to the candidate area presents a real concern to the Maine Department of Transportation. Even though the highways mentioned cross through portions of the candidate area, the population density of the communities through which they pass must make this "access" a potentially adverse condition.

The following data represent the concerns the Department has relating to these matters.

1) The exit from I-295 to U.S. Route 302 is located within the business district of Portland (population of 60,000 more or less). In addition, U.S. Route 302 and Route 35 must pass through the business district of North Windham (population 6,000 more or less). With these two communities involved most of the southern portion of U.S. Route 302 should be disqualified as a viable route due to transportation related risk to public health and safety; see 10 CFR 960.5-2-7(c)(4).

2) U.S. Route 202, Routes 11, 26, 35, 85, and 121 are highways located in the eastern portion of the candidate area. U.S. Route 202 and Route 26 are the only highways that intersect a national transportation system (Maine Turnpike). The other routes have direct or indirect access to these two highways but will need significant reconstruction or upgrading to provide an adequate route from the national highway system to the eastern portion of candidate area; see 10 CFR 960.5-2-7(c)(3).

3) Routes 5, 11, 22, 35, 107, 114, and 117 provide highway access to the western portion of the candidate area. Route 114 provides a means to intersect with a national highway system, then Route 22 and many of the routes mentioned above could be used to gain access to the western portion of the candidate area. The use of these routes will require significant reconstruction or upgrading over a long distance (25 miles more or less); see 10 CFR 960.5-2-7(c)(3).

The Maine Central Railroad in the eastern portion of the candidate area would provide access to this area but a new line built to provide access to the western portion of this candidate area would traverse 20 miles (more or less) of terrain that is hilly, has many lakes and streams, and would require the construction of many expensive and extensive structures to cross; see 10 CFR 960.5-2-7(c)(3).

The use of the Maine Central Railroad branch line southwest of the candidate area will require 20 miles (more or less) of significant reconstruction or upgrading to provide an adequate route to the regional system; see 10 CFR 960.5-2-7(c)(3).

The use of the Maine Central Railroad branch line from Standish to the New Hampshire border is listed as category 1 on the Railroads System Diagram on file with the Interstate Commerce Commission. This indicates potential for abandonment within the next 3 years.

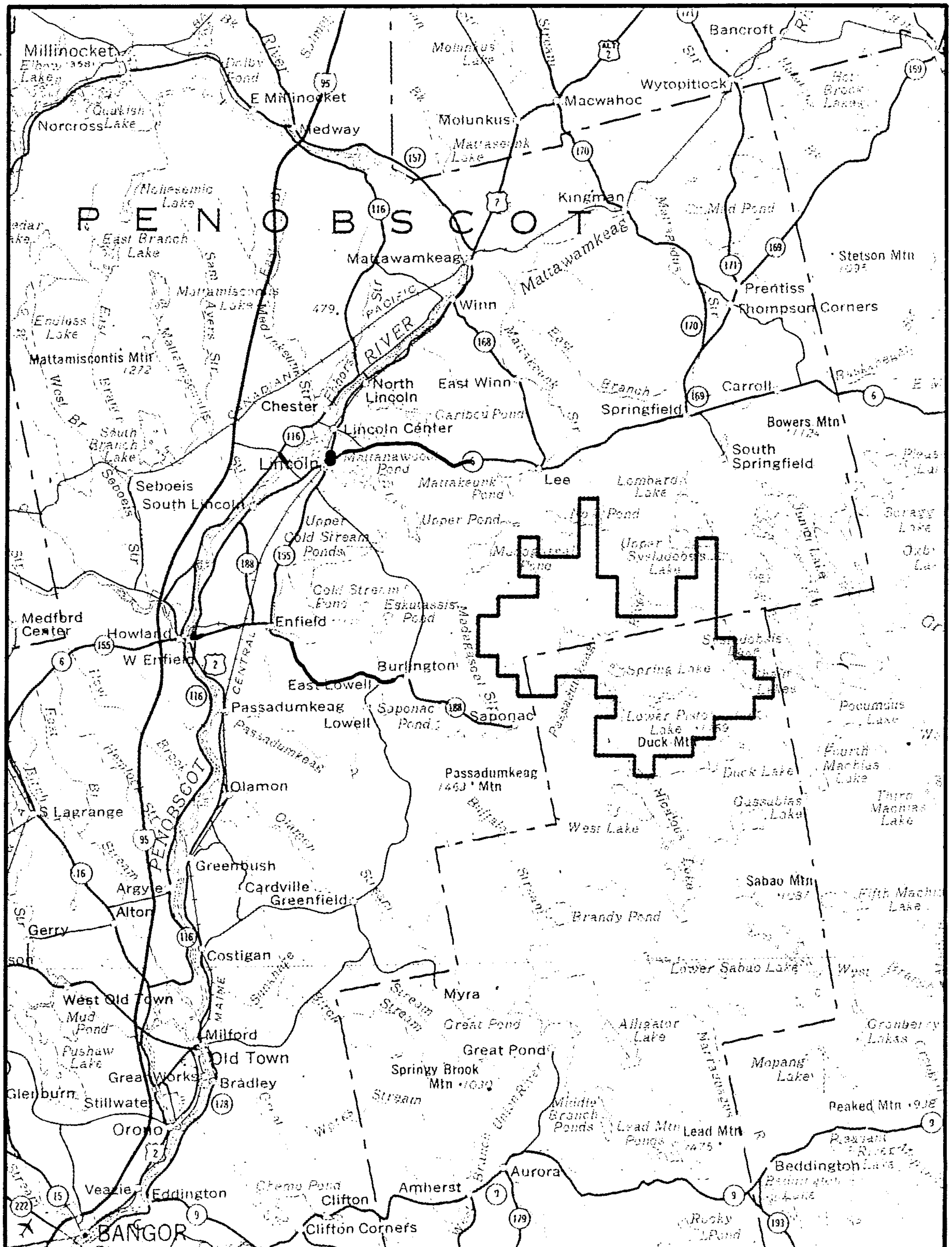
The use of the Canadian National Railway Company system should be disqualified in as much as this rail system is owned and maintained by the Canadian Government.

The attached maps of the Sebago Lake Area will provide a visual aid for the potential adverse conditions stated in the review of section 3.2.2.3.14 of the draft ARR.

Summary

An overview of both preliminary candidate areas indicate that local highways and railroads will require significant reconstruction or upgrading (see 10 CFR 960.5-2-7(c)(3)) over a terrain that is steep and has many lakes and streams (see 10 CFR 960.5-2-7(c)(2)) and in most locations could cause a transportation related risk to public health and safety (see 10 CFR 960.5-2-7(c)(4)).

The major concern of the Maine Department of Transportation relating to the transportation sections 3.2.2.2.14 and 3.14 of the draft ARR is the lack of data as to how large, how often, and how self-protecting the final transportation system will be. Therefore, it is very difficult to determine what type of transportation system and protective services will be needed to meet the qualifying conditions in 10 CFR 960.5-2-7(a). Until a comprehensive plan relating to all transportation issues now under consideration has been developed and specific requirements governing all aspects of transportation high-level waste has been stated, the Maine Department of Transportation is seriously hampered in presenting a constructive response to this crucial issue.

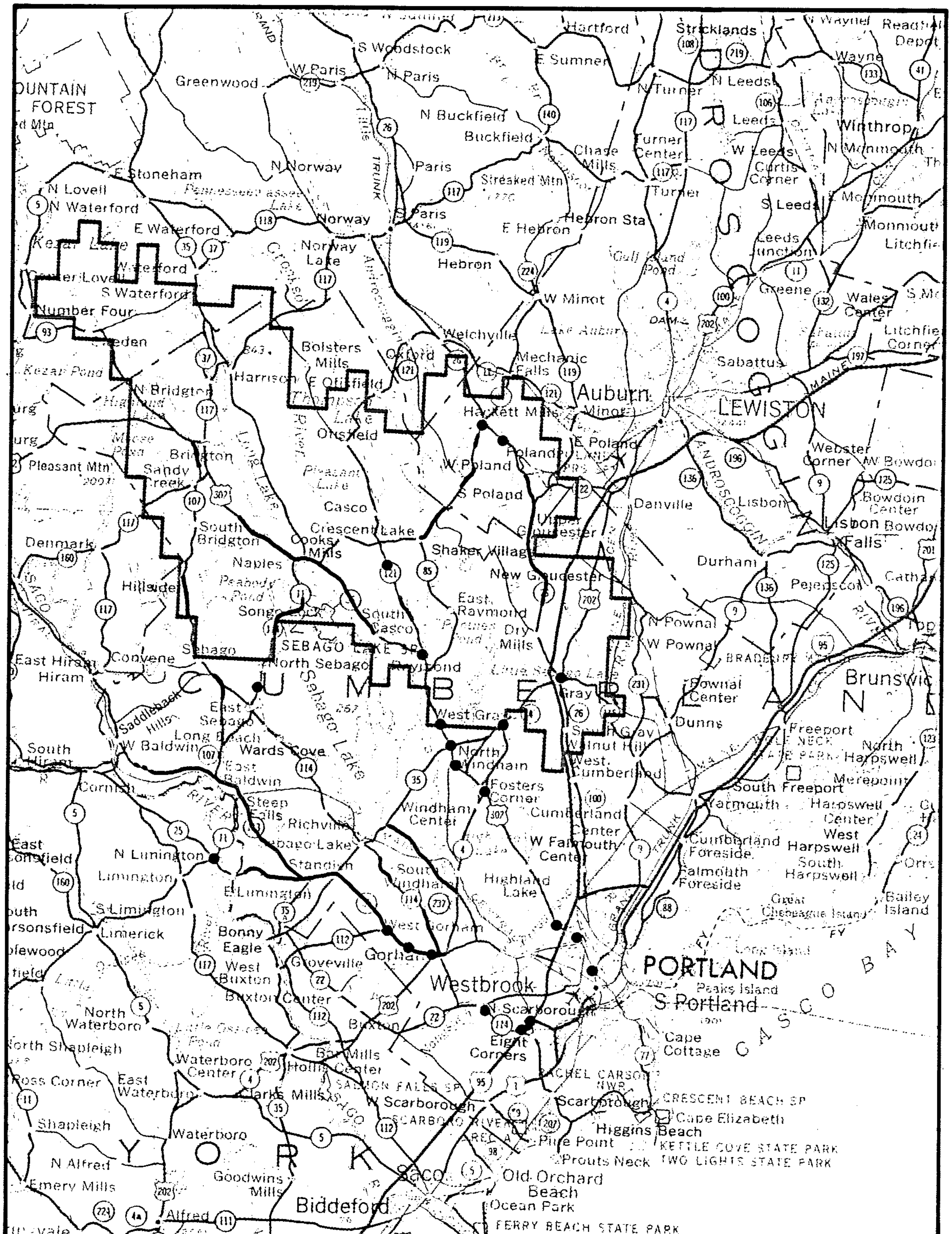


Transportation Network

- Accident rate > 1.0
- Pavement condition rating < 2.0

Source: Maine Department of Transportation

Figure A27-1



Transportation Network

- Accident rate > 1.0
- Pavement condition rating < 2.0

Source: Maine Department of Transportation

Figure A27-2

Proximity of Candidate Areas to National Transportation Network*

Candidate Area	Miles to Interstate Highway	Miles to Mainline Railway
Puritan Batholith (NC-2)	65	25
Wolf River Batholith (NC-3)	40	0
Undifferentiated granites (NC-6)	16	0
Undifferentiated granites (NC-7)	15	10
Undifferentiated granites (NC-9)	45	3
Central Minnesota (NC-10)	8	5
Archean gneiss (NC-12)	0	0
Archean gneiss (NC-13)	35	5
Archean gneiss (NC-14)	50	5
Undifferentiated granites (NC-A5)	20	2
Bottle Lake Comples (NE-2)	15	22
Sebago Lake Batholith (NE-4)	0	5
Cardigan Pluton (NE-5)	5	20
Fredericksburg Complex (SE-1)	5	15
Lovingston gneiss (SE-2)	15	0
Virgilinia gneiss (SE-3)	35	0
Rolesville Pluton (SE-4)	10	0
Elk River Complex (SE-5)	4	7
Lithonia gneiss (SE-6)	6	2
Woodland gneiss (SE-7)	0	6

* Compiled from data in the Department of Energy draft Area Recommendation Report

Comparison of Transportation Safety for States with Candidate Area

State	Vehicles Miles[1]	Fatal Accidents[2]	Non-Fatal Accidents[2]
Georgia	50,846	2.49	94.86
Maine	9,345	2.21	115.14
Minnesota	31,826	1.62	85.35
New Hampshire	7,294	2.37	94.81
North Carolina	48,182	2.68	127.34
Virginia	44,527	2.07	127.50
Wisconsin	35,367	2.02	113.77
National Average	1,716,768	2.31	125.24

[1] millions of vehicle miles

[2] accidents per million vehicle miles

Source: U.S. Department of Transportation, National Highway Administration

Comparison of Highway Condition for States with Candidate Areas

	Major Collector[1]					Minor Collector[1]				
State	<2.0	2.0	2.1-3.4	3.5-5.0	Unpaved	<2.0	2.0	2.1-3.4	3.4-5.0	Unpaved
Georgia			13.6	83.9	2.5	0.6		16.6	59.9	22.9
Maine	8.0	4.9	63.5	23.6		17.0	2.7	57.5	19.1	3.7
Minnesota	1.1	1.7	57.8	25.2	14.2		0.5	37.1	19.8	42.6
New Hampshire	5.0	5.4	76.1	13.5		26.6	4.1	67.4	1.7	0.2
North Carolina	7.7	1.7	32.2	58.4		9.3	7.9	38.7	44.1	
Virgina	4.2	2.2	65.5	28.1		1.6	4.0	65.4	27.8	1.2
Wisconsin	5.8	16.2	49.6	28.2	0.2	6.4	2.0	60.1	29.4	2.1
National Average	7.7	5.4	42.6	30.9	13.4	10.0	4.3	31.8	17.2	36.6

[1] Percentage of total road type within the classification. A rating less than 2.0 or less indicates extremely poor road condition.

Source: U.S. Department of Transportation, National Highway Administration

Appendix A28:

Greater Portland Council of Governments

Analysis of population growth
and
seasonal population increases
in the
Sebago Lake Candidate Area

Reference document; contact source agency for availability

Appendix A29:

Maine Youth Camping Association:

Comments provided the Department of Energy, April 8, 1986

Maine Youth Camping Association

ENJOYABLE LEARNING HEALTHFUL COMMUNITIES

COMMENT

April 8, 1986

TO: United States Department of Energy
Attention: Comments - ARR
Crystalline Repository Project Office
Chicago Operations Office
9800 South Cass Avenue
Argonne, IL 60439

FROM: Maine Youth Camping Association, Inc.
Alan B. Ordway, President

Alan Ordway

The Maine Youth Camping Association submits these written comments and supporting data in opposition to the nomination by the Department of Energy, of Maine's Sebago Lake Batholith or Bottle Lake Complex, as suitable for selection as a high-level nuclear waste repository.

First, we will address the fatal flaw of the D.O.E. omission in its January 1986 ARR of comprehensive data, required by the Nuclear Waste Policy Act of 1982 Section 960.5-2-1(d)(2), that would disqualify a site "if any surface facility...would be located adjacent to an area 1 mile by 1 mile having a population of not less than 1,000 individuals"; as well as under 960.5-2-1(2)(c), "Potentially Adverse Conditions (1) High residential, seasonal or day time population density within the projected site boundaries;" and "(2) Proximity of the site to highly populated areas....".

Second, we submit that under Section 960.5-2-6(c)(4) the "Potential for major disruptions of primary sectors of the economy of the affected area." has been totally neglected by D.O.E. in its ARR; certainly as related to the substantial Children's Camping industry in the state of Maine.

ARR data has completely disregarded the over 97,000 people who receive healthy, recreational, educational and therapeutic services annually at Maine's 229 Children's Camps, the 8,300 jobs they create, and the over $93,000,000 in economic activity they generate. It must therefore be concluded that the D.O.E. has also given no consideration to the immediate, disasterous impact on this institution that would result from just keeping Maine on the list of proposed sites.

It is beyond question that parents across the nation, deeply and justifiably frightened by contamination from notoriously faulty nuclear generation, transportation and disposal will quickly reject the prospect of placing

BOX 10178 PORTLAND, MAINE 04101 207-780-4419

a charitable non-profit corporation

their children anywhere near an area that is being tested to house thousands of tons of deadly, radioactive waste.

The critical perception by families for generations, that Maine is an eminently safe and healthy environment for their sons and daughters will be irretrievably destroyed, long before further investigation of the experimental burying of terribly unstable nuclear fuel rods even begins.

To demonstrate the impact of the loss of our 100-year old youth service through DOE's failure to select "a respository site that will minimize risk to the public from harmful exposure to radiation" (690.5-2-1(1)(2), we have documented the serious absence of accurate population density data (ARA-3-430); and the very high economic benefit of just the 52 Children's Camps in the Sebago Lake Batholith.

Combining these "significant adverse features" (ARA-3-343) with data submitted by cooperating Maine disciplines and agencies it is absolutely clear that this site must be disqualified for any further consideration.

Attached are:

1. Executive Summary
2. Summer Population Density Data
3. Off-Season and Adjacent Population Data
4. Economic Impact Data
5. Terminology and Methodology
6. References and Bibliography

Copies to: Senator William S. Cohen
Senator George J. Mitchell
Congressman John R. McKernan
Congresswoman Olympia A. Snowe
Governor Joseph E. Brennan
Maine Advisory Commission on Radioactive Waste
Portland Council of Governments
Maine Alliance Against Nuclear Dumps
Etc.

1. EXECUTIVE SUMMARY

A. POPULATION DENSITY

(Section 960.5-2-1)

SUMMER SEASON	=	36,900
OFF-SEASON	=	6,100
TOTAL		43,000

- 52 Children's Camps create "high residential, seasonal or day-time population density within the projected site boundaries". (see Items 2., 6.)

- 15,200 children and 2,500 employees in Sebago site Camps summer 1985. Total Youth Camp Population = 17,700. (see Item 2.)

- 19,200 people visited Camp children and employees in 1985. (see Item 2.)

TOTAL SUMMER SEASON POPULATION - 36,900

- Programs conducted other than during the summer (off-season), served over 6,000 children and employed 100 full-time staff.
  Total off-season population = 6,100. (Item 3.)

B. ECONOMIC DISRUPTIONS

(Section 960.5-2-6(c)(4)

- Loss of the 52 Children's Camps would end 2,600 jobs and cut $31,000,000 in economic activity. (see Item 4.)

2. SUMMER 1985

YOUTH CAMP LOCATIONS AND POPULATION DENSITY IN SEBAGO LAKE BATHOLITH

TOWN	CAMP NAME	PEAK CAPACITY	SUMMER YOUTH SERVICE	SUMMER EMPLOYEES	SUMMER VISITORS	TOTALS
CASCO	Arcadia	145	145	54	388	587
	Cedar	240	240	89	642	971
	Hoop Basketball	85	765	32	228	1,025
	Luther Gulick	230	230	86	616	932
	Netop	125	250	47	335	632
	Samoset II	225	225	84	603	912
	Wawenock	110	110	41	294	445
	Sub-Total	1,160	1,965	433	3,106	5,504
RAYMOND	Agawam	125	250	47	335	632
	Hawthorne	75	150	28	201	379
	Dr. Johnson's	180	360	67	482	909
	Kingsley Pines	100	200	37	267	504
	Pinehurst	100	200	37	267	504
	* Naomi	215	430	44	477	951
	Timanous	120	120	45	322	478
	Sub-Total	915	1,710	305	2,351	4,366
NAPLES	Mataponi	150	150	56	402	608
	Pinecrest/Wind-In-The-Pines	55	110	21	148	279
	Skylemar	125	125	47	335	507
	Takajo	385	385	143	1,030	1,558
	Sub-Total	715	770	267	1,915	2,952
HARRISON	Chickawah	100	100	37	267	404
	Wigwam	130	130	49	349	528
	Bendito	60	120	22	160	302
	Newfound	100	200	37	267	504
	Owatonna	100	200	37	267	504
	Pinecliffe	160	160	60	429	649
	Sub-Total	650	910	242	1,739	2,891
BRIDGTON	Winona	275	275	103	737	1,115
	Wildwood	175	175	65	368	708
	Long Lake Lodge	220	440	30	215	685
	* Kingswood	158	632	45	488	1,165
	* Pondicherry	100	100	32	350	482
	Wata-Waso - Day	80	80	12	-	92
	Sub-Total	1,008	1,702	287	2,258	4,247

* Non-Profit/Agency Owned

cont..

2. SUMMER 1985 cont..

YOUTH CAMP LOCATIONS AND POPULATION DENSITY IN SEBAGO LAKE BATHOLITH

TOWN	CAMP NAME	PEAK CAPACITY	SUMMER YOUTH SERVICE	SUMMER EMPLOYEES	SUMMER VISITORS	TOTALS
OXFORD	Fernwood	150	150	56	402	608
	Kohut	120	120	45	321	486
	* Agassiz Village	262	1,048	53	580	1,681
	Sub-Total	532	1,318	154	1,303	2,775
SWEDEN	Tapawingo	190	190	71	509	684
	Encore-Coda	115	230	43	308	667
	Sub-Total	305	420	114	817	1,351
DENMARK	Wyonegonic	160	160	60	464	684
	Walden	173	173	65	429	667
	Sub-Total	333	333	125	893	1,351
POLAND	Tripp Lake	300	300	112	803	1,215
	Potter's	30	30	11	80	121
	Ganderbrook	120	120	45	322	487
	* Pesquasawasis	150	600	30	331	961
	Connor - Day	100	900	12	-	912
	Sub-Total	700	1,950	210	1,536	3,696
WATERFORD	Waziyatah	200	200	75	537	812
	Waganaki	80	160	30	215	405
	Birch Rock	55	55	20	146	221
	Sub-Total	335	415	125	898	1,438
LOVELL	* Frontier	75	450	15	166	631
SEBAGO	O-AT-KA	150	300	56	401	757
	* Sebago	225	1,740	60	1,218	3,018
OTISFIELD	Powhatan	135	270	50	361	681
STONEHAM	* Susan Curtis	110	330	23	245	598
WINDHAM	Center - Day	220	440	26	-	466
YARMOUTH	Soci - Day	80	160	10	-	170
	TOTALS	7,648	15,183	2,502	19,207	36,892

- See Item 5. for Terminology and Methodology for gathering and reporting above data; and Item 6. for References and Bibliography.

3. OFF-SEASON AND ADJACENT POPULATION

Off-Season

A very conservative estimate has been made of the number of people who participated in, and full-time staff employed for, programs conducted other than during the summer season (Off-Season) during 1985 at the 52 Children's Camps in the Sebago Lake Batholith, that were omitted from the D.O.E. ARR, 1/86.

As described in Item 5., Methodology, a mean of 67 people were served in 20% of the Private Resident Camps; and 280 people in 55% of the Agency Resident Camps in 1985. Projected to the 40 Private and the 8 Agency Resident Camps, approximately 1,800 children, and a proportionately calculated 100 full-time employees, were involved in Off-Season programs in 1985.

However, a brief telephone survey of just 3 Camps with known Off-Season programs, indicated the following 1985 populations:

Kennebec Girl Scout Council, Camp Pondicherry, Bridgton	1,700	served
Camp Winona, Bridgton	1,300	"
Salvation Army, Camp Sebago, Sebago	1,200	"
TOTAL	4,200	Served

THEREFORE, IT IS CONSERVATIVELY ESTIMATED THAT OFF-SEASON POPULATIONS WERE CLOSER TO 6,100 IN 1985.

Adjacent

As noted in the ARR, January 1986, page 3-434, "the preliminary candidate area is within 16 km (10 miles) of highly populated areas or areas containing more than 1,000 persons per square mile". Above and beyond the numerous towns, and the city of Portland referenced by D.O.E., it is worth noting that the Children's Camp Population Density would be increased by approximately 20% (as would the "Economic Disruption") by the inclusion of at least 7 Resident Camps and 4 Day Camps located in towns on the perimeter of the Sebago Lake Batholith. These, and probably all Maine Camps would experience the same extremely adverse impact of further consideration of this site as a high-level, nuclear waste repository.

4. ECONOMIC VALUE OF ORGANIZED CAMPING IN THE SEBAGO LAKE BATHOLITH

It is important to recognize the quality, as well as the quantity of the financial impact of this unique industry on local economies.

For almost 100 years some of the nation's finest Children's Camps have operated in the Sebago Lake Region, with an exceptionally high benefit and very low municipal cost to primarily small, rural towns where they may be one of few enterprises.

They infuse essential out-of-state dollars directly into the economy, as well as attracting similar expenditures by visiting, touring parents and friends of children and employees.

Camps have been given no construction incentives, manpower training or tax concessions. They require no expensive school space or teachers for their employees or customers; they dig their own drinking water wells and construct their own sewage disposal systems; they employ their own health service personnel, require no street lights, sidewalks, or winter plowing services; and make very few demands on local fire or police departments.

The Privately Owned Resident Camps that make up over 75% of the operations in the Sebago Lake Region, have a particularly strong financial impact. These Camps draw almost 90% of their children from out-of-state, and are at the upper range of tuitions. Their "new" dollars therefore multiply to have maximum effect on the economy.

As referenced in Item 6., the Annual Industry Study of Organized Camping in Maine in 1985 reported the average Private Resident Camp had summer tuition revenue alone of $384,122. With total tuition revenue of $15,365,000, the 40 Private Resident Camps in the Sebago Region generated over $27,000,000 in direct and indirect economic activity during the summer season.

In similar fashion, the 8 Agency Resident Camps averaged $177,475 in tuition revenue, with a resulting $2,513,000 in direct and indirect economic activity; and the 4 Day Camps generated $65,700 in 1985.

THE ECONOMIC IMPACT OF THESE 52 CAMPS IN 1985 WAS $29,579,000.

In addition to the impact of their direct expenditures, in 1985 the 52 Children's Camps attracted over 19,000 Summer Visitors. (see Item 5.)

THESE VISITORS GENERATED AN ADDITIONAL $1,278,000 IN DIRECT AND INDIRECT ECONOMIC ACTIVITY IN MAINE IN 1985.

The conservatively estimated Off-Season programs in 1985 (see Item 5.), generated an additional $50,000.

TOTAL OF ABOVE ECONOMIC ACTIVITY GENERATED IN 1985 WAS $30,907,000.

5. TERMINOLOGY AND METHODOLOGY

Terminology

"Organized Camp" - A facility licensed by the Maine Department of Human Services, Division of Health Engineering, which they define as a "recreational camp: a combination of program and facilities established for the primary purpose of providing an outdoor group living experience for children for social, recreational, spiritual and educational objectives, and operated and used for 5 or more consecutive days during 1 or more seasons of the year."

"Resident Camp" - Facility constructed and equipped to house, feed, teach and care for children who will be in residence for sessions that usually range from 4 to 8 weeks each summer.

"Day Camp" - Facility which does not usually house children overnight. Recreational and educational programs are usually conducted only during weekdays.

"Agency Camp" - Facility owned and operated by an organization such as a church, Scouts, YMCA, etc.

"Private Camp" - Facility owned and operated by individuals or groups independent from any national or regional agency.

"Off-Season" - The traditional Organized Camp conducts its programs primarily during school vacation months of July and August. In the last decade however, there has been an increase in off-season use of facilities during such as Christmas and February vacations, for pre- and post-summer family camps and instructional clinics, Scout troop camping, etc.

Methodology

Camp location determined by summer address on 1985 list of camps licensed by Maine Department of Human Services, Division of Health Engineering; refined by reference to listings in 1985 Maine Directory of Children's Organized Camps; and substantiated by location on town tax maps (see D.O.E. ARR Comment from Portland, Maine, Council of Government).

"Peak Capacity" of children obtained from data published by each Camp, supplemented by telephone interviews.

"Summer Youth Service" was the product of peak capacity, times published number of sessions, times mean level of enrollment in 1985, as reported in annual Maine Camping Industry Study (see Item 6.).

The 1985 Maine Study reported the mean number of summer and off-season full-time employees. The mean capacity divided by the mean for employees resulted in a ratio for each type of Camp; which was used to determine employment in each Camp.

"Off-Season Population" was the projection of the mean attendance reported in the 1985 Annual Industry Study (see Item 6.), to the correct proportion of Private and Agency Resident Camps. However, telephone interviews with just 3 Camps in the Sebago site indicated that these state-wide means were much too conservative; reflecting barely half of the probable population density during other-than-summer season operation of many facilities. Other known, but not reported programs for pre- and post-season programs for families, special staff instructional clinics, retreats, etc. strongly suggest that there is far more population than current data has established.

The ARR report (page 3-434) indicated "adjacent" includable populations (within a 10-mile radius of the site) would "detract from repository siting". Not only a "majority...of the area", but also at least 7 more Resident and 4 more Day Camps could be considered within such a perimeter; resulting in an approximately 20% increase in all data reported in this Comment.

The number of "Summer Visitors" and the economic impact of their Tourism in 1985 was derived from findings reported in the study Children's Summer Camps - Their Economic Value To Maine (see Item 6.) that established the mean number of visitors for both Private and Agency Camps; and their mean expenditures (adjusted for changes in the Consumer Price Index of 1.94 since data was gathered). This study also contains full discussion of introduction of the indirect "Multiplier Effect", resulting from expenditure of predominantly out-of-state revenues.

6. REFERENCES AND BIBLIOGRAPHY

A. "Maine Youth Camping Association, Inc." is a non-profit, charitable organization, incorporated under the laws of the State of Maine; and granted 501-(c)-3 tax status by the Internal Revenue Service. It currently counts among its membership almost 55% of the state's Organized Children's Camps. Its stated Purposes are "to strengthen and expand the educational, environmental and recreational opportunities provided by all organized Youth Camps in Maine by fostering the exchange of information and ideas; interpreting and coordinating activities that will enhance cooperation between the organized Youth Camping Movement and various private, public and governmental interests and agencies; and identifying and creating research, programs, projects and services that will improve the quality and safety of youth experiences in Maine's organized Camps."

B. "Sections" refer to the Nuclear Waste Policy Act of 1982, as published in the Federal Register/Volume 49, No. 346/Thursday, Dec. 6, 1984/Rules and Regulations - Part 960 - General Guidelines For The Recommendation of Sites For Nuclear Waste Repositories.

C. "ARR" cited is the Area Recommendation Report For The Crystalline Repository Project, Volume 1, January, 1986, United States Department of Energy, Office of Civilian Radioactive Waste Management, Crystalline Repository Office (DOE/CH-15(1).

D. "Portland, Maine, Council of Governments"- see Comment to D.O.E. regarding Draft ARR, submitted April, 1986 by the Council of Government, including "Town Tax Maps" and to which various portions of this Maine Youth Camping Association Comment has been attached; and where cumulative data supports the disqualification of the Sebago Lake Batholith.

E. "Maine Camping Industry Study" - the report Organized Camping In Maine In 1985, published by Organized Camping Resources, Center for Research and Advanced Study, University of Southern Maine, Portland, Maine, December 1985. (see attached copy of Summary cover letter and page 1 of the Report)

F. Children's Summer Camps - Their Economic Value To Maine, Center for Research and Advanced Study, University of Southern Maine, Portland, ME, June 1976. (see attached copy of cover and Table of Contents)

G. This Comment unanimously endorsed at Maine Youth Camping Association Membership Meeting; and by New England Section, American Camping Association Board of Directors, April, 1986, Manchester, NH.

Appendix A30:

Portland Water District

Suitability of the Sebago Batholith
as a
Potentially Accepatble High Level Nuclear Waste Site

Reference document; contact source agency for availability

Appendix A31:

Comments by Dr. John Creasy provided
to the
Natural Resources Council of Maine

March 20, 1986

Mr. Andrew Smith
Natural Resources Council of Maine
271 State Street
Augusta, Maine 04330

Dear Andy:

I reviewed that section of the DOE report dealing with the geology of the Sebago Lake batholith. My report (and accompanying map) is the chief reference on the geology of the batholith and is cited at least 18 times in the DOE report. I identified several instances where the DOE use of my data is incorrect, incomplete, or in my judgement, misleading. As a result, the DOE report does not accurately represent the probable thickness, textural variations, faulting, and tectonic features associated with the candidate site. The thickness and lithologic data seem systematically biased towards a simplified description and interpretation that does not include qualifying remarks or specific details present in my report. Such a simplified portrait of the batholith is thicker and more texturally homogeneous than implied by my report or my field observations over the last decade.

Sincerely

John W. Creasy, Ph.D.

March 20, 1986

Evaluation of DOE Report
Geology of Sebago batholith
J.W.Creasy

Key Points

1. Thickness of batholith The generalized cross-section of Creasy (1979) is not interpreted correctly.

> DOE (p. 3-399): "Geologic cross-sections...introduce the possibility that the body may reach a thickness of upto 5 km (3 mi) (Creasy,1979)."

> Creasy (p. 17): "... the granites of the Sebago pluton in fact may be a multiple intrusion of several thick (100-200m) curved (?) sheets or 'fingers' ...and which might, in a regional strúctural restoration, be stacked one over another with interdigitating metasediments. Hence, the septa preserved within the granitic terrain of the Sebago pluton and its contact zone may represent such interdigitated metasediments." (Creasy, 1979, p.17)

Although abundant reference is made to the report of Creasy, the information quoted below relevant to the interpretation of thickness is notably absent in the DOE report. In addition, the gravity data cited by DOE (Hodge et al., 1982; Hayward and Gaudette,1984) suggests a sheet 1 km thick. The only support cited for a thicker body is the erroneous interpretation of my data.

2. Nomenclature The nomenclature as used in the report is incorrect.

The main phase is the "granites of the Sebago pluton" defined by Creasy. The Westbrook phase of the DOE report is incorrectly equated with the "granite with heterogeneous texture" defined by Creasy. Westbrook phase was never mentioned by Creasy. This confusion of terms means that information regarding each of these phases is confused and misapplied.

3. Lithology Several statements in DOE report do not accurately describe the lithology of the granites.

> DOE (p.3-304): "...main phase ...is generally homogeneous in texture."

> Creasy (p.9): "This granite is broadly homogeneous in texture although gradation to pegmatitic texture may be present in single outcrops....Biotite...is responsible for the variably developed foliation present in nearly all

outcrops."

I use broadly to mean on a large scale not to mean generally. Further, a foliated rock is by definition not homogeneous in texture.

DOE (p. 3-405): "Metasedimentary inclusions that may exceed 100 m (328 ft) in diameter and account for upto 40% of a given outcrop characterize the Westbrook phase (Creasy, 1979)."

Creasy (p. 10): "Areas of metasediment up to hundreds of metres is size crop out in this zone and may be either large inclusions within the granite or in situ country rock into which the granite has intruded."

I never used the term Westbrook phase; this is their mis application of terms. A look at the map shows several areas that are 1,000-2000 metres in dimension. Whether inclusions (i.e. fragments suspended in the granite or actual country rocks that persist to depth is important distinction that they fail to mention or acknowledge.

DOE (p. 3-405): "Metasedimentary inclusions are also locally abundant in the main phase granite but generally account for less than 2 to 4% of a given outcrop."

Creasy (p.9): "Septa of metasedimentary rocks,...are persistently present but not abundant (<2-4%) in all outcrops."

Perhaps the comparison above makes an oblique point but a different phrasing certainly.

DOE (p. 3-405): "Both the Sebago Lake batholith and the country rock are cut by pegmatites."

Creasy (p. 11): "Within the granite(s) os the Sebago pluton, ...pegmatites are present as ...pod-like bodies grading into the surrounding granite.

DOE (p.3-405): "In the country rock, pegmatites are generally tabular bodies which lie parallel to the lithologic banding of the host rock."

Creasy (p.11): statement paraphrased by DOE followed by "However, at contacts sufficiently well exposed, clear cross-cutting relations are observed..."

3. Faulting The existence and extent of faulting documented in the candidate area is limited due to incomplete geologic information not to a lack of faulting.

DOE (p. 3-406): "The candidate area is not affected by any known faults."

The Ben Barrows fault of Creasy is identified and extended in a southwestern direction (i.e. into the pluton) to the limit of the area mapped. It is highly probable that it continues further to the southwest where detailed mapping has not been done. The termination of this fault on the 1985 Geologic Map of Maine is based upon Creasy.

4. Tectonic Activity **The DOE's statement that "No tectonic features in the candidate area are related to Triassic or Cenozoic events." is erroneous.**

Creasy notes (p.13) swarms of mafic dikes in the candidate area of probable Triassic age and cites 100 to 300 metres of total extension to accommodate them. Such dikes may be traced for hundreds of metres.

The Rattlesnake Mountain pluton identified by Creasy in the late 1970's and shown on the 1985 Geologic Map of Maine is dated at 192 m.y. (Jurassic, which is younger than Triassic). A swarm of associated dikes (196 m.y. old) extend at least 10 km to the northeast and southwest of Rattlesnake Mountain pluton cutting across the heart of the candidate area. An aggregate width of 113 m of dikes across a 1.2 km traverse suggests at least 10% extension during intrusion.

Appendix A32:

Letter from Dr. David Sanger, Department of Anthropology,
University of Maine, Orono
to
Dr. David Wihry

UNIVERSITY OF MAINE *at Orono*

Department of Anthropology

Stevens Hall, South
Orono, Maine 04469-0158
207/581-1894

February 14, 1986

Memo to David Wihry
From David Sanger
Re Nuclear Repository Project

I have examined the Draft statement and find no appreciation of the fact that the Historical Resources must, by law, be included in any determination of suitability. A phone conversation with Earle Shettleworth, State Historic Preservation Officer, also indicates no attempt on the part of DOE to contact the SHPO office despite Federal guidelines.

The question of historical sites cannot be answered with library type research, or even archival. These areas of the state are largely unexplored from an archaeological perspective, but can reasonably be expected to contain sites that may well have National Register significance.

We have field experience in the Bottle Lake area and have the expertise to conduct background analysis of the Sebago Region. If we were so requested, we could;

a) conduct background evaluation and make a predictive statement as to the probability of finding archaeological sites;

b) conduct field examinations to verify our predictions;

c) evaluate sites in terms of National Register significance;

d) prepare documents suitable for an eligibility determination of Register significance by the SHPO.

Before the SHPO will "sign off" on either of these two areas, the above steps must be taken. Failure to do so is in violation of Federal laws. The law also provides for a statement on the historical resources in any Environmental Impact Statement.

I hope these comments will be of some use to you, and I am available for further assistance as needed.

Dave

Appendix A33:

Letter from Margaret M. Roy, Executive Director,
Saco River Corridor Commission
to
Dr. Sally Mann

Saco River Corridor Commission

March 10, 1986

U.S. Department of Energy
Attention: Comments -- Draft ARR
Chrystalline Repository Project Office
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439

Attention: Dr. Sally Mann

Dear Dr. Mann:

I am writing on behalf of the Saco River Corridor Commission to convey comments relative to selection of the Sebago Lake Batholith as a preliminary candidate area for a nuclear waste repository. I also have brief comments relative to the Bottle Lake Complex site.

The Saco River Corridor Commission was created by the Maine Legislature in 1973 to regulate land use within a defined corridor along the Saco River and its major tributaries. Among the purposes outlined by the statute under which this Commission operates (Title 38, M.R.S.A. Section 951 et seq.) is a requirement that this agency work to preserve existing water quality, prevent the diminution of water supplies, and protect the public health, safety and general welfare. With those purposes in mind, this agency wishes to express its absolute opposition to the DOE's selection of the Sebago Lake Batholith as a prelimary candidate site. We are appalled that your site selection process could be so flawed as to produce such results.

As the ARR indicates, approximately 25% of the Sebago Batholith preliminary candidate area drains to the Saco River. Although much very legitimate attention has been paid to the fact that Sebago Lake itself is a major water supply for the Greater Portland area, there has been little acknowledgement to date that the Saco River is also a major present and potential water supply source for southern Maine.

P.O. Box 283, Main Street • Cornish, Maine 04020 (207) 625-8123

Presently, the cities of Saco and Biddeford in York County use the Saco River as a water supply source through the Biddeford-Saco Water Company. Current demands range from an average daily demand of 3.896 million gallons per day to a maximum daily demand of 7.637 MGD. Portions of Scarborough and Old Orchard Beach are also served by the Biddeford-Saco Water Company. In addition, several years ago, the Kennebunk-Kennebunkport-Wells Water District, serving coastal communities outside the Saco Basin, tied into the Biddeford-Saco Water Company in order to supplement its own supplies, and currently uses up to 1.0 MGD of Saco River water through this tie-in. While these figures reflect only the present major uses of the Saco River as a water supply source, potential future use is substantially greater. A 1982 U.S. Army Corps of Engineers report (Water Supply Study: Saco and Southern Coastal River Basins, State of Maine, 1982) cites the Saco River as a potential water supply source for a number of municipalities which are presently either undergoing or anticipating severe water supply deficits within the next 50 years. These municipalities include Buxton and Hollis in York County which will need a public water supply by the year 1990; Kittery, where the principle water user is the Portsmouth Naval Shipyard; and York, where public water demand is projected to increase by 242% over the next 50 years. In addition, it can be anticipated that the towns of Kennebunk, Kennebunkport and Wells could potentially draw additional water from the Saco River, as local groundwater sources do not appear to be available.

The municipalities cited above are among the fastest growing in Maine; their future depends on a clean and plentiful water supply. The COE study emphasizes the extreme importance of minimizing any risks to Saco River water quality by stating "It can be seen that the quality of the Saco River at the site of the Biddeford and Saco Water Company intake is not only crucial to this company's consumers, but to the entire Southern Maine coastal area with its current and projected water supply deficits. It is therefore crucial that every precaution be taken to preserve this vital resource." We believe that removal of the Sebago Lake Batholith site from your preliminary candidate site listing is a precaution that should be taken immediately.

We also consider your site selection methodology to be grossly deficient in that it does not consider summer population increases, either within the preliminary candidate area or in its immediate vicinity. The DOE has been apprised of the substantial population increases that occur annually within the Sebago Lake Batholith preliminary candidate area itself as a result of summer influxes. We would emphatically point out that this influx extends throughout the Saco Basin, most particularly in those areas which are either dependent on the Saco River for their water supply or are closest to the preliminary candidate area. The Saco River is probably the most canoed river in the entire Northeast region, and the stretch of river from Conway, New Hampshire to Hiram, Maine is the most used river stretch for recreation.

Figures regarding canoe and camping use of the Saco River and adjacent lands are available in a report funded through the U.S. Department of Agriculture Soil Conservation Service and prepared by the Southern Maine Regional Planning Commission. This report (The Saco River: A Plan for Recreational Management, October 1983) indicates that total user days during the 1981 canoe season was 90,240 with over two thirds of that use being confined to the 40 mile river stretch between Conway, New Hampshire and Hiram, Maine - the river area closest to the preliminary candidate site. During the summer months, bridge crossings, which are the major river access points, are often congested areas, and a major highway, Route 302, which is the most likely highway access to the Sebago Lake site, is also the major route for tourist traffic with destinations into both the Saco River and Lakes Region areas. This route is also a major access to the White Mountains, and influxes to the region are not limited to the summer months. The fall foliage season also brings with it a large degree of seasonal traffic. I cannot anticipate a more dangerous setting for accidents than having nuclear wastes transported over high use roads which, given Maine's winter climate, are rarely in good condition.

The problem of transportation also plagues your selection of the Bottle Lake Complex site as a preliminary candidate area. If highway transport is proposed, it is likely that wastes would enter the state via the interstate system, and it would be necessary, even for transport to the Bottle Lake site, to cross the Saco River at some point. Virtually all bridges crossing the Saco River are in the midst of the more densely settled village and urban areas of the Saco Valley and highway accidents near the river could have the same disastrous effect as a leak at the site itself. The Saco River is too important both as a water supply and as a recreational resource to permit such a threat.

We have stated in this letter only those major issues which we feel have direct impact on the Saco River Basin and its citizens. There are, of course, a number of other questions which the draft ARR leaves unanswered concerning the ultimate safety of transportation and disposal of high level nuclear wastes. As a regulatory agency with the statutory purpose of protecting the Saco River as a clean and plentiful water supply and as a nationally important recreational resource, we feel these concerns must be addressed by the DOE as soon as possible.

Sincerely,

Margaret M. Roy

Margaret M. Roy
Executive Director

cc: Senator George Mitchell
Rep. John McKernan
Rep. Olympia Snowe
Governor Joseph E. Brennan
Maine Advisory Commission on Radioactive Wastes

Appendix A34:

Letter from Kenneth C. Young, Jr., Commissioner,
Maine Department of Environmental Protection
to
Mr. Howard Larsen

STATE OF MAINE

Department of Environmental Protection

MAIN OFFICE: RAY BUILDING, HOSPITAL STREET, AUGUSTA
MAIL ADDRESS: State House Station 17, Augusta, 04333

JOSEPH E. BRENNAN
GOVERNOR

KENNETH C. YOUNG, JR.
ACTING COMMISSIONER

April 8, 1986

Mr. Howard Larsen, Regional Director
U.S. Fish and Wildlife Service
Suite 700
One Gateway Ctr.
Newton Corner, MA 02158

Dear Mr. Larsen:

It has come to my attention that Maine possesses a very rare species of mayfly (Siphlonisca aerodromia) which until recently had not been found anywhere in the world since the 1930's. I am enclosing information that we have about this unique species. What I would like to request from your office is a determination of this species' merits as a candidate for inclusion on the Rare and Endangered Species list.

Maine is currently investigating the Department of Energy's proposal to locate a high level nuclear waste site in one of two locations in the state. The only known habitat of this mayfly species is closely adjacent to one of the sites in eastern Maine. It would be valuable for DOE and the State to know if this species may be deserving of protection of the Rare and Endangered Species Act.

Additional information may be available from Dr. K. Elizabeth Gibbs of the Department of Entomology at the University of Maine in Orono. I would appreciate your immediate attention to this matter.

Sincerely,

K.C. Young

KENNETH C. YOUNG, JR.
Commissioner

cc: Henry Warren, SPO
[redacted]
K. Elizabeth Gibbs, UMO
David Courtemanch, DEP

d/

Appendix A35:

Letter from Ambassador Allan Gotlieb, Canada,
to
United States Senator George Mitchell, Maine

FYI

Canadian Embassy   Ambassade du Canada
1746 Massachusetts Ave. N.W.
Washington, D.C. 20036-1985

March 5, 1986

Senator George J. Mitchell,
Room 364,
Senate Russell Office Building,
Washington, D.C. 20510

Dear Senator Mitchell:

Thank you for your letter of February 18 regarding the possible siting of a high-level nuclear waste repository in the State of Maine, which you raised during our recent meeting. As you are no doubt aware, the Canadian Government has formally conveyed its concern to the United States Administration about the potential risks to Canada of locating a nuclear waste repository close to the Canadian border or in any drainage basin system extending into Canada.

As a result of Canada's ensuing interest in the U.S. Department of Energy's site selection process, a bilateral consultative mechanism was established by Secretary of State for External Affairs Clark and Secretary of State Shultz in the spring of 1985 to facilitate a full exchange of information and views. Two bilateral meetings have been held to date and a third is being planned for early April in Washington, D.C. This consultative process has been useful as a means of conveying Canadian views and concerns and clarifying the technical aspects of the site selection process.

At the second meeting in September 1985, the United States Government made a commitment to Canada that any area requiring fieldwork or monitoring in Canada would be excluded from further consideration. ~~This commitment led to the Chain Lakes Massif~~ preliminary candidate area on the Maine/Quebec border being dropped from the January 16, 1986 Draft Area Recommendation Report.

At our next meeting, Canadian officials plan to discuss, among other things, potential concerns with the Bottle Lake complex in Maine. Should it be considered necessary, the Canadian Government may also provide written comments through the usual diplomatic channels.

.../2

Your letter suggests that the nuclear waste repository issue should be raised with the International Joint Commission. As you know, joint references to the IJC have served Canada and the United States well in the management of transboundary environmental questions. A joint reference by both countries on this matter is obviously one of the possibilities that will have to be considered.

Thank you for taking the trouble to share your concerns on this very difficult question.

Yours sincerely,

Allan Gotlieb

Allan Gotlieb,
Ambassador

Appendix A36:

Comments prepared by Dr. Gene Simmons of GEOSS, Inc.
for the
State of Vermont

REVIEW
OF
AREA RECOMMENDATION REPORT
FOR THE CRYSTALLINE REPOSITORY PROJECT
JANUARY 1986 DRAFT

Prepared for
State of Vermont
Agency of Environmental Conservation
Office of The State Geologist

by

Geoscience Services of Salem, Inc.
180 North Policy Street
Salem, NH 03079
(603) 893-3124

March 15, 1986

GEOSS

AREA RECOMMENDATION REPORT
REVIEW FOR VERMONT STATE GEOLOGIST

TABLE OF CONTENTS

		Page
1.	Introduction	2
2.	Summary	3
3.	General Comments	4
4.	Detailed Comments	5
5.	References Cited	11

1. INTRODUCTION

The Vermont State Geologist, Dr. Charles Ratte' requested Geoscience Services of Salem, Inc. to critique the Area Recommendation Report for the Crystalline Repository Project, draft dated January 1986 (DOE, 1986), Section 3.2.2 titled "Northeastern Region". This section treats the Cardigan pluton in southwestern New Hampshire, the Sebago pluton in southwestern Maine, and the Bottle Lake Complex in southeastern Maine. The preliminary candidate areas are designated in that report as NE-5, NE-4, AND NE-2, respectively.

Gene Simmons, Professor of Geophysics at The Massachusetts Institute of Technology, prepared the report. He has extensive experience in the siting of nuclear and other critical facilities and in the regional geology and geophysics of New England.

For simplicity and economy of words, REPORT is used in this review to mean "Area Recommendation Report for the Crystalline Repository Project, draft dated January 1986, published by U. S. Department of Energy, Office of Civilian Radioactive Waste Management, Crystalline Repository Project Office, Report DOE/CH-15". The volume number is appended only where it is needed to avoid ambiguity.

2. SUMMARY

The REPORT has integrated the results reported in an extensive literature on the geology and geophysics of New England. However, the conclusions are flawed by the following considerations:

1. Gravity data.

   The earth's gravity provides an excellent guide to the thickness of rock bodies, a critical item in the REPORT. However, the data, available from the Public Domain, was not reprocessed and the previously published models of thickness based on gravity were not examined critically. At least some of the models are incorrect and the resulting thicknesses are wrong.

2. Seismic data.

   The locations of earthquakes in New England are better than indicated in the REPORT.

   The data presented in the REPORT show an increased frequency of occurrence of earthquakes in the vicinity of the Sebago pluton. The cause of the increased frequency is stated to be "population patterns". The dismissal of such important data by a vague unsupported cause is probably not justifiable.

3. GENERAL COMMENTS

The REPORT is generally clearly written. It states the basis for including the three preliminary candidate areas of New England in the list of 12 "proposed potentially acceptable sites."

The DOE contractor (or contractors) that prepared the section on New England should have looked more critically at the geophysical data, particularly gravity and seismic data. The published models for the Sebago pluton and vicinity are incorrect, as can be shown easily. However, they apparently played an important role in the selection process. Reprocessing the data for the Cardigan pluton would likely show flaws in the published models also.

The seismic data for the Sebago pluton, presented in the REPORT, show the frequency of earthquakes in that area to be higher than in the "geologic setting" in which the pluton is situated. That finding was discounted on the basis of population patterns and played no significant part in the selection process. However, many of the events occurred at a time after instrumental locations became available.

The discussions of fracture zones in New England and of permeability of crystalline rocks in the GEOSS' report "Review of Northeastern Regional Geologic Characterization Report, November 1984 draft" prepared for the Vermont State Geologist, are applicable to the present REPORT; the material is not repeated here.

4. DETAILED COMMENTS

The comments in this section are keyed to specific locations in the text.

Page 3-356, first incomplete sentence ...Moench et al.,(1982). The plutons in Maine may not be as thick as the reference indicates. We have recently analyzed the gravity data for the Sebago pluton area and concluded that the Sebago is considerably thinner than indicated on page 3-356. The DOE contractor apparently did not examine critically the models that are cited from the literature. The gravity data used by us were available from the public domain.

Page 3-356, second sentence ...Hodge et al.,1982). The phrase "on the order of" is apparently used incorrectly and "approximately" should be substituted for it. The two phrases are not synonymous. However, even with the correct language, I do not understand the relevance of the statement. The intrusives with which we are concerned are not south of the Norumbega fault zone.

Page 3-358, bottom paragraph. First sentence indicates that the contractor confused eastern United States with northeastern US or with New England. Problems of associating earthquakes with specific structures in New Jersey, Virginia, North Carolina are probably not applicable to New England, the region of concern in evaluating the work done for NE-2, NE-4, and NE-5.

I had thought there was reasonably good correlation between earthquakes in Maine and a few structures.

In addition, in the work done for Boston Edison in support of the licensing of Pilgrim Unit II, we had shown a probable correlation of larger earthquakes with mafic plutonic rocks. The work is published in the NRC documents for Pilgrim II and are therefore publicly available. Martin Kane had also published similar correlations in other (eastern) provinces.

Page 3-378, paragraph "Joints and fractures ...." "Ayuso (1984)... but indicates a significant increase in jointing with proximity to the areas of intense cataclastic deformation". This finding probably indicates that the jointing is relatively recent and that the cataclastic zones have been the location of repeated faulting. The evidence should be considered a warning that relatively recent faulting has likely occurred in New England.

Page 3-380, 1st paragraph "All earthquake epicenters ..." Figure 3-90 shows two earthquakes occurred in the vicinity of NE-2 within the last 10 years. These events should have been examined more closely than the REPORT indicates that they have been. The coincidence appears to be too strong to ignore.

Page 3-380, 2nd paragraph "There is no ..." The statement that "there is no evidence for ..." is meaningless without a parallel statement detailing the effort that has been spent searching for the evidence, the methods used, and so on.

Furthermore, the statement, as written is demonstrably wrong. The data available in the Public Domain are sufficient to cast doubt on the validity of the statement. In addition, I am about ready to publish the results of a study on an area within the "geologic setting" of the particular preliminary candidate area in which we develop considerable geophysical evidence for Quaternary faulting. However, a critique of the ARR is not the place to publish initially the results.

Page 3-383, 1st paragraph, 2nd sentence. The statement that "no information is available ..." is meaningless without a parallel statement detailing the effort that has been spent searching for the information, the methods used, and so on.

In addition, my group has been fairly successful during the past several years in finding holes deeper than 1,000 feet in New England. It is likely that one or more such holes are present in the candidate area.

Page 3-385. Most of this page is repeated on page 3-387. Therefore, the material that appears to be missing is probably given on 3-387.

Page 3-397, "no evidence of drilling ..." The statement that "there is no evidence for ..." is meaningless without a parallel statement detailing the effort that has been spent searching for the evidence, the methods used, and so on. As discussed in the comment on page 3-383, we believe it is likely that one or more such holes are present in the candidate area.

Page 3-399, 1st and 2nd paragraphs of section "Host Rock Geometry and Overburden Thickness.

A. The gravity models of Hodge et al. (1982) for both the Sebago pluton and the small plutons nearby are simply incorrect and the incorrect models have been used by the DOE contractor. The words of Hodge et al. (1982, page 1297) follow:

"The nature of this gravity low adjacent to the Sebago batholith is shown by profile A-A' (fig. 3). Using a density contrast of -0.17 g cm^{-3}, the calculation of a two dimensional gravity model (Talwani, Worzel, and Landisman, 1959) indicates that felsic rocks less than 2.5 km thick extend beneath the metamorphic rocks. This profile suggests that the small outcrops of granitic rocks are cupolas that are part of a more extensive granite sheet. Since this anomaly is immediately adjacent to the Sebago pluton the comparison of the calculated extent of these granites and the observation of only a small anomaly over the Sebago batholith suggest that the Sebago pluton is very thin. If a similar density contrast (-0.17 g cm^{-3}) is assumed for the Sebago pluton, a maximum thickness of about 1 km is indicated for the granitic batholith (Ring, ms)."

The thickness of the slab used to model the small pluton shown by Hodge et al., as measured on their figure 3 is about 2 1/2 km. Their statement in the text is "less than 2.5 km thick". These values are not compatible with a density contrast of -0.17 and a residual gravity anomaly of -10 mgals. The geometry of their model is such that the value of gravity over the central half of the slab should be equal to an infinite slab of the same thickness, easily calculated from the equation

grav = 2 X pi X G X rho X thick

where

grav = gravity in milligals
pi = 3.14159
G = 6.667
rho = density in gm/cm^3
thick= thickness in km

The calculation gives 7.12 mgals per kilometer of thickness. Thus, 2 1/2 km of the granite would produce an 18 mgal gravity low. However, they indicated that the observed value was only 10 mgals.

The model shown in DOE figure 3-97, apparently copied from Hodge et al.'s figure 3, shows the same geometry as Hodge et al. but the thickness is only 1 km. Did the DOE contractor err in drawing the figure? If not, then he erred in not also following the logic of Hodge et al. that the thickness of the Sebago pluton is less than the thickness of the small pluton modeled in profile AA' and therefore only a fraction of the stated 1 km.

In any event, the DOE contractor's use of Hodge et al.'s work is inconsistent with the published paper.

B. We do not agree with Hodge et al. (1982) interpretation of the gravity data for the Sebago pluton and vicinity. We have prepared a report for the Maine Geological Survey in which we show that the Sebago pluton is much thinner than Hodge et al. suggested.

The model, reproduced by the DOE contractor, Figure 3-97, should be removed from the report and replaced with a correct version.

Page 3-404, Middle paragraph. The statement that "... the rock of the preliminary candidate area is sufficiently thick ..." is incorrect. See the discussion above for page 3-399.

Page 3-408, First paragraph on Seismicity. The following sentence is incorrect:

> "The evidence presented indicates that large uncertainties associated with the location and size of earthquakes in the eastern United States make it necessary to discuss their distribution with respect to geologic features, in a broad rather than specific sense."

First, no evidence was presented, only assertions. Second, we are concerned with the northeastern US, not the eastern US. Third, many earthquakes in the New England area can be located with an epicentral uncertainty of about 2 km. The DOE contractor should examine the New England Seismic Network data for many of the events.

Page 3-408, Last incomplete sentence. The following statement is most likely incorrect:

> "The apparent spatial coincidence of repeated earthquake activity, shown on Figure 3-100, is probably a result of population patterns"

Unless the DOE contractor presents evidence supporting this assertion, then the data must be taken at face value. The Sebago pluton area, preliminary candidate area N-4, has a significantly higher incidence of seismicity than the region. By the rules of the selection process, N-4 should have been disqualified. The unsupported assertion that "population patterns" caused the repeated seismicity of the area must be justified.

Page 3-410, Sentence "There is no evidence ... The statement that "there is no evidence for ..." is meaningless without a parallel statement detailing the effort that has been expended searching for the evidence, the methods used, and so on.

See also the comment on page 3-380.

Page 3-432, Phrase "presence of host rock with sufficient thickness and lateral extent ..." The thickness has been incorrectly estimated. See comment on page 3-399.

Page 3-433, Phrase "the frequency of occurrence or magnitude of earthquakes within the geologic setting are no higher than within the region ..." This statement is simply incorrect on the basis of the data presented in the DOE report. See comment on page 3-408.

Page 3-440, Last sentence of Paragraph beginning "Locally, the ..." The implications of the following sentence may not have been recognized:

> "The post-tectonic Concord granite intruded into a more brittle crust by using pre-existing areas of crustal weakness or multiple forcible intrusions (Nielson et al., 1976; Veranon, 1971)."

The concept of zones of crustal weakness being reactivated and thereby localizing earthquake activity is a popular one. Perhaps the recognition that such zones have been suggested for the Cardigan pluton should be heeded as a warning that the pluton will not be satisfactory for a repository.

Page 3-442, First paragraph on Seismicity. The following sentence is incorrect:

> "The evidence presented in that discussion indicates that large uncertainties associated with the location and size of earthquakes in the eastern United States make it necessary to discuss their distribution with respect to geologic features, in a broad rather than specific sense."

First, no evidence was presented, only assertions. Second, we are concerned with the northeastern US, not the eastern US. Third, many earthquakes in the New England area can be located with an epicentral uncertainty of about 2 km. The DOE contractor should examine the New England Seismic Network data for many of the events.

Page 3-442, Second paragraph on Seismicity. The statement that most earthquakes in the vicinity of the candidate area have intensities of MM III is meaningless in view of having only 3 earthquakes in the area for which intensities are given (see figure 3-111).

Page 3-442, Last incomplete sentence. The following statement is at least partially incorrect:

> "One exploration borehole (depth unavailable) is located outside of the preliminary candidate area adjacent to its northern boundary at .... (Birch et al., 11968)."

The hole is at least 260 meters deep on the basis of the data reported in the reference cited in the sentence. A phone call to any of the authors would likely have obtained the total depth of the hole.

Page 3-446, Middle paragraph. With respect to maximum depth of holes drilled inside the boundary of N-2, Jaupart, Mann and Simmons (1982) reported data for a hole within the boundary. The publication indicated that the hole was at least 155 meters deep.

Page 3-458, Fifth item. "absence of active faulting within the geologic setting..." This clause is simply incorrect. See discussion for page 3-380, 2nd paragraph.

Page 3-459, Second item. "no evidence of drilling to a depth sufficient to affect waste containment or isolation..." The data on which this statement is based is incorrect and therefore the validity of the statement is suspect.

5. REFERENCES CITED

DOE, 1986, Area recommendation report for the crystalline repository project, REPORT DOE/CH-15.

Hodge DS, Abbey DA, Harbin MA, Patterson JL, Ring MJ, Sweeney JF, 1982, Gravity studies of subsurface mass distributions of granitic rocks in Maine and New Hampshire, Amer J Sci 282: 1289-1324.

Jaupart C, Mann JR, Simmons G, 1982, A detailed study of the distribution of heat flow and radioactivity in New Hampshire, EPSL 59: 267-287.

Appendix A37:

Agreement between the Governments of the United States and Canada governing transit pipelines

TREATIES AND OTHER INTERNATIONAL ACTS SERIES 8720

TRANSIT PIPELINES

Agreement Between the
UNITED STATES OF AMERICA
and CANADA

Signed at Washington January 28, 1977

NOTE BY THE DEPARTMENT OF STATE

Pursuant to Public Law 89-497, approved July 8, 1966 (80 Stat. 271; 1 U.S.C. 113)—

"... the Treaties and Other International Acts Series issued under the authority of the Secretary of State shall be competent evidence ... of the treaties, international agreements other than treaties, and proclamations by the President of such treaties and international agreements other than treaties, as the case may be, therein contained, in all the courts of law and equity and of maritime jurisdiction, and in all the tribunals and public offices of the United States, and of the several States, without any further proof or authentication thereof."

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Subscription Price: $75 per year; $18.75 additional

CANADA

Transit Pipelines

Agreement signed at Washington January 28, 1977;
Ratification advised by the Senate of the United States of America August 3, 1977;
Ratified by the President of the United States of America September 15, 1977;
Ratified by Canada August 29, 1977;
Ratifications exchanged at Ottawa September 19, 1977;
Proclaimed by the President of the United States of America September 30, 1977;
Entered into force October 1, 1977.

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A PROCLAMATION

CONSIDERING THAT:

The Agreement between the Government of the United States of America and the Government of Canada Concerning Transit Pipelines was signed at Washington on January 28, 1977, the text of which Agreement, in the English and French languages, is hereto annexed;

The Senate of the United States of America by its resolution of August 3, 1977, two-thirds of the Senators present concurring therein, gave its advice and consent to ratification of the Agreement.

The Agreement was ratified by the President of the United States of America on September 15, 1977, in pursuance of the advice and consent of the Senate, and was duly ratified on the part of Canada;

It is provided in Article X of the Agreement that the Agreement shall enter into force on the first day of the month following the month in which the instruments of ratification are exchanged;

The instruments of ratification of the Agreement were exchanged at Ottawa on September 19, 1977; and accordingly the Agreement entered into force on October 1, 1977;

NOW, THEREFORE, I, Jimmy Carter, President of the United States of America, proclaim and make public the Agreement, to the end that it shall be observed and fulfilled with good faith on and after October 1, 1977, by the United States of America and by the citizens of the United States of America and all other persons subject to the jurisdic-

IN TESTIMONY WHEREOF, I have signed this proclamation and caused the Seal of the United States of America to be affixed.

DONE at the city of Washington this thirtieth day of September in [SEAL] the year of our Lord one thousand nine hundred seventy-seven and of the Independence of the United States of America the two hundred second.

JIMMY CARTER

By the President:
WARREN CHRISTOPHER
Acting Secretary of State

AGREEMENT BETWEEN THE GOVERNMENT
OF THE UNITED STATES OF AMERICA AND
THE GOVERNMENT OF CANADA CONCERNING
TRANSIT PIPELINES

The Government of the United States of America and the Government of Canada,

Believing that pipelines can be an efficient, economical and safe means of transporting hydrocarbons from producing areas to consumers, in both the United States and Canada;

Noting the number of hydrocarbon pipelines which now connect the United States and Canada and the important service which they render in transporting hydrocarbons to consumers in both countries; and

Convinced that measures to ensure the uninterrupted transmission by pipeline through the territory of one Party of hydrocarbons not originating in the territory of that Party, for delivery to the territory of the other Party, are the proper subject of an agreement between the two Governments;

Have agreed as follows:

ARTICLE I

For the purpose of this Agreement:

(a) "Transit Pipeline" means a pipeline or any part thereof, including pipe, valves and other appurtenances attached to pipe, compressor or pumping units, metering stations, regulator stations, delivery stations, loading and unloading facilities, storage facilities, tanks, fabricated assemblies, reservoirs, racks, and all real and personal property and works connected therewith, used for the transmission of hydrocarbons in transit. "Transit Pipeline" shall not include any portion of a pipeline system not used for the transmission of hydrocarbons in transit.

(b) "Hydrocarbons" means any chemical compounds composed primarily of carbon and hydrogen which are recovered from a natural reservoir in a solid, semi-solid, liquid or gaseous state, including crude oil, natural gas, natural gas liquids and bitumen, and their derivative products resulting from their production, processing or refining. In addition, "hydrocarbons" includes coal and feedstocks derived from crude oil, natural gas, natural gas liquids or coal used for the production of petro-chemicals.

(c) "Hydrocarbons in transit" means hydrocarbons transmitted in a "Transit Pipeline" located within the territory of one Party, which hydrocarbons do not originate in the territory of that Party, for delivery to, or for storage before delivery to, the territory of the other Party.

ARTICLE II

1. No public authority in the territory of either Party shall institute any measures, other than those provided for in Article V, which are intended to, or which would have the effect of, impeding, diverting, redirecting or interfering with in any way the transmission of hydrocarbons in transit.

2. The provisions of paragraph 1 of this Article apply:

(a) In the case of Transit Pipelines carrying exclusively hydrocarbons in transit, to such volumes as may be transmitted to the Party of destination in the Transit Pipeline;

(b) In the case of Transit Pipelines in operation at the time of entry into force of this Agreement not carrying exclusively hydrocarbons in transit, to the average daily volume of hydrocarbons in transit transmitted to the Party of destination during the 12 month period immediately prior to the imposition of any measures described in paragraph 1;

(c) In the case of Transit Pipelines which come into operation subsequent to the entry into force of this Agreement not carrying exclusively hydrocarbons in transit, to such volumes of hydrocarbons in transit as may be authorized by the appropriate regulatory bodies; or

(d) To such other volumes of hydrocarbons in transit as may be agreed upon subsequently by the Parties.

3. Each Party undertakes to facilitate the expeditious issuance of such permits, licenses, or other authorizations as may be required from time to time for the import into, or export from, its territory through a Transit Pipeline of hydrocarbons in transit.

ARTICLE III

1. No public authority in the territory of either Party shall impose any fee, duty, tax or other monetary charge, either directly or indirectly, on or for the use of any Transit Pipeline unless such fee, duty, tax or other monetary charge would also be applicable to or for the use of similar pipelines located within the jurisdiction of that public authority.

2. No public authority in the territory of either Party shall impose upon hydrocarbons in transit any import, export or transit fee, duty, tax or other monetary charge. This paragraph shall not preclude the inclusion of hydrocarbon throughput as a factor in the calculation of taxes referred to in paragraph 1.

ARTICLE IV

1. Notwithstanding the provisions of Article II and paragraph 2 of Article III, a Transit Pipeline and the transmission of hydrocarbons through a Transit Pipeline shall be subject to regulations by the appropriate governmental authorities having jurisdiction over such Transit Pipeline in the same manner as for any other pipelines or the transmission of hydrocarbons by pipeline subject to the authority of such governmental authorities with respect to such matters as the following:

a. Pipeline safety and technical pipeline construction and operation standards;

b. environmental protection;

c. rates, tolls, tariffs and financial regulations relating to pipelines;

d. reporting requirements, statistical and financial information concerning pipeline operations and information concerning valuation of pipeline properties.

2. All regulations, requirements, terms and conditions imposed under paragraph 1 shall be just and reasonable, and shall always, under substantially similar circumstances with respect to all hydrocarbons transmitted in similar pipelines, other than intra-provincial and intra-state pipelines, be applied equally to all persons and in the same manner.

ARTICLE V

1. In the event of an actual or threatened natural disaster, an operating emergency, or other demonstrable need temporarily to reduce or stop for safety or technical reasons the normal operation of a Transit Pipeline, the flow of hydrocarbons through such Transit Pipeline may be temporarily reduced or stopped in the interest of sound pipeline management and operational efficiency by or with the approval of the appropriate regulatory authorities of the Party in whose territory such disaster, emergency or other demonstrable need occurs.

2. Whenever a temporary reduction of the flow of hydrocarbons through a Transit Pipeline occurs as provided in paragraph 1:

(a) In the case of a Transit Pipeline carrying exclusively hydrocarbons in transit, the Party for whose territory such hydrocarbons are intended shall be entitled to receive the total amount of the reduced flow of hydrocarbons,

(b) In the case of a Transit Pipeline not carrying exclusively hydrocarbons in transit, each Party shall be entitled to receive downstream of the point of interruption a proportion of the reduced flow of hydrocarbons equal to the proportion of its net inputs to the total inputs to the Transit Pipeline made upstream of the point of interruption. If the two Parties are able collectively to make inputs to the Transit Pipeline upstream of the point of interruption, for delivery downstream of the point of interruption, of a volume of hydrocarbons which exceeds the temporarily reduced capacity of such Transit Pipeline, each Party shall be entitled to transmit through such Transit Pipeline a proportion of the total reduced capacity equal to its authorized share of the flow of hydrocarbons through such Transit Pipeline prior to the reduction. If no share has been authorized, specified or agreed upon pursuant to Article II, paragraph 2, the share of the Parties in the reduced

flow of hydrocarbons shall be in proportion to the share of each Party's net inputs to the total flow of hydrocarbons through such Transit Pipeline during the 30 day period immediately preceding the reduction.

3. The Party in whose territory the disaster, emergency or other demonstrable need occurs resulting in a temporary reduction or stoppage of the flow of hydrocarbons shall not unnecessarily delay or cause delay in the expeditious restoration of normal pipeline operations.

ARTICLE VI

Nothing in this Agreement shall be considered as waiving the right of either Party to withhold consent, or to grant consent subject to such terms and conditions as it may establish consistent with the principles of uninterrupted transmission and of non-discrimination reflected in this Agreement, for the construction and operation on its territory of any Transit Pipeline construction of which commences subsequent to the entry into force of this Agreement, or to determine the route within its territory of such a Transit Pipeline.

ARTICLE VII

The Parties may, by mutual agreement, conclude a protocol or protocols to this Agreement concerning the application of this Agreement to a specific pipeline or pipelines.

ARTICLE VIII

The Parties may, by mutual agreement, amend this Agreement at any time.

ARTICLE IX

1. Any dispute between the Parties regarding the interpretation, application or operation of this Agreement shall, so far as possible, be settled by negotiation between them.

2. Any such dispute which is not settled by negotiation shall be submitted to arbitration at the request of either Party. Unless the Parties agree on a different procedure within a period of sixty days from the date of receipt by either Party from the other of a notice through diplomatic channels requesting arbitration of the dispute, the arbitration shall take place in accordance with the following provisions. Each Party shall nominate an arbitrator within a further period of sixty days. The two arbitrators nominated by the Parties shall within a further period of sixty days appoint a third arbitrator. If either Party fails to nominate an arbitrator within the period specified, or if the third arbitrator is not appointed within the period specified, either Party may request the President of the International Court of Justice (or, if the President is a national of either Party, the member of the Court ranking next in order of precedence who is not a national of either Party) to appoint such arbitrator. The third arbitrator shall not be a national of either Party, shall act as Chairman and shall determine where the arbitration shall be held.

3. The arbitrators appointed under the preceding paragraph shall decide any dispute, including appropriate remedies, by majority. Their decision shall be binding on the Parties.

4. The costs of any arbitration shall be shared equally between the Parties.

ARTICLE X

1. This Agreement is subject to ratification. Instruments of Ratification shall be exchanged at Ottawa.

2. This Agreement shall enter into force on the first day of the month following the month in which Instruments of Ratification are exchanged.[1]

3. This Agreement shall remain in force for an initial period of thirty-five years. It may be terminated at the end of the initial thirty-five year period by either Party giving written notice to the other Party, not less than ten years prior to the end of such initial period, of its intention to terminate this Agreement. If neither Party has given such notice of termination, this Agreement will thereafter continue in force automatically until ten years after either Party has given written notice to the other Party of its intention to terminate the Agreement.

IN WITNESS WHEREOF the undersigned representatives, duly authorized by their respective Governments, have signed this Agreement.

DONE in duplicate at Washington in the English and French languages, both versions being equally authentic, this twenty-eighth day of January 1977.

FOR THE GOVERNMENT OF THE UNITED STATES OF AMERICA:	FOR THE GOVERNMENT OF CANADA:
[1]	[2]

[1] Julius L. Katz
[2] J. H. Warren

ACCORD ENTRE LE GOUVERNEMENT DES ETATS-UNIS D'AMERIQUE ET LE GOUVERNEMENT DU CANADA CONCERNANT LES PIPE-LINES DE TRANSIT

Le Gouvernement des Etats-Unis d'Amérique et le Gouverneme du Canada;

Estimant que les pipe-lines peuvent être un moyen efficac économique et sûr de transport des hydrocarbures à partir des régions de production jusqu'aux consommateurs, tant aux Etats-Uni qu'au Canada;

Constatant le nombre de pipe-lines à hydrocarbures qui re présentement les Etats-Unis et le Canada ainsi que l'importance d service qu'ils rendent en transportant des hydrocarbures jusqu'au consommateurs des deux pays;

Convaincus que des mesures visant à assurer l'acheminement ininterrompu au moyen de pipe-lines, par le territoire d'une Parti d'hydrocarbures ne provenant pas du territoire de ladite Partie e destinés au territoire de l'autre Partie, sont de nature à faire l'objet d'un accord entre les deux Gouvernements;

Sont convenus de ce qui suit: